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Dedicated to God and my parents

for being a continuous source of inspiration

THE DEVELOPMENT OF A METHODOLOGY FOR ASSESSING FOOD QUALITY IN HOSPITAL FOOD SERVICE SYSTEMS

by

Wan Soo Hong

BSc in Food Science and Nutrition at Yonsei University, Seoul, Korea, 1986.
MSc in Food Science and Nutrition at Yonsei University, Seoul, Korea, 1988.

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THE DEVELOPMENT OF A METHODOLOGY FOR ASSESSING FOOD QUALITY IN HOSPITAL FOOD SERVICE SYSTEMS

ABSTRACT

There are few empirical studies of food quality within hospital food service systems. Although it is widely accepted that food quality is a multi-faceted phenomenon, much attention has been paid to single component explanations in the past. The aim of this study throughout has been two fold - to develop a model suitable for evaluating the quality of food in conventional hospital food service systems; and to evaluate food quality in selected hospitals in the Trent Regional Health Authority and West Midland Regional Health Authority using the model. A key outcome in this study has been the development of a multi-faceted measurement of food quality to help catering managers deploy resources effectively, in conventional hospital food service systems. This approach was achieved using a variety of qualitative and quantitative information to score six food quality components and 15 influencing variables. Food quality was defined as a multi-dimensional measure to include measures of satisfaction of patients and catering staff, productivity, safety, and nutritional adequacy. Measures of influencing variables were chosen or adapted from those available in food service operations insofar as was possible. Where none was available, methods were developed. The variables were grouped into two major categories: human resources and system resources. A survey of 12 hospital conventional food service systems in the UK was undertaken and detailed information was collected from each, including surveys of 933 patients and 327 catering staff.

Patient satisfaction with the quality of hospital food and food-related service was evaluated by patient questionnaires. It was measured by assessing 14

variables. Patients seem to be generally satisfied with the food served. In the regression analysis none of the influencing variables explained the component of 'patient satisfaction' at the level of $P<0.05$, suggesting that it is a different kind of component from the other 4. Importantly the component 'patient satisfaction' appears to be explained predominantly by patients' own demographic and emotional variables rather than by objective catering system factors. Age and appetite were found to significantly correlate with patient satisfaction scores. The component of food waste was found to have a high negative correlation with patients' satisfaction. It may be possible to use food waste as an index of patient satisfaction in future research. Catering staff satisfaction was evaluated by measuring employee job attitudes towards five aspects of their job using the Job Description Index (JDI). The JDI is directed toward specific areas of satisfaction rather than global or general satisfaction and was easily administered. The food service workers surveyed in this research were less satisfied with their jobs than are other types of workers in other industries. In the regression analysis total number of patients explains around 36% of the variation in staff satisfaction. The productivity level was based upon the total meal equivalents divided by the total labour hours required to produce and serve them. The regression analysis suggests that around 77% of the variance in productivity is explained by labour cost. The safety component was based upon two elements which were microbiological control and temperature control. The results of regression analysis suggest that the number of menu items and the subsidizing meal ratio explain around 74% of the variation in the safety component. Nutritional adequacy was evaluated indirectly by measurement of food waste. In the regression analysis more than 68% of food waste component can be explained by the variable occupancy rate. Correlations between the food quality components show that a non-significant relationship existed between all but one of the components of food quality studied. A significant negative correlation existed between the patients'

satisfaction with the hospital meal and service and the food waste; this was expected. The non-significant correlations between the components of food quality showed the independence of components, confirming the need for a multi-dimensional model of food quality. The findings of this research support the notion that food quality is a multi-faceted phenomenon and have led to the development of a practical way of measuring it.

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CHAPTER ONE

Introduction

1.1 Identification of the Problem

The quality of hospital food is consistently described as a problem (The Times, 1990). The food service systems in hospitals are complex operations. Feeding hospital patients is perhaps more vital and complex compared with feeding in other types of institutions because of the unique requirements and conditions of patients (Cash and Khan, 1983). Hospital feeding should meet with patients' acceptance as well as providing nutritional adequacy. The safety of food is important because patients are extremely vulnerable to foodborne diseases and once introduced by food, disease may be spread from person to person. Importantly hospital food service systems are often burdened with labour problems including low productivity (Mayo *et al.*, 1984 ; Cluskey and Messersmith, 1991), employee job dissatisfaction (Swartz and Vaden, 1978 ; Sneed and Herman, 1990), high labour costs, and restricted overall budgets. It is essential that these factors should be considered in developing systems for assuring palatable, nutritious, and safe feeding.

It is reported that the total number of in-patients per day in the UK was 372,823 in 1989 and the total number in the EC is 2,785,137 (European Marketing Data and Statistics, 1992). To the patients in hospitals, food takes on an immense significance because it has a symbolic as well as a physiological importance. Feeling better is essential for getting better.

As food is an important part in the process of recovery of patients, its quality is of immense significance.

A major problem noted in the literature is the failure of most reports to define what is meant by 'food quality' in hospital food service systems, how one might measure it, and what factors influence it.

1.2 Purpose of the Research

The purposes of the research are:

1. to identify the key stakeholders in the hospital food service system and their perspectives on food quality;
2. to develop a definition of food quality suitable for evaluating the quality of hospital food which reflects its multi-dimensional character;
3. to develop a methodology to apply the definition from (2) to real hospital situations;
4. to evaluate food quality in selected hospitals in the Trent Regional Health Authority and the West Midland Regional Health Authority using the developed food quality model;
5. to identify the influencing variables which offer the highest level of explanation of food quality variability within the conventional hospital food service system.

1.3 The Structure of the Thesis

The process of the research falls into what may be seen as three parts: first a critical review of existing theories, second the development of an operationalised model of food quality, and finally an empirical analysis of hospital food service systems using the model so developed.

In more detail, the thesis consists of eight chapters. It starts by outlining the research process in Chapter 1. Chapter 2 examines the underlying nature of food quality and food service systems in general. It considers the definitions of quality, some of the models of food quality found in the literature, and the body of related empirical research undertaken in hospital food service systems. It is argued that while the existing literature outlines uni-component and multi-component definitions of food quality, such published research does not give sufficient explanation of the multi-dimensional character of food quality in hospital food service systems. This chapter provides a starting point to examine views on food quality in hospital food service systems.

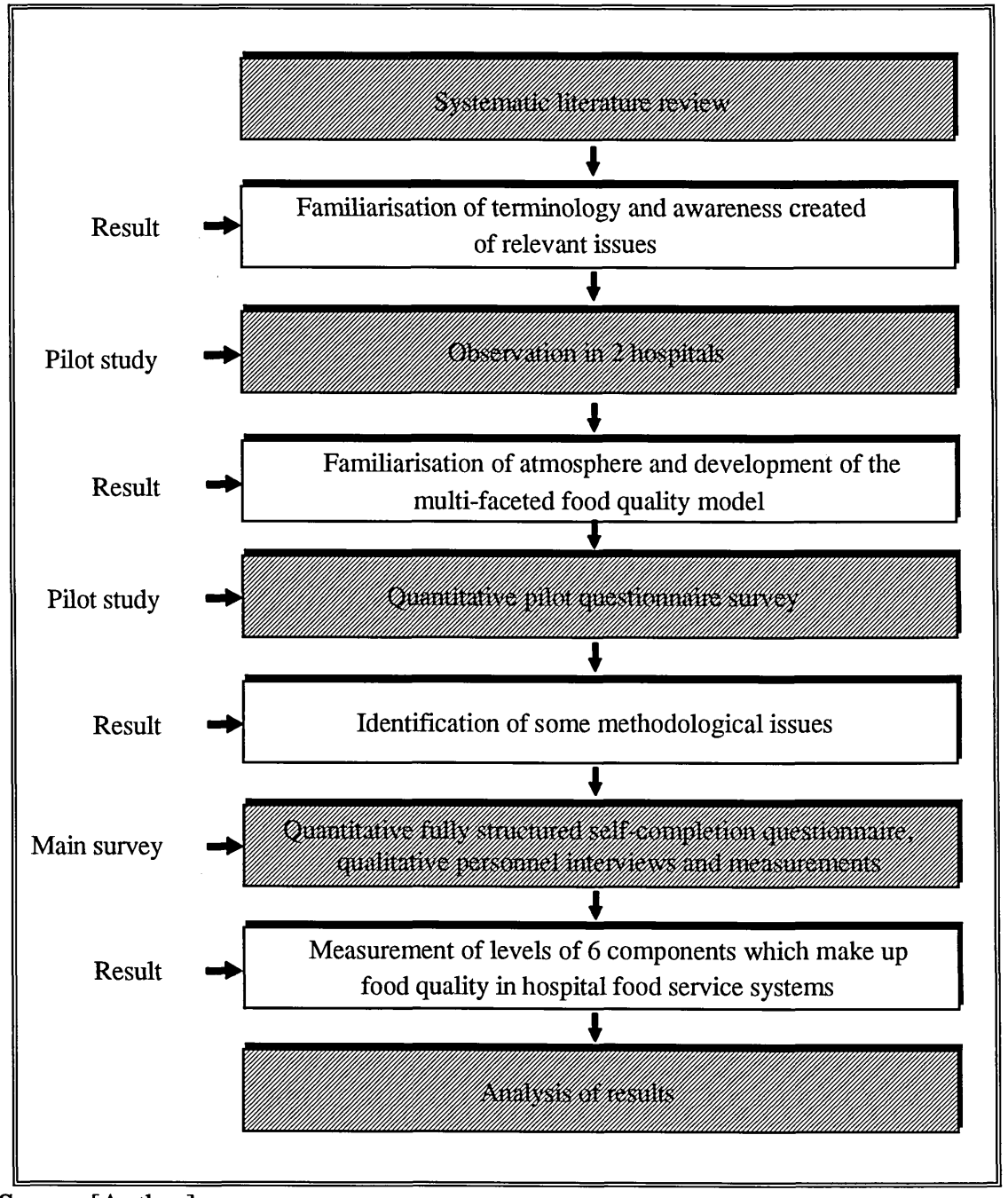
In chapter 3, a multi-faceted model of food quality in hospital food service systems is designed. Operational definitions of the main concepts are provided in the third chapter. In chapters 4 and 5 the general research problems are narrowed down into specific research issues and the methods used to operationalise the model are discussed. Chapters 4 and 5 also describe the research design for the empirical study of hospital food service systems. This includes a discussion of the development of a research strategy, the choice of methodology and the problems involved in gaining information. A survey, using questionnaires and interviews was undertaken as the main tool for collecting information.

An account of the results of the field work is provided in Chapter 6 which leads to an empirical understanding of food quality in hospital food service systems. Chapter 7 provides a statistical analysis of the relationships between the variables in the model. The final Chapter is then devoted to drawing the main findings of

this research together and linking these findings to the preliminary discussion in terms of method and practice. In this final chapter, some effort is made to provide signposts for the direction of future studies.

This flow diagram of this research is conceptualised in Fig 1.1.

FIG 1.1 MULTI-STAGED PROCESS OF RESEARCH CARRIED OUT



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CHAPTER TWO

Literature Review

2.1 Introduction

In this chapter, the general components of food quality in food service production systems are reviewed to help construct a frame of reference for the research. Food service system research literature published in English in the U.K., United States and other western countries since 1960 is reviewed. These sources have been supplemented with frequently cited studies from the pre-1960 era, obtained as unpublished reports and working papers from several of the leading researchers in this field.

2.2 Food Service Production Systems

A system can generally be defined as a 'set or arrangement of things so related as to form a whole' or as an 'established, orderly way of doing something'. A system, therefore, may be defined as an entity composed of interrelated parts or subsystems that work together to achieve a common goal (Kotchevar, 1981). The operation of a system is thus the integration of the work of various subsystems to achieve a total outcome that is greater than the independent action of any single element within the system. In biological terms it can be compared to a synergistic effect, where two or more organisms create a product or outcome that neither could achieve individually or independently (Rappole, 1972).

Food service production may be viewed from the systems point of view described in the above definitions. A food service system has been defined as an integrated program in which procurement, storage, preparation, and service of food and beverages, and the equipment and methods required to accomplish these objectives are fully coordinated for minimum labour costs, optimum customer satisfaction, quality, and cost control (Livingston, 1966). A food service production system can therefore be defined as an entity composed of subsystems designed and functioning together to accomplish specific objectives (Khan, 1991). In a systems approach, the entire foodservice organisation is considered as a system which has several complex and interrelated subsystems. This approach mandates a careful identification of all relevant aspects that must successfully interface if a system is to function smoothly, achieve customer acceptance, and be economically viable (Livingston and Chang, 1979).

The classical and preferred method of catering is to obtain fresh raw food materials and prepare them and cook them directly before service. This method, though preferable, is not possible in all food production operations simply because the space needed for storage, preparation, cooking and assembly of freshly cooked food and the number of skilled staff needed to carry out the task in large systems is prohibitive in terms of cost and organisation (Light and Walker, 1990). Because of this problem, alternative methods have evolved over the last few decades. Each method has its strengths and weaknesses.

Briefly, the conventional system consists of preparing foods and then, if service is delayed, holding them at a temperature high enough to prevent the growth of micro-organisms. Hot holding is any heated storage treatment, such as holding in steam tables or warming cabinets. Portioning and assembly includes any activities in a centralized area to prepare for distribution of meals to the consumers. In a decentralized production system, distribution of menu items to consumer units in bulk, using heated trolleys, may occur before portioning and

assembly of meals. Service includes any activities related to delivery of the meal to the consumer. Hot holding in a conventional systems is open to abuse, especially with respect to temperature control and re-heating of unused meals, leading to a poor quality product in terms of organoleptic quality and nutritional status, and to potential health hazards. Because of this, the introduction of new methods such as cook-chill or cook-freeze have been sought to improve food quality and to rationalise large scale catering operations by optimisation of the use of staff and equipment.

Cook-chill is a catering system based essentially on normal preparation and cooking of food followed by fast chilling and storage in controlled low temperature conditions above freezing point, 0^{o} C to 3^{o} C (32^{o} F to 37^{o} F) and subsequent thorough reheating close to the consumer just before consumption. Even where high standards of fast chilling practice are used and consistent refrigerated storage is maintained, product quality may be acceptable for only a few days including the day of production and consumption. According to Department of Health (DOH) Guidelines (1989) the shelf-life of cook-chill products is limited to 5 days. In a properly designed and operated cook-chill system, cooked and prepared food will be rapidly cooled down to between 0^{o} C and 3^{o} C, as soon as possible after cooking and portioning, and then stored between these temperatures throughout storage and distribution, until required for reheating and service. Other recommendations of the DOH Guidelines (1989) include the rapid chilling of cooked food to 3^{o} C within two hours of completion of cooking which is only possible with rapid chilling equipment such as a blast chiller. Food prepared through the cook-chill system should be portioned and transferred to a blast chiller unit within 30 minutes. This will reduce the risk of the food remaining at warm incubation temperatures and prevent the risk of microbial proliferation and loss of food quality. The chilled food is regenerated in finishing kitchens which require low capital investment and minimum staff.

Reheating of chilled food should begin as soon as possible and no longer than 30 minutes after the food is removed from chilled storage. The centre temperature of the food should reach at least 70°C and be maintained at not less than 70°C for 2 minutes for reasons of safety and palatability (DOH, 1989). The Electricity Council's Project Planning Unit (Catering) (1980) reported that cook-chill offers the following benefits. The divorce of production from consumption allows better utilisation of equipment and labour with resultant higher productivity. All meals are prepared in advance of requirements and production can be scheduled to gain the best use of equipment, space and staff. Nutritional value can be potentially better than that of food produced conventionally and stored hot for long periods of time prior to service. Bulk buying of food raw materials can contribute to reduced costs. Labour costs can be significantly reduced through optimising staff usage by centralisation, through the requirement for less skilled staff and through the use of more socially acceptable working hours. Energy savings are possible through efficient use of equipment by day and a reduction in the need for equipment at the satellite units. However, it is important to emphasise that many of the advantages can only be gained through good management and proper preparation for installation of a new cook-chill catering system. The disadvantages of the method are largely based on the need for capital investment and the danger of poor management. Large capital investment, including the need to build new units or even the central production unit, may be needed for some systems. Such costs can be in the million of pounds sterling. Improper preparation can lead to the installation of inadequate or unsuitable equipment. There is need for maintenance of strict standards of hygiene, for staff training and for good management in central production units, in distribution, and at the end kitchens. If not managed as a system, cook-chill catering can constitute a risk to public health. Poor management can potentially lead to bigger 'disasters' simply due to the potential size of cook-chill catering units (Light and Walker, 1990). The use of the cook-chill system as a method of mass catering has

increased in popularity in the U.K. and approximately 240 working cook-chill central production units (CPU) are in operation, representing approximately 1-2% of the UK catering industry as a whole (Light and Walker, 1990).

The cook-freeze production system uses a similar system to that used for cook-chill. Cook-freeze is a catering system based on cooking followed by blast freezing, storage in controlled low temperature conditions well below freezing point (-18^{o} C or below) and subsequent thorough reheating close to the consumer just before consumption. Blast freezing is undertaken when low temperature air is passed over food at high speed, reducing the temperature of the food, in batches, to about -20^{o}C within 90 minutes. The recipes used in cook-freeze have to be modified, enabling products to be freezer-stable. Modified starches are used in sauces so that on reheating and regeneration the sauce does not separate. The freezing must be carried out very rapidly to retain the characteristics of freshness in the food and to accelerate temperature loss through the latent heat barrier, thus preventing the formation of large ice crystals and rupturing of the cells. Pre-cooked frozen food should be stored at -18^{o}C or below. The shelf-life of pre-cooked frozen food varies according to the type of food but generally it may be stored for up to 8 weeks without any significant loss of palatability or nutrients. Reheating of the food should take place at or close to the point of consumption. Frozen food that has been reheated is as vulnerable as conventionally prepared food to contamination and loss of palatability and nutritional quality.

Cook-chill and cook-freeze systems require a combination of manufacturing and catering techniques. Both the DOH Guidelines on Cook-Chill and Cook-Freeze and the Institute of Food Science and Technology (IFST) Guide to Good Manufacturing Practice should therefore be consulted for appropriate detailed guidance.

The sous-vide system is a relatively new development based on the classic cook-chill system, with a combination of vacuum sealing in plastic pouches, cooking by steam and then rapid cooling and chilling. The purpose as with cook- chill and cook-freeze is to rationalise kitchen procedures without producing a detrimental effect on the quality of individual dishes (Kinton and Ceserani, 1989). In terms of the quality of the food produced, the main advantages are that it causes the full retention of all food juices, flavours and aromas within the bag or pouch during the cooking process. An internal document on sous-vide cooking in 1985 produced by the Hilton International hotel chain in Europe described the advantages of sous-vide cooking. Excellent food cost control is gained. Up-grading of menu items is made possible by preparing food in advance. As a properly controlled cook-chill method it is extremely hygienic, with no post-cooking contamination by air, handling or refrigeration odours. When used properly, the system can result in human resource savings. It does, however, have a number of shortcomings, some of which might be seen by some as enough reason to prohibit its widespread use or even to ban the method altogether. First, it has limited application. It cannot provide an entire menu range because many items do not suit this unusual production method. In contradiction to the claims made regarding cost savings, the system leads to increased costs, mainly due to the need to use only very high quality raw materials, the need for extra equipment, and the need to package each item thus incurring the additional costs of the packaging material. Finally, the method may pose a considerable threat to public safety if not properly used. The technique must be used within a controlled and hygienic environment, using only fresh and good quality ingredients. High quality impermeable plastic pouches in conjunction with a perfect vacuum and seal are required. Correct times and temperatures for pasteurisation, rapid chilling, refrigerated storage and re-heating must be assured (Light and Walker, 1990). A lapse in the monitoring or control of any of these parameters could lead to the growth of potentially lethal micro-organisms within

the bag. *Clostridium botulinum* spores may survive the heat process. If the food is not stored properly, these spores could grow and produce lethal doses of food poisoning toxins. A full and rigourous application of Hazard Analysis Critical Control Point (HACCP) is therefore essential (IFST, 1992).

2.3 Food Quality and Its Measurement

The Definition of Food Quality

One of the major difficulties with a study of food quality arises in defining the term 'food quality'. There is general agreement in the literature that food quality is a key concept in everyday use where food is handled and the production of high quality meals is a primary objective of food service systems (Drew and Harvey, 1986).

Despite its powerful influence on the efficiency and effectiveness of food service systems, the meaning of food quality is seldom questioned. A suitable definition of 'food quality', appropriate for its measurement in food service systems needs to be established. This definition should take a number of components into account which include; what is being judged as good food quality, from whose viewpoint, and what dimensions lead to that evaluation of food quality.

From dictionary definitions, it is usual to distinguish two aspects of 'quality':

1. peculiar and essential characteristics, (attributes) and
2. degree of excellence.

However, this is a purely abstract definition and it does not specify the content of 'peculiar and essential characteristics' or 'excellence'.

Drew and Lyons (1986) applied these two aspects of quality to food. The first, 'peculiar and essential characteristics' (attributes), were those aspects which,

> *"... include appearance, texture, flavour, mood modification, satiety, safety, nutritional value. They can distinguish between food samples and are value free. They are not concerned with desirability, preferredness or degrees of excellence"*
>
> (Drew and Lyons, 1986).

Drew and Harvey (1986) developed a food quality assessment scheme based on primary attributes and contextual excellence. 'FASTGUNS' as a checklist of headings was used for describing or surveying food quality in a value-free way. The mnemonic stands for flavour, appearance, stability, texture, geometric, uniformity, nutritional value and safety, which can be described as primary characteristics because they can form a basis for the management of food quality. Flavour is the combined sensation of taste on the tongue and aromas/odours on the epithelium at the back of the nose. Appearance includes colour and gloss. It depends on the interaction between food, the light incident upon it, the reflected/transmitted light being detected by the eye and the stimulus from the eye being interpreted by the brain. Stability means shelf life: the period of time during which food is both safe and organoleptically acceptable. For any product, shelf life is likely to be influenced by preservation method and by storage conditions. Food processing is largely designed to extend the food's storage life. Texture describes a food's reaction to potentially deforming forces such as impact, shear and compression. Describing changes in food when it is chewed is difficult as it is subjected to the three types of force together with mixing and the addition of saliva. Geometric includes the size, shape and weight of the food and the disposition of its parts. Uniformity applies to a population of units of a food product and describes the product's variability/reliability. Nutritional value depends upon the nutrient density of the food, how much is eaten, the efficiency of the body digesting, absorbing and using the nutrients, and its nutritional history. Safety may be compromised by chemical, physical and microbiological risks. Sources of danger include contamination, naturally occurring toxins, natural physical hazards eg bones, pips, contrived ingredients, additives and processes, food poisoning by bacterial infection and/or intoxication, food

poisoning by fungal intoxification, and zoonoses. Food for human consumption should be reasonably free from these hazards.

Whilst the second aspect of quality, excellence, is said to be reflected in,

> *"...judgements (which) inevitably depend heavily on circumstances. In theory a food may be rated on a good-bad scale for any or all of its attributes in a given context"*
>
> (Drew and Lyons, 1986).

Various studies have looked at the components of food quality in food service systems (Drew and Harvey, 1986 ; Fuller and Kirk, 1991 ; Nicholanco, 1973). Quality is frequently defined in the literature as the final excellence of the meals served in a food service system. Components that determine this excellence, as reported in literature, consist of microbiological safety of the food (Stauffer, 1971), aesthetic properties such as appearance, taste, texture, and temperature (McCune, 1962), service quality (Traynham, 1966), and nutritional adequacy (Pilgrim, 1957).

Nicholanco (1973) acknowledged a multiplicity of components which affect food quality and developed a model for assessing food quality in a chill food service system. Sensory, safety and nutritional characteristics were identified by him as the components of quality of food.

Paulus (1980), however, was more specific in his definition of food quality. He reported four partners, concerned with and interested in food quality. They were food producers, health authorities (legislation), food scientists, and food consumers. He assumed that their interests may differ in a quantitative as well as a qualitative respect. The four partners looked at food quality from different points of view because each had different interests in food quality. He considered nutritive value, health value, sensory value, and convenience value as the most important components of food quality. No attempt has been made by Paulus to explain the methods used to quantify these components.

Kragt (1981) commented that:

> *"Food quality is a multicomponent measure of the extent to which the units of a product..."* (Kragt, 1981).

The Measurement of Food Quality

Traditionally, the only method of measuring sensory food quality in food service was the continuous tasting of food by cooks, servers and supervisors (Christensen, 1969). This method lacked reliability due to individual sensory evaluation being subject to influence from external sources and possible disparities between the quality standard used by preparation staff and consumers. There are two separate types of measure available for the evaluation of flavour, appearance and texture. First, the taste panel or consumer test, where humans are used as the instrument to measure these sensory qualities. Secondly, chemical and physical tests including gas chromatography for flavour; spectrophotometer, colourimeter, nephelometer, and computer analysis of video images for appearance; and viscometer and texturometer for texture. These techniques have been developed to enable objective and absolute measurements of certain characteristics of sensory quality (Light and Walker, 1990 ; Drew, 1992). Safety can be assessed by chemical analysis for chemicals such as lead (Pb) and arsenic (As), by animal trials for signs of toxicity, and by microbiological enumeration to indicate microbiological threat. Microbiological safety can be inferred by measurement of temperature/time history. Weighing and measuring can be used to measure geometric aspects of quality.

The nutritional value of a food can be determined by analysis of its content of vital chemical factors which can be obtained either by feeding trials or by chemical analyses. Both analytical tests for nutritional analyses and animal feeding trials are expensive and some assay techniques for a particular nutrients

are difficult and time-consuming. Information on nutritional composition can also be obtained from food tables, in book form or in computer database form. These give typical food values and are often used as the basis of diet planning. It is clear that uneaten food has no nutritional value. Thus food waste measurement is used in food service systems as an indirect measure of the nutritional value of the food consumed. Stability is measured by shelf life tests.

2.4 Hospital Food Service Systems

Hospital food service systems are complex compared with those in other types of institution. From a nutritional point of view, patients in hospitals depend on the meals served to them in hospital because they cannot go elsewhere to get food. Caterers and dietitians must make up menus which not only meet the Department of Health (DOH) Dietary Reference Values but which are also adjusted to the demands of the patients. The National Advisory Committee on Nutritional Education (1983) and the Committee on Medical Aspects of Food Policy (1984) reports remind health authorities of the dietary recommendations to which attention should be paid. "The Health of the Nation" White Paper, published in July 1992, pursued improved 'health' in its widest sense, emphasizing the ultimate role of good nutrition in bringing about continuing improvement in the health of the nation. Attention should be paid to the specific dietary requirements of patients with particular diseases which make hospital feeding more complicated. Practical constraints imposed by overall budgets, labour cost, old-fashioned kitchens with inadequate space and old equipment, lengthy distribution of meals from the kitchen to the wards can make hospital feeding more difficult.
A number of alternative food service systems have been implemented within the hospital food service systems in order to increase efficiency and productivity

(Kinton and Ceserani, 1989). Hospitals may operate different systems for patient and nonpatient feeding or operate a mixed system depending on the menu item. The three alternative food service systems, conventional, cook-chill and cook freeze, are all used in hospitals in UK. These systems were described in section 2.2. Through procurement, preparation, and heating the systems use similar processes.

A hospital tray service typically uses a mix of all forms of raw material fresh and processed. Based on a standard menu cycle, production is to a schedule. Food is cooked in batches and plated, using a conveyer belt, and held hot or cold. Work stations are located by the side of the conveyer for all items of food on the menu, together with crockery and cutlery. They may be used for immediate consumption or for assembling cook-chill meals. When assembling meals for immediate consumption, it is important to keep hot food hot, and to keep cold food cold. Hot food may be kept hot through the use of heated pellets held under the plate or by using insulated trays. Ambient and cold foods may either be placed in separate compartments in the insulated trays or in separate trolley sections from the hot food. When the foods have been assembled, trolleys are used to transport them to the wards. It is becoming increasingly apparent that warm-holding of the food prior to serving is a very important problem. Warm-holding time is generally defined as the time from cooking of the food to its consumption by the patient. The time between cooking and serving of food in hospitals can be excessive. Platt et al. (1963) emphasized the quality deterioration during hot-trolley transport between kitchen and ward which could be a considerable distance in a large hospital. In the case of some types of cook-chill system, the trolley may also act as reheating equipment. This has the advantage that meals can be transported while still cold and reheated close to the ward at the latest possible time. In hospitals, it is necessary to transport the frozen food from a central cold store to points of re-heating before consumption. At the ward the

trolley is connected to an electricity supply which rapidly raises the centre temperature of the food to 70°C.

Technological advances in hospital food service systems have occurred involving the methods of preparation, processing and storage of food. There has been a tendency to assume that these have resulted in higher quality food, yet few reports have documented specific objectives and results. In UK although a small but increasing number of hospitals have converted to cook-chill or cook freeze catering systems, the conventional system remains the primary choice for hospital food service. Most of the research into hospital food service systems has focused on systems such as cook-chill or cook freeze, there is a need for more in-depth research into conventional hospital food service systems.

