

**EVALUATION OF COMPLIANCE TO FOOD SAFETY
STANDARDS AMONGST FOOD HANDLERS IN SELECTED
HOSPITALS IN KENYA**

BY,

JACKIM NYAMARI (Mphil. ENVH)

P97/12739/2009

**A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR
THE AWARD OF THE DEGREE OF DOCTORAL OF PHILOSOPHY IN THE
SCHOOL OF PUBLIC HEALTH OF KENYATTA UNIVERSITY**

MAY 2013

DECLARATION

This thesis is my original work and has not been presented for a degree or any award in any other University.

Signature
Jackim Matara Nyamari
Department of Community Health

Date_____

Supervisors:

This thesis has been submitted for review with our approval as University supervisors

1. _____ Date_____

Signature
Dr. Margret Keraka
Department of Environmental Health
Kenyatta University

2. _____ Date_____

Signature
Dr. Beatrice Mugendi
Department of Food Science and Technology
Kimathi University College of Science and Technology

3. _____ Date_____

Signature
Dr. John Paul Oyore
Department of Community Health
Kenyatta University

DEDICATION

To my parents Daniel and Pacifica you are the best parents ever. My loving wife Diana, your love and support are an essential part of my life and to my newborn daughter Daniella; you bring so much joy to my life.

ACKNOWLEDGEMENTS

Many thanks to God for granting me love, good health and an opportunity to pursue my studies at Kenyatta University

My sincere gratitude goes to my supervisors Dr. Margaret Keraka, Dr. Beatrice Mugendi and Dr. John Paul Oyore for their continuous support and advice throughout this study.

Special thanks to my research assistants and study participants, without whom it would have been difficult to obtain data. I also want to thank the members of staff, in the School of Public health, Kenyatta University for their academic support during my studies.

Special thanks to Dr. Daniel Akunga, Miss. Joan Njagi and Miss Judy Mugo for their continuous encouragement.

Lastly, my sincere gratitude goes to the African Population Health Research Center (APHRC) for partially funding this study.

TABLE OF CONTENTS

DECLARATION.....	ii
DEDICATION.....	iii
ACKNOWLEDGEMENTS.....	iv
ABSTRACT.....	xii
ACRONYMS AND ABBREVIATIONS.....	xiii
OPERATIONAL DEFINATIONS.....	xiv
TABLE OF CONTENTS.....	v
LIST OF FIGURES.....	x
LIST OF TABLES.....	xi
CHAPTER ONE: INTRODUCTION.....	1
1.0 Background Information.....	1
1.1 Problem Statement.....	5
1.2 Justification.....	7
1.3 Research Questions.....	7
1.4 Broad Objective.....	8
1.4.1 Specific Objectives.....	8
1.5 Significance of the Study.....	8
1.6 Limitations of this Study.....	9
1.7 Conceptual Framework.....	9
CHAPTER TWO: LITERATURE REVIEW.....	11
2.0 Introduction.....	11
2.1 Definition and Scope of Food Safety.....	11
2.2 Types of Food Contaminants.....	12

2.3 Epidemiology of Foodborne Diseases	13
2.4 Foodborne Diseases in Kenya.....	16
2.5 Food Safety Systems in Kenya	18
2.5.1 Ministries and Agencies Responsible for Food safety in Kenya	18
2.5.2 Food Safety Laws in Kenya.....	19
2.5.3 Food Safety Standards in Kenya.....	20
2.5.4 Human Resource in Food Industry	21
2.5.5 Challenges in Foodborne Disease Statistics.....	22
2.5.6 Role of Stakeholders in Food Supply Chains	22
2.5.7 Consumers in Kenya	24
2.6 Factors Underlying Foodborne Diseases in Hospitals	24
2.6.1 Causes of Foodborne Nosocomial Infections	25
2.6.2 Poor Personal Hygiene of Food Handlers.....	26
2.6.3 Contaminated Equipment and Utensils.....	28
2.6.4 Food from Unsafe Sources.....	29
2.6.5 Improper Holding Temperature	30
2.7 Food Safety Knowledge.....	31
2.7.1 Translating Food Safety Knowledge into Practice.....	33
2.8 Work-Site Barriers to Food Safety	36
2.9 Hazard Analysis and Critical Control Points (HACCP)	36
2.10 Food Safety Culture	39
2.11 Summary	40
CHAPTER THREE: METHODOLOGY	42
3.0 Introduction.....	42
3.1 Research Design.....	42

3.1.1	Priori Concepts for Training Intervention.....	44
3.2	Independent and Dependent Variable	44
3.3	Study Area	44
3.4	Target Population.....	45
3.4.1	Sampling Method for Hospitals	46
3.5	Data Collection Methods	46
3.5.1	Questionnaire	46
3.5.2	Focus Group Discussions.....	47
3.5.3	Observational Checklist	48
3.6	Pilot study	49
3.7	Data analysis	49
3.7.1	Quantitative.....	49
3.7.2	Qualitative Data Analysis	50
3.8	Logistical and Ethical Considerations.....	50
CHAPTER FOUR: RESULTS		51
4.0	Introduction.....	51
4.1	Socio-demographic Characteristics of the Study Population.....	51
4.2	HACCP	52
4.2.1	Source of Information on Food Hygiene and HACCP by Food Handlers.....	52
4.2.2	Food Service Managers Awareness Regarding HACCP	53
4.3	Extent to which Hospitals Conform to Food Safety Standards.....	54
4.3.1	Kitchen Equipments.....	54
4.3.2	Food Handlers.....	54
4.3.3	Waste Management.....	55
4.3.4	Storage and Refrigeration	56

4.3.5 Floors, Walls, Ceilings, Lighting, Ventilation and Vector/Rodent Control.....	57
4.3.6 Water Supply and Sanitary Facilities.....	58
4.4 Perceived Barriers to Compliance to Standard Food Safety Procedures	58
4.4.1 Health Beliefs and Knowledge on Food Safety	58
4.4.2 Hand Washing Practices	59
4.4.4 Cross- Contamination Practices	60
4.4.5 Hospital Management Commitment on Food Safety.....	61
4.4.6 Poor Working Conditions	62
4.4.7 Insufficient Water Supply	62
4.4.8 Quality of Food Supplies	63
4.4.9 Enforcement of Food Safety Standards	64
4.4.10 Lack of Food Safety Training	64
4.5 Evaluation of Food Safety Training.....	65
4.5.1. HACCP Implementation.....	65
4.5.2 Food Safety Knowledge.....	67
4.5.4 Food Safety Practices.....	69
4.5.5 Sanitation Rated by the On-site Inspection.....	72
<u>CHAPTER FIVE: DISCUSSION OF THE FINDINGS</u>	<u>74</u>
5.0 Introduction.....	74
5.1 Extent to which Hospitals Conform to Food Safety Standards.....	74
5.1.1 Kitchen Conditions	74
5.1.2 Routine Inspections.....	75
5.1.4 Food Service Managers Awareness on HACCP and Food Safety Standards.....	76
5.2 Perceived Barriers to Compliance to Food Safety standards	77
5.3 Evaluation of Food Safety Training.....	78

5.3.1 Knowledge	79
5.3.2 Practice.....	80
5.3.3 On-site Sanitation Inspection	80
6.0 Introduction.....	83
6.1 Extent of Hospital Conformance to Food Safety Standards	83
6.2 Barriers to Compliance to Food Safety Standards	83
6.3 Evaluation of Food Safety Training.....	84
6.4 RECOMMENDATIONS	85
6.4.1 Recommendations for Policy	85
6.4.2 Recommendations for Further Studies.....	86
REFERENCES	88
APPENDICES	102
Appendix I: Questionnaire for Hospital Manager in Charge of Food Services	102
Appendix II: Scoring Scheme for Evaluation of Kitchen Conditions.....	103
Appendix III: Focus Group Discussions Guide	107
Appendix V: Food Safety Practices Pre-Test and Posttest Questionnaire.....	113
Appendix VI: Food Safety Curriculum Outline.....	116
Appendix VII: Research Permit.....	119

LIST OF FIGURES

Fig 1.1: Conceptual Framework.....	9
Fig 4.1: Sources of Information Regarding HACCP and Food Hygiene.....	50
Fig 4.2: Food service Managers awareness on HACCP and food hygiene standards.....	50

LIST OF TABLES

Table 2. 1: Principles of HACCP System (Codex Alimentarius, 1969)	37
Table 3.1: Number of Hospital & Food Handler Participants	45
Table 4. 1: Socio-demographic Characteristics of Food Handlers	52
Table 4.2: Equipment and Food Handlers Standard Status (n=42).....	54
Table 4.3: Food Hander's Hygiene Standards (n=42)	55
Table 4.4: Waste Management (n=42).....	56
Table 4.5: Storage and Refrigeration Status (n=42)	57
Table 4.6: Floors, Walls, Ceilings, Lighting, Ventilation and Vector/Rodent Control (n=42).....	57
Table 4.7: Water Supply (n=42)	58
Table 4.8: Compliance to HACCP in Control and Intervention Hospitals before & after Training	66
Table 4.9: Effects of Food Safety Training on Food Safety Knowledge Scores	67
Table 4.10: Comparison of food handlers' hygiene knowledge scores before and after training ..	68
Table 4.12: Comparison of hospital food handlers' hygiene practices before and after training ...	71
Table 4.13: Effects of training on sanitation performance.....	73

ABSTRACT

Food borne diseases presents a widespread and growing public health problem both in developed and developing countries including Kenya. Diseases spread through food still remain a common and persistent problem resulting in appreciable morbidity and occasional mortality. Food hygiene in hospital poses peculiar problems, particularly given the presence of patients who could be more vulnerable than healthy individuals to microbiological risks. Kitchen environment and food handlers play an important role in ensuring food safety throughout the chain of production, processing and preparation; the common involvement of food handlers who are not specifically trained in food hygiene and HACCP and kitchen environments that do not meet food safety standard is a cause of concern. The objectives of this study were to assess the levels of compliance to food hygiene standards in selected hospitals in Kenya; to determine perceived barriers to implementing food safety practices amongst food handlers, and to evaluate the effectiveness of food safety training on food safety knowledge and practices among hospital food handlers. The main aim was to provide baseline data for implementing food safety standards and in hospital food services in order to enhance compliance. This study utilized a quasi-experimental study design. Through a simple random stratified sampling, 42 hospitals (22 interventional group and 20 control group) were selected for the study with a total of 343 food handlers (129 interventional group and 141 control groups). All hospitals were evaluated on their compliance to food hygiene standards; Nine FGDs having food handlers from both interventional groups and control groups were undertaken to determine barriers to implementing food safety practices. Pre and post-training assessments were conducted on knowledge and behavior related to three key food safety practices; personal hygiene, food hygiene and environmental hygiene. The study identified gaps with regard to status of the hospital kitchen, status and storage of equipments, some aspects of personal hygiene and sanitation and vector control. The following were identified in all FGDs; lack of food safety training, poor working conditions, rapid turnover, lack of sufficient equipments, lack of water, lack of recognition by the hospital management and insufficient supervision as the major barriers influencing non compliance to food safety standards. Overall food handlers knowledge scores increased from 50.6 ± 16.5 pre- training to 76.4 ± 15.5 post training ($P < 0.05$), and reported practices scores increased from 101.3 ± 11.6 pre-training to 105.3 ± 12.2 post training ($P < 0.05$) in the intervention group. However, when each practice was examined independently significant changes were not observed, results indicate that training can improve knowledge and behavior, but knowledge alone does not always improve behavior. The findings of this study highlight the importance of regular inspection of hospital kitchens; providing health education in food and personal hygiene to food handlers and incorporation of the same in existing guidelines and policies for food establishments.

ACRONYMS AND ABBREVIATIONS

CAC:	<i>Codex Alimentarius</i> Commission
CDC:	Center for Disease Control and Prevention
DPH:	Department of Public Health
FAO:	Food and Agricultural Organization
FBD:	Food borne diseases
FAO:	Food and Agriculture Organization
KARI:	Kenya Agricultural Research Institute
KEBS:	Kenya Bureau of Standards
KEPHIS:	Kenya Plant Health Inspectorate Services
MOH:	Ministry of Health
RTE:	Ready-to-eat Food
WHO:	World Health Organization

OPERATIONAL DEFINATIONS

Adequate Lighting of the Room: Health person can easily identify objects in the room without eye straining in the class.

Good Repair Condition: There were no cracks, holes and joints in which wastes and dirt's can lodge in preparation and dining rooms of floors, wall and ceiling.

Cleanliness of the Equipment Kept: - the equipment is free of dust, filth, grease and finger print.

Cooked Food Appropriately Stored: Food is placed in clean container and covered with fixtures that fit to cover to prevent from contamination of dust, splashing and insect.

Food: Any substance, whether processed, semi-processed or raw which is intended for human consumption, including drinks, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but excluding cosmetics, tobacco and substances used only as drugs (*Codex Alimentarius* 1995).

Food Contact Surface: The surface of equipment and utensils with which food normally comes in contact and those surfaces from which food may drain, drip or splash back on to surfaces normally in contact with food.

Food Handler: A person in the food trade or someone professionally associated with it, such as an inspector who, in his routine work, come into direct contact with food in the course of its production, processing, packaging or distribution.

Food Hygiene: Conditions and measures necessary for the production, processing, storage and distribution of food designed to ensure a safe, sound, wholesome product fit for human consumption (FAO/WHO 2007).

Food Hazard: A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect (*Codex Alimentarius* 1999).

Foodborne Nasocomial Infection: Infection whose development has developed due to consumption of contaminated food by the patients at the hospital environment.

Food Safety Education: education dealing with the practices that keep food safe from environmental and bacterial contamination.

Food Safety: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (*Codex Alimentarius* 1969).

Food Safety Objective (FSO) The maximum frequency an/or concentration of a hazard in a food at the time of consumption that provides or contributes to the appropriate level of protection (Codex *Alimentarius* 2004).

Hazard: A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect (Codex *Alimentarius* 1999).

Hazard Analysis and Critical Control Points (HACCP): A system which identifies, evaluates, and controls hazards which are significant for food safety (Codex *Alimentarius* 1969, 2003).

Nosocomial Infection: Also known as a **hospital-acquired infection (HAI)**, is an infection whose development is favored by a hospital environment, such as one acquired by a patient during a hospital visit or one developing among hospital staff. Such infections include fungal and bacterial infections and are aggravated by the reduced resistance of individual patients.

Personal Hygiene: Those protective measures primarily with the responsibility of individuals which promote health and limit the spread of infectious disease chiefly those transmitted by direct contact, such measures encompasses washing hands with soap and waters and keeping the body and cloths clean by sufficiently frequent soap and water bath.

Precautionary Principle: An option open to risk managers when decisions have to be made to protect health but scientific information concerning the risk is inconclusive or incomplete in some way (EC 2002).

Risk: A function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard (s) in food. (Codex *Alimentarius* 1999).

Refuse/Garbage Properly Handled: Appropriate receptacles (fit to cover, moist resistant, durable type and light to left) were placed in proper area (in distant place from food preparation place) for onsite storage of waste.

Standard Operating Procedures (SOPs): These are written practices and procedures that are critical to producing safe food.

CHAPTER ONE: INTRODUCTION

1.0 Background Information

Food is an important basic necessity; it is a critical contributor to physical well-being and a major source of pleasure (Rozin *et al.*, 1999), its procurement, preparation and consumption are vital for sustenance of life. However, diseases spread through food are common and persistent problems that result in appreciable morbidity and occasionally in death (Scharff, 2009, Tomohide, 2010). Foodborne illnesses have been described as one of the most widespread problems of the contemporary world (Zotermans *et al.*, 1994, Wheelock, 2006) as it is an important and growing public health and economic problem in many countries.