2.5 Empirical Research into Hospital Food Quality

Although there has been general agreement in the literature that food quality in food service systems is most important, little research has been undertaken to develop meaningful standards of food quality for hospital food service systems. A literature review on food quality in the industry shows that most of the work involved schools and nursing homes. Only six published studies, 4 in the U.S.A. and 2 in U.K., have comprehensively investigated food quality in hospitals; these are reviewed below. A large number of studies have focused on single component of food quality, these are reviewed in sections 2.5.2 to 2.5.7.

2.5.1 Research into the Evaluation of Hospital Food Quality

In the USA, the Commission on Administrative Services in Hospitals (C.A.S.H., 1965 ; Edgecombe, 1966 ; McLaren, 1973) established a comprehensive plan to evaluate proficiency against food quality levels on an on-going basis in

conventional hospital food service systems. A food service index was developed by CASH which included appearance of food and accuracy of the tray, and the time taken for the delivery of trays to the patients. The department was divided into 10 work areas for housekeeping and sanitation inspection. Housekeeping and sanitation were measured by evaluating cleanliness, operational status and orderliness of equipment, areas and personnel. Standards for each characteristic were established as the criteria for evaluation. Random evaluations were made during a one week period. Each evaluation involved approximately 30 minutes. The sum total of the indices was then transferred to a weekly performance chart which gave visual representation of actual quality level and acceptable ranges of quality as established by the food service department involved.

Again in the USA, Ruf and David (1975) assessed quality of output as one component of productivity in hospital food service systems. They utilized a modified version of the Commission on Administrative Services in Hospitals (C.A.S.H.) plan. Trained observers assigned a score to the following components temperature control; flavour and appearance of foods served; delivery times and accuracy of service; housekeeping; and sanitation. This research placed emphasis on productivity rather than on the quality of meals served, thus it did not improve the measurement of food quality.

In England and Wales after surveying 152 hospitals using conventional systems, Platt, Eddy and Pellet (1963) reported defects in hospital catering which resulted in poor quality food. These defects were considered to be due to old-fashioned kitchens with inadequate space and old equipment; lengthy distribution of meals imposed by badly planned and inconvenient old hospital buildings; organizational faults and an unnecessary division of catering responsibility; and the excessive attention paid by medical and nursing staff to the special dietary

requirements of particular patients to the exclusion of the general requirements of most patients. For improvement of food quality in hospital food service systems, they recommended the following:

- The nutritional needs of every patient should receive consideration.
- One person must be made responsible for all aspects of hospital catering and for the supervision and control of all staff concerned with the preparation, cooking and service of food to the patient.
- The ward sister must be responsible for the feeding of patients at ward level.
- An attempt should be made to formulate dietary scales which would meet the nutritional requirements of different types of patient.
- Catering staff should receive instruction in dietetics and should be encouraged to take part in the serving and distribution of food to the patients.
- Dietitians should be concerned with the everyday problems of hospital catering and with requirements of all patients in hospital. More attention should be given to food waste left by patients in the wards.

The report by Platt et al. drew attention to the poor food served to patients in hospitals. One result of this was the initiation of a cook-freeze catering trial in the Hospital for Women in Leeds undertaken by the full-time catering research team based in the Procter Department of Leeds University. This trial was the first attempt in the UK to introduce more systematic methods of food production within National Health Service (NHS) catering. A full evaluation of the new system including wastage, labour utilization, nutritional value, food bacteriology, consumer reaction and costs was made to assess the advantages or disadvantages of the new system compared to the old. They reported that cook-freeze catering systems resulted in improvement in consumer satisfaction, food wastage and productivity (Catering Research Unit at University of Leeds, 1972).

A large number of published papers on selected aspects of food quality in hospital food service systems exist. For convenience this literature will be reviewed using the evaluative criteria identified by Catering Research Unit at University of Leeds (1972) ie wastage, labour utilization, nutritional value, bacteriology, consumer reaction and costs.

2.5.2 Wastage

The Examination of Food Waste

The meal which is not eaten achieves nothing and high quality waste is just as useless as any other.

The following factors have been cited as the main reasons for food waste being left by patients in hospitals (Kipps and Middleton, 1990):

- food unattractive either in type or presentation
- captive, 'unwilling' customers
- customers in a state of anxiety, fear, or other stress to which may be added pain and discomfort
- customers removed from the normal security of their home and other familiar surroundings
- menu choices made unnaturally, hours or often the day before a meal is consumed
- meal times imposed by the dominant routine and not selected by choice when hungry
- unnatural eating position for many, propped up in bed

Food waste left by patients in hospitals is an important indicator of the nutritional adequacy of the patients' diet and of their satisfaction with the food. Thus food

wasted by patients or staff in hospitals is one of the most serious problems in hospital food service systems (Grater, 1980).

Food waste is an unglamourous topic and therefore comparatively little attention has been paid to it, particularly in catering systems (Colwill, 1986).

In 1979, Malmstrom, Matthiasson, Sivik and Skjoldebrand as part of the Swedish project 'Catering 1990' obtained information about the waste of food, water and energy in six kitchens including a hospital kitchen. This study found that food wasted in hospital kitchens was 60-70 gram of food per person per meal, whilst in school and hotel kitchens it was 30-40 gram.

In 1979, Hirsch *et al.* reported plate waste at the University of Kansas College of Health Sciences and Hospital during a two-week period encompassing all meals (breakfast, lunch, dinner, and snacks). Patients were asked to record after each item on their menu the amount consumed in quantitative terms: None, 1/4, 1/2, 3/4, all. The average calories wasted was 9.1 per cent on the regular select menu compared with 16.7 per cent on the regular non-select diet. The percentage of calories wasted was higher for patients on modified non-select diets than for patients on modified select diets. There was no significant differences in waste between patients on regular and modified diets.

In 1981, Banks and Collison found an average waste of 11.4 per cent of the food energy input in a range of establishments studied, such as schools, places of work, restaurants, cafes and snack bars, hospitals and welfare situations, but 30.0 per cent from the 3 hospitals included in the study. The small sample of hospitals was found not only to have a higher percentage waste but also a lower food energy input than the other types of establishment. They recommended that the hospitals be the subject of a separate survey because of the circumstances which make hospital feeding unique.

A study conducted by Collison and Colwill (1986) looked at food waste in 31 catering establishments consisting of 15 public houses, 13 licensed restaurants and 3 store restaurants. The quantity of waste was measured and the gross energy

values in kilocalories per gram of food were converted into metabolisable energy values (Miller and Judd, 1984). They reported that an average of 18.2 per cent of potentially edible food was wasted. Among the three types of waste measured, customer waste was 7.9 per cent of input which was larger than either kitchen waste or service waste.

In the U.S.A. in 1986, Frakes, Arjmandi and Halling reported the plate waste in a hospital using a cook-freeze system. Percentage waste per tray, per pre-plate, and per food item were determined according to the following formula:

$$\frac{\text{amount of food waste (gm)}}{\text{amount of food served (gm)}} \times 100 = \text{percentage food waste}$$

Mean percentage waste of all food served to patients was 21.3 per cent. Mean waste for pre-plated meals was 25.5 per cent with large variation in mean percentage waste among food items (entree, 17.6 % ; starch, 27.7 % ; vegetable, 40.7 %). They concluded that there was no significant difference in waste between pre-plated combinations and individually selected items.

In 1992, edible plate waste and its monetary value was estimated in 18 large capacity Ministry of Health (MOH) general hospitals in Saudi Arabia (Al-shoshan, 1992). Direct measurement of the plate waste was carried out over 2-days, for 554 Saudi patients and their 205 attendants. It was estimated that average waste at breakfast was 17% compared to about 42% for either lunch or dinner.

Although the surveys above give different results, customer waste of food in hospitals is considered to be higher than that in any other types of institution. These researches used different methods and measurements, therefore it is impossible to compare the results. Measurements quoted include those made on a weight basis and those made on a energy basis. Food wastage in many hospitals

is estimated to be up to 30% of the costs of the service, most of it being plate waste (Steel and Delaney, 1983).

Determination of Food Waste

Determination of plate waste by weighing has been considered to be a more appropriate and sensitive instrument than other methods reported in the literature (Kirks and Wolff, 1985). Nonetheless, measurements are time consuming and require equipment and human resources (Kirks and Wolff, 1985). Estimation of waste by methods which are less arduous and expensive than weighing lack the accuracy of the former. Weighing has been used as a major tool for measuring food waste in many hospital surveys (See Table 2.1).

Weighing waste on a dry basis may give an advantage since this method can take account of the water content of the material which may differ between the input and waste, however, even dry estimation does not eliminate the disadvantage of the input and waste having different dry weight component contents. The most satisfactory measurement of food waste may be on an energy basis, proponents of this measure claim that it overcomes the disadvantages of the other methods (Colwill, 1986). To measure the energy of food waste, food inputs for all items taken from the store are weighed and recorded. Representative samples of waste are obtained by thoroughly mixing the bulk sample. The solids content of each homogenate is then determined by drying the samples in a vacuum oven and the energy content is determined by bomb calorimetry.

However, most hospital kitchens produce food for more than one outlet, which may lead to problems of apportionment. It is also impossible to obtain an absolutely homogeneous mass of waste so that sampling is representative (Kirk and Osner, 1981). These limitations of the energy method of measurement for food waste as described above overwhelm its advantages. Considering the advantages and disadvantages of the various methods available, weighing is

regarded as the best instrument for measuring food waste of patients in hospitals (Kirks and Wolff, 1985 ; Frakes *et al*, 1986).

<Table 2.1> *Food Waste Survey in Hospitals*

Reference	Country (Year)	Method and Average of Waste	Type of Waste
Milross & *et al.*	U.K. (1974)	% gram waste 9.8 % in conventional 5.9 % in cook-freeze	Plate waste
Malmstrom *et al.*	Sweden (1979)	60-70 grams per portion	Plate waste
Hirsch *et al.*	USA (1979)	% calories waste 9.1 % regular select 16.7 % regular non-select 14.4 % modified select 15.6 % modified non-select	Plate waste
Banks & Collison	UK (1981)	30.0 % energy	Total waste
Frakes *et al.*	USA (1986)	21.3 % gram waste	Plate waste
Al-shoshan	Saudi Arabia (1992)	% gram waste 17.0 % breakfast 42.0 % lunch or dinner	Plate waste

2.5.3 Labour Utilization

In its broadest sense, productivity refers to the efficient utilization of resources including people, machines, and money. These resources are necessary for a commercial organization to grow and prosper (Bellas, 1982). Productivity has been defined as a measurement of production, with the ratio of output to input as the numerical measurement (Greenberg, 1973 ; Ross, 1978).

A wide variety of productivity ratios have been defined. Those most frequently utilized in food service studies include either a ratio of labour minutes per meal or a ratio of labour minutes per meal equivalent (Brown and Hoover, 1990). The other commonly reported ratios in food service systems were meals per labour hour worked, meals or meal equivalents per labour hour paid, and meals per total food cost (Brown and Hoover, 1990 ; Lischke, 1986 ; Olsen and Meyer, 1987 ; Shaw, 1983).

Since the earliest measurements of labour productivity in food service systems, which were reported in 1932 (Enochs and Yoder, 1932), researchers have continued to investigate productivity measurement methods for the evaluation of food service operational efficiency (Bakken and Northrop, 1956 ; Brown and Hoover, 1990, 1991 ; Donaldson, 1957, 1967 ; Halter and Donaldson, 1957 ; Kent and Ostenso, 1965 ; Kotschevar *et al.*, 1971 ; Lieux and Manning, 1991 ; Matthews *et al.*, 1986 ; Olsen and Meyer, 1987 ; Ostenso and Donaldson, 1966 ; Ruf and David, 1975 ; Schell and Korstad, 1964 ; Tuthill and Donaldson, 1956 ; Zolber, 1971 ; Yung *et al*, 1981 ; Zolber and Donaldson, 1970).

Data from studies designed to determine a variety of productivity ratios in hospital food services are summarized in Table 2.2. The levels varied from 3.50 minutes per meal to 34.30 minutes per meal. Data were mostly obtained either by work sampling or survey questionnaires. The min/meal was defined as the ratio of person minutes to total meal equivalents served (Ruf and David, 1975). Total labour time per meal represents the average number of minutes scheduled per meal for all personnel of the dietary department, including both non-professional, professional and clerical. Direct labour time per meal represented the time scheduled for non-professional personnel directly associated with all phases of food production and service.

<Table 2.2> *Summary of Productivity Levels in Hospital Food Services reported in the Literature*

Reference	Year	No*	Method	Labour Examined	Range Min/Meal	Mean Min/Meal
WWDA	1934	8		Direct	6.23-14.01	9.69
Bakken & Northrop	1956	13		Total	12.05-22.11	16.38
Tuthill & Donaldson	1956	10	Survey	Direct	8.82-16.45	13.31
Donaldson	1957	22	Survey	Direct Total	3.70-27.60 4.10-34.30	14.00 16.30
Halter & Donaldson	1957	175	Survey	Direct Total	3.50-29.60 4.20-32.60	14.90 17.10
Schell & Korstad	1964	2	Work Sampling	Direct	16.83-17.07	16.95
Kent & Ostenso	1965	10	Work Sampling	Total	11.39-27.73	21.73
Ostenso & Donaldson	1966	10	Work Sampling	Total	13.49-18.51	15.72
Donaldson	1967	7	Work Sampling	Total	11.39-15.15	13.85
Zolber & Donaldson	1970	3	Work Sampling	Total	8.32-11.53	9.71
Zolber	1971	3	Work Sampling	Total	9.32-13.12	10.95
Ruf & David	1975	25	Survey	T.L.	8.70-26.93	19.87
Matthews *et al.*	1986	12	Work Sampling	Total	11.71-15.42	13.25

*No : Total number of food services in study

Meals or Meal Equivalents / Labour Hours Worked

Reference	Year	No.	Method	Labour Examined	Range Meal/hr.	Mean Meal/hr.
Kotschevar *et al.*	1971	118	Survey	Total	3.90-25.20	11.60
H.A.S.*	1973	813	Survey	Total	2.35- 3.47	3.01

* Hospital Administrative Services

Work sampling methodology was developed at the University of Wisconsin. The technique is based on the estimation of the proportion of time spent by employees in a work activity or in a delay activity during a specific time period, by means of numerous randomly selected, instantaneous observations (Institution Management Laboratory, 1967).

Measurement of productivity using work sampling has gained wide acceptance and has been performed in hospitals (Bonini *et al.*, 1967 ; Donaldson, 1967; Matthews *et al.*, 1986; Walker, 1965) and nursing homes (Ho and Matthews, 1978 ; Yung *et al.*, 1980).

While work sampling has contributed to our understanding of productivity within the food service industry, the application has been narrow in focus and has failed to explain the role of the customer and other intangible elements associated with delivering a goods and service mix (Olsen and Meyer, 1987).

Some variance in productivity levels reported in the literature may reflect the different methods of calculating the total meals served. Bakken & Northrop (1956), Donaldson (1957), and Halter and Donaldson (1957), Tuthill and Donaldson (1956) considered total meals served as the number of meals served to patients plus the total number of cafeteria patrons. Schell and Korstad (1964) and Kotschevar, Owens and Saylor (1971) considered only total patient meals served, excluding cafeteria meal service.

In the studies by Kent and Ostenso (1965) and Donaldson (1967), the total number of meal equivalents was determined by totalling actual cafeteria and patient meals served plus an adjusted factor for coffee shop.

Hospital Administrative Services (HAS, 1973), Ruf and David (1975), Zolber (1971), Zolber and Donaldson (1970), determined meal equivalents as total patients meals plus an adjusted factor for cafeteria and coffee shop meals determined by dividing the dollar volume for those units by the average cost of a meal.

2.5.4 Nutritional Value

A good coke is half a physicyon
For the best physyck ... doth
come from the kytchen
Dr. Andrew Boorde, 1542

Historically, concern with the role that food may play in the recovery of patients from illness can be traced back to the earliest medical works. In 1859, Florence Nightingale emphasized the important role of hospital food in her 'Note on Nursing', warning that 'sick cookery should half do the work of your patient's weak digestion'.

According to the first memoranda on Hospital Diet in 1943, hospitals provided one full meal a day and patients relied considerably on provisions such as egg, butter and fruit brought in by their relatives. Consequently food rationing during the World war II caused serious dietary inadequacies (King Edward's Hospital Fund, 1943).

Platt *et al.* (1963) reported that hospital patients may require a high protein intake during illness, especially during convalescence and that in order to meet these requirements patients should be provided not only with sufficient good quality protein but an adequate provision of energy. They recommended that the nutritional requirements of individual patients should be assessed to provide adequate intake of nutrients.

Satisfactory nutrition is essential to patient recovery following illness. There is evidence that as many as 70% of surgical in-patients may be undernourished mainly from food waste (NHS, 1989). Although nutritionally adequate diets, planned by registered dietitians who have had similar training are provided in all hospitals, plate waste can lead to undernourishment.

Accurate nutritional information on food served to patients, however, is not available. Tables of food composition are frequently used by dietitians to

determine nutrient composition of food served to patients (Dahl-Sawyer *et al.*, 1982 ; Holland *et al*, 1991). LaChance *et al.* (1973) emphasized the discrepancy between values for nutrient composition of food in such handbooks and values for nutrient composition of food in hospitals. They also state that nutritional losses in processing, storage and re-heating of the served foods were not considered when these handbooks were put together.

2.5.5 Bacteriology

The concept 'safety of output' as applied to food items is vague. Food must be acceptably safe, chemically, physically and microbiologically. Generally microbiological hazards have been considered to be the most important; the number of contaminations caused by chemical agents, extraneous matter, rancid compounds or metals are extremely rare in comparison (Todd, 1987).

Microbiological Safety

Patients in hospitals are extremely vulnerable to foodborne disease and once introduced by food, the disease may be spread from person to person. Kundsin and Bodman (1976) suggest that spoilage organisms which are normally benign to a healthy person can cause serious infections to weak patients. Therefore high standards of food hygiene and sound food practices are particularly important in hospital catering, where meals must be provided for large number of patients day and night throughout the year.

According to a review of food poisoning outbreaks in the U.K. for 1970-1979, nearly 70% of incidents were directly attributable to foods prepared in the

catering or food service industry, which included restaurants, hotels, clubs and holiday camps, hospitals (11.0% of incidents), banquets, dinners, receptions and parties, institutions, school, canteens and meals-on-wheels and ships and aeroplanes (Light and Walker, 1990).

According to the report of the Communicable Disease Surveillance Centre (CDSC) of the Public Health Laboratory Service (PHLS), 537 outbreaks of foodborne disease were reported to be general outbreaks (that is, not confined to one family) between 1986 and 1988 and nearly 82% of incidents were directly attributed to foods prepared in the catering/food service industry. Of these, 253 outbreaks related specifically to restaurant, hotels and receptions, 80 to outbreaks in hospitals, 61 to institutions, 27 to staff restaurants, and 17 to schools (DOH, 1991).

The Audit Commission survey (Part II, Chapter 1) showed that food poisoning risk in the catering industry varied widely according to the type of establishment. Almost 1 in 5 take-away and more than 1 in 6 restaurants, cafes and canteens were judged to be a significant health risk, in contrast to fewer than 1 in 14 hospitals and 1 in 20 educational establishments (DOH, 1991).

The top 14 factors that contribute to foodborne disease hazards in England and Wales are listed in Table 2.3. Preparation too far in advance was reported as a major, potential or actual problem. This analysis shows that factors related to temperature control, ie storage at ambient temperature, inadequate cooling or reheating, warm holding and undercooling, most frequently cause outbreaks. With the introduction of food service systems such as cook/chill and cook/freeze, microbiological hazards in addition to those of the cook/hot-hold method are introduced.

<Table 2.3> *Factors that have been shown to contribute to Outbreaks of Foodborne Disease in England and Wales in Order of Importance.*

Number	Contributing Factor	Percentage
1	Preparation too far in advance (a day before consumed)	60.6
2	Storage at ambient temperature	39.6
3	Inadequate cooling	31.9
4	Inadequate reheating	28.7
5	Contaminated processed food (not canned)	19.1
6	Undercooking	15.4
7	Inadequate thawing	6.1
8	Cross contamination	5.9
9	Inadequate warm holding	5.7
10	Infected food handlers	5.2
11	Use of left-overs	4.8
12	Raw food consumed	4.4
13	Extra large quantities prepared	3.1
14	Contaminated canned food	4.4
	(a) freshly opened	2.8
	(b) not freshly opened	0.9
	(c) not known	0.7

(Sheard, 1983)

Assessment of the microbiological quality of menu items prepared in catering systems may be undertaken in systems simulated in the laboratory or in actual operating systems. Both studies in operating systems and in laboratories have found a wide variation in total plate counts (TPC) of menu items.

This variation has been reported within a single sample of a menu item (Bunch *et al.*, 1976), between samples produced simultaneously (Dahl *et al.*, 1980) and between samples produced at different times by the same system (Nicholanco and Matthews, 1978 ; Cremer and Chipley, 1977b, 1979 & 1980a). Some of these differences may be explained by variation in the microbial quality of ingredients, techniques of preparation, or laboratory analysis (Nicholanco and Matthews, 1978). Young (1986) explained that the microbiological quality of cooked food is determined by:

a) the microflora of the raw food;
b) the processing parameters;

c) the numbers and types of post processing contaminants; and
d) the storage conditions eg. temperature.

Few researchers report on the microbiological quality of food items prepared in either food service systems or under laboratory conditions before the 1970s. The microbiological quality of menu items prepared by cook/hot-hold, cook/chill and cook/freeze methods as reported in the literature in the 1970s and 1980s are reviewed below. Details of the reviewed studies are given in Appendix 1.

Studies Undertaken on Systems Simulated in the Laboratory

Most of the research on the microbiological quality of menu items since the 1970s has focused on the products of cook/chill systems. Of the 26 studies reported in Appendix 1, 8 were laboratory studies. Of these, 3 studies used a system which simulated a hospital food service system.

In this study, the preparation and service of beef-soy loaves as produced in hospital cook-chill food service systems was simulated (Bunch *et al.*, 1976). Three time horizons, ie, 24, 48 and 72 hours from the initial chilled storage of the final product, were studied by evaluating sensory and microbiological quality. Mean scores for overall acceptability of the product were almost identical, regardless of the length of chilled storage at 5±3°C. Numbers of aerobic bacteria in the loaves sharply decreased after reheating in a convection oven and after reheating in a microwave oven. However the final heat treatment was not sufficient to kill all viable bacteria in the centre of product.

Dahl *et al.* (1978) investigated the microbiological quality of beef loaves throughout five process steps in a simulated hospital cook-chill system.

Following initial heating, APC (aerobic plate count) decreased as the end-point temperature of the product increased. APCs were lowest following reheating. Dahl *et al.* (1980) studied the microbiological quality of beef loaf, potatoes, and frozen green beans in a simulated hospital cook-chill system. After 24 hours chilled storage at 7^{o} C the TPC decreased in the beef loaf but increased in potatoes.

Studies Undertaken in Hospital Food Production Systems

Of the 26 studies reporting on the microbiological quality of menu items produced and stored by cook/chill, cook/freeze and cook/hot-hold method presented in Appendix 1, 18 were done under standard operating conditions in food service facilities. Of these 18 studies, 5 studies were done in hospital food service systems.

The microbiological quality of beef stew prepared in a hospital using the cook-chill method of food production was investigated by Nicholanco and Matthews in 1978. Quality was determined by coliform counts and aerobic bacteria counts at a series of process steps. Coliforms were minimal, while numbers of aerobic bacteria were greatest ($7.6x10^4$ /g to $25.0x10^4$ /g) after 19.5 hours of chilled storage and least after initial ($4.6x10^4$ /g to $8.1x10^4$ /g) and final heat treatments ($0.8x10^4$ /g to $10.0x10^4$/g).

The production of roast beef in a hospital operating cook-chill system was investigated by Cremer and Chipley (1980a). After initial cooking, the food was stored for 45 hours, including a 3.5 hour hold at room temperature. After initial cooking and before reheating, TPC increased three to elevenfold. This was explained by the long storage times at temperatures conducive to microbial growth, and the contamination introduced during handling. The sensory quality

of beef was generally 'good' in this system despite unacceptable bacterial loading. The need for thorough cooking, controlled cooling rates, and prevention of contamination of food by food handlers and equipment was reported as critical for avoiding public health hazard.

In a subsequent study, Cremer and Chipley (1980b) studied the microbiological and sensory quality of scrambled eggs in an American hospital chill food service system. Although a wide variety of microorganisms were found in the product, total plate counts were low. This indicated that microbiological quality was good. Low microbial counts in this system may be attributed to the use of pasteurized eggs and limited contamination during production and storage.

Between August 1985 and July 1986, Sandys and Wilkinson examined the microbiological quality of 3,393 food items centrally produced in a hospital, chilled, stored and distributed to 24 other hospitals. No *Salmonella spp.*, *Staphylococcus aureus* or *Clostridium perfringens* were detected. In the first 4 months of the study 8.4% of samples had TVC (total viable counts) greater than 1 x 10^5 cfu/g (the criterion recommended by the DHSS, 1980), whereas in the last 3 months only 1.6% exceeded this limit because the reasons for high counts were investigated and mostly corrected. The microbiological standards recommended in the DHSS Guide-lines (1987) were found to be realistic and should be attained by all foods produced in cook-chill systems.

This review has emphasized the need for sound managerial control in order to produce food that is microbiologically safe during all process steps in cook/chill, cook/freeze and cook/hot-hold food production systems.

2.5.6 Consumer Reaction

An understanding of consumers' eating behaviour is essential in order to help them achieve a balanced food intake. The relationship between many interrelating influencing factors and food choice has been studied in a variety of contexts (Booth and Shepherd, 1988; Cowart and Beauchamp, 1986; Khan, 1981; Krondl and Lau, 1982; Pilgrim, 1957; Randall and Sanjur, 1981; Rogers and Blundell, 1991; Rozin, 1986; Schafer, 1978 ; Shepherd, 1985; Steiner, 1977 ; Yudkin, 1956).

The attitude model developed by Fishbein and Ajzen (1975) shows good prediction of behaviour and can be used to help determine the relative importance of different factors in influencing food choice. Based on this model, Shepherd and Stockley (1985) assessed the relevant importance of sensory factors, health beliefs and subjective norms in predicting food choice. Females in the survey were found to have a greater awareness of social cues, whereas males were more influenced by the perceived pleasantness of foods. Similarly Schafer (1978) reported nutrition as the most important reason for females choosing certain foods, whereas for males taste was considered most important. In another study subjects rated safety as the most important factor, followed by taste (McNutt, Powers and Sloan, 1986).

It was found that the 26-45 age group less frequently consumed foods considered to be unhealthy. In an another study, Shepherd and Stockley (1986) found no relationship between nutritional knowledge, attitudes, and reported consumption of 'healthy' foods.

Consumer attitudes and expectations are changing rapidly due to increasing

a) disposable income
b) uptake of higher education
c) exposure to a greater variety of lifestyles and values

Changes include greater emphasis on green issues, non exploitative production methods, interest in health and novelty. Thus consumption patterns are rapidly changing, not only in the home, but also within the catering industry. Although there are many suggestions and agreement on the types of influences likely to be important, the integration of these factors in food choice behaviour remains a critical area of research (Shepherd, 1989).

Patient Satisfaction Surveys

Results of work in this area show an even more complex picture. Questionnaires have been used extensively to measure consumer acceptance and evaluation of food quality in hospitals (Feldman, 1962 ; Frank, 1955 ; Maller *et al.*, 1980 ; Post, 1957). After completing a questionnaire survey at an urban hospital (n=292) and a rural facility (n=120) in U.S.A., Haglund (1990) reported that satisfaction with food was most significantly linked with general satisfaction with the hospital. This food acceptance quality, however, has always been given only cursory attention due to its subjective nature.

The primary problem in such subjective evaluation of food quality is reliability, an individual's evaluation being subject to other influences which consciously or subconsciously may introduce bias into the evaluation process (Christensen, 1969). Although the patients' acceptance may lack objectivity, it does not mean that perception does not exist or that it cannot be measured (Cardello, 1982).

One obvious reason for conflicting opinions about the quality of hospital food arises from the discrepancy between patients' and dietitians' opinions on what constitutes high quality food. Dietitians largely emphasize nutritional criteria, whereas patients largely emphasize sensory criteria (McCune, 1962).

A comprehensive review of the available survey evidence by Feldman (1962) showed overall patient satisfaction with hospital food was high. Consistently, whatever survey method was used, and regardless of the precise wording of the

questions, the majority of patients questioned rated hospital food as good or very good. In open-ended answers, more than twice as many respondents mentioned the food favourably, as mentioned it disparagingly. People in hospital for medical care are totally different from people at a restaurant for dinner in terms of their level of expectation. Generally, patients in hospitals have low expectations of hospital food. Expecting little, patients are pleasantly surprised when they find the food better than they expected (Feldman, 1962 ; Sheatsley, 1965).

Personal interviews with 1315 patients discharged from 50 short term hospitals in Massachusetts generally confirm Feldman's findings (Sheatsley, 1965). The only aspect of hospital experience that received a more spontaneous favourable mention in open-ended questioning was the attitude or personality of hospital personnel. Complaints about hospital food were more frequent than any other specific criticism but comprised only 14% of the sample or one person out of seven. This was considerably less than the 21% who spontaneously praised the food.

Glew(1968) administered questionnaires two days after discharge to 600 patients at an 800 bed teaching hospital in Leeds, England. Forty-eight per cent of patients responding indicated that they were satisfied with food quality. 61.3% were satisfied with food temperature. Portion size was acceptable to 72.9%. Appearance satisfied 70.7%, and 80.2% expressed satisfaction with the variety offered. In 1968, a survey was performed at a hospital in Harlow (Anonymous, 1968), where seventy-six patients were interviewed shortly before discharge. Patients were generally satisfied with the quality and variety of the food but were less satisfied with its temperature. A quarter of the patients did not find the food hot enough when it reached them.

In 1972, one half of the patients in a Texas hospital rated food as fair to poor whether on a regular or a special diet. The most frequent open-ended responses described food as unattractive, cold, late or poorly served (Houston and Pasanen, 1972).

A questionnaire survey of patients, ambulatory patients and hospital staff was conducted by Maller *et al.* in 1980. A total of 1,597 individuals were surveyed at hospitals in Texas, Georgia, California, and South Carolina. Ward patients were found to be more satisfied with appearance of food, aroma of food, cleanliness of dishes and silverware, and attractiveness of dishes, silverware, and tray than ambulatory patients or staff who were eating at the dining room. About 30% of respondents were dissatisfied with the temperature of the hot foods but fewer respondents (20%) were dissatisfied with the temperature of cold food.

In 1990, DeLuco and Cremer reported consumers' perceptions of the quality of hospital food, and food-related services through telephone interviews with 223 adults randomly selected from an urban county in Ohio in USA. More than 65% of respondents said that hospital food was good for the characteristics of taste, aroma, appearance, tenderness, cold temperature, freshness, and nutrient value.

Numerous papers regarding the patients' satisfaction of food quality prepared by either conventional cook-serve, cook-chill, cook-freeze, or convenience system have been reported (Bakst, 1962 ; Brown *et al.*, 1969; DeLuco and Cremer, 1990 ; Feldman, 1962 ; Haywood *et al.*, 1961 ; Maller, Dubose and Cardello, 1980 ; McCune, 1960 ; Sheatsley, 1965). However, considerably fewer reports have actually been conducted in the U.K. (Glew, 1968 ; Millross *et al.*, 1974). To date, few multi-hospital surveys concerned with these problems have been published. Of those reports, most relate to research done in the 1950s or 1960s (Bakst, 1962 ; Brown *et al.*, 1969 ; Feldman, 1962 ; Haywood *et al.*, 1961 ; McCune, 1960 ; Sheatsley, 1965).

It is difficult to refer to the data of those early surveys in any meaningful way because of substantial changes in patients' attitudes and expectations, particularly since the 1980s, owing to media exposure, foreign travel, and the growth of higher education (Kipps and Middleton, 1990).

2.5.7 Costs

As a labour-intensive industry, hospital food service has long had problems of low productivity, high absenteeism, high turnover (Riggs, 1986), and insufficient budgets. These problems are even more critical in light of the current labour shortages in the food service and industry (Slater, 1988), which is expected to continue well into the year 2000 (Current issues report, 1988). Thus, it is important for food service managers to maximize the effectiveness of the available labour resources. In this section, efficiency of hospital food service systems in terms of labour costs, and meal costs in the literature are discussed.

Costs in Hospital Food Service Systems

There are a few reports concerning costs in hospital food service systems (Brown and Hoover, 1991 ; Hospital Caterers Association, 1986). Costs can include food costs, labour costs, other operating expenses, inventories, capital, and utilities. In 1991 Brown and Hoover reported the cost of food service inputs in hospitals in U.S.A. It was found that labour and food costs represented 86% to 95% of the total costs in hospitals. These results are shown in Table 2.4.

In the U.K. most National Health Service (NHS) hospitals have rigid limits in terms of the unit cost per head which is currently £1.80p for three meals and some seven beverages per day (Kipps and Middleton, 1990); this amounts to between £8 and £12 a week per patient, though it is more in acute wards and less in geriatric or long stay institutions (The Times, 1990). This demonstrates the significant financial constraint placed on hospital catering managers.

In 1986, the Hospital Caterers Association reported the wages of non-managerial posts in the NHS and the private sector. It is shown in Table 2.5. The hours worked in the NHS are longer than those worked in private industry, which results in higher ancillary earnings, particularly for men.

It was reported by the UK inspectorate that almost half the hotel and catering industries inspected were giving less pay than the legal minimum (Dronfield and

Soto, 1980). Generally, for all employee categories, the hotel and catering industry remains amongst the lowest paid industries in the country (New Earnings Survey, 1987).

<Table 2.4> *Mean Per cent of Cost of Food Service Inputs*

Resource Category	Facilities 1 (n=30)[a]	2 (n=34)	3 (n=22)	4 (n=37)
	<——— % ———>			
food[b]	22.3	17.0	21.0	31.2
labour	68.0	78.0	65.0	56.0
other	6.3	3.0	6.0	9.0
utilities	1.8	1.0	5.6	2.8
capital	1.6	1.0	2.4	1.0
Total	100.0	100.0	100.0	100.0

[a] n represents the number of months of data evaluated in each facility.
[b] Cost data used to calculate these percentages were expressed in constant dollar values.

(Source: Brown and Hoover, 1991)

<Table 2.5> *The Wages of Non-Managerial Posts in the NHS and the Private Sector*

Direct Industrial Catering*		NHS **	
Head chef	£146.60	Head cook	£86.16
Cook	£110.00	Senior cook	£81.62
Trainee cook	£ 92.80	Cook	£79.40
Catering assistant	£ 91.60	Catering assistant	£68.98
Waitress	£ 93.60		
Kitchen porter	£104.00	Porter(Grade 3)	£71.73

* 1984 figures, basic weekly rated. ** 1985 figures
(Source : Hospital Caterers Association, 1986)

2.6 Conclusions

This chapter has examined the underlying nature of food quality in food service production systems in a broad context. In recent years the phrase 'system approach' has become popular in catering. In catering this means adopting a systematic approach to food production, recognising the various parts of the whole and organising them in a way which leads to optimal quality and output. A food service system is the commercial or non-commercial production of food for consumption by groups of people. The major methods of food production system which are conventional, cook-chill, cook-freeze and sous-vide are extensively used today.

Studies which used a uni-component definition of food quality, most commonly relied upon sensory, nutritional or microbiological quality as the single criterion of food quality. From a catering manager's point of view, this type of 'go / no go' method for food quality evaluation yielded only superficial results with no indication of the degree to which other components of food quality were achieved by a particular organisation. Not surprisingly studies which used uni-component failed to agree not only on which criterion to use, but also how to measure each single criterion. Studies reliant solely on one criterion showed little agreement in answering these questions and sometimes did not address them. The use of multi-faceted food quality measurement have, to date, been scarce, despite the fact that the inadequacies of uni-factor measurements for purposes of system management have been widely accepted. The main reason for the use of uni-factor measurements is that most researchers have a specialized interest which makes them emphasize one component of food quality (McCune, 1962 ; Peryam and Shapiro, 1955 ; Pilgrim, 1957).

Although there were some trials to evaluate food quality in hospital food service systems using multi-faceted explanations, to date only very a few multi-hospital surveys concerned with these problems have been published (C.A.S.H., 1965 ;

Edgecombe, 1966 ; Catering Research Unit at University of Leeds, 1972 ; McLaren, 1973 ; Ruf and David, 1975). Of these, most were done in 1960s or 1970s and few reports have been conducted in the U.K. (Catering Research Unit at University of Leeds, 1972).

Most of the research has focused on hospital cook-chill food production systems, although hospital food production systems are predominantly conventional. Overall, the review indicates the need to undertake research into food quality in conventional food service systems as a basis for improved system management.

SECTION III : MODELLING AND DESIGN OF THE RESEARCH

CHAPTER THREE : MODELLING OF THE HOSPITAL FOOD SERVICE SYSTEM

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CHAPTER THREE

Modelling of the Hospital Food Service System

In this section of the thesis the aim is to model food production and service in a hospital setting. This will facilitate the identification of aspects of the system and of food quality important in the management of a hospital catering unit.

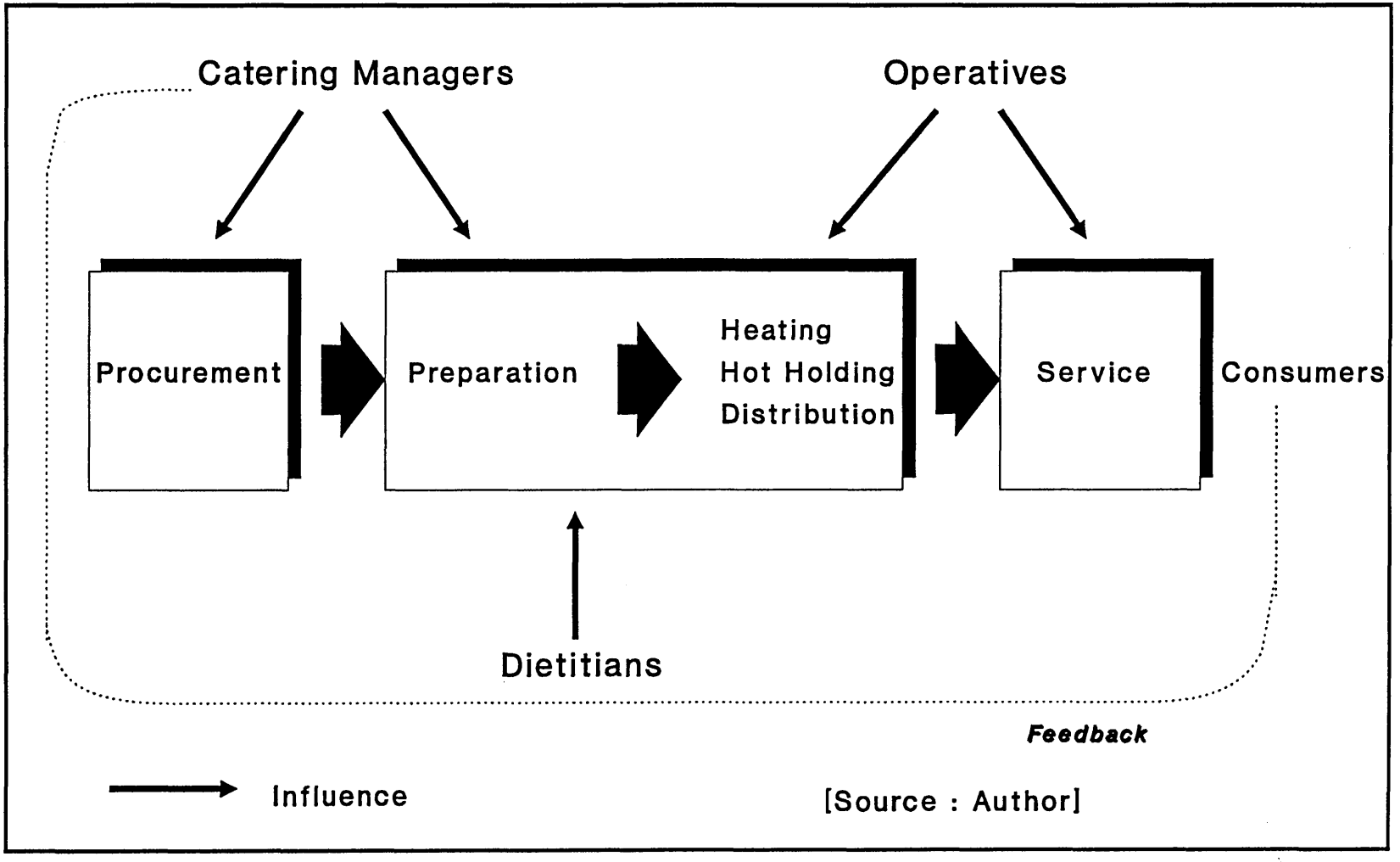
3.1 Overview of the Model

Fig 3.1 shows a simplified representation of the conventional hospital food service system. Each box represents a stage in the process which must be undertaken in conventional hospital food service systems. For any food production service system to function, there are two essential components which are input and output. Input is referred to 'procurement' and output to 'service' in this figure. The input of a system is the drive that starts the entire system and results in an output. The pace of the entire system can be adjusted by feedback, which is based on the nature of the outcome. Feedback helps in assessing the functioning of a system (Khan, 1991).

Briefly, the conventional system consists of traditional quantity food production. After the cooking or preparation process, menu items are stored by hot-holding between production and service. Hot holding is any heated storage treatment, such as holding in steam tables or warming cabinets.

Distribution, portioning, and assembly includes any of those activities in a centralized area which prepares for the distribution of trays to the patients. Service includes any activities related to delivery of the meal tray to the patient.

FIG 3.1 SIMPLIFIED DIAGRAM OF POINTS IN THE CONVENTIONAL FOOD SERVICE SYSTEM



In conjunction with the main flow of the diagram, procurement is carried out by catering managers or catering staff, then preparation, hot holding and distribution are mainly achieved by catering staff in co-operation with catering managers and dietitians. Finally, the service stage is closely related to consumers as they are the final receiver of food and give feedback on their satisfaction.

3.2 Identification of the 'Food Quality' Components and Influencing Variables

For the development of the model, it is important to identify the criteria[1]* and components[2] of food quality significant in the hospital food service system. Components of food quality can be viewed as the quantitative aspect of the criteria of food quality which are qualitative. In the selection of quality criteria and components, it was essential to identify the most influential stakeholders[3] in the hospital food service system (* 1-3: defined in 3.5).

Even if the significance for food quality of the areas of the process specific to the hospital food service system is known, another level of complexity arises from the conflicting interests of those concerned with food quality within hospital food service systems. Whilst it is obvious to all in the hospital food service system that the ultimate goal of their efforts is the satisfaction of consumers within the broad constraints imposed by overall budgets, dietary needs, and the absolute requirements of hygiene, it is nevertheless the case that the interests of each of the four partners are different not only in a qualitative but also in a quantitative respect.

Consumers place emphasis on the sensory quality of food rather than on the nutritional aspects, the latter being emphasized by dietitians (McCune, 1962).

Catering managers have an important role in providing enjoyable, nutritious and safe meals for consumers within practical constraints of increasing food costs and labour costs. Catering managers emphasize efficiency to include costs per meal and productivity as an important component for evaluation of food quality as well as safety, nutrition and satisfaction (Bobeng, 1982). However, catering staff pay much attention to their working environment which can affect their job satisfaction. Many food service management practices have originated from the assumption that changes in employee satisfaction would be reflected in increased quantity and quality of output (Pedderson, *et al.*, 1973).

Reliance on a single criterion of food quality evaluation would be unsatisfactory, not least, because of the complexity of hospital food service system. The criteria used to assess the food quality in hospital food service system should relate to the key stakeholders; managers, dietitians, patients and catering staff. The components used to assess food quality in this situation will thus include measures of satisfaction (patients and employees), efficiency, safety and nutritional adequacy. These are shown in Fig. 3.2.

Of the stakeholders identified, the catering manager has a pivotal role. S/he is responsible for allocating resources, human and technical, and responding to the needs (voiced and unvoiced) of the other stakeholders. The needs of the patients and those of catering workers may not be obvious. Dietitians, by contrast, are employed specifically to communicate their demands clearly and precisely.

Each quality component is discussed below.

3.2.1 Satisfaction Components

The ultimate goal of a hospital food service system should be the satisfaction of consumers and their recovery of full health. An accurate understanding of consumers' perceptions is important if a hospital food service department is to meet consumers' needs.

FIG 3.2 COMPONENTS FOR THE ASSESSMENT OF FOOD QUALITY IN HOSPITAL FOOD SERVICE SYSTEMS

STAKE HOLDERS	CRITERIA	DIMENSIONS	COMPONENTS	
Patient	Enjoyable to Eat	Consumer Opinion	Patient Satisfaction	Assessment of Patient Satisfaction
Caterer	Enjoyable to Produce	Producer Opinion	Employee Satisfaction	Assessment of Employee Satisfaction
Catering Manager	Good Value for Money	Efficiency	Productivity	Productivity of Output
Dietitian	Promoting Good Health	Safety	Microbiological Control	Level of Microbiological Control
			Temperature Control	Temperature Level of Meals Served
		Nutritional Adequacy	Food Waste	Level of Plate Waste by Consumers

Source [Author]

The component of patient satisfaction relates to the 'end-product experience' which in turn indicates patient's acceptance of the meals served.

The component of employee satisfaction refers to operational aspects of the use of the system.

Both components were measured via questionnaires.

3.2.2 Efficiency Components

Even though the object of a hospital food service system is to satisfy and facilitate the recovery of patients, the system has practical constraints imposed upon it by overall budgets, labour costs, etc. It is reported that catering costs in National Health Service (NHS) hospitals amounted to £397 million in 1983/4, representing 4.9 per cent of NHS hospital expenditure (Hospital Caterers Association, 1986). In 1990 £1.80p was allocated for three meals and some seven beverages per day for one patient in NHS hospitals (Kipps and Middleton, 1990). This rigid limit to the unit cost is a powerful constraint on the supply and production of meals. Considering these facts, an efficiency component was selected which gave an overview of actual use of the system. It was measured in terms of the productivity of total food output.

3.2.3 Safety Components

Sources of food associated risk include toxic hazards, microbiological hazards and hazards deriving from the presence of foreign objects in food. Generally microbiological hazards have been considered to be most important; the number of contaminations caused by chemical agents or extraneous matter are extremely rare in comparison (Todd, 1987). As mentioned in the literature review, the chief hazard in hospital food is microbiological food poisoning. Considering these facts two measures of food safety were included in the model, a temperature control component ie a direct measure of food temperature prior to food service,

and a microbiological control component ie an indirect measure of microbiological control procedures undertaken in the hospital food production service system.

3.2.4 Nutritional Adequacy Components

As previously quoted (See Chapter 2.5.2.), it is reported that plate waste is the largest part of food waste in hospitals (Steel and Delaney, 1983), estimated at up to 30 per cent of the costs of food. Food waste is thus important both financially and nutritionally.

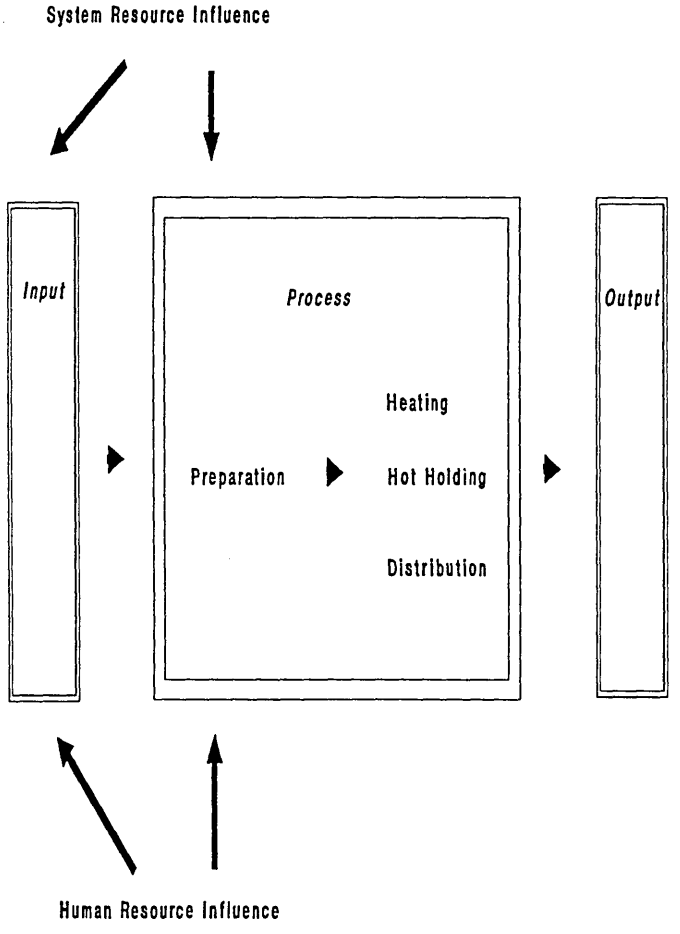
Nutritional adequacy was explored by measurement of food waste instead of analysing the composition of various nutrients in patients' meals. This is because, so long as the meal is eaten, its nutritional adequacy can be assumed since all menus are planned by registered dietitians.

The component 'food waste' provided practical although admittedly crude index of patients' nutritional intake.

3.3 Influencing Variables

Figure 3.3 represents the food producing system and shows the routes by which the catering manager can influence the performance of the system. These routes are via human resources (see 3.3.1) and system resources (see 3.3.2). Some resource issues are beyond the catering manager's control but nevertheless affect the system's performance. The literature is thin in this area, consequently some of the relationships discussed below are conjectural, but will be tested in the empirical research.

FIG 3.3 SIMPLIFIED DIAGRAM FOR DETERMINATION OF FOOD QUALITY IN HOSPITAL CONVENTIONAL FOOD SERVICE SYSTEMS



Source [Author]

3.3.1 Human Resources

Influencing variables within the category of human resources include full-time ratio, supervisor ratio, labour costs, catering staff satisfaction with pay and promotion (See chapter 4).

As the full-time or supervisor ratio increases, the level of productivity decreases due to reduced scheduling flexibility. This outweighs the benefits of the greater skills of full time workers. Yung *et al.* (1981) reported that as the ratio of full-time to part-time employees increased, labour productivity decreased. Labour cost might affect food quality because a better paid labour force is likely to be happier and to work more effectively (Opsahl and Dunnette, 1966). Staff satisfaction with pay and promotion may increase patient satisfaction, productivity, and staff satisfaction.

3.3.2 System Resources

System resources assumed to influence food quality include the total meal equivalents, food and consumables costs, number of menu items, non-patient meal ratio, modified meal ratio, catering function ratio, number of patients, bed capacity, occupancy rate, and subsidizing meal ratio (See chapter 4).

As hospital size, ie meal equivalents, number of patients, bed capacity or occupancy rate increase so might quantity of labour up to a maximum of efficiency beyond which point food waste or quality deterioration may occur. Yung *et al.*, 1981, found that higher counts of total meal equivalents were positively associated with labour productivity. An inverse relationship between hospital size and staff satisfaction may exist since intra and inter-departmental relationships become more impersonal in large organisations.

In 1967 Donaldson reported that hospitals serving a larger ratio of nonpatient meals had higher levels of productivity. Staff satisfaction may increase as result of increased job variety and more social involvement with other departments. An

increase in the number of diet modifications increases the number of items to be prepared and can decrease productivity (Brown, 1971). As the food service system involves itself in more catering functions, productivity levels may decrease because of the additional duties required.

The budget allocated for food costs can determine the quality standards of food purchased. It is possible that an increase in food costs resulting from increased use of preprocessed foods can increase productivity and the satisfaction of patients and staff.

3.4 Conclusions

In this chapter a model of hospital food quality has been developed for application in a management context. **Methodologies for its practical deployment are fully discussed and developed in the next chapter.**

3.5 Footnotes

1. **Criteria** refers to excellence which permits simultaneous awareness of subject and object and is dependent on context.
2. **Components** refer to attributes which are all closely related to a food quality's components, are almost entirely independent of each other, and each may represent a cluster of dimensions. They are not concerned with preferredness or degrees of excellence.
3. **Stakeholders** are defined as people related with an interest in food quality in hospital food service system, such as patients, catering managers, catering staff and dietitians.

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CHAPTER FOUR

Methodology

4.1 Introduction

The six components of food quality and the 15 influencing variables found in the model and discussed in chapter 3 identify the parameters to be measured. Not all of these parameters are susceptible to simple, straightforward measurement. Methods for obtaining these measurements had to be investigated and this is discussed in this chapter. In addition a pilot study was undertaken which is also reported in this chapter.

4.2 Sources of Information

Clearly given the nature of the stakeholders identified in the model, three sets of respondents had to be approached in order to obtain the range of information required. Firstly, detailed information was needed from the main decision maker, usually the catering manager. Secondly, it was considered essential that information was obtained from the actual producers within the catering system, ie the catering staff. Thirdly, it was imperative to ascertain the levels of patient satisfaction with the food served in each hospital.

4.3 Methods of Data Collection

A wide variety of research methods are available for collecting empirical data to include quantitative questionnaire surveys, qualitative personal interviews, objective scientific measurements. In this research, it was necessary to use

methods of data collection which were appropriate to each variable in the model. Moser and Kalton (1985) have identified four main research methods for empirical field work ie Documents, Observations, Mail Questionnaires and Personal Interviews. For this research, the following principal methods seem to be particularly relevant.

a) Documents
b) Observation
c) Measurement
d) Questionnaires
e) Personal Interviews.

The choice of methods used in this research are discussed in the following sections.

4.3.1 Documents

Documents can supplement data collected by subjective assessment methods such as observation and interviews and act as a method of cross-checking data obtained by other means. Documents may also help the researcher identify those issues deserving consideration and clarify preliminary frameworks.

In this respect, the financial records and personnel information in catering departments in hospitals can provide useful data about the systems studied. Within this research, the use of documentary sources was not widespread, but it proved useful for obtaining information on influencing variables, for example on costs per meal or labour costs which were obtained from documentary sources.

4.3.2 Observation

Observational methods can have great relevance in some types of empirical field work. All research depends on observation to some extent. As one of the most

frequently used types of research methods (Cole, 1980), it may take many forms and is both the most primitive and the most modern of research techniques (Goode and Hatt, 1952).

Observation of Human Components

When information is likely to be inaccurate or distorted by direct questions, observations can be used most effectively. Also, observations can offer a checking procedure to compare answers given to questions. It would be impossible to obtain all the data needed for the current study by the use of the observation method alone, because the presence of an additional person such as a researcher in the kitchen may affect the measurement. Several studies have illustrated that people alter their work patterns when they are conscious of being watched (Mayo, 1949). This is known as the 'Hawthorne Effect' and generally results in increased efficiency on the part of the worker. This may possibly affect the results by making the worker more conscious of productivity or other aspects. However, observation can be used to great effect in conjunction with a 'covert questionnaire' with patients or catering staff. This involves 'casually' conversing with patients or catering staff whilst focusing on activities which are taking place in the wards or kitchen and drawing these activities into the conversation. This method can help elicit information which cannot be easily exposed by formal questionnaire or interview.

Observation of Technical Components

As a part of the pilot study, the researcher observed the whole process of food preparation at two hospitals for the purpose of familiarisation with the processes.

4.3.3 Measurement

Within the current research, the use of direct measurement was widespread. For example, measurement of temperature control and food waste levels helped to get information which was likely to be inaccurate or distorted by direct questioning.

4.3.4 Questionnaires

The mail questionnaire is usually cheaper than other methods, particularly when the population is scattered, but this advantage is outweighed by the usually low response rate. Mail questionnaires were not be used in this research because they can involve the following disadvantages:

- Respondents answers are final. It is impossible to overcome a respondents 'unwillingness' to answer particular questions.
- It is inappropriate where spontaneous answers are wanted.
- It is difficult to ensure that the questionnaire is completed by the person at whom it was aimed.
- There is no opportunity to supplement the respondent's answers by observational data (Moser and Kalton, 1985a).

With these disadvantages in mind, a questionnaire was distributed to patients and catering staff by the researcher for self completion and collected from the respondents by the researcher after completion. The advantage of using questionnaires is that it is relatively cheap and less time consuming than other methods, particularly when the population is large.

4.3.5 Designing Questionnaires

Questionnaires were designed specifically to suit the aims of a study. As Moser and Kalton (1979) point out, questionnaire design is of critical importance.

> *"...no matter how efficient the sample design or sophisticated the analysis, ambiguous questions will produce non-comparable answers, leading questions, biased answers and vague questions, vague answers...It is fair to say that question design is the survey director's most persistent headache, particularly since it is still so largely a matter of art rather than science"*
> (Moser and Kalton, 1979).

Development of questionnaires for the use in the study followed a similar process to that used by Churchill (1987) outlined in Figure 4.1.