Foodborne disease is attributed to consumption of contaminated food with a wide variety of bacteria, parasites and viruses. Cases of foodborne diseases occur daily throughout the world, from the most to the least developed countries. It is difficult to obtain accurate estimates of the incidence of microbiological foodborne disease. However, in developed countries, the percentage of people suffering from microbiological foodborne disease each year has been reported to be up to 30%, while the problem is likely to be even more widespread in developing countries (WHO, 2002). According to the WHO, the global incidence of food-borne diseases is difficult to estimate, but it has been reported that in 2005 alone 1.8 million people died from diarrheal diseases. Other studies also show that food and waterborne diarrhea diseases are considered as the leading causes of illness and death in less developed countries (Schlundt *et al.*, 2003), causing an estimated 1.9 million deaths annually in the world (Kafenstein, 2006).

There are many indicators that point to the fact that the incidence of food-borne disease is increasing globally, and is a substantial cause of morbidity and mortality worldwide. Although the vast majority of cases are mild, a significant number of deaths do occur and the high levels of acute infections and chronic sequelae lead to billions of dollars in medical costs and lost productivity (Duff *et al.*, 2003). The economic burden of foodborne diseases is large and thus increased efforts to identify and control threats are

advantageous and necessary. The economic burden encompasses many direct and indirect factors: cost related to lost worker productivity, and costs to food industry from loss of sales. In less developed countries, neglect of the problem can constitute a major threat to health and development itself (Ehiri and Morris, 1996). While it has long been considered that most cases of diarrhea in developing countries are waterborne, Keferstein (2006) stated that it is a grave mistake to ignore the role of contaminated food and that there is an urgent need to integrate food safety, along with water and sanitation programs, as an essential strategy to prevent diarrhea. Foodborne diseases are a global threat as a result of the increase in international travel and trade, microbial adaptation and changes in the food production system, as well as human demographics and behavior (Patil *et al.*, 2005, Schlundt *et al.*, 2003, WHO, 2002). Although numerous control strategies are in place, person to person disease transmission has not ceased.

Food handlers play an important role in ensuring food safety through the chain of production, processing, storage and preparation (Goh, 1997, Hedberg *et al.*, 1994). Approximately 10 to 20% of food-disease outbreaks are due to contamination by the handler. Mishandling of food and disregard of hygiene measures enable pathogens to come into contact with food and, in some cases, to survive and multiply in sufficient numbers to cause illness in consumers. Personal hygiene and environmental sanitation are key factors in the transmission of food-borne diseases. Investigations of outbreaks of foodborne disease throughout the world show that in nearly all instances, they are caused by failure to observe satisfactory standards in the preparation, processing, cooking, storing or retailing of food (Tomohide, 2010).

In the last decades, the epidemiology of foodborne diseases is changing with new or unexpected pathogens often emerging on a countrywide or worldwide scale, new foods expanding the range of potential vehicles of pathogens, wider social contexts being involved and new classes of individual being at higher risk (MacKenzie *et al.*, 2004). These changes may also be attributed to several socio-economic and demographic factors, including dramatic qualitative changes in primary production, processing, distribution and handling of food and the increasing exposure of individuals, like elderly,

patients with impaired immunity and many hospitalized subjects (Bubzy, 2001, Bubzy, 2002). Epidemiological and surveillance data suggest that faulty practices in food processing plants, food service establishments and home play a crucial role in the causal chain of foodborne diseases as well. As a result, more stringent quality control is a must in the food industry, and customers' confidences are more dependent on the quality assurance promised by the food provider.

The Kenyan public is exposed more extensively than ever before to exotic foods and pathogens via international travel, changing lifestyles and domestic contact with fresh foodstuff. Global warming, changing microbial ecology and resistance, and reduced host immunity are also having their effect in increasing the risk. The main foodborne diseases reported by WHO/FAO (2006) in Kenya are; gastroenteritis, cholera, dysentery, brucellosis, and aflatoxin poisoning. While the pathology, disease spectrum and causative agents differ, the same basic disease risk factors influence transmission. In Kenya, like in other African countries, there are great challenges in putting in place efforts to promote food safety at all levels of the food chain.

Although foodborne disease is a matter of concern for the general public, it is even of high concern for immune-suppressed patients for whom food-borne infections can be life threatening (Hayes *et al.*, 2003). The issue of food safety and foodborne disease has also proved to be critical in some foodborne nosocomial outbreaks in the hospital environments (Guallar *et al.*, 2004). In nosocomial outbreaks of infectious intestinal disease, the mortality risk has been proved to be significantly higher than the community outbreaks and highest for foodborne outbreaks (Meakins *et al.*, 2003).

Food hygiene in the hospital can acquire peculiar features: indeed, many patients could be more vulnerable than healthy subjects to microbiological and nutritional risks; large numbers of persons can be exposed to infections and possible complications; gastroenteritis can impair digestion and absorption of nutrients and the perception or fear about poor food hygiene practices might result in patients rejecting the meals supplied by the hospital catering (Barrie, 1996).

The importance of safe food for hospitalized patients and the detrimental effect that contaminated food could have on their recovery has been emphasized (Kandela, 2004). Patients receiving foods from a single kitchen with poor food handling practices could suffer a foodborne infection which could result in an outbreak affecting the whole hospital (Ayliffe, 1992). Outbreaks of foodborne infection in hospitals are associated with high attack rates and disruption of services (Maguire, 2000). In 2002, hospitals in The Netherlands were implicated in 9% of 281 gastroenteritis outbreak (Van Duynhoven, 2005). In Poland, the annual outbreaks of food poisoning and foodborne infections in hospitals and sanatoria from 1985 to 1999 constituted from 1.5% to 6.3% of the total number of such outbreaks in the country (Przybylska, 2001). A foodborne outbreak of *Salmonella* infection at a private hospital in London in 1994 had an attack rate estimated to be 5% among the approximately 200 patients and staff at risk (Maguire, 2000). Outbreaks of foodborne infections in hospitals are preventable but are facilitated by several factors; these include staff carriers, poor hygiene conditions in the kitchens, carelessness, and lack of training of food handlers. The particular danger of contaminated food in hospitals is that such food is given to consumers in poor health (Custovic and Ibrahimagic, 2005). In Bavaria, a *Salmonella* outbreak in hospitals and nursing homes resulted in 6 deaths and in Australia, outbreaks in hospitals and facilities caring for the aged were responsible for 35% of deaths from foodborne infections (Dalton, 2004).

In Kenya there are limited studies and documentation on foodborne nosocomial infection. However, the most recent studies (Githiri *et al.*, 2009b) indicate possible contamination of food served to patients by food handlers. The studies also raise concern from the common involvement in the role of food handlers of nurses or domestic staff, who are not specifically trained about food hygiene standards and Hazard Analysis Critical Control Points (HACCP), but can be engaged in receipt, distribution and serving of readymade foods and supervision of these services. Hence there is a great need for research, education and increased awareness among food services staff in hospitals regarding safe food handling practices. This study targets food handlers because they are directly responsible for the hygiene of the food served in hospitals.

1.1 Problem Statement

Foodborne diseases present a serious challenge to public health in both developing and developed countries. Studies done in both developing and developed countries have indicated that the majority of reported foodborne diseases originate in food service establishments (Kaferstein, 2003, Jones and Lockwood, 2009), and studies on foodborne disease risk factors have indicated that most outbreaks associated with food service establishments can be attributed to food handlers' improper food preparation practices (Friedman *et al.*, 2004). Additionally, observational studies have shown that food handlers frequently engage in unsafe food preparation practices (Clayton and Griffith, 2004, Howes *et al.*, 1996b, Manning and Snider, 1993). Worldwide, there were a total of 816 food borne disease outbreaks, with 80 682 reported cases, from 1927 until the first quarter of 2006, in which food handlers were implicated in the spread of the diseases (Greig *et al.*, 2007).

In Kenya, few studies have been undertaken to assess the roles played by food handlers in the transmission or control of foodborne diseases in various setting (Githiri *et al.*, 2009, Oloo, 2010, Muinde and Kuria, 2005); In particular, there is a paucity of knowledge of food safety in special setting especially the hospitals that prepare meals for patients. Foodborne disease outbreaks in hospitals have affected patients, personnel and visitors. Studies in both developing and developed countries indicate that nosocomial (hospital-acquired) diarrhoea is a common problem in hospitals, child care facilities and nursing homes (Somwang *et al.*, 2005, Prianka *et al.*, 2012, Cecilia *et al.*, 2007). Indeed, patient meals are an integral part of hospital treatment and the consumption of a balanced diet and safe food, crucial to aid recovery (Stratton *et al.*, 2006). The relevance and importance of patient meal service, when compared with many clinical activities is not always appreciated and it is often seen as an area where budgetary cuts will have least impact. Studies carried out in Kenyatta National Hospital in 2001 showed that foodborne nosocomial infection account for 2.5% (*Shigella*) and 3.0% (*Salmonella*) (Paton *et al.*, 2001). Other studies in the same hospital show that 56% of the food handlers in the hospital environment could be major contributors to foodborne nosocomial infections

(Githiri *et al.*, 2009). As clinical manifestations are common in hospitalized patients, the true incidence of outbreaks of foodborne disease in hospitals and extended-care facilities is not known.

These findings indicate that improvement of food handlers' food preparation practices is needed to reduce the incidence of foodborne illness. Food handlers intervention programs are needed to effect this improvement. However, health professionals have argued that an understanding of current practices and factors affecting those practices is necessary before behavior change efforts can be successful (Ehiri and Morris, 1996, Kaferstein, 2006).

Food safety training has been identified as a way to assure public health, yet evidence supporting the effectiveness of training has been inconclusive. However, WHO indicates that education of food handlers to improve their hygiene-related knowledge and practice is of paramount importance in the prevention and control of food borne diseases. Research in this area has been given low attention in developing countries, including Kenya. Although some studies in Kenya document knowledge about food and personal hygiene among food handlers (Githiri *et al.*, 2009, Oloo, 2010, Muinde and Kuria, 2005) none has assessed change in their knowledge and practices following health education. Furthermore, very few studies (Githiri, *et al.*, 2009) have targeted the hospital environment and those that have assessed food handlers 'perceptions of barriers to implementing food safety practices.

In an effort to contribute to the understanding and prevention of foodborne diseases in hospitals, this study was undertaken to evaluate the status of hospitals compliance to food safety standards; determined perceived barriers contributing to unsafe food handling practices among food handlers in the hospitals and assessed the food safety knowledge and practices amongst food handlers before and after an educational intervention. Given the relevance of this subject and because there are few studies in Kenya in this important area of Public Health, the need to develop related studies within a multi-disciplinary context has arisen, with the aim of contributing to a better understanding of food safety

issues and to outlining indicators that lead to an increase in the health and well-being of the occupants of hospital environments.

1.2 Justification

Foodborne illness in hospitals is a serious issue in Kenya. The implementation of food safety strategies that focus on procedures to prevent food borne illnesses are necessary. The major element which will ensure a lasting and growing benefit throughout the food services in the hospital environments include; the requirement for its food handlers and the hospital management to receive information and food hygiene awareness training because human error is one of the largest driving forces behind food borne illness outbreaks. This recognition of the important role the hospital kitchens and food handlers have in food borne illness outbreaks has lead to a realization that there is need to understand risk factors leading to foodborne diseases and to educate and train food handlers (Clayton and Griffith, 2008).

This study assessed the level of compliance to food safety standards in the hospital that participated in the study; assessed the perceived factors by food handlers that contribute to noncompliance to food safety standards and assessed the knowledge and practice of food handlers before and after a food safety educational training. The purpose of this study was therefore to provide detailed representative information on food safety standards in the hospital environments in Kenya, and assess the efficacy of an educational training in order to form a basis for decision making, policy formulation and planning towards the prevention of foodborne diseases in Kenya.

1.3 Research Questions

1. To what extent do hospitals in Kenya conform to standard food safety operating procedures?
2. What are the perceived barriers to compliance to food safety operating procedures among food handlers in the hospital environment?
3. What is the effect of food safety training on the knowledge and practices of food handlers in the hospital environment?

1.4 Broad Objective

To evaluate compliance to food safety standards amongst food handlers in selected hospitals in Kenya.

1.4.1 Specific Objectives

1. To assess the extent to which hospitals in Kenya conform to food safety standard operating procedures.
2. To determine perceived barriers to compliance to food safety operating procedures among food handlers in selected hospital in Kenya.
3. To evaluate the effectiveness of food safety training on food safety knowledge and practices among hospital food handlers.

1.5 Significance of the Study

Kenya faces many challenges to providing quality public healthcare to its people, and high among these challenges is nosocomial infections. In Kenya, as in many developing countries, nosocomial infection is a devastating problem that impacts many vulnerable groups. There is limited research concerning food handlers in the hospital environment and the risks they pose to patients. Previous studies indicate that food handlers in the hospitals engage in risky food handling practices. There have been no documented efforts to increase food safety knowledge or improve safety practices of food handlers. This study therefore highlights the need for greater improvement in overall food safety knowledge and sets out to show how knowledge of food safety affects the behaviors being implemented specifically in the hospital environments

Given that food handlers are the main food contamination vehicles, this study aims at contributing with proposals for health promotion, adoption of legislation and use of appropriate tools to increase knowledge, and changing wrong beliefs concerning food habits and changing food handlers' practice that increase the risk of food borne diseases in hospitals and in various food premises through health education programs. Further, this study offers new insight and examination of this important area and thus makes an original contribution to the literature.

1.6 Limitations of this Study

The most important limitation of this study was that it was not guaranteed that this food safety education program would actually make food safer for the patients in the hospital. This study did not involve actual testing of food, but measuring the knowledge, and adoption of safe food handling practices of food handlers in the hospital environment.

Frequent turnover of the food handlers exist, and inability to locate the original participants of the study posed a detrimental limitation. In the present study, 21% (72) food handlers left either without receiving health education or without its assessment. This high attrition rate in a short period of time is a limitation. At the same time, it also highlights the problem of attrition in this informal sector and presents a challenge of timely dissemination of health education to workers in a setting with a high turnover. The methodology of the present study does not offer a solution to this problem. Novel training techniques are required to address this problem.

1.7 Conceptual Framework

This study was guided by the conceptual model in figure 1.1 below. Three main factors were identified to have an effect on hospital food safety, namely; socio-demographic factors of food handlers, the hospital environment/management and food safety education.