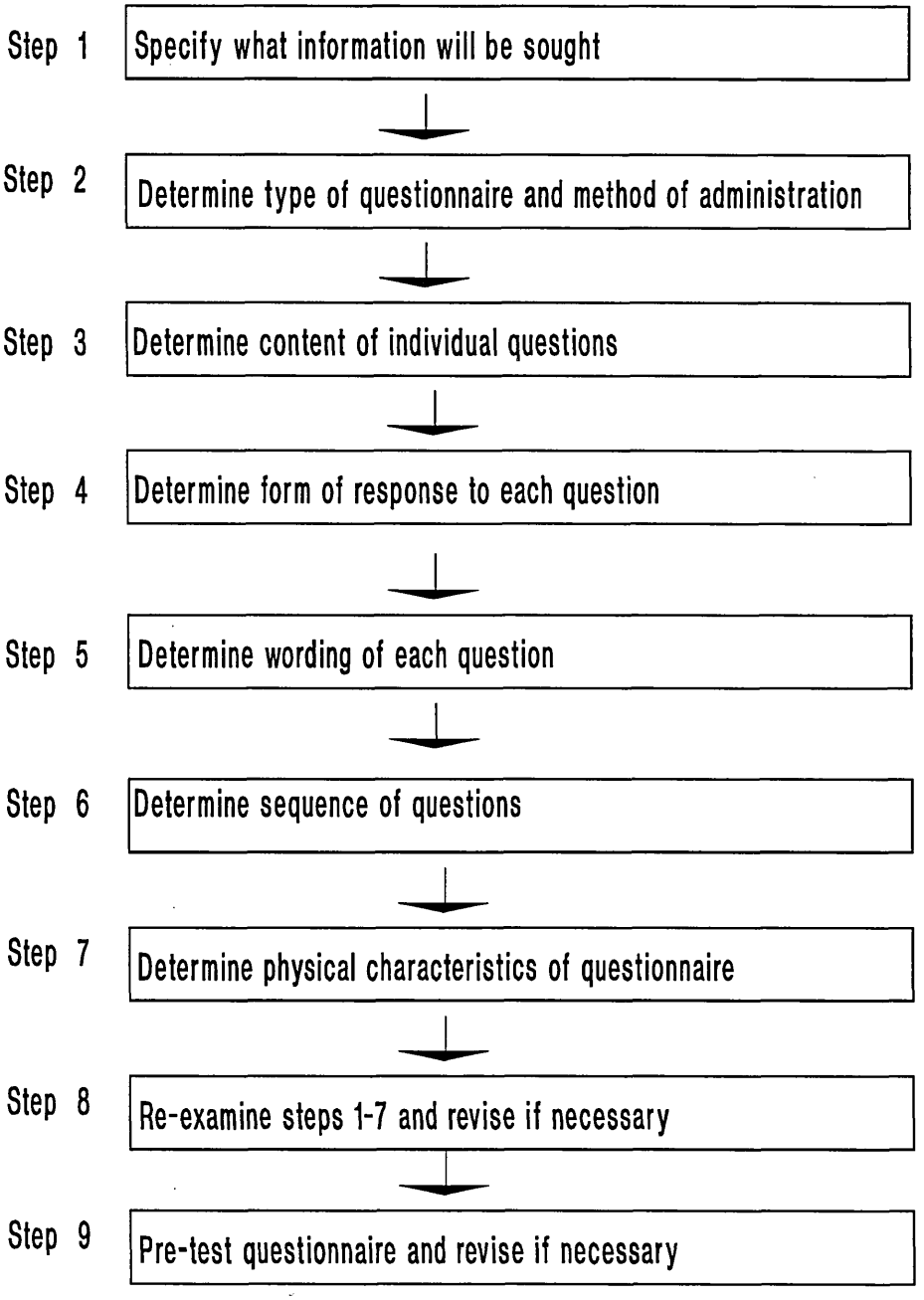
In general, question wording should be short, simple, clear, unambiguous and concrete. Bailey (1987) states :

> *"In general, the chief goal of questionnaire construction is to construct an instrument that will not only minimize non-response, but will also ensure that the information collected is complete, valid and reliable. The best questionnaire for accomplishing this goal is generally relevant, non ambiguous and has clear answer categories that are easy to respond to"*
> (Bailey, 1987).

Hence the wording of questions must avoid words unfamiliar to respondents, negative implications, ambiguity and memory dependent questions (Moser and Kalton, 1979 ; Belson, 1985).

Thus, during questionnaire development, question wording, as far as possible, should use words in common, everyday use and question length should be kept as short and precise as possible. Belson (1959) has shown that prompt list questions produce a higher yield than open questions. The main problem with open questions is that responses may be unusable, non-comparable or irrelevant to the study. In this research prompt list questions were used ie the respondent was offered a choice of replies and asked to tick the appropriate box. This design also allows the answers to be easily coded and transferred into a computer file for analysis.

FIG 4-1 DEVELOPING QUESTIONNAIRES



Source: Churchill, G. (1987)

4.3.6 Personal Interviews

Theoretically, interviews are classified into two categories based on the degree of structuring: structured and unstructured. The former, where each subject is asked the same set of questions, allows for comparability. Responses are converted into standardised scales, notably into a numerical code. This method helps to avoid the interviewer's bias and to compare the respondent's answers. However, little freedom is permitted within the particular encounter (Bulmer, 1983). The unstructured interview provides a more intimate view. It gives considerable freedom to the interviewer in the questioning procedure and emphasizes the informants' world of meaning. By utilizing the informants' categories rather than those of the interviewer, the respondents can be encouraged to speak freely. These advantages are balanced by disadvantages. Because of the non-standardized way the data are collected, metrical analysis may be difficult or impossible. Another major limitation flows from the researcher's use of impressionistic interpretation of the data (Dean *et al.*, 1967). It contains the possibility of bias and prejudice.

The main purpose of the hospital survey was to elicit detailed information for evaluating the food service system. As the information was routine, standardised, and factual rather than opinion, structured interviews were used. It enabled comparative information to be obtained for the hospital units.

Two of the major advantages of the interview technique for the current research were flexibility and allowance for the complicated questionnaire. It enabled the interviewer to repeat, or re-word a question when a response indicated that the respondent had misunderstood. In addition, a face to face interview allowed a much more detailed questionnaire than would otherwise have been the case and ensured that the appropriate person was interviewed. Another advantage of using an interview is that it can provide the interviewer with extra information from, for example, the respondent's body language and facilitate the development of a rapport between the respondent and interviewer. Healey (1983) reports a

response rate of 60% or more for interviews against 30% or less for postal methods. A high response rate is critical in order to minimise bias through the self selection of respondents.

Interview methods tend to be more expensive than other methods of data collection, in terms of time and transport costs. This was not a major problem for the current research as the geographical scope of the hospitals was limited. Secondly, respondent reaction can be influenced by age, colour, sex and general appearance of the interviewer. However, it was felt that the disadvantages of this technique were outweighed by the quality of information obtainable.

4.3.7 Pilot Study

A pilot study was conducted to familiarize the researcher with the atmosphere of hospital catering systems. It also provided an opportunity to administer the pilot questionnaire survey at one hospital with characteristics similar to the sample hospitals. The purpose of the pilot study was therefore to determine:

1) that the model was applicable to real hospital situations.
2) that the data to be collected from records within the hospital and/or food service department were available,
3) that questionnaires* could all be administered within the time span allotted,
4) that the methods selected for the administration of questionnaires and their evaluation were feasible,
5) the reaction of employees and patients to the research, and
6) that data collected could be compiled and analysed as planned.

* At the time of pilot study the questionnaires were not in their final format; nor had the model of food quality in hospital food service systems been finalised.

Initially the two local hospitals selected for the feasibility study were

1) Royal Hallamshire Hospital, Sheffield and
2) Nether Edge Hospital, Sheffield.

Both the catering managers were most helpful, enthusiastic and informative. Permission was obtained for the observations and a pilot questionnaire survey of the opinions of catering staff and the consumers (ie hospital staff and patients) about the quality of food production and service in the hospital.

Through the observations in the two hospital catering departments for two weeks each, once in the middle January and later in the early July, 1991 and also through the discussions with catering managers, the multi-faceted food quality model was finalised.

The pilot questionnaire survey on consumers (hospital staff and patients) and catering staff was conducted in the one Hospital in mid April, 1991. A total of 130 people participated in this survey:

50 members of hospital staff as consumers
50 patients (10 from each ward)
30 members of catering staff

Three questionnaires were designed to survey the opinion of people likely to be affected by the food quality in hospital food service system.

Questionnaire 1 - 'Opinion of Patients Towards Hospital Catering'
Questionnaire 2 - 'Opinion of Hospital Staff Towards Hospital Catering'
Questionnaire 3 - 'Opinion of Hospital Catering Staff Towards their Work'.

As a result of the pilot study, some new methodological issues were identified, and the implications of these for further research were considered. These are:

1) The feasibility of the proposed research was established through discussion with catering managers, patients, dietitians, and catering staff. It was found to be possible to apply the model of food quality developed in this research to real hospital situations.

2) The model proved to be adequate to reflect the complexity of food quality in hospital food service systems.

3) The variables: selection, appearance, cleanliness, smell, temperature of hot food, temperature of cold food, portion size, seasoning, cooking, flavour, meal time, overall quality of food and drinks, quality of food service personnel, overall quality of service were included in order to consider the contributors to 'overall satisfaction of the meal'. These variables indicated good reliability and generalizability of these components and they were retained for use in the main questionnaire for consumers (See section 4.4).

4) For consumer opinion it was found better to include only patients rather than both staff and patients, because usually less than a third of hospital staff eat their meal in the canteen and most of them eat just one meal there, and their attitude is quite different from that of patients. The plan to survey hospital staff as consumers was dropped to make the study more focused.

5) Consumer questionnaires should be distributed only at the noon meal in order to obtain the largest level of participation. Patients were more alert at mid-day.

6) The consumer questionnaire was reduced in size from 4 pages to 3 pages by removing 9 questions. The 5 point scale was changed to a 7 point scale to provide greater discrimination.

7) The questionnaire for catering staff, the Job Description Index (JDI) developed by Smith, Kendall and Hulin in 1969 proved to be suitable for determining job satisfaction within the catering department. This was used for this purpose. (See section 4.4)

8) Data relating to the influencing variables was available from the records kept by the catering managers (See section 4.5)

9) For analysing the data of questionnaires, 'The Statistical Package for the Social Sciences' (SPSS) computer programme was used and regarded as suitable for the main surveys. It has a large capacity and can provide a wide range of statistical

analysis procedures eg regression, correlation etc. It also provided the opportunity to produce fully labelled tables and graphs.

4.4 Measurement of 'Food Quality' Components and Influencing Variables

The object of the research is to evaluate food quality in hospital food service systems. Specifically, the model derived in chapter 3 places emphasis on aspects of quality of concern to the main stakeholders: the catering manager, the dietitian, the patient and the catering worker.

As discussed before, the manager's concerns are

1) to produce the 'best' food and service within tight resource constraints, and
2) to keep the other stakeholders happy

The methods adopted to evaluate the efficiency of resource use are largely based on those developed by other workers. This allowed for comparison of results obtained in other organisations at other times. They do, however, represent a compromise between precision and practicability.

Dietitians are concerned with the nutritional value and the safety of the food. This might most accurately be assessed by direct metabolic studies of the consumers. This is clearly impractical in this situation, as is direct examination or analysis of the meals served. Waste measurement provided a cheap and quick and admittedly crude index of the nutritional adequacy of food consumed. There is evidence that as many as 70% of surgical in-patients may be undernourished mainly from food waste (NHS, 1989). Although nutritionally adequate diets, planned by registered

dietitians who have had similar training are provided in all hospitals, plate waste can lead to undernourishment.

Similarly, safety is more accurately judged by medical examination of people who have consumed the food. Even comprehensive microbiological laboratory analysis was outside the scope of this study. Temperature control of food was judged a key indicator of risk and easy to collect. Details of the unit's microbiological control procedures were easy to collect and a powerful information source.

To judge the reaction of consumers one could use several very different methods, eg hidden cameras for direct observation, interviews, examination of plates before and after the meal is eaten, and so on. Questionnaires provide a quick, cheap and easy way of assessing opinion. The weaknesses of questionnaires are well known. For example, respondents may give what they think of as the 'correct' answer rather than the truthful one; the questions may be based on the view of the designer rather than that of the respondent, etc. In this study, questionnaires, with all their limitations, were adopted and some information on consumer opinion gleaned from studies of plate waste.

To assess employee satisfaction indirect data such as absenteeism and turnover can be used. However, such measures have become an increasingly inaccurate indicator of employee satisfaction as a result of a 'locked-in' effect resulting from fewer job openings, human obsolescence, and increased financial incentives to stay in a position until retirement (Hershey, 1973). The use of more direct data such as interview and job attitude surveys has been reported to be an accurate index of employee satisfaction (Woolf, 1970). Specifically in this research an adapted JDI index was used.

Whilst virtually every method used sacrificed some accuracy and precision to expediency, the analysis confirms that they produced useful and reliable results. If the protocol developed is to be useful to catering managers on an occasional or even routine basis, practicality is essential.

4.4.1 <Component 1> Patient Satisfaction Level

Patient satisfaction can be measured by questionnaire survey. In hospitals questionnaires have been used extensively to measure consumer acceptance (Feldman, 1962 ; Frank, 1955 ; Maller et al, 1980 ; Post, 1957) because of their practicality and sensitivity.

In this study patient satisfaction with the quality of hospital food and food-related service was determined through patient questionnaires. A questionnaire was developed specifically to suit the aims of this research. General aspects of the design and development of the questionnaire are discussed in Chapter 4.3.5.

The questionnaire was designed for patients eating their meals in their wards. It consisted primarily of multiple-choice questions, although some open-ended questions were included to get information on attitudes not easily obtained by a multiple-choice format. An index called 'Overall Satisfaction of Food Quality' score was defined as the sum of the respondent's ratings on fourteen items related to the meals and food-related service. Assuming equal weights for all items, these items reflected the 'Overall Satisfaction of Food Quality'.

The survey questionnaire consisted of 21 questions which could be categorised into three parts; 1) variables of overall satisfaction of the meal, 2) food habits of patients, and 3) others, including gender and age. The survey questions are presented in Appendix 2. Patients were asked to assess each variable on a seven point scale ranging from positive to negative in most survey questions.

4.4.2 <Component 2> Employee Opinion on Job Satisfaction

Understanding the satisfaction and dissatisfaction of employees has been deemed important for smooth and efficient food production. However, few measures of employee satisfaction levels in hospital food service systems have been reported (Calkins, 1973 ; Ruf, 1975).

The Job Description Index (JDI) was developed by Smith, Kendall and Hulin in 1969 as a measure of employee satisfaction which was sensitive to the effects of differences between employees and what they bring to their varying work situations. The JDI as developed by Smith, Kendall and Hulin measured job satisfaction in five areas: the type of work, the pay, the opportunities for promotion, the supervision and the co-workers on the job. For each area there was a list of adjectives or short phrases, and catering staff were asked to indicate how the listed descriptive terms in each scale described their feelings by marking (Y) for yes (this is how I feel), (N) for no (this is not how I feel) or (?) if the item was not applicable or if they could not decide. A total score of 216 was possible for someone who was delighted with their job.

Plotting the distribution of scores on the five scales yields a negatively skewed curve when traditional scoring systems were used. The (?) response was found to be more indicative of dissatisfaction than of satisfaction. In 1969 Smith, Kendall and Hulin assigned the following weights to the responses to improve the distribution of scores:

Responses	Weight
Yes to a positive item	3
No to a negative item	3
? to any item	0
Yes to a negative item	0
No to a positive item	0

The JDI has been extensively used in food service systems by many researchers to evaluate the satisfaction of employees (Calkins, 1973 ; Ruf, 1975 ; Mok and

Finley, 1986). They commended the measure as effective in this context. The JDI was utilized to measure employee satisfaction in this research because it provided the following advantages:

- it is directed toward specific areas of satisfaction rather than global or general satisfaction;
- the verbal level required to answer the JDI is low enough to be easy to administer and standardise;
- the responses are job-referent rather than self-referent;
- it permits comparison with other studies.

It is important, however, to recognize that this approach has all the weaknesses associated with questionnaire surveys.

In this research a two-part questionnaire was developed for use by both supervisory and non-supervisory catering staff in the hospital food service systems studied. Part 1 was based on the 72-item Job Descriptive Index developed by Smith, Kendall, and Hulin to determine employees' perceptions of job satisfaction related to work, pay, opportunities for promotion, the supervision and the co-workers on the job. Responses were made on the revised scale, with 3 being 'Yes to a positive item' or 'No to a negative item', and 0 being '? to any item', 'Yes to a negative item', or 'No to a positive item'. A total job satisfaction score was obtained by summing the responses to the 72 questions. Possible scores ranged from 0 to 216, with a higher score indicating a higher level of job satisfaction.

Part 2 comprised six demographic items related to gender, age, employment status, job title, education level and years employed in food service. Responses to demographic items were made by selecting the appropriate descriptive category (See Appendix 3).

4.4.3 <Component 3> Productivity

Information on productivity was obtained from catering managers.

Productivity measurements in food service are complex due to the inherent diversity of hospital food service systems. Those parameters most commonly used include labour minutes per meal or meal equivalent, meals per labour hour, and unit of output per labour cost.

The Hospital Administrative Services' weekly meal equivalents index (Hospital Administrative Services, 1973) and Mayo's index of productivity (Mayo, *et al.*, 1984) were used in this research. Mayo found that Servings Produced per Labour Hour (SPLH) was the best criterion for productivity measurements in his research because nine of the hypothesized predictor variables explained 59% of the variance in this ratio. The weekly meal equivalents index calculated by the Hospital Administrative Services (1973) was used (in a modified form*) because it included meals other than those served only to patients.

The productivity index in this study thus is defined as the numbers of meals produced per person-hour. Thus a low productivity index would indicate a low level of productivity, and vice versa. The ideal direction of movement is an increase in the measure. A range of 0 to - Ø (infinity) 'adjusted meals' would be possible for this index using the following formula:

$$PI = me / M \qquad (4.1)$$

wherein:

PI = productivity index
me = adjusted weekly meal equivalents
M = total weekly food service department hours worked including all direct and indirect time by paid food service employees plus all hours actually worked by managers or other centre staff on food service-related functions, plus all hours actually worked by part-time employees.

The adjusted weekly meal equivalents were calculated by use of the formula:

$$me = P/m_x + m_p \quad (4.2)$$

wherein:

P = total weekly monetary turnover of cafeteria, coffee shop and catering function meals
m_x= average cost of a meal (1 entree, 1 vegetable, 1 salad, 1 dessert, and 1 beverage) (Zolber and Donaldson, 1970 ; Zolber, 1971 ; Hospital Administration Services, 1973)
m_p= weekly total patient meals served

* Average cost of a meal (m_x) defined above was used in USA hospitals, and was not entirely appropriate to UK. The modified average cost of a meal was calculated by 1 main dish, vegetables, dessert and beverages.

4.4.4 <Component 4> Microbiological Control

Each hospital was examined individually to ascertain the level of microbiological control. Catering managers were asked:

- whether food poisoning accidents had occurred;
- what kind of microbiological monitoring is done;
- whether hospitals have microbiological standards or a qualified person doing microbiological testing;
- what temperature control methods are used for chilled areas and meals;
- what training courses related to microbiological control or safety are available for catering staff.

These issues were posed as questions which mostly required a simple 'yes/no' answer (See Appendix 4).

For every 'yes' response, a score of '1' was allocated and for every 'no' response a zero score was allocated (except Ques. No. 1 which is vice versa). Question No. 8 and 9 were given scores from 0 to 5. Although this method introduced the potential for a zero score. This did not arise, because each hospital gained a 'yes'

for at least one question. A maximum total score of 15 was possible. This score was judged on a relative rather than an absolute basis.

4.4.5 <Component 5> Temperature Control

Conventional hospital catering is typically based on cooking, warm holding, and service. The guide-lines for hospital foods stress the importance of temperature control at all stages of this process in order to minimize microbiological hazards (DHSS, 1988 ; DOH, 1990). Measurements for the temperature control component, in this research, were based on the temperature control guidelines published by DHSS (1988). These principles stated that food should be cooked to a centre temperature above 70°C. Hot foods should be kept above 63°C and cold foods below 10°C during distribution and service.

The arithmetic means of triplicate food temperature measurements made just before food was delivered to patients were compared to the published recommendations. The numbers of times the food temperature exceeded or equalled, or failed to meet the recommendation were totalled for each hospital system. The temperature of every kind of hot and cold dish produced was monitored.

The number of times the food temperature met the recommendation was totalled for each hospital food system. To compare hospitals on an equal basis the following frequency ratio was computed:

$$Ft = \frac{\text{No. of times food temp. met recommendation}}{\text{total number of readings}}$$

4.4.6 <Component 6> Food Waste

Various measurements for food waste were discussed in Chapter 2.5.2 in terms of their advantages and disadvantages. Based on the literature review, percentage waste per tray (w/w) was used for this index. This method is supported by Kirks and Wolff (1985) as the preferred method and is determined as follows:

$$\frac{\text{amount of food waste (gm)}}{\text{amount of food served (gm)}} \times 100 = \text{percentage food waste}$$

Data on waste were collected at the 11 hospitals during a period of three consecutive days. Waste at breakfast, lunch and dinner was measured on each of these 3 days. About 30% patients were selected randomly from various wards. The same selection criteria were used as for the patient satisfaction survey. Hospital staff were not included since most of the staff had only one meal at the canteen. Patients on regular diets were included, but not those on modified diets, clear liquid diets or tube feedings.

Food quantities were checked by weighing every type of meal item served. Weighing occurred at the time the trays were set out. Patients' menu cards were placed on top of each tray, and the data collector stuck a selector card on the pre-identified trays. On return to the kitchen, the selected trays were separated for the weighing of the edible plate waste. The same procedure was followed for the all 9 meals. A kitchen scale with 0.1 gm sensitivity and 3 kg capacity was used. Kirk and Osner (1981) reported a practical difficulty in defining edible and inedible waste. The list of inedible materials issued by the 'Food Waste Survey Unit' (MAFF, 1979) was used for uniformity in this study (Appendix 5).

4.5 Measures of Influencing Variables

The influencing variables, eg key factors thought to influence the food production service process, include human resources and system resources. These were derived because food quality in hospital food service systems can be easily influenced by the catering staff and the operating food service system. The human resource parameters selected include full-time catering staff ratio, supervisor ratio, labour costs, promotional opportunity index and satisfaction with pay. The system resource parameters are meal equivalents, food and consumables costs, number of menu items, non-patient meal ratio, modified meal ratio, catering functions ratio, number of patients, bed capacity, occupancy rate and subsidizing meal ratio.

4.5.1 Human Resources

Full-Time Staff Ratio

For this research, a full-time member of staff was considered to be any employee who is working an average of 35 hours per week on a year-round basis. The full-time staff ratio (FT) was calculated with the following formula:

$$FT = \frac{\text{Total number of full-time staff}}{\text{Total number of catering staff}} \qquad (4.3)$$

Supervisor Ratio

The supervisory staff ratio (SR) was calculated with the following formula:

$$SR = \frac{\text{Total number of supervisors}}{\text{Total number of catering staff}} \qquad (4.4)$$

Labour Costs

The total average labour costs for a month were requested in the general information questionnaire. Labour cost per meal equivalent (LC) was calculated using this formula:

$$LC = T/30^{*} \times 7/me \qquad (4.5)$$

wherein:

LC = labour cost (£) per meal equivalent
T = total monthly labour cost in catering department
7 = days per week
me = total weekly meal equivalents (Formula 4.2)
* 30 or 31 according to month

Satisfaction with Pay

The scores of satisfaction with pay (SP) in the JDI were used.

SP = JDI Satisfaction Scores with Pay (4.6)

Satisfaction with Promotion

The promotion scores (PO) in the JDI were used.

PO = JDI Satisfaction Scores with Promotion (4.7)

Most of these variables were straight forward and simple and were easily collected as planned in the pilot study. No attempt was made to measure actual payments and whether promotional opportunities did or did not exist within the food service departments because it is important to know what the catering staff feel about these aspects.

4.5.2 System Resources

Meal Equivalents

The adjusted weekly meal equivalents (me) were calculated by use of formula 4.2.

$me = P/m_x + m_p$

wherein:

P = total weekly monetary turnover of cafeteria, coffee shop and catering functions
m_x = average cost of a meal (1 main dish, vegetables, dessert and beverages)
m_p = weekly total patient meals served

Food and Consumables Costs

Average food and consumables costs for a month were obtained from the general information questionnaire (Appendix 6). Food plus consumables cost per meal equivalent (FC) was calculated using this formula:

$$FC = t/30^* \times 7/me \qquad (4.8)$$

wherein:

FC = food plus consumables cost (£) per meal equivalent
t = total monthly cost of food and consumables
7 = days per week
me = total weekly meal equivalents (Formula 4. 2)
* = 30 or 31 according to month

Number of Menu Items

The number of menu items (NI) for one week was counted from a complete set of patient menus.

Non-patient Meal Ratio

The non-patient meal ratio (NM) was calculated from information recorded on general information questionnaire using the following formula:

$$NM = \frac{(T + F)}{(me \times mx)} \qquad (4.9)$$

wherein:

NM = non-patient meal ratio
T = total turnover of cafeteria and coffee shop sales per week
F = total turnover of special catering function meals per week
m_x= average cost of a meal (Formula 4.2)
me = meal equivalents (Formula 4.2)

Modified Meal Ratio

Modified meal ratio (MR) included all patient meals except normal diet meals. This information was obtained from the general information questionnaire. The formula used to calculate this ratio was:

$$MR = mm / me \qquad (4.10)$$

wherein:

MR = modified meal ratio
mm = total number of modified meals served per week
me = adjusted weekly meal equivalents (Formula 4.2)

Catering Functions Ratio

The catering functions ratio (FR) was calculated from information recorded on the general information questionnaire using the following formula:

$$FR = \frac{F / m_x}{T/m_x + me} \qquad (4.11)$$

wherein:

FR = catering functions ratio
F = total turnover of special catering function meals per week
m_x= average cost of a meal (Formula 4.2)
T = total turnover of cafeteria and coffee shop sales per week
me = meal equivalents (Formula 4.2)

Number of Patients

The average number of patients (NP) in each hospital was obtained from the catering manager's questionnaire.

Bed Capacity

The total number of beds (BED) in each hospital was obtained from the catering manager's questionnaire.

Occupancy Rate

The average occupancy rate of patients (OC) for one week in each hospital was obtained from the catering manager's questionnaire.

Subsidizing Meal Ratio

The subsidizing meal ratio (SM) was calculated from information recorded by the catering manager using the following formula:

$$SM = \frac{\text{monthly output for subsidizing patients meals}}{\text{monthly profit by running special catering functions}}$$

No difficulties were encountered in collecting this information due to its standardised and simple nature.

4.6 Conclusions

A variety of data collection processes and measures were designed to assess significant dimensions of food quality, and the factors which influence food quality within the hospital food service system.

Analysis of the data will allow for assessment of the relative contribution of the different components and furthermore for assessment of the interactive effect of these components and influencing factors. It appears that a robust multidimensional measure of food quality has been developed, suitable for application to hospital food service system.

CHAPTER FIVE : DESIGN OF THE EMPIRICAL RESEARCH

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CHAPTER FIVE

Design of the Empirical Research

Hospital food service systems are a 'vehicle' for applying the multi-faceted measure for the evaluation of food quality developed in Chapters 3 and 4. The details discussed in this chapter include the sampling procedure for hospitals, patients and catering staff, the data collection process, and an assessment of the reliability and validity of the research.

5.1 The Need for Field Work

To test the multi-faceted measure of food quality developed, it is essential to do field work in various hospital food service systems.

Extensive information is required to get a fully realistic insight into the variables associated with hospital food quality. The intensive examination of food quality in a reasonable number of hospital operations requires attitude, opinion, and factual data, which could only reasonably be obtained through field work.

In the present research, information was collected from a variety of respondents, to include catering managers, catering staff and patients, using the measures discussed in chapter 4, to obtain a full picture of the activities at different levels and from different viewpoints throughout hospital food service systems.

5.2 The Selection of Samples

Sampling is considered crucial in ensuring the generalisability of a survey's findings. The sample selected must be representative of the total population in

terms of both the nature of hospital food service systems and the patients for meaningful conclusions to be drawn from the data analysis.

5.2.1 The Selection of Hospitals

Because of the number of hospitals scattered in different parts in the U.K., it would have been virtually impossible to choose a random sample of hospitals. In order to obtain a suitable sample size for this research, within practical travelling distance, the hospitals were selected on the basis of the following criteria.

1. Organisation - NHS Hospitals

In the UK hospitals are divided into two categories. One is NHS hospitals and the other is registered private hospitals. It was reported that there were 2,600 National Health Service (NHS) hospitals and 1,200 registered private hospitals in the UK (HCITB, 1984). It is assumed that NHS hospitals might be different from registered private hospitals in terms of their operations and systems. NHS hospitals are supported by national funding. NHS hospitals provide standardised training for staff in terms of hygiene, food preparation and service in compliance with NHS Health and Safety Recommendations. NHS hospitals receive their guide-lines for operating their food service systems from the Health Authority. Thus their operational system is more homogeneous and they comprise the largest segment of hospital populations in the UK.

2. Admissions - Short term Admission

Hospitals are also divided into two groups according to their admission policy. Generally, long term admission hospitals are for mental or geriatric patients. Long term admission hospitals are excluded from this survey, because patients' understanding and co-operation is important in order to obtain large numbers of

patients and reliability of results, and this is more difficult with mental and geriatric patients. For this reason, short term admission hospitals were chosen.