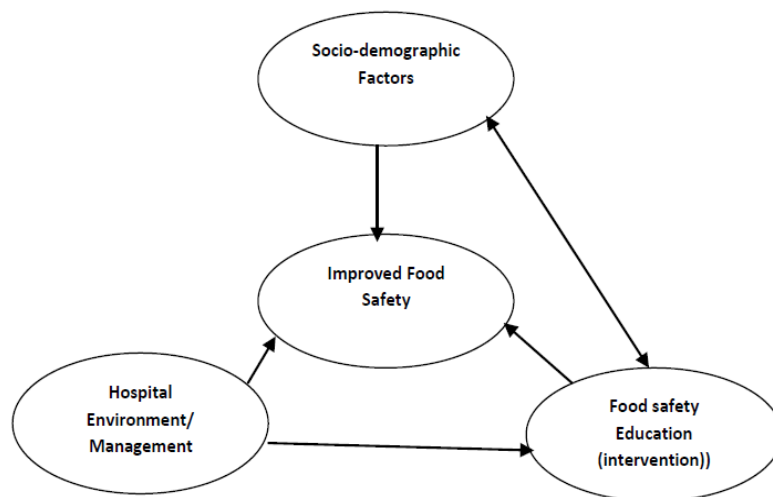


Figure 1.1: Conceptual Framework

In this model, food is considered to be safe when it has reasonably demonstrated that no harm will result from its consumption by patients. In the current model, socio-demographic factors refers to age, sex, educational level, professional training and experience in food handling among other factors. These socio-demographic factors were explored and used to understand how they affect food safety in the hospital environment. It is presumed that these socio-demographic can influence food safety positively or negatively in the hospital environment. The hospital environment and management in the conceptual model eludes to various aspects that the hospital management system can use to influence food safety either positively or negatively these include; availability of adequate working environment, hospital sanitary conditions, food safety manuals, appropriate facilities to the food handlers, incentives, constructive policies among other factors. The model also eludes to the fact that food safety education or interventions in form of refresher courses, seminars, on the job demonstrations, protocols among others help improve food handlers attitudes, skill, behavior and practice through learning experience to achieve effective performance in safe handling of food. All these factors in general can operate singly and/or collectively to influence the food safety aspects in hospitals. The food safety situation in hospitals equally determine the extent to which food borne nosocomial infections occur in a hospital environment.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

In this chapter a literature review relating to food safety and key factors that have direct impact on food hygiene and safety are explored, Additionally, food safety systems in Kenya; causes of foodborne nosocomial infections in the hospitals; the impact of knowledge on food safety; the role of HACCP in food safety and the role of food safety culture in the organizations are covered. These are broadly covered under the following subheadings; Types of food contaminants, epidemiology of foodborne diseases, foodborne diseases in Kenya, food safety systems in Kenya, factors underlying foodborne diseases in hospitals, food safety knowledge Vs food safety, hazard analysis and critical control points (HACCP) and food safety culture.

2.1 Definition and Scope of Food Safety

Food is vital for life but can only serve such an important purpose if it is safe and secure to ingest. Food can be defined as “edible substances whether in natural or manufactured state which, from a public health perspective form part of the human diet (Will and Guenther, 2007) Understanding the necessity of access to healthy and nutritionally sound foods is important for all.

“Food safety” is a broader term, which means an assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. This can be achieved through the utilization of various resources and strategies to ensure that all types of foods are properly stored, prepared, and preserved so that they are safe for consumption (WHO, 2000). Practicing this level of food sanitation begins with the purchase or acquisition of different food items and ends with the proper storage of leftovers for future use. One of the most important aspects of practicing food safety involves preventing foods from becoming contaminated. Making sure foods are stored properly goes a long way in avoiding any type of food contamination. Basic kitchen sanitation guidelines are an important component of any food safety strategy (Jevs'nik *et al.*, 2006a). Food elaborated with satisfactory hygienic standards is one of the essential conditions for promoting and preserving health, and inadequate control is one of the

factors responsible for the occurrence of foodborne disease outbreaks (Oliveira *et al.*, 2003).

Inadequate food safety is a significant contributor to the burden of disease in developing countries including Kenya, and should be addressed as the food system develops and along with related investments in public health. The heavy burden of foodborne diseases imposes substantial economic losses to individual, households, health systems and entire nations. Economic losses as a result of rejected food exports due to shortcomings in food safety are also often very significant (FAO/WHO, 2005a).

2.2 Types of Food Contaminants

Apart from objectionable materials, such as rust, dirt, hair machine parts, nails and bolts (physical contaminants), food contaminants fall into two broad categories; biological agents such as bacteria, viruses, moulds, antibiotics, parasites, and their toxins, which can cause a wide range of illnesses and chemicals such as lead cadmium, lead, mercury, nitrites and organic compounds which can have both acute and chronic health effects. Such contaminants can gain access to the food chain at any of a multitude of stages during growing, processing, preparation or storage. Microbiological sources stand out for posing a great risk to public health because of the severity of the clinical symptoms and the large number of foods and microorganisms that can be involved (Silva *et al.*, 2003).

Historically, pathogenic bacteria have been the most prevalent food safety hazard, with viral cases following closely behind according to a CDC report on the etiology of foodborne illness (CDC, 2004). Such pathogens cannot be detected organoleptically (seen, smelled or tasted) but can cause disease of varying severity, which may result in death. Generally, microbial sources account for upwards of 95% of all reported foodborne disease outbreaks (Marshall and Dickson, 1998). Surveys of microbial pathogens and toxins have been published in several useful compilations (CDC, 2002, Lynch *et al.*, 2006). Overall, most of the summaries agree in their conclusion that bacterial pathogens are responsible for the majority (>80%) of outbreaks cases. Members of the *Enterobacteriaceae*, particularly *Salmonella serovas*, *enteropathogenic E.coli* and

Shigella spp and members of the *Campylobacteraceae*, *Campylobacter jejuni* and *C.coli*, are responsible for the majority (>70%) of foodborne bacterial illnesses. Of secondary importance are toxicoinfections by *Clostridium perfringens* and *Bacillus cereus*, intoxications by *Staphylococcal* enterotoxin, *Bacillus cereus* and Botulinum neurotoxin, and infections by *Vibrio* spp., *Streptococcus* spp and *Listeria monocytogenes*.

Chemical food safety hazards vary widely, but the most common problems cited in the literature include contamination with pesticides, allergens, and natural toxins, including scrombotoxins found in fish and mycotoxins found in crops. Foreign objects, or physical safety hazards, are the least likely to affect large numbers of people and usually are easily recognized.

Foodborne disease is caused mainly by the oral ingestion of viable microorganisms (infection) or of the toxins they produce (intoxication) in sufficient amounts to develop pathology (Souza *et al.*, 2004). Health problems associated to food safety is an important cause of death in developing countries (WHO, 2007a, WHO, 2007b). The problems of food safety in the developed countries differ considerably from those of developing countries. Whereas, in developing countries traditional methods of processing and packaging, improper holding temperature, poor personal hygiene of food handlers are still observed during food marketing and technology (Mensah *et al.*, 2002).

2.3 Epidemiology of Foodborne Diseases

Foodborne disease has been defined by WHO as a disease of infectious or toxic nature caused by, or thought to be caused by, the consumption of food and water (WHO, 2008). However, food poisoning is used as synonymous for foodborne diseases or foodborne illness. They are regarded as acute illnesses associated with the recent ingestion of food, having normally a short incubation period and symptoms with gastrointestinal features. Typically, they are characterized by a combination of nausea, vomiting, stomach pains, abdominal cramps and diarrhea. However, in some cases, there are not restricted to the gastrointestinal tract so they may be a neurological and other symptoms connected with the alimentary as illustrated by viral hepatitis, tuberculosis, and haemolytic-uraemic syndrome caused by *Escherischia coli* O157 (Motarjemi and Kaferstein, 1997).

There is also growing evidence of the serious long-term health effects of foodborne hazards, including kidney failure, and disorders of the brain and nervous system (Mossel and Struijk, 1995). The dietary exposure of vulnerable groups to hazardous chemicals is of particular concern. Different groups vary in their intake of chemicals, and adequate risk assessments are needed for the most susceptible. Infants and children are at special risk.

The bacteria most commonly involved are *Salmonella ssp*, *Bacillus cereus*, *Staphylococcus aureus*, *Clostridium botulinum*, *Clostridium perfringens*, *Escherichia coli*, *Shigella ssp*, *Campylobacter ssp* and *Vibrio cholerae* (WHO, 2007a). The recognition of these pathogens has come about through collaborative efforts of scientists in a variety of disciplines including epidemiology, public health, microbiology, medicine and others. Surveillance and epidemiological analysis often initially provide evidence of causal relationship, and this can lead to isolation and characterization of the suspected etiological agent. However, some infectious agents such as many viruses and parasites as well as prions are difficult or impossible to culture, and diagnosis will depend on alternative methods of detection.

Further, all types of foodborne illness can be more serious in vulnerable groups, such as infants and children, and people who are elderly, sick, pregnant or immunocompromised. There is a rising number of people in the Kenya and other developing countries who are immunocompromised due to a wide range of risk factors. This means that susceptibility to foodborne illness is likely to increase and its consequences to become more severe.

Globally, the WHO has estimated that approximately 1.8 billion episodes of diarrhea and more than 3million deaths occur in children under 5years of age, and a significant proportion of these results from food contaminated by microbial pathogens and toxins (WHO, 2008). These estimates are probably 100 – 300 times less than the actual occurrence for a variety of reasons (Lund *et al.*, 2000). Mead *et al.*, (2000) discussed three important difficulties that have a major impact upon the accurate compilation of foodborne disease data, although his/her discussion focuses on the US situation, the difficulties would seem to be universally applicable. Firstly, food-related illness,

hospitalization, and death is under-reported because treatment may not be sought, diagnostic testing not done, or test results not forwarded for tabulation. Secondly, pathogens causing food-related illness may also be transmitted from one person to another or through other vehicles such as water. Thirdly, some foodborne illnesses may be caused by currently unrecognized pathogens, and hence not be attributed to food at all.

Surveillance and epidemiological analysis of foodborne disease are also limited by other several factors; Most bacterial foodborne illnesses involve sporadic cases and go unnoticed since they occur as isolated incidences that often are not diagnosed and reported to public health authorities, furthermore, chronic diseases associated with ingestion of bacterial pathogens or toxins are poorly recognized because of the long incubation time for the disease process to occur. Thus the reported number of foodborne illnesses reflects a large underestimation (100 to 300-fold) of the actual occurrences of the food-mediated illness in the human population.

About 50% of the health burden of malnutrition has been attributed to poor water, sanitation and hygiene, including food hygiene. In developing countries, foodborne diseases can cause or exacerbate malnutrition. Together foodborne diseases and malnutrition cause an estimated 12 to 13 million child deaths annually; survivors are often left with impaired physical and/or mental development (IAASTD, 2008). Wheeler *et al.* (1999) estimated that for every infectious intestinal disease (IID) case detected by national laboratory surveillance, of which foodborne disease is only a part, there are 136 in the community. Therefore, the actual incidence of foodborne illness throughout the world could be much higher than official statistics suggest.

The epidemiology of foodborne illness is changing. WHO (2002), reported that in a period of over 25 years [retrospectively], bacterial infections caused by *salmonella ssp* increased. They are considered emerging because they have recently become more common. Foodborne pathogens recently emerging include *Vibrio vulnificus*, *Cryptosporidium parvum* and *Cyclospora cayetanensis*. These pathogens have been either newly described or newly associated with foodborne transmission. New hazards

that could affect human health are continuously being identified (Nguz, 2007). Analysis shows an increase of viral infections in comparison with classical bacterial infections (Jevs'nik *et al.*, 2006b). It is also unknown in the absence of thorough surveillance if such changes in foodborne disease agents are occurring globally. Primary factors probably contributing to paradigm shifts in foodborne disease epidemiology are similar to changes in other infectious diseases.

The frequency of reported outbreaks of food poisoning incidents have risen substantially in most countries, and has become an important topic of concern among consumers and governments. Well publicized outbreaks of microbial and chemical food poisoning cases have been continuously increasing within the African region in recent years. While most of the outbreaks are localized, others have affected thousands and are broader in scope. Cholera traditionally associated with water has been shown to be largely foodborne. Some studies have demonstrated that foods play an even greater role than water in causing this infection; many foods support the growth of *V. cholerae* to disease causing levels and may protect the microorganism from gastric acidity (WHO, 2000). Cholera is endemic in many areas and eating leftover cooked foods/ and or rice meals are some of the reported vehicles of transmission within the African region.

Analyses of foodborne disease notifications throughout the world have shown that the majority of outbreaks result from malpractice during food preparation in small food businesses, canteens, residential homes, and other places where food is prepared for human consumption (Motarjemi and Mortimore, 2005). Therefore, a lack of adequate training and education of the food handlers within such premises could pose significant public health risks.

2.4 Foodborne Diseases in Kenya

Food safety is an issue that is drawing increasing concern in Kenya. Unfortunately, the current food safety system in Kenya faces increasing challenges due to ineffective enforcement of laws required to reduce the number of foodborne illnesses and the contradictions in food regulations and inspection procedures. Few studies have been carried in Kenya to estimate the health impact of foodborne diseases. The FAO/WHO

(2005), reports that disease outbreaks in Kenya have affected productivity, expenditure on health, while failure to meet food safety requirements of importing countries has attracted threats of banning the horticultural produce and fish exports.

In Kenya, 2004 reports by the Ministry of Health (MOH, 2006) showed that among the ten leading causes of outpatient visits to health institutions were all forms of diarrheal diseases and intestinal parasites which may be related to food directly or indirectly. However, health institutions that compile monthly morbidity statistics do not identify if the cause for such illnesses is due to food or other causes (FAO/WHO, 2005b). In addition, no systematic surveillance system is in place due to weak structural organization, underdeveloped human resource and insufficient resource allocated to food-borne surveillance. Occurrence of such diseases is rarely reported and exchange of information between regulatory bodies is virtually absent. As a result, the prevalence and magnitude of the problem inflicted by food-borne illnesses is not known (FAO/WHO, 2005).

Up to 70% of all episodes of diarrhoea may be attributed to ingestion of contaminated food and water. According the WHO/FAO, the most prevalent diseases in the year 2004 were typhoid, dysentery and gastroenteritis, which affected 643,151, 600,660, and 722,275 people respectively. Others include aflatoxin poisoning (323) and brucellosis, and cholera (68). Some of these are seasonal and require adequate planning for preventive response. For example, aflatoxin poisoning prevalence peaks during food shortages and rainy seasons preceded by drought conditions within specific regions, while typhoid peaks mainly during the rainy seasons. Additionally, available statistics are not well documented and processed for use in decision making. Investigations into causative factors and magnitudes of exposure to trigger their management are inadequate, and require strengthening. In order to develop strategies that will reduce such occurrences, health workers require improved knowledge in epidemiology in order to carry out investigations; send out an alert for response on a looming foodborne disease outbreak within the community where they work.

Infections due to *Salmonella typhii*, *Salmonella paratyphii*, *Shigella ssp* and *Vibrio cholerae* are under constant surveillance by the Ministry of Health as they pose a serious public health hazard resulting in high morbidity and mortality (FAO/WHO, 2005b). These diseases continue to be a problem with outbreaks being reported from various parts of the country. A number of other food poisoning agents have attracted little attention, although there are many newspaper reports of occurrence of foodborne illness or deaths resulting from consumption of contaminated foods such as maize. This indicates the presence of a public health hazard that deserves more attention.

There is a paucity of research to prove that there is lack of food safety in Kenya, especially among the food-based providers. However, most research proposes that there might be high levels of contamination among food consumed by the masses that may potentially pose a health risk (Githiri, *et al.*, 2009). It is apparent that this could be related to previous training received by the food producers, location of sale or production, price and handing methods, inter alia. There is thus a need for more information to be generated to provide a meaningful basis for relevant stakeholders to intervene to improve the safety of food.

2.5 Food Safety Systems in Kenya

Certain significant aspects of food items must satisfy all legal, customer and consumer requirements in order to achieve the required quality and safety standards. While food quality focuses on all product characteristics which influence food's value in the consumers' viewpoint, food safety comprises all the measures aimed at protecting human health. Food is said to be safe when there is sufficiently proved evidence that no harm on human health will emanate from its use. Unequivocal guidelines on food safety should be the nation's target to make food safety an achievable goal for every food product. This should be done in tandem with other health targets to achieve vision 2030.

2.5.1 Ministries and Agencies Responsible for Food safety in Kenya

In a broad perspective, a food safety action plan draws the line for the minimum expected standards and the overall objectives of the food safety system of a country (Nguz, 2007). It identifies the approach the nation uses and the goals/targets the system aims to achieve.