3. Size - Middle Size

Hospitals in the National Health Service are subdivided into 3 groups on the basis of size: small hospitals (less than 50 beds), medium sized hospitals (50-499 beds) and large hospitals (500 or more beds). Medium sized hospitals were selected for this research, since medium sized hospitals provide enough variability in terms of size to test the food quality model developed in chapter 3. Additionally it was felt that it might be difficult to find very small or very large hospitals willing to participate in the survey and that these hospitals if found may be using rather different types of food production service systems.

4. Food Production System - Conventional System

System factors, such as conventional or cook-chill system, may be the main variables to affect food quality in hospitals (Allen *et al.*, 1991). Conflicting reports have emerged in terms of food satisfaction of patients, sensory food quality and economic efficiency in each system (Allen *et al.*, 1991 ; Cardello *et al.* 1981 ; Cremer, 1983 ; Glew, 1968 ; Mason *et al.*, 1990 ; Zallen *et al.*, 1975).
In the UK the conventional system remains the primary choice for hospital food service, although a small but increasing number of hospitals are converting to cook-chill.
Hospitals using the conventional system were selected in this study because they form the majority and the development of a model of food quality requires concentration on one type of catering system only.

5. Location - Located in the Trent and West Midland Regional Health Authorities

In the UK., Health Authorities are divided into 3 types by region ie the Regional Health Authorities of England, the District Health Authorities of Wales, and the

Health Boards of Scotland (The Institute of Health Services Management, 1992). The Health Authorities of Wales and the Health Boards of Scotland were excluded for practical reasons. Considering costs and time limitations, and the difficulties involved in conducting pilot studies and field work at a long distance, hospitals located in the Trent Regional Health Authority and West Midland Regional Health Authority were chosen because of their accessibility from Sheffield.

Thus the total population of 12 hospitals selected for this study were all NHS hospitals, all medium sized, all had short term admission patients, all used conventional catering systems and all were located within the Trent and West Midland Regional Health Authorities of England.

It is not possible to say that these 12 hospitals are representative of all those hospitals in the U.K. which fall into categories 1-5 above. However, it is likely that these hospitals provide a reasonable representation because they are controlled by national standardised training and national standardised menus in compliance with NHS Health and Safety Recommendations (DHSS, 1988).

It is recognized that the sample size is small ie 12 hospitals. However the time and resources available for the study made it difficult to enlarge the sample.

5.2.2 The Selection of Patients

It is important that the sample selected from the relevant population is representative in all respects.

About 30 per cent of all of patients in each of the 12 hospitals were surveyed. This was considered a large enough sample to give representative and reliable results. Obviously a larger sample would elicit more precise results, but due to the complexity of the survey, this was impractical.

The population selected for this survey consists of patients who were:

- hospitalized during survey periods
- on normal diets
- short-term patients
- not having impending testing, medical examination, surgical procedures, or laboratory tests
- received their meals for at least one full day.

The questionnaire survey was conducted with patients during hospitalization in order to maximise the collection of data and accuracy of results. It has been reported that most former patients are so grateful after discharge that the entire hospital experience takes on a positive bias. Retrospectively they tend to consider that their meals were 'highly good' or 'good', although they may not have been satisfied with the quality of food or the way in which it was served while they were in hospital (Feldman, 1962).

Patients on special diets were not included since it was felt that dietary modifications would affect both their feelings about the food and food waste. The results obtained from them would therefore not be representative. It was necessary to include more than one ward from each hospital in the survey to avoid bias resulting from unanticipated problems with food service eg when the trolley for that ward arrives late, when the distribution of trays is delayed, or when other sudden events occur which might affect one particular ward. Within those wards surveyed, patients were chosen at random. Almost the same number of male and female patients were selected. Patients of various age groups were chosen to prevent age-related errors. Anonymity of responses was guaranteed to all respondents to encourage valid judgements and candid comments.

Lunch time was chosen for the survey to maximise participation in the survey. It was reported that patients do not like to participate in the late afternoon and evening due to anticipation of visitors and fatigue from the day's activity (Cash

and Khan, 1983). Questionnaires were distributed at lunch time and collected some 45 minutes later. Each patient participated only once in this survey.
The selection of patients for the plate waste survey was based on the criteria discussed above.

5.2.3 The Selection of Catering Staff

The research questionnaire was administered to supervisory and non-supervisory catering employees in their work setting during normal working hours. A 30% sample size was considered to be adequate for this study. Thus the catering staff on a list were numbered and then every third worker was selected. Participation was voluntary and employees were told that their responses would be confidential. The researcher collected the questionnaires so that the participants would know that their supervisors had not seen the responses.

5.3 Implementation of Methodology

Co-operation from the 12 hospitals was vital to the success of this research. The process outlined below was followed to help ensure a high level of response from the hospitals in the sample.

1. Introductory Letter mailed to the Catering Managers.

Regional Catering Advisers in the Trent and West Midland Regions were contacted to ask their help in arranging the field work in hospitals. They contacted the hospital catering managers by letter to explain the purpose of the research and to ask if their food service personnel would be willing to participate. All of the catering managers in the selected hospitals were told that all of the results would be strictly confidential. The data would not be used for evaluation

of individual systems, but for the identification of overall trends in food service systems that might be useful in improving food quality.

2. Follow-Up Phone Call.

Several days after the letters were mailed, the catering managers were contacted by telephone. Follow-up visit dates were arranged with catering managers who were willing to participate.

3. Follow-Up Visit.

During a follow up visit the followings were discussed:

how the research results would be used; the methods to be used in the collection of research data; and to confirm the research dates in each hospital.

5.4 Data Sources and Collection

The process of obtaining permission to carry out the field work in hospitals was complicated. Permission resulted in a special researcher's identity card to facilitate access to patients, catering staff and catering managers in the various hospitals. Once it was clear that permission had been granted to carry out the research, the researcher had free access to people who could provide useful data and information. Once there was access, people tried to give the researcher as much information as they could to facilitate the research.

Research data for the food waste and temperature monitoring in this research were obtained by objective measurements in the 12 hospital food service systems. Most hospital kitchens prepared breakfast at 7 o'clock in the morning and washed up evening meals at 7 o'clock in the evening. It is worth mentioning that the data collection during a period of three consecutive days including 3 breakfasts, 3 lunches and 3 evening meals was extremely difficult due to its time consuming nature. Fortunately thanks to the help of the Trent and West Midland Regional Health Authorities, the researcher was provided with hospital accommodation

which made it much easier to access each hospital from early morning until late evening.

5.5 Survey Implementation

The survey was conducted by the researcher from April 1992 to November 1992. The survey questionnaires were delivered to 1015 patients, 355 catering staff and 12 catering managers. This process depended heavily on four advisers: two were lecturers of Sheffield Hallam University and the others were Advisers of the Regional Catering Authorities involved.

The survey for patients and catering staff were mainly self-administered (see section 4.3.4). The respondents were told that participation was voluntary and that their responses would remain confidential. Of the 1015 patients and 355 catering staff issued with a questionnaire, 933 patients and 327 catering staff returned a completed questionnaire, giving response rates of 91.9 and 92.1 per cent respectively. This unusually high response rate was due to the careful planning and implementation of the questionnaire administration process.

5.6 Validity and Reliability

Validity refers to the success of the instrument in measuring what is sets out to estimate. Therefore, when the validity of an instrument is satisfactory, differences between individuals' scores can be taken as representing true differences in the characteristics under study (Moser and Kalton, 1985b). There are three main ways of assessing validity (Wilkin and Thompson, 1989a): content validity, criterion validity and construct validity. Content validity is the simplest of these, where the emphasis is on ensuring that the measure apparently reflects the

content of the concept in question (Bryman and Cramer, 1990a). Criterion validity is based upon comparisons between the results obtained using the measure in question and some alternative measure, either of the same concept or of outcomes which might be expected to reflect results obtained using the measure (Wilkin and Thompson, 1989a). Finally, construct validity involves looking at whether the results support the hypotheses that were used to construct the measure in the first place.

Despite these various approaches to estimating the validity of measures, the notion of validity is of little practical use in questionnaire surveys. The most serious problem of validity lies in the lack of empirical methods to test or ensure it. In the case of criterion validity, of course, the validity coefficient is suggested by several advocates like Dooley (1990). A criterion, in this case, is an existing measure that is accepted as an adequate indicator of the characteristics of interest. Criterion validation consists of correlating the criterion with the new measure that is being assessed for validity. The correlation of the new measure with the criterion measure is the criterion validity coefficient. However, it is highly questionable whether every researcher has an existing criterion that is explicitly defined and accepted as an adequate indicator of the characteristics of interest.

As an attempt to test for the construct validity of the questions in this study, the survey questions which had been deduced from related theories were submitted for critical appraisal by four advisers from the academic and practical field of food service management. Their relevance and understandability were increased after discussions with the advisers. Also, a pre-test was conducted in mid April, 1991 (see pilot study in section 4.3.7). 130 questionnaires were administered to patients and catering staff in one hospital during this pre-test.

As a result, considerable changes were made to the questionnaire before being set out. Patients and catering staff were found to be able to understand most terms appearing in the questionnaire. However, two kinds of major amendment were suggested by the results of the pre-test. Firstly, it was suggested that the number

of survey questions should be cut, because four pages of questionnaire was too long and some respondents missed a page. The number of survey questions was reduced from 30 to 21. A much more severe problem was found in the scaling of patients answers. Five point scales did not adequately show the differences in patients' opinions of hospital food. Therefore, there was a change from a five point scale to a seven point scale.

The notion of reliability is concerned with consistency of measures (Wilkin and Thompson, 1989b). Unlike validity, three types of reliability measures are often used in empirical studies: test-retest reliability, split-half reliability and *Cronbach alpha*. The correlation of scores from two administrations of the same test estimates test-retest reliability. This is a method which has been suggested to test external reliability. External reliability refers to the extent of consistency of a measure over time while internal reliability means the degree of consistency between item scales in a single time of survey. The split-half method splits the test into two parts (either randomly or on an odd-even basis) and correlates one half with the other half. A coefficient is calculated which ranges from 0 to 1. *Cronbach alpha* generates the average of all possible split-half reliability coefficients (Bryman and Cramer, 1990b). In this study, *Cronbach alpha* is employed to test the reliability of the survey results. Two supposedly equivalent versions of the scale were given to the respondents and the results were analysed using SPSS. A reliability of 0.67 was produced by the *Cronbach alpha* method. Here, the reliability 0.67 means that there is a strong intercorrelation between the two equivalent versions of the scale. If there had been more than two items, they would have a much higher reliability than 0.67.

5.7 Conclusions

The hospital food service system has been used to test the multi component measure of food quality derived in chapter 3. The field work which involved approaching the different stakeholders in the system should provide the detailed information required to build up a holistic view of food quality in the hospital food service system, and the factors that affect it.

SECTION IV : ANALYSIS OF RESULTS

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CHAPTER SIX

Analysis of Results of Main Survey and Main Findings

This chapter describes the results of the empirical research undertaken in the 12 hospital food service systems surveyed, 8 of which were located in the West Midland Regional Health Authority, 4 of which were located in the Trent Regional Health Authority.

6.1 Dimension of Satisfaction

6.1.1 Patients' Satisfaction

A. The Sample Population

Altogether 933 patients in the 12 hospitals surveyed took part in the survey. The total response rate was 91.9 per cent. Several respondents remarked that participation in the survey relieved their boredom. The gender, age, and length of stay in hospital are shown in Table 6.1. The distribution of gender, age and length of stay in hospital of the patients in this survey closely approximated to that of the Glew's research (Glew, 1968). There were about 16.4 per cent more women than men in the sample, and their relative proportion was approximately the same in all twelve of the surveyed hospitals.

B. Attitudes of Patients to Hospital Food

Table 6.2 shows patient satisfaction ratings as described by the various terms used in the patient questionnaire. A 7-point scale was used, with a score of 7 representing 'very good', a score of 1 representing 'very poor' and a score of 4 representing 'neutral'.

I————————	I————————	I
1	4	7
Very Poor	Neutral	Very Good

<Table 6.1> *Demographic Description of Patients*

Characteristics	Percent (%)	
SEX		
Female	58.2	
Male	41.8	
AGE	Female (%)	Male (%)
Under 25 years	10.1	3.0
26-35 years	12.9	3.3
36-45 years	7.4	4.6
46-55 years	5.6	5.7
56-65 years	6.2	8.7
Over 65 years	16.0	16.5
LENGTH OF STAY (DAYS)	Female (%)	Male (%)
1 - 2 days	15.3	9.3
3 - 7 days	22.8	17.9
8 - 14 days	10.3	7.2
15 -30 days	5.5	5.4
Over 30 days	4.3	2.0

<Table 6.2> *Overall Mean and Standard Deviation for Patients' Satisfaction Scores*

VARIABLES OF FOOD	Mean	S.D.
Selection	5.6	1.2
Appearance	5.6	1.2
Cleanliness	6.0	1.1
Smell	5.4	1.2
Hot Temperature	5.6	1.3
Cold Temperature	5.5	1.2
Portion Size	5.6	1.2
Seasoning	4.9	1.5
Cooking	5.5	1.3
Flavour	5.3	1.4
Meal Time	5.7	1.2
Overall Quality	5.7	1.2
Food Service Personnel	6.0	0.9
Overall Service	6.0	1.0
Total Score*	**78.6**	**12.4**

1) Selection and Variety of Food

For the entire patient population, the mean score was 5.6 with standard deviation of 1.2, which implies a score between 'Good' to 'Slightly Good'. This positive response may imply that the two weekly or three weekly menu cycles offered were sufficient to combat 'food fatigue'. All but one (Hospital I) of the hospitals surveyed used a set menu, due to the refurbishment of its Catering Department. As expected, the hospital using a set menu gained the lowest mean score of 4.8.

2) Appearance of Meals Served and Cleanliness of Dishes and Tray

The average mean scores for appearance of meals and cleanliness of dishes and trays were 5.6 and 6.0 out of 7.0 respectively. In general patients seemed to be more satisfied with presentation and cleanliness compared with other aspects of quality. The higher rating by ward patients for cleanliness of dishes and trays reflects the emphasis placed on hygiene in this area.

The favourable rating by patients for appearance of food was probably due to the fact that patients are served a pre-loaded tray on which all food items are carefully and neatly arranged by kitchen personnel.

3) Smell of Meals

Patients ratings for smell and flavour of meals are favourable (Mean 5.4 and 5.3). Wards are characterized by antiseptic and medicinal odours. When the foods are brought to the patients' room, food odours released from the dishes are easily noticed by patients, and are in sharp contrast to the prevailing room odours.

4) Temperature of Food Served Hot and Cold

Although there were no significant differences between satisfaction with the temperature of the hot foods (Mean 5.6) and the temperature of the cold foods (Mean 5.5), the rating of temperature of the hot foods was higher than that of

temperature of the cold foods. Most of the hospitals used insulated dishes for hot foods, which keep the food hot during delivery. On open-ended questioning, a few patients complained about melting ice cream. The greater the time lapse between the loading of the trays and the consumption of the food the greater likelihood of chilled items warming.

5) Size of Food Portions

Patients rated the size of food portions as being 'good' or 'slightly good', however, many patients indicated portion size to be 'big' on open-ended questioning.

6) Seasoning of Meals

The mean score for seasoning of meals was 4.9, with a standard deviation of 1.5, which implies between 'Slightly Good' and 'Neutral'. This rather unfavourable response is probably due to the fact that most hospitals are using minimum seasoning for patients. Currently patients are not given salt and pepper on their trays except by request. Patients would like to be given individual salt and pepper on their trays.

7) Summary

The aspect of the meals which received the lowest ratings by patients was 'seasoning of meals' (indicated to be too bland on open-ended questioning). The highest rated items were: (a) attitude of personnel serving food (Mean 6.0), (b) overall quality of service (Mean 6.0), and (c) cleanliness of dishes and tray (Mean 6.0).

C. Effect of Demographic Variables and Food Habits on Total Satisfaction

An index called 'Satisfaction' was defined as the sum of the respondent's ratings on all 14 of the questionnaire items related to the meals eaten in hospital. Assuming equal weighting for all items, this variable reflected the 'overall satisfaction' with the meal. The variables included are selection, appearance, cleanliness, smell, temperature of hot food, temperature of cold food, portion size, seasoning, cooking, flavour, meal time, overall quality of food and drinks, quality of food service personnel, overall quality of service. The total possible score was 98.

Least squares analyses of variance were computed to compare the means of the 'Satisfaction' scores with demographic variables and food habits. The effect of: appetite, patient satisfaction with hospital care, length of stay in hospital on patient 'Satisfaction' scores were assessed using Pearson correlation analysis. The results are shown in Table 6.3a and 6.3b.

<Table 6.3a> *Comparison of Patients' Satisfaction Scores with Demographic Variables and Food Habits*

Gender	Male	Female	Probability
Total Satisfaction	79.2	78.1	.213
Age	Under 25	Over 65	Probability
Total Satisfaction	72.7	82.3	0.03*
Food Habits	Food Left	No Food Left	Probability
Total Satisfaction	75.5	84.5	0.0001***

* P<.05, *** P<.001

<Table 6.3b> *Pearson Correlations*

Variable	Total Satisfaction
Length of Stay	.1174
Appetite	.7989***
Hospital Care	.7460***

*** P < .001

1) Effect of Gender of Patients

The female patients tend to be less satisfied with the food than males, although the difference is not statistically significant in this analysis (See Table 6.3a).

2) Effect of Age of Patients

The types of response to the questionnaire varied considerably with the age of the patient. Patients under 25 are significantly less satisfied with the food than are patients over 65 ($p<0.05$) (See Table 6.3a). Glew (1968) has shown that the older patients are more satisfied with the food, suggesting that older people are generally tolerant and less critical of the quality of hospital food. It can be suggested that this is due to diminished taste and olfactory sensitivity which can decrease the ability to distinguish the sensory quality of foods (Schiffman, 1977).

3) Effect of Food Habits

A significantly higher rating for overall satisfaction was given by those patients who do not usually leave any food and by those patients who did not leave any hospital food at the time of survey. T-tests on both the total 'Satisfaction' scores and 'size' scores showed that patients who either usually leave hospital food or who left their meal at the time of survey gave significantly lower ratings for both 'satisfaction' and 'size' scores in comparison with those who did not. This was probably due to the fact that patients who are less satisfied with the meals served tend to leave their food. It confirms that the index of food waste is useful in finding out whether patients are satisfied with the food or not (See Table 6.3a).

4) Effect of Length of Stay in Hospital

Since the length of time in a hospital may affect satisfaction with food quality, patients were asked to indicate the length of their hospitalization since admission. The majority had been hospitalized for less than a week, only 6.3 % patients had been there longer than one month.

The effect of length of stay on 'Satisfaction' scores was assessed by Pearson correlational analysis. Pearson correlation between both the reported length of stay at the hospital and the ratings of 'Satisfaction' score were not statistically significant for patients. However, small positive correlations were found between length of stay and ratings for 'Satisfaction' score (See Table 6.3b). Thus this finding confirmed the fact cited by Sheatsley (1965) that familiarity with hospital food resulted in a slight positive effect on satisfaction with hospital food.

5) Effect of Appetite and Hospital Care

'Satisfaction' score was significantly correlated with the patients' appetite at the time ($r=0.7989$, $P<0.001$) (See Table 6.3b). Also significantly correlated with the patients' opinion of the hospital food was their satisfaction with hospital care ($r = 0.7460$, $P<0.001$) (See Table 6.3b). This confirms the findings of Sheatsley (1965) that the quality of food served in a hospital actually does correlate with the quality of its staff and other services.

D. Overall Satisfaction Scores for 12 Hospitals

The range in scores for the 12 hospitals was 72.6 to 82.9 with a mean of 78.6, and a standard deviation of 12.4. This standard deviation indicated extensive variance in patient satisfaction among patients in the 12 hospitals in this study (See Table 6.4).

<Table 6.4> *Patient Satisfaction in 12 Hospitals*

	HOSPITALS					
VARIABLES OF FOOD	A	B	C	D	E	F
Selection	5.1	5.9	5.9	5.6	5.5	5.6
Appearance	4.7	5.8	5.7	5.7	5.5	5.5
Cleanliness	5.8	6.2	5.7	6.3	5.7	6.0
Smell	4.8	5.5	5.4	5.5	5.4	5.1
Hot Temperature	5.2	5.9	5.6	5.7	5.7	5.5
Cold Temperature	5.4	5.6	5.4	5.4	5.3	5.0
Seasoning	4.6	5.4	4.8	5.1	4.6	4.6
Cooking	4.8	5.9	5.6	5.6	5.2	5.3
Meal Time	5.8	5.8	5.7	5.7	5.7	5.7
Overall Quality	5.1	6.0	5.8	5.8	5.5	5.5
Service	5.8	6.3	5.9	5.9	5.8	5.9
Total Score*	**72.6**	**82.3**	**78.2**	**79.1**	**76.1**	**76.2**

	HOSPITALS					
VARIABLES OF FOOD	G	H	I	J	K	L
Selection	5.8	5.7	4.8	6.0	5.4	5.2
Appearance	5.8	5.8	5.4	5.9	5.5	5.8
Cleanliness	6.3	6.2	5.9	6.2	6.0	6.4
Smell	5.8	5.8	5.3	5.7	5.4	5.3
Hot Temperature	6.0	6.0	5.5	5.9	5.8	6.0
Cold Temperature	5.3	5.7	5.6	5.9	5.7	6.0
Seasoning	5.3	4.6	4.9	5.2	5.1	4.9
Cooking	5.9	5.7	5.1	6.0	5.3	5.4
Meal Time	5.9	5.9	5.5	6.0	5.4	6.2
Overall Quality	5.9	5.9	5.5	6.1	5.7	6.0
Service	6.2	6.1	5.7	6.2	6.0	6.6
Total Score	**81.7**	**80.8**	**76.0**	**82.9**	**78.5**	**82.4**

* : Add up these 11 scores above and 3 remaining other scores which are portion size, flavour of food and service of foodservice personnel (See p.104).

6.1.2 Catering Staff Job Satisfaction

A. The Sample Population

The catering staff JDI satisfaction survey was completed by 327 catering staff. This represented a total response rate of 92.1 per cent.

Characteristics of the study sample are summarized in Table 6.5. There were about three times as many women as men in the sample, and their relative proportion was approximately the same in all twelve of the surveyed hospitals.

<Table 6.5> *Demographic Description of Catering Staff*

Characteristics	Percent (%)	
SEX		
Female	75.9	
Male	24.1	
AGE	Female (%)	Male (%)
Under 25 years	15.7	4.6
26-35 years	21.9	10.5
36-45 years	15.7	4.9
46-55 years	17.0	3.2
56-65 years	5.6	0.9
YEARS FOOD SERVICE EXPERIENCE		
Less than 1 years	9.9	3.4
1 - 2 years	11.7	5.6
3 - 5 years	19.1	7.1
6 - 10 years	13.9	4.0
11 -15 years	10.8	2.5
More than 15 years	10.5	1.5
Full-time staff	37.4	20.7
Part-time staff	38.5	3.4
Supervisor	13.9	5.3
Non-supervisor	62.0	18.8
EDUCATION		
None	45.1	8.4
CGLI*	12.0	7.1
BTEC Diploma	2.2	2.5
BTEC Higher Diploma	0.0	0.0
O Levels	12.9	4.6
A Levels	2.8	1.2
1st Degree	0.3	0.0
Higher Degree	0.6	0.3

* CGLI refers to City and Guilds of London Institute

B. Overall Attitudes of Catering Staff

Catering staff satisfaction was evaluated by measuring employee attitudes towards five aspects of their job using the Job Description Index (JDI). The JDI has a possible numerical total score of 216.

Smith, Kendall and Hulin in 1969 found mean overall scores for workers in general to be 162 for female staff and 172 for male staff. Somewhat lower means were noted for food service personnel, 113 for females and 116 for males (Mok and Finley, 1986). For the 12 hospitals in this research, average overall scores for female personnel were 102, and for male personnel, 93. Except for the category of 'supervision' where female workers scored highly, the workers in the present study achieved lower scores than those reported by Mok and Finley. In this study, catering staff appeared to be more satisfied with their interpersonal relations with supervisions and co-workers than with work content, pay, and promotional opportunities. Patterson (1972) and Mok and Finley (1986) reported similar findings concerning job satisfaction. This dissatisfaction with pay, promotion and work itself were in agreement with findings from other research into food-service workers (Calkins, 1973 ; Martin and Vaden, 1978 ; Hopkins *et al.*, 1979 ; Ruf, 1975). The UK inspectorate reported that almost half the hotel and catering industries inspected were paying less than the legal minimum (Dronfield and Soto, 1980). Generally for all employee categories, the hotel and catering industry remains amongst the lowest paid industries in the country (New Earnings Survey, 1987). In labour-intensive catering operations which use relatively little technology, labour is ultimately the most expensive commodity, therefore its reduction is often an obvious choice for reducing costs. The catering system itself may need modification in order for such reduction to be made. This modification may be achieved in relatively simple ways, such as the use of labour saving equipment or convenience products (Walker, 1988). A number of key factors have been considered for effective change within the catering industry;

probably the most important of which has been the improved working conditions and pay levels of workers.

Mean and standard deviation of JDI scores in this study are shown in Table 6.6. Table 6.7 presents mean and standard deviation of overall Job Description Index (JDI) scores in the 12 hospital catering departments surveyed in the Trent and West Midland Health Authorities.

The large standard deviation for satisfaction indicates that large differences exist in levels of employee satisfaction in hospitals in this study. Fig 6.1 shows the average scores in five areas for 12 hospitals in this study.

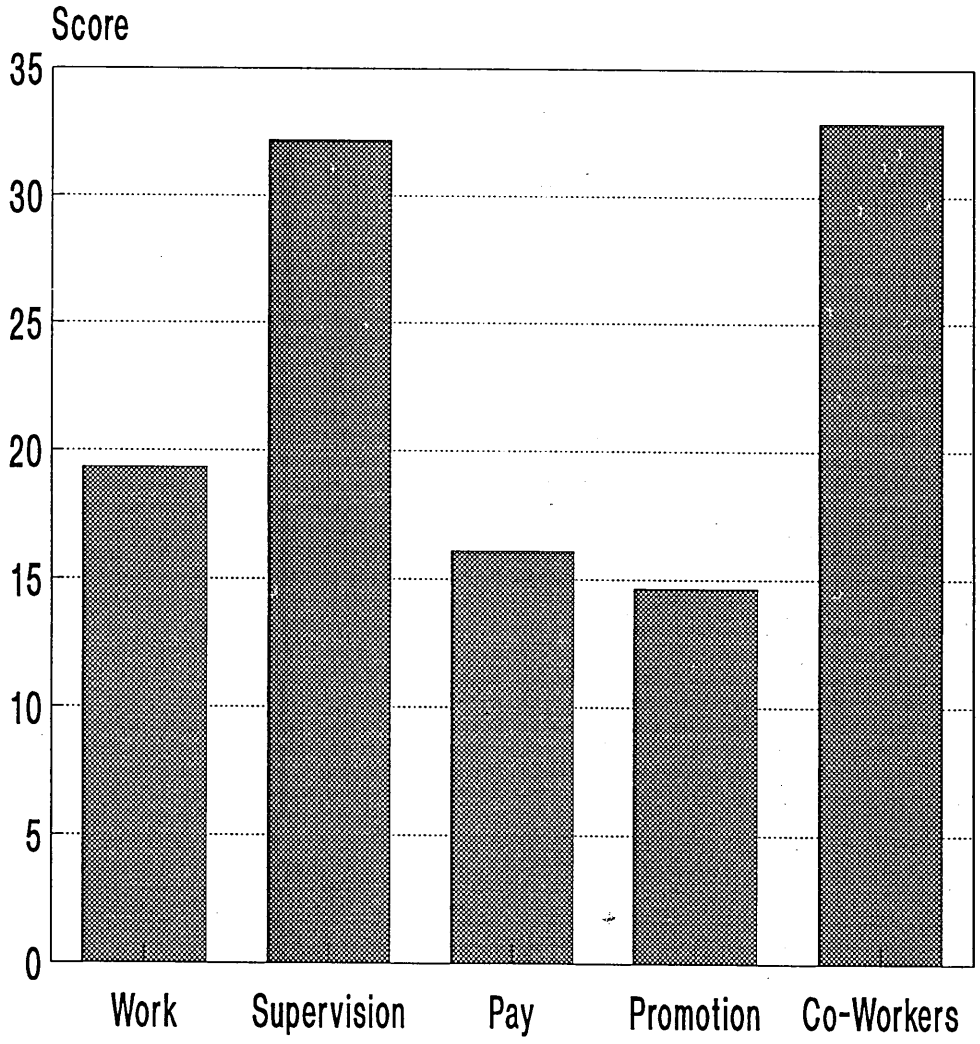
<Table 6.6> *Mean Job Description Index (JDI) Scores for Catering Staff in 12 Hospitals Compared with Means for Other food Service Workers and Workers in General*

JDI SCALE	Catering Staff in 12 Hospitals		Food Service Personnel[1]		Workers in General[2]	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Female						
Work	19.4	10.0	25.3	9.1	35.7	9.9
Supervision	32.8	13.4	32.2	11.4	41.1	10.1
Pay*	17.0	6.5	22.3	11.0	28.0	13.7
Promotion*	14.8	6.1	16.7	10.6	17.8	13.9
Co-Workers	33.8	13.3	36.3	10.9	42.1	10.5
Male						
Work	19.4	11.1	26.0	11.4	36.6	10.5
Supervision	30.1	13.9	32.7	13.1	41.1	10.6
Pay*	13.4	6.3	22.4	11.6	29.9	14.5
Promotion*	14.2	7.2	24.3	14.4	22.1	15.8
Co-Workers	29.8	14.2	33.8	12.5	43.5	10.0

1 Mok and Finley, 1986 (Hong Kong)
2 Smith, Kendall and Hulin, 1969
* Scores were doubled to provide a better comparison with other components.

Fig 6.1 Catering Staff Satisfaction

12 Hospitals in Trent and West Midland



(See Table 6.4)
[Source : Author]

<Table 6.7> *Mean and Standard Deviation of Overall Job Description Index (JDI) Scores in 12 Hospital Food Service Systems*

HOS.	N	MEAN	S.D.
A	20	101.1	30.6
B	31	86.7	35.7
C	41	92.6	44.9
D	29	100.2	32.4
E	22	96.2	34.6
F	43	93.0	30.5
G	34	114.6	27.0
H	35	103.8	37.1
I	37	103.0	35.1
J	14	97.6	28.2
K	14	103.1	26.8
L	7	134.6	33.5

Key : N = number of respondents
S.D. = standard deviation

C. Relationships with demographic data

Least squares analyses of variance were computed to compare the means of the JDI scores with demographic variables including gender, age, length of employment, and education level.

1) Effect of Gender of Staff

Compared to male staff, female staff had higher scores for satisfaction with work content, supervision, pay, promotion, and co-workers than male staff, although the difference is not statistically significant in this analysis.

2) Effect of Age of Staff

Satisfaction with work and supervision varied significantly among age groups. The under 35-year-olds scored significantly ($P<0.05$) lower for satisfaction with work content than the older age groups. Workers who were 46 years old or above were more satisfied with their supervision than the younger workers. These results supported Gibson and Klein's (1970) finding in which a positive linear relationship between age and job satisfaction was found. In this research age had a roughly U-shaped-pattern relationship with satisfaction with pay, those in the

twenty-six-to-fifty-five-year age group were less satisfied than those under 25 or those over 56 years old.

With regard to overall level of satisfaction among staff, age was positively related to job satisfaction, in accordance with findings reported by others (Calbeck, *et al.*, 1979 ; Gibson and Klein, 1970 ; Mok and Finley, 1986). Those under thirty five years of age were least satisfied, and those over fifty six were the most satisfied.

This may be explained by younger employees having unrealistic expectations of their jobs. As time passes younger employees adjust their expectations or leave their jobs, which causes the higher means for job satisfaction scores for employees who remain with the organisation (Mok and Finley, 1986).

3) Effect of Length of Employment

The number of years of employment was related to satisfaction with the work itself, supervision, pay, promotion and co-workers. Those with ten years' or less experience as catering staff were less satisfied than those with longer work histories. Satisfaction with the work itself increased as catering staff gained more experience, except for a slight decrease in those with 3 to 10 years experience. These results were compatible with the Morse study (1953) in which satisfaction increased with tenure in the organization.

Mean satisfaction with pay and supervision scores for those with less than 1 year in the profession were significantly higher ($P<0.01$) than those for other groups. This can be explained by the fact that those with less than 1 year's experience are likely to have recently started their first or full-time permanent position therefore the newness of the job makes them feel positive about their salary levels after recently experiencing financial constraints and they also tend to be very positive about their supervisors.

4) Effect of Education Level

Workers with A levels or first degrees had the highest satisfaction scores for work content, supervision, and total satisfaction. This result could indicate that workers who are highly educated occupy senior or professional positions, resulting in higher job satisfaction compared to the rest of the sample. However, due to the very small percentage of subjects (A level, 4.0% and 1st degree, 0.3%) in the sample that fell into these two categories, these results may not be statistically valid.

5) Effect of Status

58 supervisory and 257 non-supervisory employees from 12 hospitals participated in this survey. Supervisors were older than other employees, with 21.9 per cent of the supervisors being between the ages of 46 and 65. As expected, supervisors were more experienced than other employees. The majority of supervisors (46.8 per cent) had between 11 and more than 15 years experience while the majority of non-supervisors (47.5 per cent) had between 1 and 6 years experience.

Mean job satisfaction scores for the five job dimensions for supervisors and non-supervisors were analyzed and are presented in Table 6.8. Supervisors were significantly more satisfied with work content ($P<0.001$), promotion ($P<0.001$), and the supervision they received ($P<0.001$) than the non-supervisory employees. Analysis using T-Tests showed a significant difference ($P<0.001$) in total job satisfaction scores between supervisors and non-supervisors. Supervisors may experience intrinsic satisfaction because of promotion to their present positions. The results could also indicate that supervisors, who are more likely to be older or to have been working longer, may feel more sympathetic towards management because they can understand the constraints and difficulties that management has to deal with.

The part-time staff tend to be more satisfied with their supervision, pay and co-workers than full time staff, although the difference is not statistically significant in this analysis.

<Table 6.8> *Job Satisfaction as perceived by Supervisory and Non-supervisory Staff and Full-Time and Part-Time Staff*

	Job Satisfaction Score			
	Supervisors		Non-supervisors	
Job Dimensions	Mean	S.D.	Mean	S.D.
Work	24.5	9.5	18.3	10.2
Supervision	37.5	12.2	31.2	13.5
Pay*	19.8	6.9	15.2	6.3
Promotion*	21.2	8.3	13.3	5.7
Co-Workers	34.1	13.3	32.9	13.6
	Full-Time		Part-Time	
	Mean	S.D.	Mean	S.D.
Work	20.3	10.6	18.1	9.6
Supervision	31.2	13.4	33.3	13.9
Pay*	14.3	5.9	18.2	7.0
Promotion*	14.7	6.4	14.6	6.4
Co-Workers	31.4	13.6	34.9	13.3

* Scores were doubled to provide a better comparison with other components.
No. of supervisors=58, No. of non-supervisors=257
No. of full-time=190, No. of part-time=137

6.2 Dimension of Efficiency

6.2.1 Productivity

Productivity was measured in terms of meals produced per human hour and referred to as the productivity index (PI). The calculation made to obtain the PI for each hospital used Formula 4-1.

The range in meals served per hour is from 2.12 to 5.84 with a mean of 3.45 and a standard deviation of 1.13. Table 6.9 shows the productivity indices for the 12 hospitals surveyed.

<Table 6.9> *The Index of Productivity for 12 Hospital Food Service Systems*

Hospitals	Productivity (Meals/Hour)
A	4.40
B	4.83
C	5.84
D	2.89
E	2.23
F	3.74
G	2.17
H	3.44
I	3.10
J	2.12
K	3.05
L	3.60

These ranges are similar to ranges found in other studies of quantitative productivity levels. Prior study has established a range from a low of 2.23 meals per hour to a high of 6.90 meals per hour (Ruf, 1975). The mean of 3.45 found in this study was slightly lower than means found in prior studies which were 3.66 (Bakken and Northrop, 1956), 3.68 (Donaldson, 1957), 3.51 (Halter and Donaldson, 1957), 3.54 (Schell and Korstad, 1964), and 4.33 (Donaldson, 1967). In all of these studies, calculation of meal equivalents were based on formulae which differed from the one used in this study, which means that the results are not strictly comparable. Methods of calculating meal equivalents similar to those used in this study were used by HAS (1973) and Ruf (1975). They found average meals per hour to be 2.35, 2.58, 2.67, 2.99, 3.11, 3.26, 3.30, 3.47, 3.34 and 3.13. These are nearer to the mean of 3.45 found in this research and are comparable methodologically.

Mean and median values for meals produced per hour in the 12 hospital catering department were approximately the same, indicating a normal distribution. The standard deviation of 1.13 indicates a rather large amount of variance among food service systems in this study. Hospitals E, G, and J were below the range of

the mean minus one standard deviation, however, two hospitals (Hospital B and C) were over one standard deviation above the mean. There appeared to be no similar characteristics among the five to differentiate them from the others.

6.3 Dimension of Safety

6.3.1 Microbiological Control

Information on safety was obtained via questionnaires administered to the catering managers.

None of hospitals surveyed had reported any food poisoning incidents in the last 10 years. The Department of Health (DOH, 1991) reported that the number of foodborne outbreaks in hospitals has not risen. The Department of Health attributes this achievement to a number of factors: commitment to improve food safety on the part of the DOH and individual health authorities (particularly at local level), improved awareness by catering managers, a high level of training of all staff handling food, and modernisation of kitchens.

None of the hospitals took samples for the sole purpose of microbiological testing except one hospital where they had regular swab tests for equipment and facilities. Only one hospital kept every food produced for one week in order to test the samples microbiologically if a problem occurred. One hospital sent sandwich fillings to the microbiologist in the hospital on a weekly basis. Most of catering managers were aware of the importance of microbiological testing despite their non-compliance, but financial constraints make it difficult to adopt microbiological testing.

Questions on temperature control were in the questionnaires administered to catering managers because the DHSS guide-lines (1987) emphasise the necessity for temperature control throughout the operation for ensuring microbiological safety. In order to fulfil the criteria set by the DHSS guide-lines, there needed to

be specific controls within the catering system. There were a number of temperature control methods used in the hospital food service systems surveyed (eg. automatic temperature indicators). Two critical points for temperature control were identified ie in the blast chiller and in the chilled storage area. Another essential consideration was the frequency of temperature checks, ie

0. No checking
1. Check less than weekly
2. Weekly check
3. Daily check
4. At regular set intervals throughout day
5. At regular set intervals throughout day with fully automatic temperature control for chilled storage and blast chiller (computer controlled temperature recorders with built-in alarms).

In a third of all hospitals surveyed, staff check regularly throughout the day, making great use of fully automatic temperature controls with built-in permanent records. The temperature controls with built-in alarms were activated if the temperature rose above $3^{o}C$. In chilled storage areas, an advantage of such equipment was the permanent recording of temperatures either continually or at pre-set time intervals. This enabled catering staff to be aware of any temperature fluctuations at any point in time.

In the rest of the hospitals staff were doing only daily checks or regular set check throughout the day without the use of automatic temperature controls. In such cases, they did not have automatic methods of controlling temperature, which was unsatisfactory.

Research information was collected with regard to the frequency of temperature checks for meals produced. Among the 12 hospitals surveyed, only one hospital made checks regularly throughout the day on all food items produced. Half of

them had regular set intervals for checking hot food items only. In one third of the 12 hospitals surveyed, staff did not check the temperatures of the meals produced. The total possible score for microbiological control was 15.

6.3.2 Temperature Control

Temperature control in this instance was evaluated on the basis of the objective measure described in Chapter 4. The total score possible was 100. The range in scores for the 12 hospitals was 74.0 to 96.1 with a mean of 88.1, standard deviation of 5.7. This standard deviation indicated extensive variance in temperature control among hospitals in this study. The mean of 88.1 is low compared to the temperature principles recommended by DHSS (1988), which stated that hospitals should maintain hot foods above 63^{o}C and cold foods below 10^{o}C during distribution and service. None of the hospitals surveyed reached this overall standard. Out of 965 hot foods checked, 9.6% were below temperatures recommended for microbiological safety. In 1968 Glew found similar problems. Of 241 cold foods checked for temperature, 79.3% were above the recommended temperature of 10^{o}C maximum.

Accurate temperature control can only be achieved with appropriate equipment and adequate measurement and control devices. Temperature control is important both for consumer satisfaction and legal compliance. A problem was found with foods served cold, such as salads, sandwiches, and cold desserts. After preparing salads or sandwiches, most hospitals kept them at room temperature, which resulted in a rise in temperatures above temperature recommended for cold food. Only one of the hospitals surveyed checked the temperature of cold food and therefore they nearly all failed to monitor this important aspect of quality. The temperature of cold as well as hot food should be monitored. The current Food Hygiene (Amendment) Regulations (1990,1991) stipulate that cold food should be kept either 8^{o}C or 5^{o}C depending on food type, but they do allow most cold food to be held at room temperature for up to 4 hours during service.

6.4 Dimension of Nutritional Adequacy

6.4.1 Food Waste of Patients

Table 6.10 presents the average daily total amount of food served to patients for each of the 11 hospitals. One hospital was not included because domestic staff clean the patients' trays in every ward instead of the main kitchen.

The total amount of food weight served did not significantly differ between 1st, 2nd, and 3rd days. The weight of food served to female patients was statistically less than that served to male patients ($P<0.001$). On average, lunch weight was statistically higher than breakfast and dinner weight ($P<0.001$ and $P<0.05$).

<Table 6.10> *The Total Amount of Each Meal (Gram)*

Days	No. of Patients	Daily Input (g)	S.D.
1st	2145	1245	164
2nd	2156	1238	161
3rd	2168	1219	155
Gender	**No. of Patients**	**Mean (g)**	**S.D.**
Male	2995	1258	162
Female	3474	1213	158
Meal	**No. of Patients**	**Mean (g)**	**S.D.**
Breakfast	2282	287	92
Lunch	2063	500	158
Dinner	2124	459	133

Table 6.11 shows the patients' mealwise distribution of mean plate waste for all the hospitals. The comparison of patients' plate waste showed significant differences between the first and second day (14.8 vs 13.2) ($P<0.05$), and the first and third day (14.8 vs 13.3) ($P<0.05$). Mean lunch and dinner plate waste were significantly higher ($P<0.05$) than that of breakfast. The mean plate waste

between lunch and dinner was not significantly different (16.2% at lunch and 15.5% at dinner).

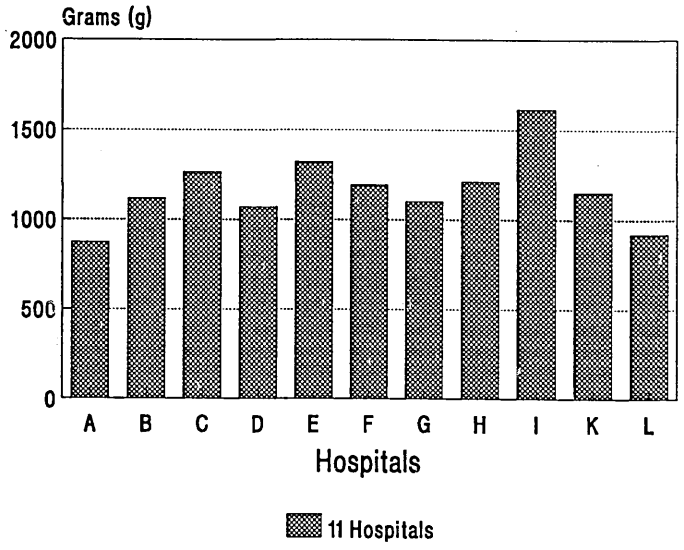
<Table 6.11> *The Mean Plate Waste of Patients (Per Cent)*

Gender	No. of Patients	Mean (%)	S.D.
Male	2995	10.8	16.1
Female	3474	16.4	20.5
Days	**No. of Patients**	**Mean (%)**	**S.D.**
1st	2145	14.8	19.8
2nd	2156	13.2	18.3
3rd	2168	13.3	18.3
Meals	**No. of Patients**	**Mean (%)**	**S.D.**
Breakfast	2282	9.9	17.4
Lunch	2063	16.2	19.7
Dinner	2124	15.5	18.7

Figs 6.2 and 6.3 show total input of food and average food waste of patients in 11 hospitals. The range in plate waste for the 11 hospitals was 8.0% to 16.5% with a mean of 13.9%, standard deviation of 18.8. Milross, Hill and Glew (1974) estimated plate waste of female patients, showing a 9.8% plate waste in conventional system compared to a 5.9% in cook-freeze system. Frakes *et al.* (1986) observed a mean plate waste of 21.3% for non-modified diets with hospitalized patients.

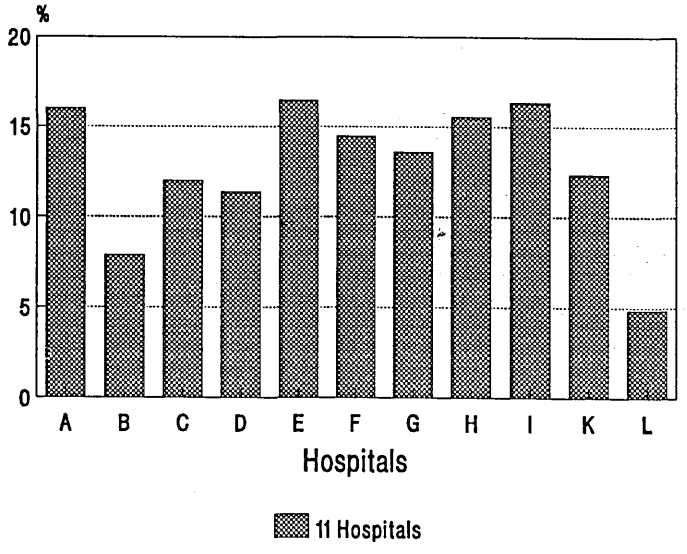
A large standard deviation indicates extensive variance in waste among hospitals in the present study.

Fig6. 2 Total Input of Food in 11 Hospitals in Trent and West Midland



[Source : Author]

Fig 6. 3 Food Waste of Patients 11 Hospitals in Trent and West Midland



[Source : Author]

Among the hospitals, hospitals E and I have larger food waste compared with others. Hospital E is a maternity hospital. Female patients were found to have statistically higher food waste compared to males. Hospital I has been using a set menu, probably contributing to higher food waste. These characteristics differentiated these two from the other 9 hospital food services.

55.8 % of all surveyed patients indicated that they left food. Table 6.12 shows the reasons why patients left their food in hospital. There is a big difference between male and female patients, showing that 'too big portion size' is the primary reason for female patients for leaving their food in hospital whereas male patients indicated 'low appetite' as the main reason.

T-tests on both the total 'Satisfaction' scores of patients and their ratings on 'size' of meals in the hospital indicated that patients who reportedly left their meals gave significantly lower rating on both measures, compared with those who did not. Thus, dissatisfaction with served meals appears to contribute to patients not finishing their meals.

'Too big portion size' would discourage many of the patients from finishing their meals. Thus the selection of portion size should appear on the menu card and be strictly followed when serving food in the kitchen. Better training of food service workers in preparing tasty food, ensuring that food is neither overcooked nor undercooked, and that food is served hot are shown to be important.

<Table 6.12> *The Reasons for Leaving food in 12 Hospitals*

Reasons	Total	Female	Male
		<------ % ------>	
Low Appetite	31.5	26.9	40.5
Too big portion size	25.5	28.9	19.1
Food is not tasty	18.6	19.5	16.9
Food is too overcooked or undercooked	11.7	12.5	10.1
Food is not hot enough	7.3	6.7	8.4
Others	5.4	5.5	5.0
Total	100.0	100.0	100.0

6.5 Measures of Influencing Variables

The framework discussed in Chapter 4 grouped the influencing variables into two major categories: human resources and system resources.
Measures and methods of collecting the data were presented in Chapter 4 and 5. Findings are discussed under each category.

6.5.1 Human resources

Included under human resources were ratio of full-time staff to part-time staff, ratio of supervisors to staff, labour cost, staff satisfaction with pay and staff satisfaction with promotional opportunities. Formulas used to calculate the data were explained in Chapter 4. Means, standard deviations and range of scores for human resource variables for the 12 hospitals are presented in Table 6.13.

<Table 6.13> *Mean, Standard Deviation and Range for Human Resource Variables in 12 Hospital Food Service Systems*

Variables	Mean	S.D.	Range
Supervisor ratio (%)	40.6	19.7	20.0-89.7
Labour cost (£)	13.1	5.0	4.1-20.5
Satisfaction score with pay	1.60	0.55	0.71- 2.48
Labour cost (£)	8.1	1.9	5.8-11.0
Satisfaction score with pay			
Satisfaction score with promotional opportunity	7.6	1.7	5.1-10.9

The full-time staff ratio ranged from 20.0% to 89.7% with a mean of 40.6% and a standard deviation of 19.7. The ranges in this study were less than those reported in similar studies. Ruf in 1975 reported a full-time ratio of 68.9% for all food service employees in 25 hospitals in U.S.A.

The range in supervisor ratio was from 4.1% to 20.5% with a mean of 13.1% and a standard deviation of 5.0.

The range in labour cost was from £0.71 to £2.48 with a mean of £1.60 and a standard deviation of 0.55.

The index of staff satisfaction with pay ranged from 5.8 to 11.0 with a mean of 8.1 and a standard deviation of 1.9. The range of employees satisfaction with promotion opportunities within the food service department was from to 5.1 to 10.9 with a mean of 7.6 and a standard deviation of 1.7. In 1975 Ruf found a similarly low perception of pay and promotional opportunities. Means of satisfaction with pay were 12.9 for males and 12.4 for females and means for promotion were 10.9 for males and 11.3 for females. No attempt was made to measure whether promotional opportunities did or did not exist within the food service departments.

6.5.2 System Resources

Table 6.14 shows means, standard deviations and range of scores for system resource variables.

<Table 6.14> *Mean, Standard Deviation and Range for System Resource Variables in 12 Hospital Food Service Systems*

Variables	Mean	S.D.	Range
Meal equivalents	7551	5852	2154 - 19209
Food & Consumables cost (£)	0.97	0.31	0.51 - 1.44
Number of menu items	246	96	94 - 413
Non-patient meal ratio (%)	36.2	8.9	17.3 - 47.2
Modified meal ratio (%)	11.8	5.4	1.8 - 19.0
Catering function ratio (%)	8.0	6.2	0.6 - 20.4
Number of patients	208	104	85 - 480
Bed capacity	300	105	105 - 495
Occupancy rate (%)	77.8	13.0	62.0 -100.0
Subsidizing meal ratio (%)	10.0	28.9	0.0 -100.0

Meal equivalents served per week was in the wide range 2,154 to 19,209 with a mean of 7,551 and a standard deviation of 5,852.

The range in food and consumables costs per meal equivalent was from £0.51 to £1.44 with a mean of £0.97 and a standard deviation 0.31. A wide range and standard deviation in the number of menu items served was noted in the 12 hospital food service systems studied. Total menu items served within one-week span ranged from 94 to 413 with a mean of 246 and a standard deviation of 96.

The non-patient meal ratio ranged from 17.3% to 47.2% with a mean of 36.2% and a standard deviation of 8.9. The modified meal ratio comprised 1.8% to 19.0% of the meals served with a mean of 11.8% and a standard deviation of 5.4.

The range of the catering function ratio in the hospitals surveyed was from 0.6 to 20.4 with a mean of 8.0 and a standard deviation of 6.2. The range for number of total patients was 85 to 480 with a mean of 208 and a standard deviation of 104.

The range in the size of the unit in terms of bed capacity was from 105 - 495 with a mean of 300 and a standard deviation of 105.

At the time the data were collected, many hospitals in Trent Region and West Midland Region were experiencing high occupancy rates. Occupancy rate ranged from 62.0% to 100.0% with a mean of 77.8% and a standard deviation of 13.0.

The percentage of subsidy to patients meals by the income from various catering functions ranged from 0.0% to 100.0%, with a mean of 10.0% and a standard deviation of 28.9.

CHAPTER SEVEN : STATISTICAL ANALYSIS OF INFLUENCING VARIABLES AND FOOD QUALITY COMPONENTS

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CHAPTER SEVEN

Statistical Analysis of Influencing Variables and Food Quality Components

7.1 Technique of Analysis

In this research, the influencing variables and food quality components for the 12 hospitals (See Table 7.1) were correlated to find the relationships between each of the components of food quality and each of the influencing variables (See Table 7.4). Pearson correlation is a technique which is typically used to identify the strength of relationships among parametric data (Selkirk, 1979).

A statistical approach to the summation of quantitative data is comparison of ordinary least square (OLS) regression coefficients. The regression technique is a flexible statistical method employed to identify the relationship between a dependent variable and a set of independent variables. This technique is useful in the analysis of the strength and direction of relationships between the variables.

7.2 Correlation of Measures of Food Quality Components

Pearson correlation is a technique which is typically used to identify the strength of relationships among parametric data (Selkirk, 1979). It is useful in showing the degree to which variables are linearly related. No claim is made that this necessarily indicates cause and effect. However, correlation is useful in that it may provide further confirmation of a relation that theory says should exist. It is often helpful in suggesting causal relations that were not previously suspected (Wonnacott and Wonnacott, 1969).

<Table 7.1> *Dependent Variables and Independent Variables in 12 Hospital Food Service Systems*

VARIABLES	A	B	C	D	E	F
P.S1	72.6	82.3	78.2	79.1	76.1	76.2
S.S2	101.10	86.74	92.63	100.17	96.23	92.9
PRO.3	4.4	4.83	5.84	2.89	2.23	3.74
TEMP.4	73.97	96.05	91.43	85.71	91.87	84.18
MICRO.5	11	14	6	11	7	7
Waste6	15.99	7.88	12.01	11.37	16.45	14.47
Bed	350	445	415	354	105	495
FC	1.33	0.61	0.80	0.86	0.87	0.78
FT	89.74	28.10	37.50	42.86	20.00	36.84
LC	1.48	1.04	0.71	1.58	2.31	1.36
ME	4724	19209	15615	6183	2628	14100
MR	15.24	15.64	12.87	16.98	1.83	8.94
NI	161	245	319	206	287	413
NM	28.74	40.20	47.21	45.94	38.86	30.28
NP	210	235	236	220	90	495
OC	62.43	62.00	63.90	69.75	95.95	100.00
PO	7.65	5.58	7.59	8.03	9.28	5.70
SM	0.00	100	0.00	0.00	0.00	0.00
SP	6.65	10.61	7.95	8.17	6.27	6.47
SR	20.51	4.13	6.73	15.71	17.78	10.00

VARIABLES	G	H	I	J	K	L
P.S1	81.7	80.8	76.0	82.9	78.5	82.4
S.S2	114.56	103.83	102.95	97.57	103.07	134.57
PRO.3	2.17	3.44	3.10	2.12	3.05	3.60
TEMP.4	87.50	93.46	91.89	88.61	87.10	85.29
MICRO.5	5	11	10	10	11	9
Waste6	13.62	15.53	16.37	-	12.37	4.87
Bed	105	375	400	216	210	130
FC	0.51	0.83	1.27	1.34	1.44	1.00
FT	20.59	58.89	30.59	37.93	56.67	28.00
LC	2.24	1.62	1.31	2.48	1.95	1.06
ME	3835	10333	6407	2154	2715	2714
MR	8.21	18.99	17.47	12.77	5.41	7.00
NI	404	245	173	187	212	94
NM	35.07	17.33	30.17	45.30	43.33	31.82
NP	85	232	240	199	128	126
OC	85.00	62.02	62.00	87.01	86.43	97.42
PO	8.62	5.06	8.24	10.93	6.21	8.57
SM	0.00	100	0.00	0.00	0.00	0.00
SP	7.65	7.09	10.70	9.36	5.79	11.00
SR	10.29	11.11	10.59	17.24	16.67	16.00

1-Patient Satisfaction, 2-Catering Staff Satisfaction

3-Productivity, 4-Temperature Control, 5-Microbiological Control, 6-Food Waste.

Correlations between some of the food quality components are shown in Table 7.2. This shows that a non-significant relationship existed between all but one of the components of food quality studied. A significant negative correlation (r=-0.7063, P<0.01) existed between the patients' satisfaction with the hospital meal and service and the food waste; this was expected. As the patients satisfaction with the food served and the food service increased, there was a higher consumption of food resulting in lower food waste by patients. The non-significant correlations between the components of food quality showed the independence of components, demonstrating the need for a multi-dimensional model of food quality.

The ranges for these measures were discussed in chapter 6.

<Table 7.2> *Correlations of the Components of Food Quality in 12 Hospital Food Service Systems*

	Patient Satisfaction	Staff	Produc-tivity	Safety	Food Waste
Patient S.	1.0000				
Staff S.	.3746	1.0000			
Productivity	-.0510	-.3633	1.0000		
Safety	.2477	-.2665	.1866	1.0000	
Food Waste	-.7063*	-.4068	-.2979	-.2613	1.0000

* P < .01
S. for satisfaction.

7.3 Intercorrelation of Measures of Influencing Variables

The influencing variables were grouped into two major categories: human resources and system resources. The ranges of these measures were discussed in Chapter 6. Correlation between the influencing variables are shown in Table 7.3.