In Kenya, the nationwide food quality and safety systems are legally controlled by various government agencies under different ministries (FAO/WHO, 2005). Food safety regulation agencies work under the Ministries of Trade, Industrialization, Public Health and Sanitation, Livestock, Fisheries and Agriculture. Such agencies include the Kenya Bureau of Standards (KEBS), Kenya Agricultural Research Institute, Department of Public Health (DPH), and Kenya Plant Health Inspectorate Services (KEPHIS) among others (Mwangi *et al.*, 2004). These agencies aim to disseminate information on the code of hygiene and safe agricultural practices by various stakeholders in the food chains from the producers to the consumers. This is followed by supervision of implementation of the mentioned practices. Their chief objective is to promote public health, guard the consumers against health dangers and stimulate fiscal progress of the country (FAO/WHO, 2005).

2.5.2 Food Safety Laws in Kenya

Kenya is deficient of a distinct and published policy for food safety. However, separate laws have been put in place to safeguard the consumers. The primary food safety laws are the Food, Drugs and Chemical Substances Act, Chapter 254; The Public Health Act, Chapter 242 and The Meat Control Act, Cap 356 (GOK., 2007b). The law mandates the minister for Public Health and Sanitation to orchestrate all the activities by the various agencies concerned in food safety management through the Department of Public Health (DPH). Moreover, the minister is mandated to form boards to manage enforcement of the basic laws for safety of food. This is targeted towards minimization of replication of responsibilities and possible omission of obligations in the enforcement of food laws by the various implementing agencies (Nguz, 2007).

Each agency performs its duties with reference to its mandate as stipulated in the law (GOK., 2007a). Some agencies execute the task of regulation as in the case of the ministry of Health and Ministry of Agriculture. Other specified roles of the agencies include: training and advisory services on production of fish, crops and animals; provision of certification audits on food safety for particular products upon demand; laboratory analysis; development of standards; inspection of safety of agricultural inputs;

inspection and surveillance during movement and storage food items; and coordination of food safety management systems (FAO/WHO, 2005).

The Public Health Act Chapter 242 gives authority to the local government to put in force food safety and environmental sanitation guidelines (GOK., 2007b). Proper implementation of food safety laws is vital to reduce the outbreak of food-borne diseases and hence minimize the pressure on healthcare providers (FAO/WHO, 2005). Moreover, it enhances economic growth and food security by promoting tourism and foreign trade. There is a very strong link between the health of a nation and its economic progress (FAO/WHO, 2005).

2.5.3 Food Safety Standards in Kenya

According to Will and Guenther (2007), food standards are categorized as mandatory or voluntary. In Kenya, mandatory standards for food and agricultural goods have been developed by technical teams whose administrative departments are at the KEBS (KEBS, 2005). Food standards dictate the guidelines for constituent requirements of food products, microbial regulation, the acceptable amounts of contaminants, packaging and labeling and hygienic requirements for manufactured products. The standards applied in Kenya are taken up from the International Organization of Standards (ISO) and the Codex *Alimentarius* Commission – Codex (CAC), using the basic guidelines of the Technical Barriers to Trade (TBT), Sanitary and Phytosanitary Standards (SPS) and the World Trade Organization (WTO) (Frohberg *et al.*, 2006).

Voluntary standards are set up through recognized harmonized procedures by significant stakeholders in the supply chain such as business associations. These standards may not be compulsory according to the law; however, some have become like obligatory requirements (Will and Guenther, 2007). In preparation of national standards, precedence is given to pertinent codex and international standards as a foundation on which national standards may be adopted to suit the national food safety situation (FAO/WHO 1999).

2.5.4 Human Resource in Food Industry

The FAO/WHO (2005) also reports that human resource capacity is inadequate in terms of knowledge in food safety management tools such as HACCP and Risk Analysis among food inspectors and food safety managers in micro, small, and some medium scale enterprises. Despite the availability of food standards and regulations that make reference to the Codex texts, their implementation and enforcement is not coordinated and reference is made to internationally recommended practices, but do not make reference to local standards.

In many countries in the developing world including Kenya, the personnel handling food is not proficient and hence the standards set are not strictly followed (World Bank, 2005). The human resource involved in inspection and food management is limited in the knowledge of key food safety management tools such as the HACCP and science based risk assessment (Tompkins, 2001). Oloo found out that there is common misplacement of human resource in the food industry in Kenya despite having trained food technologists (Oloo, 2010).

Food inspection involving visual inspection and random sampling for laboratory analysis is supposed to be done by agencies such as KEBS and DPH at various critical points in the food chains (GAIN, 2005). Unsafe food is supposed to be confiscated and destroyed together with closure of unhygienic premises and prosecution of the accused parties. However in many instances, inspection actions are directed to the end products and not the processes involved; and often in response to an identified case(s), or food borne outbreaks and alarm raised about specific products in the market (Jongen, 2002). Furthermore, frail enforcement efforts by the agencies, low penalties and widespread corruption have hampered the inspection process.

The existing laboratory services used by the regulatory agencies are limited in time and scope (Wangalachi and Oiye, 2010). To cater for the gap, the agencies have entered into collaboration with research institutes such as Kenya Agricultural Research Institute and International Livestock Research Institute (ILRI) to cover food safety issues that are not satisfactorily handled (FAO/WHO, 2005).

2.5.5 Challenges in Foodborne Disease Statistics

The scope of burden and costs emanating from unsafe food remains unknown in Kenya (WHO, 2008). Statistics available in Kenya on food borne diseases is poorly analyzed and skimpy in documentation (Oloo, 2010). Moreover, there is no separate documentation in records of disease burden making it intricate to segregate the intensity of food borne diseases from other diseases. However, food borne diseases continue to burden our nation. About 7 out of every 10 cases of diarrhea result from consumption of contaminated water and food (WHO, 2008). Approximately 75% of the urban dweller's diet is processed food while among the rural dwellers it constitutes to about 25% (FAO/WHO, 2006). These are subject to contamination and may consequently result to diarrheal infections if poor manufacturing and distribution practices are applied. The matter worsens when the inspection process is skipped or hardly carried out.

Food vending by small and medium sized enterprises is a common practice along the food chain. This informal segment in the food industry contributes to about 80% of the food products supplies in the market (WHO/AFRO, 2007). This is usually done under very limited hygiene standards (Mwangi *et al.*, 2000). Food poisoning due to poor agricultural and distribution practices along the food chain has resulted to an increase in the morbidity and mortality rates in the country. For instance, in 2004, there were 317 reported cases of aflatoxin poisoning in Eastern Province with around 125 cases of death. Surprisingly, maize sampled from the involved regions had concentrations of aflatoxin that were 220 times more than the permissible levels (Azziz-Baumgartner *et al.*, 2005). Consumption of animal products infected with zoonotic diseases such as Rift-valley Fever in the recent past has also raised Public Health concerns over food safety in many regions of the country. This is an obvious indication of the flaws as evidenced by food safety control agencies in the country. This also puts on glance the negligible efforts in coordination of the various agencies involved maintaining food safety along the food chain (Nguz, 2007).

2.5.6 Role of Stakeholders in Food Supply Chains

The various stakeholders in the food supply chain should apply good practices at each Critical Control Point to contribute to ultimate food safety and quality. Such stakeholders

include: farmers who should apply proper practices in agricultural production (Jaffee and Masakure, 2005); sellers at the local and global level who should use appropriate distribution practices (Gebrehiwet et al., 2007, UNCTAD, 2007, Mausch *et al.*, 2006) and manufacturers who should be concerned with food safety during the entire manufacturing process (Abila, 2003a, KAM, 2007). However, the situation in Kenya has been characterized by food-borne disease outbreaks and food insecurity (Nelson, 2005).

Inability to meet food safety requirements of the EU consequently led to threats of forbidding horticultural produce (2002) and fish exports in the year 1998 and 1999 from Kenya (Abila, 2003b). Application of Hazard Analysis and Critical Control Points (HACCP) tool is a key challenge due to prevalence of informal food markets (Mwangi *et al.*, 2000). Food handlers and the consumers are not informed; many are ignorant of the most rudimentary hygiene practices. Thus the chain supporters have revealed inadequate capacity to ensure food safety independently without stringent supervision (Nguz, 2007).

In the chain of supply, the legal framework working through agencies aforementioned has a significant role in regulation (Wangalachi and Oiye, 2010). Research and training institutions too have an enabling role in capacity building and providing the necessary prerequisites for conducting research (Ojijo, 2010). Training of human resource in the field of food science and technology is done at different levels (NCST, 2009); however, the output is insufficient in the market. All over the world, research is central to evidence-based policy formulation whereby universities and research institutions are the leaders. However, in Kenya insignificant work has been done in research as evidenced by scanty statistics concerning food safety situation in the country (FAO/WHO, 2005).

Communication among the various stakeholders in the food industry is low (FAO/WHO, 2005). Presently, communication is limited to regulator, producer and processors. This implies that the consumers have been left out in the communication cycle (NCST, 2009). There seems to be effective communication in the export supply chain e.g. in the horticultural industry (FPEAK, 2007). Such efficiency echelons should be the target of food safety communication among all the stakeholders within the country.

2.5.7 Consumers in Kenya

Other imperative stakeholders who participate in the chain of supply of food products are the consumers (Lasztity *et al.*, 2004). They have the right to decide on the products they purchase other than storing, preparing and discarding the products' wastes (Will and Guenther, 2007). Although there exists many consumer organizations in Kenya, there is evidence that several consumers are not informed on their rights. Scores of consumers do not check the KEBS 'diamond mark' on products to ascertain whether quality and safety is certified (NCST, 2009). Food insecurity coupled with poverty worsens the food safety scenario. This prevents useful participation of the consumers in ensuring food safety along the chain.

There are definite laws that streamline the stakeholders in the food chain in Kenya with specified agencies to supervise their enforcement. Food safety being a key health issue should be regarded more critically by all the stakeholders involved. The informal sector is the main supplier of food products in the country. This sector has a shortage of trained food handlers, equipment and regulatory services to enhance hygienic conditions for food safety. There is need for coordination among all stakeholders in the food safety management system. Technical institutions and universities should continuously participate in and research and capacity building in the field of food science.

Partnership should be scaled up in training and research activities among all the food safety agencies and stakeholders. There is a need for increased enforcement of regulations and involvement of the government, preventive measures via public health initiatives, and personal responsibility, to create the much needed change.

2.6 Factors Underlying Foodborne Diseases in Hospitals

Food service establishments (FSE) such as restaurants, hotels, bars, and hospital kitchens and cafeterias are considered an important source of foodborne outbreaks as studied in various European countries (Effler *et al.*, 1999, Hughes *et al.*, 2007, Olsen *et al.*, 2001). There are several studies that have discussed that the main causes of microbial contamination typically occurring in foodservice establishments are contaminated supplies, dirty food contact surfaces, poor personnel hygiene practices, inappropriate

storage temperatures, and insufficient cooking (Griffith *et al.*, 2010, Jones *et al.*, 2008, Kaferstein, 2006, WHO, 2007b)

More in detail, various studies have demonstrated that the main sources of cross contamination during processing come from food contact surfaces, equipment and food handlers (Aarnisalo *et al.*, 2006, Bagge-Ravn *et al.*, 2003, Cools *et al.*, 2005, Fuster-Valls *et al.*, 2008, McEvoy *et al.*, 2004, Tsalo *et al.*, 2007). Equipment and surfaces can be source of direct contamination when they have not been effectively cleaned or remained wet between cleaning and use (Evans *et al.*, 2004). Food handlers have a major role in the prevention of foodborne diseases since they may cross contaminate raw and ready-to-eat food, and be asymptomatic carriers of food poisoning microorganisms (Walker *et al.*, 2003).

2.6.1 Causes of Foodborne Nosocomial Infections

Patients require a balanced, nutritious diet and safe food to facilitate healing as a component of hospital treatment (Stratton *et al.*, 2006). However, the hospital environment and meals may be the source of additional infections. Patients who have been hospitalized are more susceptible to foodborne infections and experience more severe consequences than healthy persons (WHO, 2002). Among the immunocompromised patients, unsafe food has an immense possibility of causing nosocomial infections and therefore the hospital management has to ensure that there are checks to minimize pathogen exposure (French, 2001). It is the responsibility of the hospital food service supervisors to ensure the food they prepare and serve meets the acceptable standards in terms of nutritional quality, temperature and safety. Moreover, the food should be microbiologically safe.

Microbes that cause food borne diseases outside the hospital setting are also implicated in the causal of food borne nosocomial diseases (Githiri *et al.*, 2009b). The list of such microbial agents is extensive; but few examples include bacteria (e.g. *Escherichia coli*, *Salmonella* species, *Staphylococcus aureus*, *Clostridium perfringens*, *Clostridium botulinum* and *Vibrio cholerae* among others), viruses (e.g. Rotavirus and Calisiviruses),

fungi and parasites such as *Giardia lamblia* and *Entamoeba histolytica* (WHO, 2002). Practically, any microbe has the potential to cause an opportunistic disease in a person whose immunity has been compromised from a previous infection.

There has always been a complexity issue of food handling especially in mass hospital catering hence the possibility of food contamination. Religious, vegetarian and other kinds of special diets must be put into consideration and provided. Certain attributes of food such as safe temperature and texture must be maintained after cooking and before serving. This in turn demands for a flexible service since patients have variable meal times. Evidence from investigations proves that many foodborne outbreaks culminate from inappropriate food handling practices (Jones and Angulo, 2006) along the particular food service system applied by the facility.

The occurrence of foodborne nosocomial diseases in hospitals is on the rise. There have been numerous reported outbreaks in medical facilities that are attributable to poor food handling practices (El Derea *et al.*, 2008). An epidemic of *Clostridium Perfringens* foodborne infection affecting two wards in the United Kingdom was caused by contaminated pork not properly chilled (Regan *et al.*, 1995); a nosocomial, food borne outbreak of *Salmonella enteric serovar enteridis* exploded at a university hospital in Greece in 2005 (Gikas, 2007); *E. coli* food poisoning was among the numerous foodborne nosocomial disease outbreaks in the records of Oregon Public health division caused by unsafe food handling practices (Lynch *et al.*, 2006) and in several countries of the world, staphylococcus is among the chief etiological causes of food poisoning (Atanassova *et al.*, 2001).

2.6.2 Poor Personal Hygiene of Food Handlers

Food safety is dependent upon the significant roles played by food handlers along the food service system. Food handlers may introduce pathogenic microbes to the food during the process of preparation, distribution and serving (Green *et al.*, 2007). This is through inoculation of the food with infected excreta, pus, exhalations and other body discharges. Hence in such instances food handlers are the source of contamination and

eventual health consequences (Kaferstein, 2003). Research findings from the food industry suggest that hands may play the role of a vehicle in the transmission of enteric pathogens. Food handlers with poor personal hygiene (i.e. no hand washing) especially after visiting the restrooms pose the risk of carrying high loads of microbes such as *E. coli* and *S. aureus* on their hands (Shojoei *et al.*, 2006).

Staphylococcus and *E. coli* pathogenic microbes have been linked with foodborne morbidity and even mortality in many world populations each year (Borch and Arinda, 2002). Workers may also carry the microbial pathogens on their skin, hair, digestive systems or respiratory tracts. These pathogens are associated with poor personal hygiene practices. Deficiency of knowledge among food handlers/consumers and negligence are contributing factors to unhygienic practices (WHO, 2002). However, other studies have shown that improved knowledge of food hygiene practices does not always result to the required transformation in food handling behavior (Howes *et al.*, 1996a). The findings of a research done at Kenyatta National Hospital in Kenya elucidate on a case study of food handlers who scored highly in a questionnaire on hygiene practices whereas each contaminated a sample of food he/she had handled (Githiri *et al.*, 2009).

Safe hygienic practice among food handlers in hospitals is an outcome of their intrinsic knowledge and attitudes on food safety. Experience from developed countries has depicted that prevention of foodborne nosocomial diseases may be successful with the combined strategies in enforcement of educational and regulatory measures. Educational measures facilitate on capacity building and therefore raise the knowledge base of the food handler; while regulatory measures may impact the workers' attitude (El Derea *et al.*, 2008).