* The keys for table 7.3

BED	:	bed capacity
FC	:	food and consumable costs
FT	:	full-time catering staff ratio
FR	:	catering function ratio
LC	:	labour costs
ME	:	meal equivalents
MR	:	modified meal ratio
NI	:	number of menu items
NM	:	non-patient meal ratio
NP	:	number of patients
OC	:	occupancy rate
PO	:	satisfaction with promotion
SM	:	subsidizing meal ratio
SP	:	satisfaction with pay
SR	:	supervisor ratio

7.3.1 Human Resources

Significant positive correlations were found between the full-time ratio (FT) and the percentage of supervisory staff (SR) ($r=0.467$, $P<0.05$) because most supervisory staff were full-time. Negative correlation existed between the full-time staff ratio and staff satisfaction with pay (SP) ($r=-0.425$, $P<0.05$). This may be because mean satisfaction with pay for all part-time staff in this research was higher than for full-time staff.

<Table 7.3> *Correlations between the Influencing Variables*

	FT	SR	LC	SP	PO	ME	FC	NI	NM	MR	FR	NP	BED	OC	SM
FT	1.000														
SR	.467*	1.000													
LC	-.065	.477*	1.000												
SP	-.425*	-.409*	-.579*	1.000											
PO	-.356	.425*	.267	.165	1.000										
ME	-.097	-.832***	-.646*	.213	-.302	1.000									
FC	.591*	.622*	.013	-.144	-.011	-.486*	1.000								
NI	-.344	-.466*	.267	-.456*	-.164	.367	-.639*	1.000							
NM	-.301	-.091	-.075	-.007	.138	.079	-.074	.104	1.000						
MR	.383	-.336	-.477*	.349	.213	.445*	-.012	-.240	-.296	1.000					
FR	.062	-.217	-.390	.379	.027	.482*	-.009	-.182	.113	.346	1.000				
NP	.009	-.726**	-.626*	.151	-.047	.962***	-.389	.346	-.004	.464*	.520*	1.000			
BED	.105	-.641*	-.515*	-.016	-.367	.868***	-.319	.434*	-.212	.471*	.342	.947***	1.000		
OC	-.315	-.121	-.505*	.578	.014	.238	-.172	-.413*	.472*	-.106	.432*	.169	-.110	1.000	
SM	-.155	-.513*	-.267	.371	-.491*	.571*	-.253	-.046	.241	.157	.651*	.517*	.277	.520*	1.000

* P<.05, ** P<.01, *** P<.001 (For keys, see p. 132)

A positive correlation existed between the percentage of supervisory staff and the labour cost ($r=0.477$, $P<0.05$). Wages for supervisory staff were generally higher than those of non-supervisors causing an increase in labour cost.

Negative correlation also existed between the labour cost (LC) and size of hospitals including the total meal equivalents (ME) ($r=-0.646$, $P<0.05$), the number of patients (NP) ($r=-0.626$, $P<0.05$), the bed capacity (BED) ($r=-0.515$, $P<0.05$), and the occupancy rate (OC) ($r=-0.505$, $P<0.05$). As these variables increased, the labour cost (LC) decreased supporting the assumption that as the hospital size increased, the efficiency of labour force increased. As the bed capacity increased, the supervisor ratio decreased ($r=-0.641$, $P<0.05$).

Positive correlation existed between the staff satisfaction with pay (SP) and the occupancy rate of the hospitals (OC) ($r=0.578$, $P<0.05$). Possibly this was a reflection of a higher proportion of part-time labour. Part-time staff, who were found to be more satisfied with pay in this survey, could be employed to meet increasing patient numbers more readily than full-time staff, resulting in greater satisfaction with pay.

7.3.2 System Resources

Highly significant correlations ($P<0.001$) were found between total meals served per week (ME), the total number of patients (NP) ($r=0.962$) and total bed capacity (BED) ($r=0.868$). Negative correlation existed between the total meal equivalents (ME) and the supervisor ratio (SR) ($r=-0.832$, $P<0.001$) and satisfaction with promotional opportunities (PO) ($r=-0.302$, $P<0.05$).

Food and consumables costs (FC) ($r=-0.486$, $P<0.05$) and labour costs (LC) ($r=-0.646$, $P<0.05$) were negatively correlated with total meals served per week, reflecting the fact the mass production can result in a lower cost for food and labour when compared to small food service systems.

There was a negative correlation between food and consumable costs (FC) and number of menu items (NI) ($r=-0.639$, $P<0.05$). This suggests that producing a variety of menu items is not necessarily associated with increased food and consumables costs.

With an increase in non-patient meals (NM), there was a slight decrease in the percentage of full-time staff (FT) ($r=-0.301$). The only variable with a significant negative correlation with the modified meal ratio (MR) was the labour cost (LC) ($r=-0.477$, $P<0.05$). An increase in modified meals was associated with a decrease in the labour cost. In large hospitals more modified meals are prepared and more meal equivalents are produced which results in lower labour costs.

As the percentage of modified meals (MR) increased, the number of meal equivalents (ME) ($r=0.445$), the total number of patients (NP) ($r=0.464$), and the bed capacity (BED) ($r=0.471$) increased.

As the total meals per week (ME) ($r=0.482$), the total number of patients (NP) ($r=0.520$), and the occupancy rate (OC) ($r=0.432$) increased, the ratio of catering functions (FR) performed increased.

As the number of patients (NP) increased, the total meals ($r=0.962$) served per week (ME) and the bed capacity (BED) ($r=0.947$) increased. The percentage of supervisory staff (SR) ($r=-0.726$, $P<0.01$) significantly decreased with increased number of patients (NP). As the food and consumables costs increased, the supervisory staff ratio increased ($r=0.622$, $P<0.05$).

As the bed capacity (BED) increased, the satisfaction with promotional opportunities (PO) decreased ($r=-0.367$). A possible explanation is that as a group enlarges, increased potential difficulties for promotion within the group emerge or intergroup rivalries form but there is no clear evidence to support this. Another possibility is that as the bed capacity increased, the supervisor ratio decreased causing a decrease in satisfaction with promotional opportunities (PO). More menu items (NI) were prepared as the bed capacity (BED) increased ($r=0.434$, $P<0.05$).

As the occupancy rate (OC) increased, the labour cost (LC) decreased ($r=-0.505$, $P<0.05$). This may be a reflection of the use of more part-time staff (Sneed and Herman, 1990). Since part-time staff with a lower level of payment could be employed to meet increasing patient numbers more readily than full-time staff. Positive correlations were found between the ratio of subsidizing patient meal (SM) and the number of meals served per week (ME) ($r=0.571$, $P<0.05$), the catering function ratio (FR) ($r=0.651$, $P<0.05$) and the total number of patients (NP) ($r=0.517$, $P<0.05$); these were expected. As the hospital increased in size there was a greater diversity of catering activities, a higher catering function ratio resulting in higher subsidizing ratio of patient meal within the food service systems.

7.4 Correlations between Influencing Variables and Food Quality Components

In this research, after scatter diagrams indicated that linear relationships (See Table 7.4) were present, the influencing variables and food quality components were correlated to find the relationships between each of the components of food quality and each of the influencing variables. The theoretical basis assumed that patient satisfaction, staff satisfaction, productivity, safety, and food waste were affected by variables grouped under the two categories human resources and system resources. Significant correlations between the components of food quality and the influencing variables are now discussed.

<Table 7.4> *Correlation Coefficients of the Components of Food Quality and Influencing Variables in 12 Hospital Food Service Systems*

Var.	Patient Satis.	Staff Satis.	Produ-tivity	Safe-ty	Food Waste
ME	.1840	-.6448**	.7254**	.3085	-.1701
FC	-.5715*	.1367	-.0263	.1753	.2193
LC	-.1024	.0971	-.8612***	-.2418	.4842*
NI	.0266	-.4210*	-.0725	-.5208*	.3403
NM	.0767	-.2811	.1604	-.0564	-.3305
MR	-.0015	-.2554	.3841	.5114*	.0971
FR	-.2635	-.5323**	.4166*	.4977*	-.0839
FT	-.5024*	-.1120	.2849	.1964	.2962
NP	.0726	-.6436**	.6651**	.3156	-.1268
SR	-.4783*	.3805	-.4437*	-.1791	.2143
SP	.4598*	.3144	.2181	.3741	-.5997*
PO	.1722	.4234*	-.3807	-.5163*	.0297
BED	.0506	-.5959**	.5436**	.1755	.0910
OC	.3901	.0863	.3894	.3419	-.8248***
SM	.3995	-.4066	.3467	.7066**	-.4497*

* P<.05 , ** P<.01 , *** P<.001

7.4.1 Patient Satisfaction and Influencing Variables

Significant correlation coefficients with patient satisfaction are presented in Table 7.5. Positive correlations indicated that as the score for the specific variable increased, the patient satisfaction index increased. A negative correlation indicated that as the specific variable score increased, the patient satisfaction decreased.

Human resource variables correlating significantly with satisfaction of patient included the full-time staff ratio, supervisory staff ratio and staff satisfaction with pay. Both the ratios of supervisory staff and full-time staff had negative correlation with the patient satisfaction index, which would not necessarily have been predicted. It is possible that job boredom of full-time and supervisory staff might lead to a deterioration of patient satisfaction.

<Table 7.5> *Significant Correlation Coefficients of Patient Satisfaction and Influencing Variables in 12 Hospital Food Service Systems*

Variables	Patient Satisfaction
Full-time staff ratio	-0.5024*
Supervisory staff ratio	-0.4783*
Staff satisfaction with pay	0.4598*
Food & consumable cost	-0.5715*

* $P < .05$

As catering staff perceived more satisfaction with their pay, patient satisfaction increased.

An unexpected correlation was noted with food costs in that as food costs increased, patients satisfaction decreased. One possible cause for this reported by Ruf (1975) is that increases in food costs result from an increased use of ready-to-serve foods which might have poorer quality than fresh or from inappropriate methods of food reconstitution.

7.4.2 Staff Satisfaction and Influencing Variables

Significant correlation coefficients with the staff satisfaction component are shown in Table 7.6. Negative coefficients indicated that as the score for the specific variable increased, the staff satisfaction level decreased.

The human resource variable which correlated significantly with employee satisfaction was the satisfaction with promotion opportunities. The significant positive correlation between staff satisfaction and perceived promotional opportunities were noted, reemphasizing the importance of establishing career ladders within the food service departments.

System resource variables significantly influencing the staff satisfaction were the total meals served per week, the total number of patients, the number of beds, the catering function ratio, and the number of menu items. All of these had a negative

correlation coefficient with the staff satisfaction index. The negative correlation indicated that as the total meal equivalent, total number of patients and the number of beds increased, a decrease in employee satisfaction occurred. As the size of hospitals increased there was more routinization of work and less intergroup member contact which can result in lower satisfaction among food service personnel. However, there is no clear evidence to support this.

<Table 7.6> *Significant Correlation Coefficients of Staff Satisfaction and Influencing Variables in 12 Hospital Food Service Systems*

Variables	Staff Satisfaction
Satisfaction with promotion	0.4234*
Meal equivalents	-0.6448**
Number of patients	-0.6436**
Bed capacity	-0.5959**
Catering function ratio	-0.5323**
Number of menu items	-0.4210*

* P < . 05 , ** P < . 01

As the ratio of catering functions and the number of menu items increased, staff satisfaction decreased. Possibly this was because of increased complexity and heterogeneity of food preparation.

7.4.3 Productivity and Influencing Variables

Significant correlation coefficients with the component of productivity are shown in Table 7.7. Positive correlations indicated that as the score for the specific variable increased, the productivity index increased meaning more meals per human hour were produced, an increase in productivity. A negative correlation indicated the opposite, as the specific variable increased, fewer meals per human hour were produced, a decrease in productivity.

<Table 7.7> *Significant Correlation Coefficients of Productivity and Influencing Variables in 12 Hospital Food Service Systems*

Variables	Productivity
Labour cost	-0.8612***
Supervisor ratio	-0.4437*
Meal equivalents	0.7254**
Bed capacity	0.5436**
Number of patients	0.6651**
Catering function ratio	0.4166*

* P < . 05 , ** P < .01 , *** P < .001

As the supervisory staff ratio increased, fewer meals per labour hour were prepared. This may be a reflection of more paper work or indirect catering work done by catering supervisors in this study. Less flexibility in scheduling might also be responsible for this trend since non-supervisory staff could be scheduled to meet increasing or decreasing patient numbers more readily than supervisory staff. Hospitals which had more supervisors causing higher labour cost compared to non-supervisory staff tended to have lower productivity.

System resource variables significantly influencing the productivity were the meal equivalents, bed capacity, total number of patients, and catering function ratio. All of these had a positive correlation coefficient with the productivity index.

As the hospital size increased, more meals served per human hour were produced. This may be a reflection of more highly standardized and controlled food service systems in large hospitals. Implied in most management practice is the concept that routinization or standardization will result in more effective

utilization of time (Blumenthal, 1969 ; Pedderson, *et al.*, 1973 ; Keiser and Kallio, 1974). This correlation seems to support this.

As the ratio of catering functions performed increased, the productivity index increased. As more catering functions were prepared, menus were adapted so that they were applicable in as many areas as possible whereas, with fewer functions more careful attention was given to each function. Large hospitals tend to have greater diversity of catering functions.

7.4.4 Safety and Influencing Variables

Significant correlation coefficients with the safety component are shown in Table 7.8. Positive correlations indicated that as the score for the specific variable increased, the safety index increased meaning the safety level was increased. A negative correlation indicated that as the specific variable score increased, the safety level decreased.

<Table 7.8> *Significant Correlation Coefficients of Safety Level and Influencing Variables in 12 Hospital Food Service Systems*

Variables	Safety Level
Satisfaction with promotion	-0.5163*
Number of menu items	-0.5208*
Modified meal ratio	0.5114*
Catering function ratio	0.4977*
Subsidizing meal ratio	0.7066**

* P < .05 , ** P < .01

The human resource variable correlating significantly with safety included the staff satisfaction with promotion. Unexpectedly as satisfaction with promotion increased, the safety level decreased. The usual assumption is perhaps that

increases in satisfaction with promotion result in employees who viewed food service as a career, and thus have more interest in and more concern for safety. Further investigation should be made to verify this relationship and to investigate the reasons for this relationship, if verified.

The system variables that correlated significantly with safety index were the number of menu items, modified meal ratio, catering function ratio, and subsidizing meal ratio. An increase in the number of menu items caused an decrease in safety level. This deterioration in safety may be a result of poorer control among the increased number of menu items. Catering function ratio and subsidizing meal ratio had significant positive correlations with the safety level. When money is available from profit oriented catering activities within the hospital, it is available for reinvesting in safety eg regular swab tests for equipment and facilities, or regular temperature checks on patient meals and chilled storage throughout the day. Modified meal ratio had a significantly positive correlation with safety. Modified meals and catering function meals were prepared separately from normal diet meals, where staff gave more individual and special attention to each meal this may increase safety levels.

7.4.5 Food Waste and Influencing Variables

Significant correlation coefficients with the food waste level are presented in Table 7.9. Positive coefficients indicated that as the score for the specific variable increased, the food waste index increased meaning more food was wasted by patients. A negative correlation indicated the opposite. As the specific variable increased, food waste was less, resulting in an increase in food consumption by patients.

<Table 7.9> *Significant Correlation Coefficients of Food Waste and Influencing Variables in 11 Hospital Food Service systems*

Variables	Food Waste
Labour cost	0.4842*
Satisfaction with pay	-0.5997*
Occupancy rate	-0.8248***
Subsidizing meal ratio	-0.4497*

* P < .05 , *** P < .001

Human resource variables significantly influencing the food waste were the labour cost and staff satisfaction with pay. Possible causes for the increase in food waste as labour cost increased are puzzling. As employees perceived more satisfaction with their pay, the food waste of patients decreased. Satisfaction with pay may result in more care in preparing meals served.

System resource variables, occupancy rate and subsidizing meal ratio, had a significant negative correlation with food waste of patients. As these variables increased, food waste decreased. This may be an indication that as occupancy rate increased, food service departments needed a better controlled and improved system to feed patients causing less waste from patients. The more the hospital food service department subsidized patient meals, the less patients wasted food. This would seem to indicate that an increase in the amount of money used in buying necessary equipment results in a decrease in the waste of food by patients. The field work for the research showed in the hospitals subsidizing patient meals the standard of cutlery, tray, etc used for patient service were much higher than in hospitals which did not subsidize.

7.4.6 Summary of Correlation Between Influencing Variables and Food Quality Components

Table 7.10 summarizes the significant relationships between the influencing variables and the components of food quality. As the influencing variables of full-time staff ratio, supervisory staff ratio, food and consumable cost decreased, the patient satisfaction increased. An increase in staff satisfaction with pay also increased the satisfaction of patients.

A decrease in meal equivalents, total number of patients, bed capacity, catering function ratio, number of menu items resulted in an increased staff satisfaction with their job as did increased staff satisfaction with promotion.

Productivity index increased as the meal equivalents, bed capacity, total number of patients, catering function ratio increased and labour cost and supervisory ratio decreased.

As the influencing variables of modified meal ratio, catering function ratio, and subsidizing meal ratio increased, the safety level increased. A decrease in the number of menu items and satisfaction with promotion also increased the level of safety.

A increase in satisfaction with pay, occupancy rate and subsidizing meal ratio resulted in an increased food consumption as did decreased labour cost.

<Table 7.10> *Direction of Movement of Measures of Influencing Variables with an Increase in Components of Food Quality in 12 Hospital Food Service Systems*

Components of Food Quality	Influencing Variables: Influence Direction of Movement of Variables	Direction of Movement of Influencing Variables
PATIENT SATISFACTION	Staff satisfaction with pay	Increase
	Full-time staff ratio	Decrease
	Supervisory staff ratio	Decrease
	Food and consumable cost	Decrease
STAFF SATISFACTION	Satisfaction with promotion	Increase
	Meal equivalents	Decrease
	Number of patients	Decrease
	Bed capacity	Decrease
	Catering function ratio	Decrease
	Number of menu items	Decrease
PRODUCTIVITY	Meal equivalents	Increase
	Bed capacity	Increase
	Number of patients	Increase
	Catering function ratio	Increase
	Labour cost	Decrease
	Supervisory ratio	Decrease
SAFETY LEVEL	Modified meal ratio	Increase
	Catering function ratio	Increase
	Subsidizing meal ratio	Increase
	Satisfaction with promotion	Decrease
	Number of menu items	Decrease
FOOD CONSUMPTION	Satisfaction with pay	Increase
	Occupancy rate	Increase
	Subsidizing meal ratio	Increase
	Labour cost	Decrease

7.5 Stepwise Multiple Regression Analysis

Although Table 7.10 shows the variables associated with an increase or decrease in the components of food quality, it indicates neither the interrelationships nor the magnitude of the relationships. One of the purposes of this research was to find out the effect of influencing variables on the components of food quality. The effects of influencing variables on the components of food quality are now examined by stepwise (OLS) regression analysis.

Regression analysis makes it possible to identify the relative explanatory power of a set of dependent variables on a single independent variable. It quantifies the direction of causality (Graft, 1985 ; De Vaus, 1991) between the related factors. Regression can be used when both the independent and dependent variables are interval. The regression technique is useful in the analysis of the strength and direction of relationships between the variables.

Statistical multi-variate analysis techniques have been widely used to estimate or predict a measurement dependent on a number of variables (Jelinek and Steffy, 1966). The stepwise regression procedure estimated the parameters of a linear model of the form:

$Y = ao + a1x1 + a2x2 \ldots anxn,$

variable by variable in order of relative importance, until all significant variables are included in the equation. The stepwise procedure sorts out the relevant variables for potential predictors of the dependent variables.

Table 7.11 lists the results of regressing the influencing variables on the components of food quality. Table 7.12 shows the regression equations between the components of food quality and the influencing variables. What the raw figures (regression coefficients R^2) mean here in the following table is the percentage of the variance in food quality components explained by each of the influencing variables. Regression was conducted on the five components of food

quality. However, no influencing variables could be established for patient satisfaction.

<Table 7.11> *Results of OLS regression: Percentage of the Variance (R^2) in the Components of Food Quality explained by Influencing Variables*

Components of Food Quality	Influencing Variables	Multiple Regression R^2
Patient Satisfaction	None	---
Staff Satisfaction	Number of patients	0.36171 (.0386)*
Productivity	Labour cost	0.77003 (.0002)
Safety	Number of menu items Subsidizing meal ratio	0.73655 (.0025) 0.47721 (.0129)
Food Waste	Occupancy rate	0.68034 (.0018)

Note 1) * refers to probability.

<Table 7.12> *Regression Equations*

Staff Satisfaction = 113.426016 + -0.036488 Number of patients

Productivity = 6.317875 + -1.797518 Labour cost

Safety = 170.234732 + 0.438923 Subsidizing meal ratio +
-.099039 Number of menu items

Food Waste = 30.273862 + -0.225214 Occupancy rate

The regression analysis suggests that total number of patients explains around 36 per cent of the variation in staff satisfaction. R^2 records 0.77003 for productivity indicating that around 77 per cent of the variance in productivity is explained by

labour cost. This confirms again what emerged from the previous correlation analysis.

The results of regression analysis suggest that subsidizing meal ratio explains around 48 per cent of the variation in safety and that the number of menu items and the subsidizing meal ratio explain around 74 per cent of the variation in the safety component. More than 68 per cent of food waste component can be explained by the variable occupancy rate.

It is very interesting that none of these variables can explain the component of patient satisfaction. Several factors might account for this:

Patients seem to be homogeneous because of their common situation, however, considering their personal background and special conditions they are a very heterogeneous group. In this regression analysis variables were selected based on objective variables which did not include patients' personal information and mood. In the findings of Chapter 6, patient satisfaction was largely influenced and explained by their own demographic and emotional variables rather than the objective catering system factors. From this analysis, subjective psychological factors seem to play a much more important role in determining patients' satisfaction with hospital food and service than objective circumstances. However it was found in this research that the quality and attractiveness of the food does vary from one hospital to another, depending upon system of operation and administration. The component of patient satisfaction seems to be most complicated combining subjective, emotional and personal factors and objective food service system factors.

SECTION V: CONCLUSION

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CHAPTER EIGHT

Conclusion

8.1 Nature of the Study

For several decades there has been concern about the quality of hospital food and measures have been taken to improve both its quality and the economics of its production. Changes have however been uncoordinated and ad hoc. The quality of hospital food is still a cause for concern and improvements are sought. This thesis represents a contribution to this search.

The aim of this study throughout has been two fold - to develop a model suitable for evaluating the quality of food in conventional hospital food service systems; and to evaluate food quality in selected hospitals in the Trent Region and West Midland Region using the model. A key outcome in this study has been the development of a multi-faceted measurement of food quality to help managers deploy resources effectively, in conventional hospital food service systems. This approach was achieved using a variety of qualitative and quantitative information to score six food quality components and 15 influencing variables.

This chapter is devoted to summarising the major findings of the research and to discussing their implications for catering managers and researchers. The chapter will summarise the nature of the present study, and revisit methodological issues using the findings of the field work. The conclusions of this chapter fall into four main parts: 1) methodological implications 2) substantive implications, 3) the evaluation of the model of food quality and 4) possible directions for further research.

8.2 Major Findings and Conclusions

8.2.1 Methodological Implications

8.2.1.1 Identifying and Measuring the Components of Food Quality

It is difficult to identify criteria of food quality with universal applicability as all catering departments are different. Each operation must set its own standards based on experience, available resources and the constraints of the system. Clearly, reliance on a single criterion of food quality for the evaluation of hospital food service systems would not be satisfactory as a management tool.

The few studies which tentatively explore a multi-dimensional definition of food quality, do not exhaustively examine, or clearly explain it. The criteria used to evaluate hospital food quality in this study related to the interests of key stakeholders in the system ie not only to managers and patients, but also to catering staff and dietitians. Food quality in this research was thus defined as a multi-dimensional measure to include measures of satisfaction of patients and catering staff, productivity, safety, and nutritional adequacy.

This measure of food quality may be applicable to other types of food service system. However, there is a need for caution because the components chosen may be specific to the type of food service system being investigated.

Patient satisfaction with the quality of hospital food and food-related service was evaluated by patient questionnaires. A multiple choice questionnaire was developed specifically to suit the aims of this research. In the regression analysis none of the influencing variables explained the component of patient satisfaction at the level $P<0.05$, suggesting that it is a different kind of component from the other 4. The component 'patient satisfaction' appears to be explained by patients' own demographic and emotional variables rather than by objective catering system factors. The component of food waste was found to have a high negative correlation with patients' satisfaction. It may be possible to use food waste as an index of patient satisfaction in future research, although its accuracy as an index

would be seriously compromised if portion sizes of meals served varied considerably.

Catering staff satisfaction was evaluated by measuring employee job attitudes towards five aspects of their job using the Job Description Index (JDI). The JDI is directed toward specific areas of satisfaction rather than global or general satisfaction and was easily administered. The responses were job-referent rather than self-referent. Employees were receptive to the ease and low verbal level of the questionnaire and the anonymity provided. The catering manager could easily key and score the completed questionnaire to provide a quick accurate indication of catering staff morale within the catering department. It was found to be an effective measure of catering staff satisfaction in hospital food service systems in this research as indicated in other published research.

The productivity level was based upon the total meal equivalents divided by the total direct and non-direct labour hours required to produce and serve the total number of patient meals plus the number of cafeteria and catering function meals. In other published research, catering function meals were not included in the productivity index. The field work for this research showed that catering function meals formed an important element of hospital catering and their inclusion gives a more accurate measure of meal equivalents. All personnel in the catering department make some contribution to the food service's output (Greenberg, 1973) and therefore all were included in the calculation of productivity ratios. The productivity index formula produced output in terms of meals per labour hour, which was found to be a satisfactory measure.

The safety component was based upon two elements which were microbiological control and temperature control.

The total possible score for the component of food safety was 115 made up a score of 15 for microbiological control (which was measured indirectly) and a score of 100 for temperature control which was measured directly. The safety score thus gives greater emphasis to temperature control. This can be justified in

that temperature control is emphasised by the DHSS for ensuring safety in hospital food service systems. This should be borne in mind when considering the substantive findings of the research.

Food Waste was used as a crude index of nutritional adequacy, instead of analysis of the nutritional composition of patients' needs. Based on the literature review of catering food waste, percentage waste per tray was used for this index, providing an objective measure.

8.2.1.2 Measures of Influencing Variables

Measures were chosen or adapted from those available in food service operations insofar as was possible. Where none was available, methods were developed. The influencing variables discussed in Chapter 3 were grouped into two major categories: human resources and system resources. Data for full-time staff ratio and supervisor ratio were obtained from personnel records and calculated as percentage ratio which was objective and simple. This seemed a satisfactory method of measurement. The satisfaction scores for pay and promotional opportunity were calculated from the catering staff questionnaire, and reflected how individual catering staff felt towards payment and promotion. No attempt was made to measure how much they receive or whether promotional opportunities did or did not exist within the food service departments. A measurement of actual payment or promotional opportunities was not deemed necessary, since satisfaction of the catering staff results from what they feel exists. Labour costs were measured by dividing the total daily labour costs in catering department by the total daily meal equivalents. No problems were noted in the application of this measure.

The size indices of meal equivalents, total number of patients, bed capacity and occupancy rate were included as system variables. Food and consumables costs were measured by dividing the total weekly expenditures for foodstuffs and consumables by the total meal equivalents served. This measure assumed that

inventory levels remained constant which would not necessarily be a valid assumption. A more valid measure would be food stock at beginning of inventory plus purchases minus food stock at end of inventory, particularly in large food service systems. Data for the non-patient meal ratio, modified meal ratio, catering function ratio and subsidizing meal ratio were obtained from the general information questionnaire completed by the catering manager and calculated as percentages, which turned out to be satisfactory methods of measurement. Data provided by the catering managers were confirmed by looking at the records.

8.2.2 Substantive Implications

The substantive findings of the research need to be treated with some caution since the sample size of 12 hospitals was small. This is particularly important with regard to the statistical analysis of influencing variables and the components of food quality.

8.2.2.1 Findings of the Survey

The standard of food production and service in the hospital sample is relatively high. This is indicated by the high level of patient satisfaction reported in the findings of the questionnaire survey. The range in scores for the 12 hospitals was 72.6 to 82.9 with a mean of 78.6 out of total possible score of 98. The standard deviation of 12.4 indicated, however, extensive variance in patient satisfaction in the 12 hospitals in this study. Patients seem to be generally satisfied with the food served, although seasoning of food received the lowest score. Currently salt and pepper are not given to patients on their tray. Patients want to be given individual salt and pepper with every meal. Food service on the wards should begin at the top end of the ward on one day and at the bottom end of the ward on another. This rotation should ensure that patients in different areas of the ward get served first on every other day. One hospital is using rotation at breakfast, lunch and

dinner, which is preventing complaints from those patients who would otherwise be consistently served last.