Food handlers should maintain a high level of personal cleanliness and wear suitable protective clothing, head gear and footwear. People involved in food handling should refrain from smoking, spitting, chewing and sneezing or coughing over unprotected food. Personal effects like jewellery, pins and other adornments should not be brought into food handling areas. A food handler implicated to be a carrier of a disease illness should

neither be allowed to go into food handling areas or handle food. Food handlers should undergo full medical examinations and issued with a certificate before allowed to handle food. Food hygiene training is basically significant to equip the handlers with the knowledge and skills to handle food safely. Regular appraisals of the effectiveness of training and instruction activities should be made together with periodic supervision to enforce adherence to hygienic procedures (WHO, 2001).

2.6.3 Contaminated Equipment and Utensils

The source of an infecting organisms on food may be endogenous (i.e. the source is the patient's own flora) or exogenous (Jarvis, 2004). In exogenous contamination, the source of food contamination includes the hospital staff or the inanimate environment within the hospital. Food may be contaminated by polluted water, insects e.g. flies, rodents and pets, unclean utensils, dust and dirt (Gudeta., 2007). Equipment and containers that come into contact with food should be designed to enable easy cleaning and disinfection. The materials used for making the equipment should not have a toxic effect on food. Adequate facilities should be made available for the different core functions in food handling. The working area within the production area should be maintained clean to prevent contamination. All sinks, dish washing machines and other equipment should be so constructed to be easily cleaned and to be kept in good repair (WHO, 2001).

Cross contamination is a very significant concept in food safety. Raw food, particularly meat, should be successfully separated, either physically or by time, from ready to eat and cooked foods, with transitional cleaning or disinfection where essential. Poorly cleaned utensils and equipment surfaces harbor and encourage the spread of pathogens. Equipment and utensils used in the hospitals (e.g. aluminum plates) need to be cleaned with warm water and detergent followed by disinfection (Brougham, 1998). Suitable cooking procedures and recommendations need be observed in order to prevent the growth of pathogens (WHO, 2002). Furthermore, if food is not chilled or frozen during storage; and heated to temperatures between 70 and 80⁰ before consumption, then there are high chances of growth and subsequent ingestion of pathogens.

Sufficient natural or artificial lighting should be enhanced to enable operations in a hygienic manner. Moreover, adequate means of natural or mechanical ventilation should also be provided. Ventilation systems are made in a way not to allow for air circulation from contaminated areas to clean areas (WHO, 2001).

2.6.4 Food from Unsafe Sources

One of the many malpractices which increase the risk of food borne nosocomial disease is the acquisition of food from unsafe sources. There are increased rates of importation of potentially contaminated food products from other countries (WHO, 2002). Vegetables may become contaminated with pathogenic microorganisms while still in the fields or during the process of harvesting or post harvest handling in food service enterprises (Beurchart, 1998). Use of bare hands and high storage temperatures raises the count of coliforms and staphylococcus in raw salads served in the hospitals. Results from a study in an institutional hospital in France evidenced that 10% of all salads served had total viable bacteria counts far beyond the acceptable limits (Prianka *et al.*, 2012).

During a food safety project's research period in a hospital in Egypt, fecal coliforms were identified in dairy products such as pasteurized milk (El Derea *et al.*, 2008). This emphasizes on the significance of identifying the origin of a product in order to avoid future acquisition from the supplier(s) whose food items are proved unsafe. Measurement of fecal coliforms and other microbe counts on all food items such as meat, chicken and eggs, dairy products and vegetables is a viable step in prevention of foodborne nosocomial infections (WHO, 2001).

Water as a resource has several different uses in the hospitals. The hospital should ensure that the water supply systems provide safe water for use in the hospital. Water for drinking should be potable for intake. Where safe potable water is not available, it should be made safe through boiling or various purification mechanisms. It should meet the recommended guidelines for drinking water quality. The raised storage tanks should be cleaned on a regular basis. Water should be sampled from time to time for laboratory analysis to check for fecal and pathogen contamination (WHO, 2002).

Key HACCP principles should be applied to enhance food safety from the source to serving point. The hospital management team should list all the possible hazards at each step, carry out hazard analysis and consider possible measures to mitigate the identified hazards (WHO, 2001).

2.6.5 Improper Holding Temperature

Insufficient food temperature control is one of the most frequent causes of foodborne nosocomial diseases in hospitals. A wider variety of foods may be prepared to cater for the different nutritional needs of the patients which raise the risk of mishandling and temperature abuse (WHO, 2001). In hospital mass catering, many patients need to be fed in a short space of time and food may be prepared hours before it is served. Food may be held under refrigeration, in hot holding equipment or even at ambient temperature for short periods.

All refrigerators should be made in way that allows unproblematic cleaning. Enough shelves and units should be provided to avoid piling and to allow for adequate ventilation and clean-up. There are internationally recommended temperatures for storage of various perishable goods (CAC, 1999). Foods held hot are placed put in a hot-holding container which is at temperature of at least 62.8°C (145°F) and sustained at that temperature until use. The entire list of perishable foodstuff or drinks is chilled at or below 4°C (40°F) except during preparation or when held for instantaneous serving after preparation. Chilling at 4°C (40°F) is also acceptable when food is stored for a longer period. Meat and fish is preserved at 0-3°C (32-37°F), milk and milk products at 4°C (40°F) and fruits and vegetables in cold rooms at 7-10°C (45-50°F). Frozen foods are maintained at a temperature below -12°C (10°F).

Salmonellae and other pathogens may thrive in undercooked and inadequately thawed meat products. Thawing of meat and poultry products is significant to ensure the food is safe from pathogens after reheating. After refrigerated cooked food has been thawed, it should be reheated to temperatures above 80°C and maintained there before being served

to the patients. Careful handling is paramount during storage to prevent transfer of pathogens from one food item to another. All the food handlers should be trained in proper handling practices during food storage. Moreover, they should be able to check the temperature recording devices at regular intervals and carry out tests of precision of the equipment (WHO, 2001).

Food handlers working in the hospitals have been identified to be important agents for contamination and therefore a significant means in the spread of foodborne nosocomial diseases. Their role is enhanced when they lack the right knowledge and attitude resulting to practice of unhygienic behaviors. The spread of nosocomial infections further increases when hospital management makes purchases of food items already contaminated with pathogens or chemicals. Contaminated equipment and unsanitary working environments exacerbates the situation. Finally poor storage techniques and preparation procedures further advances the risk of spread to even higher levels.

2.7 Food Safety Knowledge

Food safety courses are administered worldwide as a means to inform food service workers on matters of food safety. Furthermore, data suggest that the food service industries are more likely to hire workers trained in food safety (Hine *et al.*, 2003). The expectation in providing these courses is ultimately to reduce the incidence of foodborne illness (Kassa *et al.*, 2010). However, there are conflicting results in the literature. For instance, Hammond *et al.*, 2005 found that critical food violations actually increased after training. Furthermore, Ehiri *et al.* (1997) suggest that there are no significant improvements after training on a number of critical concepts in food safety such as, food storage, cross-contamination, temperature control, and high risk foods. The authors further identify problems in training regimes that tend to rely merely on dissemination of information with no practical reinforcement. Powell *et al.*, (1997) determined that there was no relationship between the level of knowledge of staff and hygiene standards in restaurants. Cates *et al.* (2009), however, suggest that the presence of a certified kitchen manager is protective for the majority of critical food violations, and therefore employing and properly training such a manager is essential to ensuring a safe food product. Kneller

and Bierma (1990); Cook and Casey (1979); and Mathias *et al.*, (1995) found that health inspection scores increased after food safety training, thereby implying the knowledge imparted from food safety training is sufficient in achieving higher inspection scores.

Knowledge regarding some of the key principles in preventing foodborne outbreaks, such as use of thermometers to verify safe internal food temperatures, is often overlooked and could potentially result in illness. For instance, Green *et al.* (2005) in their study of assessing food safety practices indicate that half of their respondents did not use a thermometer to properly ensure safe internal food temperatures. As such, this imposes a critical concern regarding food safety. Askarian *et al.* (2004) assessed knowledge, attitudes, and practices of food service staff on food hygiene in government and private hospitals. The study illustrated that staff comprehension, regarding pathogens that cause disease and the correct temperature for the storage of hot and cold foods, was limited. They further suggest that additional food safety courses and manuals be easily available for staff, however, the validity of such a comment has not been successfully proven (Askarian *et al.*, 2004). A similar study assessing food hygiene knowledge, attitudes, and practices in food businesses in Turkey revealed an immediate need for education and increasing awareness among food handlers on food safety practices (Bas *et al.*, 2006). Seven hundred and sixty-four food handlers participated in the study that used a multiple choice questionnaire survey to determine food safety knowledge. The questionnaire was sent out to the participants and followed up by a face-to-face interview. There were ten interviewers who were trained by the researchers to assess the accuracy of responses. However, it is important to note that interviewers' background was in nutrition and dietetics, not food safety. The study revealed a lack of knowledge among food handlers regarding critical temperatures of hot or cold ready-to-eat foods, refrigeration temperatures, and cross-contamination.

A study conducted by Angellilo (2000) and his associates examined foodservice staff in hospital environments. The results suggested a lack of knowledge regarding temperature of food storage of hot and cold foods, the identification of pathogens associated with foods, and common food vehicles that transmit pathogens (Angelillo *et al.*, 2000). The study recommends food safety training and implementation of a hazard analysis critical

control points (HACCP) system to reduce the likelihood of a foodborne illness in the hospital setting.

HACCP is a food safety management tool utilized worldwide in many small and large food service businesses. However, in a study conducted by Walker *et al.* (2003), lack of knowledge not only is a major contributor to the rise of illness but also a major obstacle to the implementation of safety programs, such as HACCP, geared toward decreasing such outbreaks. The authors evaluated food handlers' hygiene knowledge in small food businesses by way of a questionnaire survey to demonstrate that a lack of knowledge is a significant barrier to an effective HACCP program. Four hundred and forty-four food handlers from 104 small food businesses participated in the study. Results suggested poor understanding of food safety knowledge, in particular, temperature control, bacterial multiplication rates, and lack of knowledge regarding food poisoning. Fifty-seven per cent of participants thought that one could tell if food was contaminated with bacteria by sight, smell, and taste; 55% of 444 participants had received some sort of formal food safety training. The paper does not successfully distinguish between these two groups of participants in the study. Acquiring food safety knowledge is one component in attempting to reduce the likelihood of a foodborne illness. More important is the translation of knowledge into practice.

2.7.1 Translating Food Safety Knowledge into Practice

The provision of knowledge to change food safety attitudes and behaviors has not been adequately proven in the literature (Seaman and Eves, 2006). An effective food training course should not only provide food safety information, it should implement knowledge into practice for proper information retention. Campbell *et al.* (1998) suggests that implementation of a food safety training regime must target both managers and food service workers; furthermore the course must be active, such as a workshop. Food safety training courses are often administered via computer-based programs, classroom-based seminars, or hands-on training (Seaman and Eves, 2006). Little research has confirmed the effectiveness of hands-on training delivered in the work environment. Rennie (1994) suggests that training programs that are more closely associated with the work site with practical reinforcement of hygiene messages are more effective than traditional methods

of training. Practical in house, hands-on training tends to be the most favorable approach in relaying food safety messages (Hendry *et al.*, 1992).

Food safety training will lead to an improvement in food safety if the knowledge imparted reflects a positive change in behavior (Seaman and Eves, 2006). For instance, a manager of food service establishment in South Carolina that received food safety training was required to take an exam for evaluation purposes. Six months after passing the exam, an outbreak of salmonellosis, involving 135 confirmed cases and approximately 800 affected persons occurred in his establishment (Rennie, 1994). This suggests that the information was not translated into effective food safety practice thereby causing a substantial outbreak.

The majority of food safety courses rely solely on the dissemination of information with very little emphasis on practice which is ineffective (Egan *et al.*, 2007). They tend to adopt the Knowledge, Attitudes, and Practices (KAP) model which has substantial limitations (Griffith *et al.*, 2000). This model has become synonymous with health education and assumes an individual's behavior is dependent on their knowledge and the provision of information alone will lead to a direct change in attitude and thus behavior (Bas *et al.*, 2006). However, one such limitation to this model is that it assumes that people who are provided with food safety information will act upon the information gained (Ehiri *et al.*, 1997). Ehiri *et al.*, (1997) in their study of evaluating a food hygiene training course in Scotland noted that after the training, there was no significant improvement in course participants' pre-course knowledge of a number of crucial aspects of food safety, including food storage, cross contamination, temperature control, and high risk foods. This reflects poor training designs whose sole purpose is to comply with regulations and produce certified personnel. MacAuslan (2003) also suggests training in food safety relies too heavily upon attaining a certificate rather than paying attention to achieving competency in food hygiene practice (MacAuslan, 2003).

Behavioral changes in food safety will not occur as a result of training alone (Clayton *et al.*, 2002). Roberts *et al.* (2008) conducted an assessment of knowledge and behavior on three food safety practices in the work environment: cross contamination, personal hygiene, and time/temperature abuse (Roberts *et al.*, 2008). The study suggests food

safety training can have a significant impact on improving knowledge and behaviors of food operators; however, an increase in knowledge alone does not necessarily guarantee a change in behavior. Pre-and-post training observations were assessed by trained researchers during restaurant hours. Throughout the observations, researchers determined whether or not food related behaviors were performed correctly. A critical flaw in the study design was that behaviors were directly affected when monitored, otherwise known as the Hawthorne effect. The Hawthorne effect describes positive behavioral results in intervention studies due to the awareness of being directly monitored (Wickstrom and Bendix, 2000).

Kirby and Gardiner (1997) assessed the effectiveness of health education in changing food handler behavior in a case control study. A food safety course was administered by one central body with 20 food premises assessed before and after completion of the food safety training course (Kirby and Gardiner, 1997). A control group was studied concurrently. The study suggests that the food safety training course made little or no difference to the practices/behaviors in the kitchen. Pilling *et al.* (2008) evaluated the effectiveness of knowledge, behavioral antecedents, and behavioral compliance between two groups of food handlers in restaurants. The first group had all food handlers trained in food safety. Alternatively, the comparative group had only shift managers trained. Results suggested there was no difference in having either shift managers knowledgeable in food safety or having all food handlers trained. Observations in the study included hand washing, the use of a thermometer, proper handling of food, and work surfaces. It is important to note that training regimes for both groups may have differed significantly. One group may have had better food safety training than the other which may have affected the results. One food safety training model may have proven to be more effective than the other. Furthermore, direct monitoring from researchers will alter behaviors via the Hawthorne effect (Pilling *et al.*, 2008).

Chapman *et al.* (2010) evaluated the provision of information sheets, a communication tool, designed for food handlers to assess whether the info sheets had any bearing upon food safety behavioral practices. Info sheets are posters that contain food safety information built around stories. Info sheets were posted in visible locations throughout

the restaurant to assess food handler practices. Visual observations via video surveillance of 47 food handlers, pre-and post- observations, in eight food service establishments were analyzed. Results suggest that info sheets had a positive influence in behavioral change among food handlers. The videotaping may have decreased bias from the Hawthorne effect

2.8 Work-Site Barriers to Food Safety

To modify food safety behaviors, work-site barriers must be taken into consideration. Food safety research suggests that barriers in the work environment will impact employees' food safety attitudes and behaviors. Such barriers include a lack of technical resources, poor working conditions, high staff turnover, and lack of funds for training (Seamen and Eves, 2006). Food operators must overcome these barriers to achieve an environment that will reduce foodborne outbreaks. Furthermore, factors that play a significant role on employees' behaviors are directly correlated with organizational structure in the company, the level of job satisfaction, labor conditions, and relations between employees and their supervisors (Jevsnik *et al.*, 2008). Clayton *et al.* (2002) suggest barriers such as lack of time, lack of staff, and a lack of resources will ultimately affect food safety behaviors. In their study to determine food handlers' beliefs and self-reported practices, 95% of the food service staff had received some sort of formal food safety training, yet 63% admitted to not carrying out food safety behaviors. Food safety practices will only be implemented given adequate resources and the proper attitude of management. This is consistent with Seamen and Eves (2006) who suggest proper food handling and effective implementation of training programs depend highly on qualified, positive managers. In order to be effective, food hygiene training must target changing those behaviors most likely to result in foodborne illness (Egan *et al.*, 2007).

2.9 Hazard Analysis and Critical Control Points (HACCP)

HACCP is a structured and rational approach to the analysis and prevention of potential hazard points at every stage of food operation. It requires operators to enumerate and identify all steps in their activities that are critical to achieving food safety and to identify and evaluate safety measures. In hospitals, food hygiene requires attention to detail in relation to all preventive measures to minimize the hazards of food poisoning,

particularly given the presence of “consumers” (hospitalized patients at risk) who often are more vulnerable than healthy subjects.

Therefore, the HACCP program is an ideal, proactive approach to ensure food safety.

This

system identifies potential hazards before problems occur. It is applied to the food chain from purchase to consumption. It ensures the safety of food and nutrition products while creating a process for corrective action and continuous improvement rather than relying on spot checks of manufacturing processes and random sampling of finished products to ensure safety.

This program, first developed for the National Aeronautic and Space Administration food space program consists of seven main principles namely: 1) Identify hazards and assess their severity and risks; 2) Identify the Critical Control Points (CCP) in food preparation; 3) Establish critical limits for preventive measures associated with each identified CCP; 4) Establish procedures to monitor CCPs; 5) Establish the corrective action to be taken when monitoring shows that a critical control limit has been exceeded; 6) Establish effective record keeping system that document the HACCP system; and 7) Establish procedures to verify that the system is working HACCP principles have since become a widely used reference standard for safe food practices. Even though clear controversy exists on its use, HACCP guidelines can ensure that all sick patients in hospitals get the advantage of receiving safe food.

Table 2. 1: Principles of HACCP System (Codex Alimentarius, 1969)

Principle 1	Conduct a hazard analysis
Principle 2	Determine the critical control points
Principle 3	Establish critical limit (s)
Principle 4	Establish a system to monitor control of CCP
Principle 5	Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control
Principle 6	Establish procedures for verification to confirm that the HACCP system is working effectively
Principle 7	Establish documentation concerning all procedures and records appropriate to these principles and their application

HACCP system concentrates on prevention strategies on known hazards; it focuses on process control, and the steps within that, rather than structure and layout of premises (Worsfold and Griffith, 2003). HACCP establishes procedures whereby these hazards can be reduced or eliminated and requires documentation and verification of these control procedures (CAC, 1999). Local and international agencies are acting to encourage better public health protection against foodborne diseases. One of the principal actions has been the development of HACCP based regulations or by federal agencies and the United Nations Codex Alimentarius Commission (Sperber, 1998).

Food Hygiene Regulations in Kenya require that all food businesses (except primary producers) implement food safety management procedures based on HACCP principles. The principal objective of the new general and specific hygiene rules is to ensure a high level of consumer protection with regard to food safety (Regulation EC, 2004).

Various authors (Azanza and Zamora-Luna, 2005, Henroid and Sneed, 2004, Taylor, 2004, Taylor and Kane, 2005, Vela and Ferná'ndez, 2003) started to doubt about the efficiency of HACCP system, especially in small and medium sized enterprises (SMEs) and began to search for potential causes for potential failures and reduction of system efficiency. Meta-analysis of barriers during HACCP implementation has shown that among 21 elements, seven elements (training, human resources, planning, knowledge and competence, documentation, resources, management commitment) represent almost 50% (47.8%) of all identified barriers. Other studies have also identified lack of expertise, absence of legal requirements, financial constraints and attitudes (Ehiri and Morris, 1996, Taylor, 2001, Walker *et al.*, 2003).

The influence of each element on HACCP efficiency was ranked according to frequency of their citation in analyzed studies (Jevs'nik *et al.*, 2006a). Practical experience and a review of food safety literature performed by Taylor and Kane (2005) indicate that success in developing, installing, monitoring and verifying a successful HACCP system depends on overcoming a complex mix of managerial, organizational and technical hurdles. Even the largest and well equipped food companies with significant resources of

money, technical expertise and management skills face a difficult challenge; while the SMEs often feel that the difficulties of HACCP are potentially insurmountable (Taylor and Kane, 2005).

The fact that a person is and will be responsible for HACCP implementation and further control calls for an in-depth analysis and understanding of individual's reaction to received information (Jevs̃nik *et al.*, 2006). This can be approached from different perspectives as was indicated already in 2001 for complex behavioral barriers in food safety area (Taylor *et al.*, 2005).

Owners or managers are mostly not convinced that HACCP is either effective or practical for their businesses (Taylor, 2001); they also have insufficient knowledge of food safety requirements and mostly they are not competent to educate their employees. Wallace (2001) emphasized that it is important to consider the different levels of HACCP training needed for an organization. Selection of competent food safety educators seems to be the most important thing to achieve proper attitude of people and performance of technical solution required to implement HACCP. Clayton *et al.*, (2004) found that an increase in the knowledge of a food handler does not necessarily change their food handling behavior and it depends upon their attitude. These are some of the main reasons that foodborne diseases still occur despite the widespread use of HACCP approach.

2.10 Food Safety Culture

A relatively new emerging risk factor in the food industry is food safety culture (Griffith *et al.*, 2010). Griffith *et al.*, (2010) propose a definition of food safety culture as the aggregation of the prevailing, relatively constant, learned, shared attitudes, values and beliefs contributing to the hygiene behaviors used within a particular food handling environment. Further studies investigating and understanding the underlying attitudes and beliefs may help to discover why and how to make a positive and balanced food safety culture at all levels.

An organization's culture is ultimately its beliefs, attitudes and values that the employee is exposed to everyday (Griffith *et al.*, 2010). For example, if an employee observes a

manager continuously coming to work late, the employee may then think the lateness is an acceptable behavior in this particular work environment. In other words the workplace culture constitutes workplace practices that reflect the visible symbols that can be specific to a business culture and maybe subject to planned change (Hofstede, 1998). Investigating the culture of an establishment and understanding the beliefs and attitudes toward food safety may help understand why employees do not perform safe practices while working. Corrective measures can then take place to rectify and improve the workplace culture especially concerning food safety practices.

Yiannas (2009) states that organizations can choose to create a strong food safety culture. Leaders are accountable for instigating a strong food safety culture since they have the power and influence to create such an atmosphere. Practicing a positive food safety culture may have the potential to reduce the global burden of food borne illness. Creating a positive food safety culture can support this process by actually changing the thoughts, behaviors, and beliefs of individuals within a group (Yiannas, 2009). Therefore it appears that by investigating the beliefs and knowledge of food handlers in the hospital environments, specific factors which contribute to poor practices may be identified and may further suggest what management can implement in the workplace to help develop a more positive food safety culture.

2.11 Summary

Foodborne diseases caused by biological contaminants place a burden on the entire society. Food handlers, unhygienic kitchen environments, and poor policy reinforcement are amongst the underlying causes of foodborne diseases. One strategy to lower the burden of foodborne illnesses is to reduce the prevalence of foodborne pathogens through interventions along the food supply chain. There is an ongoing trend that food safety systems are moving towards performance-based regimes, which rely on the implementation of food safety standards. However, the implementation of food safety standards has not garnered much interest in the Kenyan policy environment. The assessment of food safety interventions to achieve a standard is challenging as the underlying processes are complex. Evaluating the effectiveness of food safety training courses has been researched and documented extensively with conflicting results. Studies

that assess knowledge and behavior of food service staff/managers have relied on survey questionnaires, either mailed or via telephone, to determine if a food safety course was beneficial. Furthermore, it is imperative that the knowledge acquired from such courses translates into positive behavioral changes. However, there is a need to effectively assess behavioral changes in the food industry as opposed to merely relying upon visual observations which affect food handler. There are limited studies evaluating the provision of food safety training. There is a need to assess and evaluate food safety training programs taking into consideration possible work environment barriers. Moreover, there is limited research to assess the implementation of a HACCP based program at the hospital environments. This thesis investigates the implementation of HACCP in the hospital environment, the perceived barriers to the implementation of food safety standards and the cost-effectiveness of food safety training interventions.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter will address the procedures and methodology used to examine the purpose of the study and to explore the objectives presented in chapter one. Section two (3.1) presents the design of the study. Section three (3.2) will present the variables of the study; Section four (3.3) describes the study area; Section five (3.4) will discuss subject selection and sampling methods, addressing the population chosen for study, and the procedures used for sampling hospitals involved in the study; Section six (3.5) will present the methods of data collection. Section seven (3.6) shows how the pilot study was done; section eight (3.7) will present the statistical analysis and qualitative methods used for data analysis and lastly section nine (3.8) covers the logistical and ethical considerations of the study.

3.1 Research Design

This study largely utilized a non-equivalent quasi-experimental study design. This design dictates the use of existing group of participants who receive a treatment and another existing group of participants to serve as a control or comparison group. Participants are not randomly assigned to conditions, but rather are assigned to the treatment or control conditions along with all the others in their existing group.

This study was multi-phased (see fig 3.1). A baseline survey was undertaken in both food handler and the hospital environment, and educational intervention was done, followed by a qualitative assessment of perceived barriers to food safety standards and a final evaluation of the intervention outcomes. A pre-test was done in form of a baseline survey of food handlers. The pretest provided the baseline information required and served as criteria to recruit the food handlers to be trained and to identify a control group. The pretest helped in describing and explaining the prevailing circumstances or conditions as perceived by the food handlers, obtain baseline information on the current level of adherence to food safety standards operating procedures and factors affecting adherence to food safety operating procedures. The findings of the baseline informed the

interventions/treatments to be designed and implemented. The standard requirements of food safety were measured against HACCP.

A control group and an intervention group of hospitals was used for the test of internal validity for the training effect. One group of hospitals was invited to participate voluntarily as the intervention group which received food safety training and other group was also be invited as the control group which was not given the training.

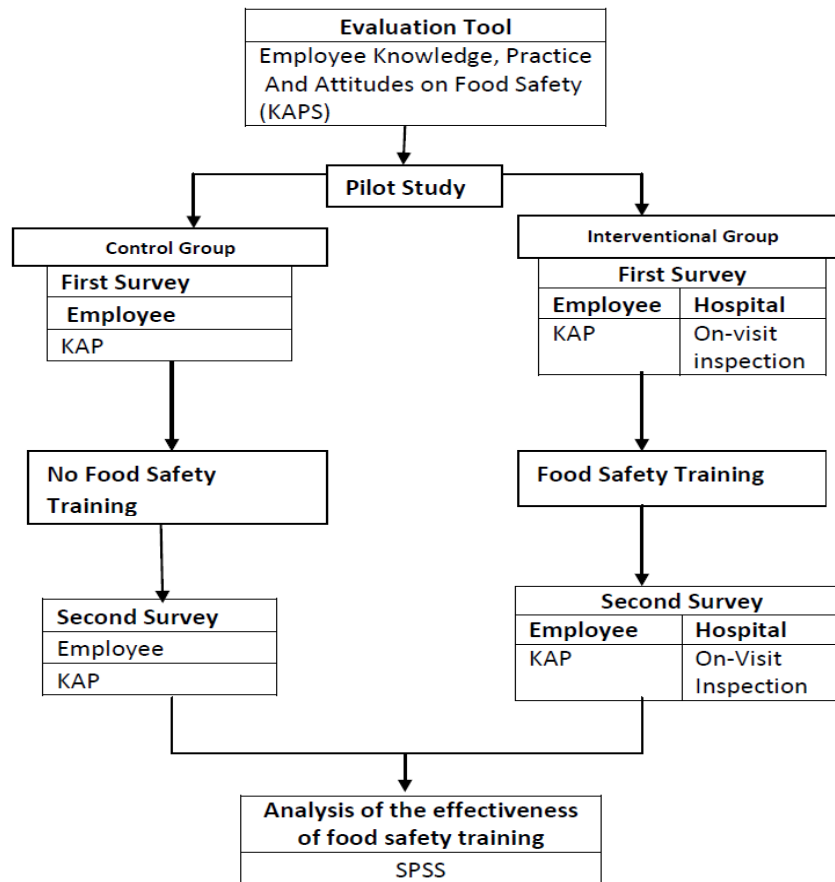


Fig 3.1: Study Procedures

Questionnaires for measuring the food handlers' food safety knowledge and safety practices were administered to the control and the intervention group before and after food safety training. Food safety performances of the hospitals were also evaluated by trained panelists through the on-site inspection (observation) with the food safety monitoring tool. The food handlers in the interventional group were provided with a

window within which to apply the knowledge and skills provided. After a period of three months, data collection using the initial protocol and tools was implemented to evaluate the impact of the intervention on the level of adherence to food safety standards operating procedures among the hospital food handlers.

3.1.1 Priori Concepts for Training Intervention

The training materials were constructed in accordance with WHO food handling protocols (WHO, 1994, WHO, 2001) and based on previous works that focus on personal and food hygiene such as “A Training Guide for Managers of Food Establishments” (Jacob, 1989) and HACCP guidelines. The training contents were finalized only after completion of the first phase baseline survey, so as to tailor the content to target common lacunae and deficiencies observed. The training curriculum (see appendix VI) was reviewed by experts from Foods and Dietetics Department of Kenyatta University in order to improve its adequacy. For effective training, a group of not more than twelve food handlers were trained at a time. The training methods involved lectures, demonstration, group discussions, and practical experiences. This was achieved by use of flip charts, posters, actual food handling and preparation for educating food handlers as advocated by the WHO (Jacob, 1989). Training was done within a period of one week and was done within the hospital facilities so that actual safe food handling techniques could be demonstrated at the hospital kitchens.

3.2 Independent and Dependent Variable

The independent variables in this study were the social demographic data of the food handlers, food safety education curriculum, and hospital environment. These independent variables were evaluated to measure how they influence the dependent variables, which are the participants’ food safety knowledge, attitudes and behavior and practice.

3.3 Study Area

This study was conducted in selected hospitals with in-patient facilities in Kenya. There are approximately 4,767 health care facilities in Kenya (hospitals, health centers and dispensaries) with 1175 with in-patient facilities. On average each of these hospitals can accommodate about 160 patients (MOH., 2005). This translates to an in-patient hospital capacity of approximately 200,000 patients countrywide. Largely bed occupancy in most

hospitals is beyond capacity on a normal day. This means that hospitals get overwhelmed with patient numbers which may also strain food and nutrition services and enhances nosocomial infections. It is also worth noting that the Population of Kenya is growing at an alarming rate yet health care infrastructure remains unexpanded. This means hospitals have to contend with an ever increasing patient population competing for limited services. Such growth in patient numbers is having an implication for the planners and local authorities in provision of necessary health facilities. Preliminary studies (Githiri *et al.*, 2009) indicate that a majority of the hospitals do not have hospital records on inspections related to food hygiene and food-borne illnesses. With the aforementioned facts, it was important that an assessment on adherence to food safety procedures was conducted in these hospitals with a view of developing sustainable mechanisms to address the identified gaps. The study targeted public, mission and private hospitals.

3.4 Target Population

This study targeted all hospital food handlers and supervisors in charge of the catering services in inpatient hospitals in Kenya. The study population was all the food handlers in selected inpatient hospitals together with catering supervisors who consented to the study. This sampling technique - convenient sampling was used to maximize the number of participants. Participants were purposively chosen so that they could be available for as long as three consecutive months.