The questionnaire survey of catering staff provides evidence that food service workers surveyed in this research were less satisfied with their jobs than are other types of workers in other industries. The majority of staff who work in the catering departments are female, due to the flexible hours of the shifts. Age, job level, length of employment, sex and education were significantly related to job satisfaction. The majority of the staff were reasonably happy with 'supervision' and 'co-workers'. 'Work content', 'pay', and 'promotion' received low satisfaction scores. Food-service jobs have been characterised as being repetitive, unskilled or semi-skilled, physically demanding, poorly paid, and with limited incentive to do better, all of which cause low levels of job satisfaction. In general terms, all catering managers should take constructive steps to enrich food-service jobs and make them more challenging and rewarding, in order to improve job satisfaction. Systematic induction and continuous training should be provided for employees, to boost the sense of belonging and to upgrade managerial and technical skills. Pay structures, fringe benefits, and monetary rewards should be based on objective and overt measures. These are likely to be promising steps towards satisfied workers, lower staff turnover, and improved quality in hospital food service systems.

The productivity index used represents meal equivalents produced per human hour. The range in meal equivalents produced per hour was from 2.12 to 5.84, with a mean of 3.45 and a standard deviation of 1.13. These ranges were similar to those found in other studies which measured productivity in terms of total mins per meal equivalent in hospital catering departments. The mean of 3.45 meals per hour found in this study was slightly higher than means in prior studies, using similar methods of calculating meal equivalents.

The dimension of safety included microbiological control and temperature control. Microbiological control was evaluated by questionnaire administered to

the catering managers. A total positive score of 15 was possible, which was judged on a relative rather than an absolute basis. The range in score for the 12 hospitals surveyed was 5 to 14, with a mean of 9.3. Temperature control was evaluated on the basis of the objective measurement discussed in Chapter 4. The range in scores for 12 hospitals was 74.0 or 96.1 with a mean of 88.1 out of the total possible score of 100. The mean of 88.1 was low compared to the temperature control guidelines published by DHSS (1988), which stated that a food distribution trolley should **always** maintain hot foods above 63^{o}C and cold foods below 10^{o}C during distribution and service. By definition none of hospital systems reached this standard. There is evidence from the research in this area that there should be more training of catering staff together with more extensive documentation on microbiological safety. The more recent guidelines on the storage, distribution and service of cold food make the situation even more concerning (DOH, 1990, 1992).

The average edible plate waste represented approximately 14% of the food served, breakfast waste being significantly less than that from lunch and dinner. These results were similar to those produced by other studies. Further reduction in waste should be possible with careful planning. Patients in most hospitals are allowed to choose their portion size: however many female patients complained of portion sizes being too big even though they ordered small portion sizes. In order to reduce plate food waste, improved menu choice and choice of portion size are recommended. 55.8 per cent of all surveyed patients indicated that they left food. There was a big difference between male and female patients, 'low appetite' is the primary reason given by male patients for leaving their hospital food whereas female patients indicated 'too big portion size' as the main reason. T-tests on both the total 'Satisfaction' scores of patients and their ratings for 'size' of all meals in the hospital indicated that patients who reportedly left their meals rated significantly lower score on both measures, compared with those who did

not. Thus, not surprisingly, dissatisfaction with served meals seemed to contribute to patients not finishing their meals.

8.2.2.2 The Identification of Variables Correlating with the Food Quality Components

The influencing variables and the components of food quality were correlated, the assumption being made that satisfaction of patients and catering staff, productivity, food safety, and food waste were influenced by 15 variables classified into two categories, i.e. human resources and system resources. Four of the influencing variables significantly related to patient satisfaction, six significantly related to staff satisfaction, six significantly related to productivity, five significantly related to safety, and four significantly related to food waste. Table 7.10 represented the significant correlations for the components of food quality and influencing variables in the sample hospitals.

Human resource variables significantly influencing patient satisfaction were the full-time staff ratio, supervisory staff ratio, and staff satisfaction with pay. A negative significant relationship existed between the ratios of full-time and supervisory staff and patient satisfaction, whereas a significant positive relationship was evidenced between patient satisfaction and staff satisfaction with pay. A system variable correlating significantly with patient satisfaction was the food and consumables costs. As food costs increased, the satisfaction of patients decreased. This is not what would be predicted, and warrants further investigation.

A human resource variable correlating significantly with catering staff satisfaction was employee satisfaction with promotion. As the score for employee satisfaction with promotion increased, the overall satisfaction of catering staff increased.

Meal equivalents, number of total patients, bed capacity, catering function ratio, and number of menu items were factors in the system resources that had significant negative correlations with the satisfaction of catering staff.

Human resource variables significantly influencing the productivity level were the labour cost and supervisory ratio. As each of these decreased, the meals served per human hour worked increased. System resource variables correlating significantly with productivity were meal equivalents, bed capacity, number of patients, and catering function ratio. As each of these increased, more meals were produced per human hour.

The system resource variables that correlated significantly with safety level were the number of menu items, modified meal ratio, catering function ratio, and subsidizing meal ratio. An increase in the modified meal ratio, catering function ratio and subsidizing meal ratio was associated with an increase in safety level. As the number of menu items increased, the safety level decreased.

Human resource variables correlating significantly with food waste included employee satisfaction with pay and labour cost. As the score of employee satisfaction increased, less food was wasted by patients, whereas as the labour cost increased, food waste increased. The occupancy rate and the subsidizing meal ratio were factors in the system resource variables that were significantly negatively correlated with food waste. The negative correlations indicated that as the occupancy rate and the subsidizing meal ratio increased, a decrease in food waste occurred.

The correlations discussed above are relatively easy to interpret for staff satisfaction, productivity and safety levels but more difficult to interpret in the case of patient satisfaction and food consumption. As discussed in chapter 7, patient satisfaction was significantly correlated with food waste. As discussed in chapters 6 and 7, patient satisfaction was also shown to be largely dependent on personal variables and food habits rather than on influencing variables.

Hospital capacity had a negative correlation with staff satisfaction. This was possibly due to increased complexity and heterogeneity of food preparation. Satisfaction with promotion was significantly correlated with overall satisfaction of catering staff. In large hospitals a relatively smaller proportion of the catering staff are promoted, thus it may be useful to provide other incentives to encourage staff. As the size of hospital increased, productivity increased. The standardization or routinization in large hospital food service systems results in greater productivity through the efficient use of labour and other resources. From the results of the research the goals of staff satisfaction and high productivity conflict, a conflict which is difficult for catering managers to resolve. Catering managers should be aware of this and of the compromises needed. Safety level was positively correlated with subsidizing meal ratio. When money is available from profit oriented catering activities within the hospital, it is available for reinvesting in safety. Safety level was negatively correlated with number of menu items. Care needs to be taken as the complexity of the food service system increases to make sure that safety standards are maintained.

The results of the regression analysis showed that number of patients, labour costs, subsidizing meal ratio and occupancy rate explained the largest amount of variance in the components of catering staff satisfaction, productivity, safety and food waste respectively.

8.3 The Evaluation of the Model of Food Quality

The main purpose of this research was to develop a model to identify and measure components of food quality and selected variables that influence food quality in hospital food service systems. A multi-dimensional model was utilised for describing food quality. Food quality was defined in terms of the dependent composite variables of satisfaction, efficiency, safety, and nutritional adequacy.

Patient satisfaction, staff satisfaction, productivity, safety level and food waste components were used as measurements of food quality. The influencing variables, assumed to influence the direction and extent of the food quality of a food service system, were classified as human resources and system resources.
As discussed in chapter 7, the non significance of the correlations between the components of food quality showed the independence of the components, demonstrating the need for a multi-dimensional model of food quality, the exception being plate waste and patient satisfaction which were significantly negatively correlated with each other. The large number of significant correlations between the influencing variables indicates the complexity of hospital food service systems and suggests that a larger sample of hospitals would improve the reliability of the results. As discussed in chapter 7.5, the data from the 12 hospitals, consisting of 4 components and 15 variables were used in a stepwise OLS regression analysis. With the exception of the component of patient satisfaction, a number of the influencing variables explained a large proportion of the variance in the components of food quality.

Recommendations for the improvement of this model suggested by this study are:

1. To review the definition and measurement of the components of food quality, in particular the components of patient satisfaction and plate waste.
2. To review the definition and measurement of variables assumed to influence the components of food quality eg staff training type or length may be worth evaluating as an influencing variable.
3. To review the patient 'Satisfaction' scores which were calculated by using in equal weighting for all the variables included.
4. To simplify the presentation of results, it is suggested that the food waste levels should not be presented as 'food left' but as 'food consumed' by patients.

Then numerical scores for all the components of food quality will then increase with improved performance.

5. To conduct the research on a larger sample of hospitals in order to increase the reliability of results.

6. To investigate the feasibility of an intensive evaluation in one or two food service systems in a time series study.

With additional research, application and testing, it may be possible to refine the model, using multiple regression techniques, to help catering managers within conventional hospital food service systems optimise the utilization of resources.

8.4 Possible Directions for Further Research

This study explored methodological issues in analysing the food service system in hospitals and assessed food quality in the hospital food service system. The methodological issues which have been under discussion in this thesis could certainly be the starting point for further studies. As noted earlier, some choices were made during the development of the methodology to strike a balance between the demands of methodological adequacy on one hand and practical feasibility on the other (Booth, 1990).

Here, opportunities for future studies are considered.

First and foremost, work to refine methodological definitions of food quality would be worthwhile. It is suggested that methodological issues be treated as a decisive element in food management studies. This work would be a starting point for the development of a holistic definition of food quality in this field.

Second, this study can be supplemented by time-series analysis of food service systems. The empirical research in this study was focused upon the need to explore the present situation in hospital food service systems. Time-series

analyses would be able to give additional information, using the present study as a base line.

Third, this study is confined to the analysis of food quality within conventional hospital food service systems. Although conventional systems dominate hospital food production it is not the only method of food preparation. It could prove instructive to analyse different food service systems such as cook-chill or cook-freeze.

Fourth, the methodology used here could be adapted for application in other hospitality situations such as school food services, university canteen services, and nursing homes.

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APPENDICES

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THE SUMMARY OF MICROBIOLOGICAL STUDY A1

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THE GENERAL INFORMATION QUESTIONNAIRE A14

< APPENDIX 1 >

The Summary of Microbiological Study

Studies Undertaken to Examine the Naturally Occurring Microflora of Menu Items under Actual Operating Systems.

-Studies of simulated systems-

Tuomi, *et al.* 1974	Beef gravy Cook-chill	TPC Cl. perfringens Staphylococci Time-Temperature

After cooking: TPC;5.0 X 10^1/g
After storage: TPC;4.4 X 10^2/g, C. perfringens;negative Staphylococcus aureus; positive in some samples

Zallen, *et al.* 1975	Beef loaves Conventional Cook-chill Cook-frozen	TPC Time Cooking losses TBA test Moisture Sensory Analysis

After cooking: all loaves but 1 TPC;<1.0x10^2/g
After storage: all loaves but 2 TPC;<1.0x10^2/g
A freshly prepared loaf had a higher taste panel scores.

Bunch, *et al.* 1976	Beef-soy loaves Cook-chill	TPC Time Sensory Analysis

After cooking: TPC corner of loaf; 2.1-4.4x10^3/g centre of loaf;5.0-7.0x10^4/g
After chill storage:TPC centre of loaf1.0-1.5x10^5/g
Sensory scores of beef-soy were 6.8-8.1 (moderately desirable, 13-point scale) for all characteristics.

Bobeng & David 1978b	Beef loaves Conventional Cook-chill Cook-freeze	APC Time-Temperature Weight loss Thiamin retention Sensory Analysis

Almost all of the bacteria were destroyed after baking among systems.
Scores for overall acceptability of the foods in the conventional system were significantly greater than for those of the other systems.

Dahl, *et al.* 1978	Beef loaves Cook-chill		APC Coliform Streptococci pH Time-Temperature

After terminal heating: APCs were lowest.

Dahl, *et al.* 1980	Beef loaves Potatoes Green beans Cook-chill		APC pH Time-Temperature

After 24h chilled storage: TPC; decreased in beef loaf, increased in potatoes

Rini, *et al.* 1981	Beef loaves Conventional Cook-chill		TPC Yeast & Moulds Coliforms Staphylococci Clostridia Temperature Sensory Analysis

After cooking: coliforms, staphylococci, yeasts, and moulds-all negative. TPC;7.8x10/g, Clostridia;1.7x10/g
After storage: TPC:1.3x10^2/g, Clostridia:3.3x10/g
Sensory scores of all loaves were 6.9-8.0 (relatively high, 9-point scale) for all characteristics.

Shelton & Ainsworth 1981	Brussel sprouts Minced beef in stock Cook-freeze Cook-chill		TPC Coliforms Salmonella Ascorbic acid

After cooking: TPC sprouts; 4.8x10^3/g, meat; 6.3x10^4/g
After cook-chill storage: TPC sprouts;7.8x10^3/g, meat; 5.0x10^5/g after 6 days.
After cook-freeze storage: TPC sprouts3.0x10^3/g after 70 days, meat 3.0x10^4/g after 70 days

-Studies of actual operating systems-

Bryan & Kilpatrick 1971	1 Fast Food Service Restaurant Cook-chill	Roast beef	Salmonellae *Cl. perfringens* Time-Temperature

Salmonellas were not found in samples except a swab sample of raw chicken.
C. perfringens were detected in raw beef, cooked meat, and kitchen environment.

Bryan, *et al.* 1971	1 School Cook-chill	Turkey Staphylococci Salmonella Time-Temperature	*Cl. perfringens*

Raw turkey: Cl. perfringens, Staphylococcus aureus, and Salmonella were isolated.
Cooked meat, stock, and kitchen equipment: Cl. perfringens was isolated.

Bryan & McKinley 1974	3 Schools Cook-chill	Turkey Staphylococci	*Cl. perfringens* Salmonellae Time-Temperature

After cooking: all tests negative

Rowley 1976	Military food service cook/freeze	Bakery items meat & entree salad	TPC Sensory Analysis Consumer tests

After cooking: TPC <200/g in most samples

Cremer & Chipley 1977a	Satellite System Cook-chill	Hamburger Patties	TPC Clostridia Staphylococci Coliform Time-Temperature Sensory Analysis

After reheating: TPC 1.27-1.54x10^3/g
Sensory quality scores 5.1-6.9 (fair or below good, based on a 9-point scale)

Cremer & Chipley 1977b	1 School Cook-chill	Spaghetti & chilli	TPC Clostridia Staphylococci Coliform Time-Temperature Sensory Analysis

After cooking: TPC spaghetti 2.1x10^3/g chill 1.1x10/g
After storage: TPC spaghetti 5.7x10^3/g, chill 2.1x10 /g
Clostridia numbers increased during storage from 0.34 to 2.04x10^3 /g, 0.52 to 1.04x10^3 /g in spaghetti and chilli respectively.
Sensory quality scores 6.3-7.4 for chilli and 5.9-6.8 for spaghetti (fair to very good based on a 9-point scale)

Nicholanco & Matthews 1978	1 Hospital Cook-chill	Beef stew	APC Coliform Time-Temperature Sensory Analysis Thiamin retention

After cooking:APC 4.6-8.1 x 10^4/g, After storage:APC 7.5-18.0 x 10 /g

Mean sensory score was 3.0 or above (fair) on a 5-point scale, with one exception.

Avens, *et al.* 1978	4 Schools Conventional Cook-chill Frozen Foods	10 menu items entrees vegetable desserts	APC Coliforms Escherichia Coli Coagulase positive Staphylococci

The microbiological quality of the food was not statistically significant among food preparation and delivery systems.

Cremer & Chipley 1979	1 Commissary food service Cook-chill	Meat loaves	TPC Coliform Clostridia Staphylococci Yeast & moulds Time-Temperature Sensory Analysis

After cooking: TPC;2.3-3.7x10^3 /g, Staphylococci;1.0-3.0x10^2 /10g, Coliforms; 2.0-4.0x10^2 /10g, Clostridia; 6.0-12x 10^2/g
Mean scores for sensory quality were 6.2-7.2 (above fair to good, 9-point scale).

Bryan & McKinley 1979	8 Food-service establishments Conventional	Roast beef	Clostridia Staphylococci Salmonellae

After cooking: Salmonellae negative, Clostridia and Staphylococci isolated.

Cremer & Chipley 1980a	1 Hospital Cook-chill	Roast beef	TPC Staphylococci Clostridia Coliform Yeast & moulds Time-Temperature Sensory Analysis

After cooking: TPC; 1.2x10^3 /10g, Staphylococci; 10/g, Coliforms;-, Clostridia;2.7x10^2 /g, Yeast & moulds; 40/g
Overall mean scores for sensory characteristics were 6.6-7.5 (good, 9-point scale)

Cremer & Chipley 1980b	1 Hospital Cook-chill	Scrambled eggs	TPC Staphylococci Clostridia Coliform Time-Temperature Sensory Analysis

After cooking: TPC; 2.2x10^2/10g, Staphylococci;- , Coliform;- , Clostridia;70/g

Overall mean scores for sensory quality ranged from 6.9-8.1 (above fair to good, 9-point scale).

Bryan, *et al.* 1980	3 Food-service establishments Cook-chill	Gyros	Staphylococci Clostridia Salmonellae Time-Temperature

After cooking, cooling and reheating: Salmonellae negative.
C. perfrengens;10-10,000/g, S. aureus;3-750/g

Bryan, *et al.* 1981	6 Cantonese Style Restaurants Conventional	Boiled Rice	Bacillus cereus Time-Temperature Water Activity

Each of raw, polished rice contained B. cereus.
During preparation and storage: B. cereus < 10^3/g

Brown, *et al.* 1982	10 School food service Cook/hot-hold	20 menu items	APC Time-Temperature

APC: 5 items with cheese were > 1.0 X 10^5/g

Cremer, *et al.* 1985	1 Hospital Cook-chill	Chicken Noodles	TPC Staphylococci Coliforms Anaerobic spores Time-Temperature Sensory Analysis

After 4 wk storage:TPC 3.87x10^2 /g(Mesophilic), 1.97x10^2 /g (Psychrotrophic), Coliforms;<3, Staphylococci;<10, Anaerobic spores; 6
Mean scores for general acceptability (60-point scale) were 29.7 for the fresh product and 25.4 after 4 wk storage.

Sandys & Wilkinson 1988	24 Hospital Cook-chill	Cold desserts Meats Bulk liquids Cold dishes Cook-serve	TVC Staphylococci Clostridia Salmonellae

Salmonellae, Staphylococci, and Clostridia negative.
In the first 4 months of the study, 8.4% of samples > 10^5 cfu/g. In the last 3 months, 1.6% of samples > 10^5cfu/g.

Burch & Sawyer 1989	9 c-stores Convenience	Roast beef sandwiches	APC Staphylococci Time-Temperature

Mean $\log_{10}$counts for APC 5.71-8.40 CFU/g
Mean $\log_{10}$counts for S. aureus 1.68-2.58 CFU/g

< APPENDIX 2 > The Patient Questionnaire

OPINIONS ON FOOD SERVICE SYSTEMS IN HOSPITAL

Please complete this questionnaire after you have eaten.
All of your responses will be kept confidential. Your participation will be of value in improving the food quality. If you have any questions about how to complete this form, please contact the person who distributed the questionnaire and please do not discuss with your fellow patients until you have returned the questionnaire.

---

1) Selection & Variety of Food

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

2) Appearance of Meals Served

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

3) Cleanliness of Dishes and Tray

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

4) Smell of Meals

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

5) Temperature of Food Served Hot

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

6) Temperature of Food Served Cold

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

7) Size of Food Portions

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

8) Seasoning of Meals

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

9) Standard of Cooking

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

10) Flavour of Meals

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

11) Time of Meal Distribution

Very Good | Good | Slightly Good | Neutral | Slightly Poor | Poor | Very Poor

12) Overall Quality of Food & Drinks

Very Good	Good	Slightly Good	Neutral	Slightly Poor	Poor	Very Poor

13) Quality of Food Service Personnel

Very Good	Good	Slightly Good	Neutral	Slightly Poor	Poor	Very Poor

14) Overall Quality of Service

Very Good	Good	Slightly Good	Neutral	Slightly Poor	Poor	Very Poor

FOOD HABITS

1. Do you usually leave any food:
at **home:** Yes ( ) No ( ) in a **hospital:** Yes ( ) No ( )

2. How is your appetite today?
Very Good Good Fair Poor Very Poor

3. Did you leave any food this time?
Yes ( ) No ( )
(If No, Please skip to No. 5)

4. **If yes,** which food item(s) this time did you not finish and/or touch? (Please write down)

Main Dishes :

Vegetables :

Desserts :

Why did you not finish? (Please tick the one number according to the food)

Main Dish : 1 2 3 4 5 6_____

Vegetables : 1 2 3 4 5 6_____

Desserts : 1 2 3 4 5 6_____

REASONS	
1=	Too big portion size
2=	Food is not hot enough
3=	Food is not tasty
4=	Food is too overcooked or undercooked
5=	Low appetite
6=	Others (Please specify!)_____

5. Are you : Female ( )
Male ( )

6. Which of the following age group do you belong?

Under 25	( )	46 - 55	( )
26 - 35	( )	56 - 65	( )
36 - 45	( )	Over 65	( )

7. How long have you been at this hospital?

1 - 2	days	( )
3 - 7	days	( )
8 -14	days	( )
15 -30	days	( )
Over 30	days	( )

THANK YOU VERY MUCH FOR YOUR CO-OPERATION !

< APPENDIX 3 > The Catering Staff Questionnaire

Please state 'Y' beside an item if the item described the particular aspect of your job (work, pay, etc.), 'N' if the item did not describe that aspect, or '?' if you could not decide.
All your responses will be kept confidential and there will be no way to identify your responses. Your participation is voluntary and will be of value in improving the food service system. If you have any questions about how to complete this form, please contact the person who distributed the questionnaire and please do not discuss your responses with your fellow staff.

WORK

_____ Fascinating
_____ Routine
_____ Satisfying
_____ Boring
_____ Good
_____ Creative
_____ Respected
_____ Hot environment
_____ Pleasant
_____ Useful
_____ Tiring
_____ Healthful
_____ Challenging
_____ On your feet
_____ Frustrating
_____ Simple
_____ Endless
_____ Gives sense of accomplishment

PAY

_____ Income adequate for normal expenses
_____ Satisfactory
_____ Barely live on income
_____ Bad
_____ Income provides luxuries
_____ Insecure
_____ Less than I deserve
_____ Highly paid
_____ Underpaid

PROMOTIONS

_____ Good opportunity for advancement
_____ Opportunity somewhat limited
_____ Promotion on ability
_____ Dead-end job
_____ Good chance for promotion
_____ Unfair promotion policy
_____ Infrequent promotions
_____ Regular promotions
_____ Fairly good chance for promotion

SUPERVISION

_____ Asks my advice
_____ Hard to please
_____ Impolite
_____ Praises good work
_____ Tactful
_____ Influential
_____ Up-to-date
_____ Doesn't supervise enough
_____ Quick tempered
_____ Tells me where I stand
_____ Annoying
_____ Stubborn
_____ Knows job well
_____ Bad
_____ Intelligent
_____ Leaves me on my own
_____ Lazy
_____ Around when needed

CO-WORKERS

_____ Stimulating
_____ Boring
_____ Slow
_____ Ambitious
_____ Stupid
_____ Responsible
_____ Fast
_____ Intelligent
_____ Easy to make enemies
_____ Talk too much
_____ Bright
_____ Lazy
_____ Unpleasant
_____ No privacy
_____ Active
_____ Narrow interests
_____ Loyal
_____ Hard to meet

1. Are you : Female ( )
Male ( )

2. Which of the following age group do you belong?

Under 25	( )	46 - 55	( )
26 - 35	( )	56 - 65	( )
36 - 45	( )	Over 65	( )

3. How long have you been working at this hospital?

Less than 1 Year	( )
1 - 2 Years	( )
3 - 5 Years	( )
6 - 10 Years	( )
11 - 15 Years	( )
More than 15 Years	( )

4. Are you : Full-time staff ( )
Part-time staff ( )

5. Are you : Supervisor ( )
Non-supervisor ( )

6. What is your highest academic qualification?
None ( )
City & Guilds of London Institute ( )
BTEC Diploma ( )
BTEC Higher Diploma ( )
O Levels ( )
A Levels ( )
1st Degree ( )
Higher Degree ( )
Others (Please specify) _____

THANK YOU VERY MUCH FOR YOUR CO-OPERATION !

< APPENDIX 4 >

The Questionnaire for Microbiological control

1. Have been there any food poisoning accidents in your hospital last 10 years?

Yes _____
No _____ (Skip to No. 3)

2. If Yes, could you describe the detail?

When ?

How many people affected ?

What kind of food poisoning?

What source of food caused that?

3. Do you regularly do microbiological testing for samples from each batch of food produced in the hospital?

Yes _____
No _____ (Skip to No. 6)

4. If Yes, do you do

a) random tests at irregular intervals _____

b) routine tests at set intervals _____

5. How often ?

How many samples ?

Where ?

Which test are used ?

Total aerobic colony _____
Salmonella Species _____
Escherichia coli _____
Staphylococcus aureus _____
Clostridium perfringens _____
Listeria monocytogenes _____
Others (Please specify !) _____

6. In your hospital, have you got a microbiological standard for your food items?

Yes _____
No _____

7. In your hospital, is there a suitably qualified person, who is able to undertake microbiological analysis if required?

Yes _____
No _____

8. Temperature control for chilled storage area and blast chiller. (Please choose one which applies)

a) No checking
b) Check less than weekly
c) Weekly check
d) Daily check
e) At regular set intervals throughout day
f) At regular set intervals throughout day with fully automatic temperature control for chilled storage and blast chiller (computer controlled temperature recorders with built-in alarms)

9. Temperature control for meals. (Please choose one which applies)

a) No checking
b) Check less than weekly
c) Weekly check
d) Daily check
e) At regular set intervals throughout day on only hot food items produced
f) At regular set intervals throughout day on all food items produced

10. Do you provide training about microbiological control or safety for non-supervisory and supervisory employees?

Non-supervisory		Supervisory	
Yes	_____	Yes	_____
No	_____	No	_____

11. If Yes, how many times do you provide?

_____ times per year for non-supervisory
_____ times per year for supervisory

< APPENDIX 5 >

The List of Inedible foods excluded from the Survey

INEDIBLE FOODS

Fish heads and tails.

Meat and fish bones after meat of fish has been scraped off.

Gristle.

Bacon rind, meat or fish skin.

Giblets, intestines.

Egg shells.

Vegetable trimmings - outer trimmings, leaves, stems, peelings or skins from potatoes, lettuces, cabbage, onions, peppers, beans etc.

Orange and citrus fruit peel.

Stones, pips, cores etc.

Cheese rinds.

< APPENDIX 6 >

General Information Questionnaire for Catering Manager

1. Total supervisory and other staff (catering managers, dietitians, clerical) labour hours for week of study. (Exclude sick leave, holiday, or vacation hours)

2. Total number of catering employees (direct labour) labour hours for week of the study. (Exclude sick leave, holiday, or vacation hours)

3. Total monetary turnover of cafeteria or coffee shop for week of study

4. Total monetary turnover of functions for week of study.

5. Cost of food and consumables (disposable ware eg. paper cups...) for January in 1992.

6. Total monthly labour cost (including supervisory, professional and clerical) in catering department for January in 1992.

7. The number of full-time catering staff.

8. The number of part-time catering staff.

9. The number of supervisory catering staff.

10. The number of dietitians.

11. Bed capacity of the hospital.

12. Seating capacity of cafeteria.

13. Seating capacity of coffee shop if separate operation.

14. Serving hours of the cafeteria: Breakfast
Lunch
Dinner

15. Serving hours of the coffee shop: Open
Close

16. Operating hours of main kitchen :

Break time of catering staff :
Breakfast break
Lunch break
Dinner break

17. _____ Weeks menu cycle for patients

18. How many patients are in hospital?

19. Please write down the number of patients,

- On normal diet
- On modified diet (eg. diabetic, tube feeding etc.)

20. The cost of a meal for staff. (1 Week)

1 entree
1 vegetable
1 salad
1 dessert
1 beverage

21. How much are given by the NHS for patient meal?

A meal £ _____
Three meals a day £ _____

22. How much do you spend for patient meal?

Breakfast £ _____
Lunch £ _____
Dinner £ _____

23. Does your hospital catering make profit by running special functions?

Yes _____
No _____ (Please skip to No. 24)

-If Yes, What kind of function are you operating except providing patient and staff with meals?

-How much does your hospital catering make profit per month by running special functions?

_____ % profit

£ _____ / month

-How does your hospital catering spend the profit?

-Among these profits, how much does your hospital catering spend for subsidizing patient meal?

_____ % of total profit

£ _____ / month

< MEAL CENSUS >

DAY	MEAL	GENERAL	DIABETIC	OTHERS	TUBE	TOTAL MEALS
MON	B					
	L					
	D					
TUS	B					
	L					
	D					
WED	B					
	L					
	D					
THUR	B					
	L					
	D					
FRI	B					
	L					
	D					
SAT	B					
	L					
	D					
SUN	B					
	L					
	D					
TOTAL						