Table 3.1: Number of Hospital & Food Handler Participants

Category	No	No of Food Handlers	No of Respondents
Mission	11	176	105
Private	5	132	63
Public/ Government	26	230	175
Total	42	538	343

In total 343 of the 538 identified food handlers participated in the study giving a response rate of 64%. From the 343 food handlers; One hundred and sixty two 162 (43.2%) from 22 hospitals were recruited for interventional group and the remaining 181 (52.7%) from 20 hospitals that were recruited as a control group.

3.4.1 Sampling Method for Hospitals

A multistage sampling strategy was used to select the participating hospitals. First a listing of all inpatient hospitals in the country was obtained from the MOPHS database. These were then stratified according to their indentifying categories e.g. Public, Mission and private. Then using a simple random sampling technique, a representative sample of hospitals was drawn from each category. In a selected hospital, all willing and available food handlers were involved in the study. This procedure maximized the information to be obtained from the participants. Forty two (42) hospitals participated in the study, 62% (26) were public government hospitals, 12% (5) were private hospitals and 26% (11) were mission hospitals as presented in table 3.1.

3.5 Data Collection Methods

Three categories of instruments were used in this study and these included; questionnaire, the focus group discussions and the observational checklist.

3.5.1 Questionnaire

In assessing knowledge, and practices of food handlers in the hospitals under study, two different types (for knowledge and practice) of questionnaires were used. The questionnaires were addressed to all staff potentially involved in food related functions in the hospitals. To overcome the difficulties arising from the habitual 8-hours shifts of the food handlers and minimize the non-respondent prevalence, the questionnaires were self-administered.

The knowledge questionnaire covered demographic characteristics, knowledge and practice on food hygiene (see appendix IV). A different questionnaire was also administered to the supervisors/administrators in charge of the food services in the hospital environment in order to establish the number of hospital beds, number of meals served in the hospital, sources of food to the hospital, hospital capacity, food hygiene practices and the service catering organization in the hospital (see appendix I).

The questionnaires consisted of 3 sections; the personal hygiene (4items), food hygiene (11items) and environmental hygiene (5items), it was set up with 5points for correct

answers and 0 points for wrong answers with the total possible score of 100points (see appendix IV).

Questionnaires used for evaluation of food safety practices was measured using a 5-point likert scale, from 1 point for very poor practice of food safety to 5 points for excellent in meeting food safety standards. Possible score for 25 questions was 125points which were given when answered correctly. The questionnaire consisted of three sections; personal hygiene, food hygiene and environmental hygiene (see appendix V).

3.5.2 Focus Group Discussions

In order to determine perceived barriers to compliance to standard food safety operating procedures among food handlers in the hospital environment, focus group discussion (FGDs) were used. Focus groups have been particularly effective in providing information about why people think, feel or behave, and group interaction provides more insight into why certain opinions are held (Lobdell *et al.*, 2005, Redmond and Griffith, 2003). In addition, this method allows the collection of descriptive data via direct and interactive contact of the researcher with the object {in this case food handlers} of the study, obtaining information where the meaning of something or of a situation is the essential topic of interest. The impetus for using a focus group design in this study was the desire not only to involve food workers in safer food safety practices and but also to start a collaborative action to formulate solutions.

Nine focus group discussions in groups of 6 - 8 were conducted. Participants in the focus group discussions comprised of two groups; control (group A) and interventional (group B) who were randomly selected from those willing to participate. Group A was composed of food handlers who had not received a food safety training prior to the focus groups. Group B included food handlers who participated in focus group discussions immediately following food safety training. The purpose of group A of focus groups was to identify the most obvious barriers to implementing food safety practices. The purpose of Group B of focus groups was to examine more subtle barriers that could be identified by trained participants who had access to the more obvious barriers discussed with the Group A participants.

The subjects within focus groups were homogenized with respect to their social roles and categories. This homogeneity allowed each participant's interaction and discussion of their opinions together with the views and perspectives of the other participants. Prior to the focus groups, participants were given a questionnaire to complete, which contained the questions asked during the discussions (see appendix III). The questionnaire gave employees the opportunity to think about their answers and was intended to improve the quality of data obtained.

A focus group guide provided the framework for discussion, allowing a focus on any aspects considered to be relevant. Sessions were held in both Swahili, English and other local languages, and questions were unstructured, so as to illicit interaction and create an environment such that participants felt they were merely engaging in conversation about the topics provided. Focus group sessions centered on the following dimensions: health beliefs, knowledge, attitude, learning, self-efficacy, and job environmental barriers. These dimensions were chosen in order to identify the current knowledge the participants may have regarding food safety and sanitation. Each FGD session lasted 45 minutes on average and was undertaken within the hospital environments (board rooms) and all sessions were audio-recorded to ensure accuracy of the data.

3.5.3 Observational Checklist

In assessing the extent to which hospitals in Kenya conform to food safety standard operating procedures, kitchen conditions were evaluated using a customized scoring scheme based on *Codex Alimentarius* general principles of food Hygiene, as observed by the researcher at the time of visit (see appendix II). All 42 hospitals studied had their own kitchens. These kitchens were evaluated on the status and maintenance of the premises, these include; walls, floors, ceilings, ventilation, lighting, vector and rodent control, sanitary conditions of kitchen equipment, personal hygiene of food handlers, water supply, waste management and refrigeration facilities.

One of the great limitations of an observation is that food handlers may change their behavior from the natural, unobserved behavior while under observation. Nevertheless, efforts were made to minimize the influence of observation by using a known trained

hospital worker (public health officer) as an observer as the food handlers would already be accustomed to this observer.

3.6 Pilot study

It is essential that the instrument be carefully designed and tested before use in a given study. Pretesting procedures help to ascertain that the instrument for collecting data is free from any pitfalls and mistakes that would have surfaced in the main data collection process if the pretesting of the instrument had not been done. Pretesting was done to help point out any flaws or errors that might be committed during the construction of the instrument. The findings of the pretest study were used to revise and refine the instrument questions to enhance the reliability and validity of the final instrument in this study. The questionnaire was pre-tested on a simple random sample in non participating hospitals (one from each category) to ensure clarity of interpretation.

3.7 Data analysis

Both qualitative and quantitative analysis techniques were used in this study to complement each other.

3.7.1 Quantitative

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS Version 12). The average and the standard deviation were calculated as the food general hygiene management performance. For the evaluation of food handlers' pre/post food safety knowledge attitudes and practices, the average and the standard deviation were calculated, and paired t-tests with a cut-off point $P < 0.05$ statistical level of significance were carried out for testing levels of significance. Pearson correlation tests was done to identify the correlation among food handlers' food safety knowledge, behavior and on-visit inspection scores was used to determine the relationship between variables, whereas, multivariate analysis was performed to examine if there are any significant relationships between demographics, training, knowledge, food safety and microbial knowledge, cooking practices and food safety practices.

3.7.2 Qualitative Data Analysis

Qualitative data collected from FGDs was analyzed by thematic content analysis. This is a research tool used to determine the presence of certain words or concepts within texts or sets of texts. Six hours of recording were integrally and literally transcribed into verbatim transcripts which generated 112 pages that were analyzed using NVivo 9 – QSR International software to identify patterns and themes for thematic content analysis. The transcriptions were coded, into manageable categories (words or themes with similar meanings or connotations) of a variety of themes focusing on and coding for specific words patterns that were indicative of the research question. Repetitions, filler words and hesitations were eliminated in the reporting, as they did not add value to the context. Nonetheless, new patterns and themes identified from the data were added; thus the analysis was both deductive and indicative.

3.8 Logistical and Ethical Considerations

The research permit was obtained from the ministry of higher education (see Appendix VII) and the ministry of public health and sanitation authorizing data collection from hospitals. Hospital administrators were contacted for permission to conduct the study in their hospital settings. There were also visits to the hospital prior to the commencement of the study in order to familiarize with the study environment.

The participants (administrators and food handlers in the hospital) were asked to participate in the study voluntarily by seeking verbal consent. Confidentiality was guaranteed by not indicating participant names in data collection tool and in FGDs. If the respondents preferred not to participate in the study, they were assured that their employment was not to be affected.

CHAPTER FOUR: RESULTS

4.0 Introduction

This chapter presents the results of analysis of the responses collected by use of questionnaires administered to hospital food handlers, managers and/or supervisors in charge of food services in the hospital; observational checklist, focus groups, and pre- and post training results from food handlers. The results are presented in respect to the objectives of the study, that is; results on status of compliance to food safety standards in hospital kitchens, perceived barriers to compliance to food safety standards and the evaluation of the effectiveness of the food safety educational intervention on knowledge and practices of the hospital food handlers.

4.1 Socio-demographic Characteristics of the Study Population

Characteristics of the hospital food handlers who participated in the study are presented in Table 4.1. The majority of food handlers were females (54.8%). The age of employees ranged from 22 to 54, with a mean of 31 years. The majority of the participants had secondary school education and above (73.5%); 30.6% secondary school education and 42.9% tertiary education respectively. Further, 43.4% of the participants had 1-5 years of working experience in food handling as Cooks (41.1%), Nurses (18.1%), and Dietitian (5.5%), domestic staff servers (20.7%) and other (14.6%); others included cleaners, messengers and assistants who sometimes assisted in the food preparation and distribution.

Unlike various studies done in developing countries (Chitnis *et al.*, 1986, Angelillo *et al.*, 2001, Mohan *et al.*, 2001), this study had a significant number of food handlers with high school and higher educational levels (75%). The remaining 25% were illiterate and had lower educational levels; an indicator that education may not be a criterion for selecting employees in food service establishments in Kenya.

Table 4. 1: Socio-demographic Characteristics of Food Handlers

Characteristic	Hospital Type			Total (n=343)
	Government (n=175)	Private (n=63)	Mission (n=105)	
Male	83 (47)	30 (47.6)	42 (40)	155 (45.2)
Female	92 (53)	33 (52.3)	63 (60)	188 (54.8)
Age				
>25	38	11	7	56 (16.3)
26 - 35	58	13	33	104(30.4)
36 - 45	52	25	48	125 (36.4)
< 46	27	14	17	58 (16.9)
Educational Status				
No education (illiterate)	14	8	7	29 (8.5)
<5yrs	7	2	4	13 (3.8)
Primary school education	23	10	16	49 (14.3)
Secondary school education	65	14	26	105 (30.6)
Tertiary education	66	29	52	147 (42.9)
Nature of Job				
Cook	88	33	20	141(41.1)
Nurse	19	20	23	62 (18.1)
Dietitian	6	9	4	19 (5.5)
Domestic Staff	36	17	18	71(20.7)
Other	33	11	6	50 (14.6)
Years of Experience				
<1	51	23	22	96 (28)
1-5	72	22	55	149 (43.4)
> 5	52	18	28	98 (28.5)

Figures in parentheses are percentages

Other included ; cleaners, messengers and assistants who sometimes assist in the food preparation and distribution

4.2 HACCP

4.2.1 Source of Information on Food Hygiene and HACCP by Food Handlers

Table 4.2 shows the results on sources of information on food safety and HACCP by food handlers. The results show that twenty seven percent (27%) of the respondents learned about HACCP and Food hygiene primarily from the mass media, educational courses (22.7%), audio or visual materials (10.5%) and other sources (12.5) which includes

public health officers, hygiene campaigns and various social forums. Ninety (90%) of the hospital food handlers have never heard about HACCP. However, 92.7% of all hospital food handlers showed the need for more information about HACCP and food hygiene in hospitals.

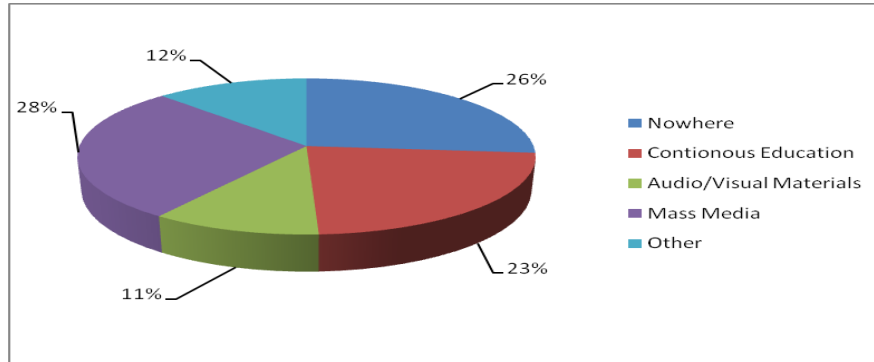


Fig 4.1: Sources of Information Regarding HACCP and Food Hygiene

4.2.2 Food Service Managers Awareness Regarding HACCP

Table 4.3 presents the results on food service manager's awareness on HACCP and food hygiene standards. The results show that the majority of the managers (71%) had never heard of HACCP before. Only 15% of the food service managers reported to have sufficient knowledge of HACCP. Seventeen percent (17.3%) of the managers reported to have used CCP (critical control points) decision tree to determine whether a food risk should be controlled.

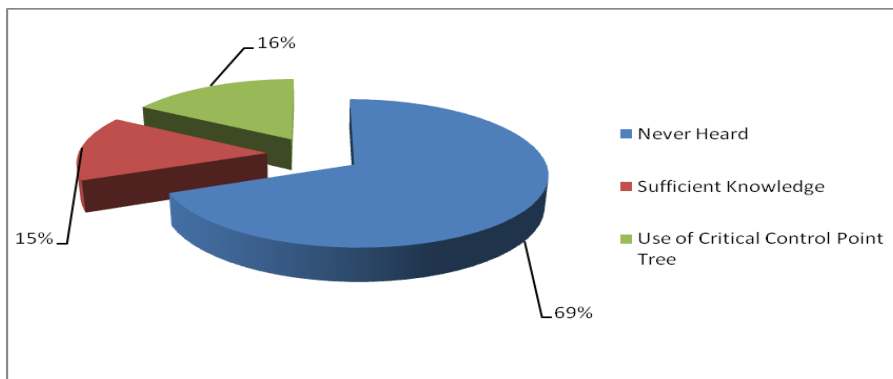


Fig 4.2: Food service Managers awareness on HACCP and food hygiene standards (n=42)

4.3. Extent to which Hospitals Conform to Food Safety Standards

4.3.1 Kitchen Equipments

Table 4.2 shows the status of the kitchen facilities as observed during the study. The results show that (80%) of the kitchens had clean appropriate kitchen equipment that are easily cleanable and made of stainless steel. However, some equipment were observed to be defective (missing handles and had some cracks). Sixty three percent (63%) had fixed smooth and rough surface with tap water type basin for washing utensil and preparation of food. Cleanliness of the washing basin and surrounding area was observed only in 41% of the hospital kitchens. Only 31% of the hospital kitchen cleaned and sanitized utensils by using hot and cold water with detergent. Only 9% of the hospitals use drying racks for the cleaned and sanitized equipments. All hospitals stored utensils in conditions that could easily expose them to contamination.

Table 4.2: Equipment and Food Handlers Standard Status (n=42)

Items	Frequency	% of Hospitals
Kitchen equipments		
Clean equipments	34	80
Easily cleanable equipments	35	83
Presence of basin for washing utensils	36	85
Type of basin		
Fixed smooth basin with tap water	26	63
Fixed smooth and rough surface with tap water	32	76
Cleanliness of basin and surrounding area	17	41
Modes of cleaning and sanitizing utensils		
Hot and cold water with detergent	13	31
Only cold water with detergent	18	44
Storage of utensils under conditions which prevent contamination	4	9

4.3.2 Food Handlers

Table 4.3 shows the results of inspection of food handler's hygiene status. The results show that food handlers in 79% of the hospitals use appropriate clothing (head caps and dust coats) when working in the kitchen. However, it was noted food handlers in 72%

hospitals had no clean clothing. Food handlers who had minor injuries (cuts and burns) were observed working in the 4% of the hospital kitchens.

Table 4.3: Food Handler's Hygiene Standards (n=42)

Food Handlers	Frequency	% of Hospitals
Wearing appropriate clothing	33	79
Short trimmed and clean nails	11	28
Discharges from nose and eyes	0	0
Visible skin rash, boil, cut or wound	1	4
Wearing jewelry	2	6
Managerial supervision of workers	8	20
Presence of separate room for clothing	22	53

None of the observed food handlers had discharges from the nose, eyes, and visible skin rashes at the time of data collection. On rare occasions wearing of jewelry was observed in 6% of the hospitals amongst the food handlers. Fifty three percent (53%) of the hospitals had changing rooms for the food handlers and Irregular managerial supervision was observed in 20% of the kitchen observed.

4.3.3 Waste Management

Table 4.4 shows the results of the status of waste management. The results show that 77% had appropriate kitchen waste management systems. However, it was noted that some of those that had appropriate waste management systems had faulty receptacles that had no appropriate covers, it was observed that this encourages vermin and rodents at the receptacle stations. Forty two percent (42%) of the hospitals dispose their kitchen solid wastes by supplying it to municipal services while the rest disposed of its waste within the hospital premises by burying and burning (pits and crude dumping). All hospitals have drainage systems for their liquid waste which is eventually disposed in the municipal sewage systems. Stagnation of liquid waste was observed in 33% of the hospitals showing an overload and malfunction of the drainage systems.

Table 4.4: Waste Management (n=42)

Items	Frequency	% of Hospitals
Solid waste		
Presence of appropriate refuse receptacles	32	77
Proper covering of refuse receptacle	42	65
Overfilling of receptacles	0	0
Supplied to municipal service	17	42
Burnt at site	24	58
Liquid Waste		
Presence of a drainage system for collection and handling of liquid waste	42	100
Type of drainage		
Closed type	42	100
Final disposal of liquid waste		
Municipal sewage	16	40
Discharged into river	25	60
Presence of liquid waste stagnation	13	33

4.3.4 Storage and Refrigeration

Table 4.5 shows the results on the status of food refrigeration in the hospitals studies. The results show that 82% of the hospitals had cold storage facilities in form of refrigerators and cold rooms. These facilities were used to store perishable food items. Fixed working thermometers readings were only available in 21% of the hospital kitchens with cold storage facilities. There was no cold room or refrigerator that was observed to have been filled beyond capacity. Storage of cooked and raw foods were put in the same cold rooms and refrigerators separately in 26% of the hospitals. Highly perishable foods such as meat and milk were exceptionally stored in refrigerators in 27% of the hospital kitchens. All hospitals were observed to have separate store rooms for raw materials. However, 18% of the hospitals stored raw materials, chemicals (such as detergents) and other equipments in the same rooms.

Table 4.5: Storage and Refrigeration Status (n=42)

Items	Frequency	% of Hospitals
Refrigeration		
Availability of refrigerator for perishable foods	34	82
Storage of highly perishable and non perishable together	13	32
Storage of cooked and raw foods		
Same refrigerator (cooked and raw separate)	14	42
Separate refrigerators for cooked and raw	42	100
Same refrigerator (cooked and raw side by side)	10	26
Presence of fixed thermometer reading	8	21
Storage		
Presence of a separate storage room	42	100
Presence of contact of stored chemical with equipment and/or food	7	18

4.3.5 Floors, Walls, Ceilings, Lighting, Ventilation and Vector/Rodent Control

Table 4.6 shows that 96% of all hospitals had plastered floor types, the other 4% had not plastered their floors, this was common in those hospitals that had constructed extensions of their kitchen outside the 'main kitchens'. Fifty two percent (52%) of the hospitals had floors in good conditions while the rest (48%) had floors in bad conditions (chipped floors, large pot holes on the floor and cracks on the floors). Only 42% of the hospitals had clean floors at the time of visit. Sixty two percent (62%) had visible cracks, dust and soot on their walls. Sixty eight percent (62%) had adequate lighting and 52% had inadequate ventilation. Particularly disturbing was lack of vector and rodent control mechanisms in 82% of the hospital kitchens that were studied, 71% were infested by cockroaches and houseflies.

Table 4.6: Floors, Walls, Ceilings, Lighting, Ventilation and Vector/Rodent Control (n=42)

Items	Frequency	% of Hospitals
Plastered	40	96
Visible cracks, dust and sooth on wall and floor	26	62
Clean Floors	17	42
Adequate Lighting	26	62
Inadequate Ventilation	21	52
Lacking Vector/Rodent Control	34	82
Insect Vectors Infestations	29	71

4.3.6 Water Supply and Sanitary Facilities

Table 4.7 shows the source of water supply and the status of sanitary facilities in the hospitals studies. Results indicate that 72% of the hospital use water sources installed from the municipal as their major source while 20% of the hospitals use water supplied to them by private suppliers (tankers).

Table 4.7: Water Supply (n=42)

Items	Frequency	% of Hospitals
Water supply		
Source of water		
Privately installed from municipal water supply	30	72
From communal distribution	0	0
Buy from privately installed pipe	33	8
From tanker	8	20
Presence of a storage tanker for water shortage times	33	80

Presence of water plastic and concrete tanks used to store water was observed in 80% of the hospitals. All hospitals had both pit and flush toilets; however, these ablutions had no water in 43% of the hospitals. Hand washing is an essential component of infection control (Larson, 2003). During the study, observations were revealed that all pit latrines in all hospitals had no hand wash basins present.

4.4 Perceived Barriers to Compliance to Standard Food Safety Procedures

Described in this subsection are the themes identified in the workers' discussions of their current food handling knowledge, practices in food handlers and supervisors' discussions of the perceived factors that influence their ability to comply/not comply to the recommended food safety standards.

4.4.1 Health Beliefs and Knowledge on Food Safety

On being asked on what food has to do with illness, the participants were able to identify that unsafe food practices cause illness, in particular due to bacteria present in food that has been contaminated, not well cooked, or stored not kept at proper temperatures. All focus group discussions did not mention other food related causes of illnesses, such as viruses, mould, yeast and allergens. They generally mentioned the importance of good personal hygiene, especially proper hand washing and keeping utensils clean in

preventing disease. A small number of participants were able to identify very specific temperature controls important for keeping food safe.

4.4.2 Hand Washing Practices

To determine food workers' knowledge of hand washing practices, the food handlers discussed hand washing materials, hand washing practice, situations, and glove use in relation to hand washing. When asked to describe materials used to wash their hands at work, participants named soap and water, and hand sanitizers. Some participants had observed other workers using hand sanitizers without washing their hands: *“A lot of people think once they sanitize their hands they don't have to wash their hands. They use it as an alternative.”*

When asked to describe when they washed their hands at work, some workers in every group said they washed their hands after visiting rest rooms, before preparing food in general and when they changed tasks, work stations, or items they were handling. Some workers said they washed their hands periodically, either because their hands felt dirty, or because of a restraint process that required hand washing. To a lesser extent, workers also said they washed their hands before putting on gloves or when changing their gloves, and after sneezing or coughing, eating or drinking, taking a break, or touching their face, hair or clothes.

4.4.2.1 Barriers to Hand Washing Practices

Food handlers and their supervisors/managers most frequently identified sink accessibility as a barrier that impacted the ability to wash hands as recommended. Some of the participants in all groups said that having too few sinks or sinks inconvenient to the work area were barriers to hand washing, particularly when workers were experiencing time pressures. Time pressure because of high numbers of patients accompanied by inadequate staffing, was also frequently mentioned as a factor that negatively impacted proper hand washing. Participants indicated they were not able to wash their hands when they had large numbers of patients with different food demands.

Participants identified several reasons that they believed impacted washing hands positively. They said management and coworker emphasis on and attention to proper

hand washing was a facilitator of hand washing (e.g. “*if I forget to wash my hands, my supervisor speaks up*”), kitchen procedures that encourage hand washing, worker motivation, personal preferences to clean hands, food safety education and training on proper hand washing practices, adequate resources (e.g soap). A few participants indicated that frequent hand washing sometimes made hands chapped and raw, which they believed could be a barrier to hand washing.

Several participants from both groups (A and B) said that they found glove use to be a nuisance: “*Gloves are difficult to deal with because you have to take them off a lot; they get really dirty.*” Many at times gloves are not provided by the management. Other reasons given for the lack of glove use included concern that gloves slow down the food preparation process, that they make hands sweat and break out into blisters, and that it is dangerous to use gloves near an open flame.

Food handlers also noted frequent neglect of hand washing facilities, including broken towel and soap dispensers, and lack of hot water and sanitation solutions. Time pressure was consistently mentioned as a negative factor, regardless of how conscientious food workers were about handwashing. Having to complete multiple tasks during a work shift was also mentioned as a barrier to adequate hand washing. Participants said there was not enough time to visit the sink area after each food preparation task.

4.4.4 Cross- Contamination Practices

When asked to describe how they handled raw meat and poultry, participants described several different cross contamination prevention practices. Workers in all groups said they cleaned their work surfaces, utensils and equipment after preparing raw meat or poultry. A few said they used gloves and utensils to prevent bare hand contact with the raw meat and poultry during storage and preparation. Food handlers said they keep these separately from vegetables when storing and in different work surfaces. Workers also said they washed their hands after preparing raw meat and poultry. A few workers reported that after getting one side of the cutting board dirty, they flipped the board over to its other side rather than cleaning it or getting a new one.

As with hand washing, some participants expressed concern that use of gloves could act as a barrier to cross-contamination prevention because glove wearers may not wash their hands as often as they should. Participants in most groups also said that using sanitizer was a facilitator of cross-contamination prevention because it allowed them to sanitize their equipment (e.g., knives, cutting boards) quickly. The participants also felt that cross contamination during food preparation could occur due to insufficient working surfaces;

“If your work surface is small, the likelihood of you mixing raw with cooked food or clean with dirty utensils is high.”

Other identified facilitators of cross-contamination prevention included: separation of work areas and tasks, to ensure that raw meat or poultry and other foods are kept separate; management and coworker emphasis on and attention to cross-contamination prevention, food safety education and training on cross-contamination prevention and its importance, pre-cooked or prepared meat, which allows minimal meat preparation; and negative consequences for lack of cross-contamination prevention.

4.4.5 Hospital Management Commitment on Food Safety

Hospital Management commitment emerged as a key barrier for food handlers and supervisors to embrace food safety. According to the participants, the hospital administration does not prioritize food quality and safety issues when allocating financial resources. They felt that other hospital services are given priority at the expense of food services departments, which resulted in displeasure and resentment amongst hospital food handlers. Other participant complaint was delay of the procurement of kitchen equipment when they request and sometimes they could not get the equipment unless they put pressure on the persons in charge. According to some participants:

“For us to ensure that we serve safe food to the patients, the management should show a high degree of commitment, not only by paying us well, but also by providing what we require for our work on time.”

“Some of the cooking pots we use are very old, because of this they are difficult to clean and their handles are broken, getting these pots from the fire exposes us to great danger, we have requested for new ones several times but there is no feedback”

The participants concurred that there was a need for the hospital management to demonstrate compliance to food safety operating procedures by facilitating the food handling departments

4.4.6 Poor Working Conditions

Insufficient work spaces, high temperatures and humidity, constant high levels of noise and poor ventilation, were amongst the barriers the participants mentioned that made the working environment un-conducive. These factors they said threaten both themselves as well as the health of patients by increasing the probability of errors that can cause food contamination during preparation process, these factors they said also provoked irritation, mental and physical fatigue. They were also aware that these poor working conditions could be detrimental to their health:

“The jikos we use in the small kitchen ‘take away’ sufficient air, because they produce a lot of smoke and heat, sometimes you feel like you are about to faint..... maybe they should provide some air conditioning or more ventilation.”

“...Large cooking pots produce a lot of noise during cleaning, the pressure cookers produce noise too, we also shout at each other in order to communicate effectively, by the time you leave work, you are so tired and having headaches.”

4.4.7 Insufficient Water Supply

Adding to the already precarious situations, a particularly disturbing situation was the lack of sufficient water supply forcing the food handlers to practice improper sanitary procedures, of which they were aware. Participants reported to have often used the already used dirty utensils to prepare and store food due to lack of water, and they also

reported that appropriate kitchen cleaning procedures were often not followed due to lack of water.

“In this part of the country, water is very scarce, so even cleaning the Kitchen is not done in the most appropriate way; in most cases we sweep other than moping and sometimes we use cooking pots over and over again without cleaning.”

Moreover, it was found that some food handlers did not wash fresh foods and their hands properly and the same water was used without replacement for washing utensils , this is because they did not have enough water hence hygiene was compromised.

“We keep using same water [already used water] now and then because we have no sufficient supply of water.”

This finding is in agreement with a study done in within country (Kenya) on food safety in commercial setting in Kenya, which found that running water was not available (Mensah *et al.*, 2002; Muinde and Kuria, 2005). It is important to note that without sufficient amounts of water, hygiene and sanitary practices cannot be met.

4.4.8 Quality of Food Supplies

The participants also identified lack of supply of quality food to the kitchen as one of the major setbacks in the preparation of quality food. The participants stated that most food suppliers were known to the management [do business with the management] and whenever they brought poor quality food, no appropriate measures are taken. According to the participants, they unfairly took the blame on poor quality meals by patients.

“...We are the ones to take blame when the food quality is not good, yet it is the supplier and the management.”

“It is very unfair to take blame of serving stale food to patients when you know it in your heart that is the management and supplier who should take the responsibility.”

“Withered cabbage and Sukima wiki bought by the management can never be tasty”

4.4.9 Enforcement of Food Safety Standards

The majority of the participants indicated infrequent or seldom visitation from their public health/environmental health officers. Of those who said they had been visited, only a few had received communication (written reports) on the aspects that were assessed. The ones who received communication in form of reports indicated that their supervisors that recommendations in the report were helpful.

“From the time I started working in the kitchen, I have never seen a public health officer coming to inspect the kitchen.”

“Sometime back we used to be visited, but these days I never see people coming to visit us, but even when they came, they never gave us any feedback”

“The public health officers visit us often; they give us the reports which we use to improve our kitchen”

4.4.10 Lack of Food Safety Training

Training emerged as a critical barrier in all FGDs. The participants showed a good understanding of the meaning of training. For them, training provides employees with skills and knowledge to do their jobs. They reported that no regular training programmes were in place and they see this as a sign that their superiors believed they were not of sufficient importance to deserve training courses. They reported that initial training for new co-workers was placed under the responsibility of older and more experienced colleagues.

“I normally see other hospital staff being taken for training, in our department it is only the supervisor who goes.”

“Our work is normally taken to be too casual to require training that is why any new employee in our department is under the hands of the older employees, so if you have been doing something inappropriately, you will pass it on to the new one.”

“Our supervisor thinks calling for a meeting once a month for 30mins is part of training”

4.4.11 Rapid Turnover

The challenge of turnover was one of the major challenges that were reported by participants in all FGDs, this probably because most of the food handlers were not public servants with secure job tenure. This turnover was attributed to poor terms of employment, so there were frequently new employees who were handling food in large scale for the first time. They reported that this can lead to detrimental effects when it comes to food safety.

4.5 Evaluation of Food Safety Training

This subsection presents the results of pre and post food safety educational training (intervention) amongst food handlers and hospitals in the control and interventional groups.

4.5.1. HACCP Implementation

Table 4.8 shows the level of compliance to food safety operating procedures in control and interventional groups of hospital with reference to HACCP in before and after food safety training. The results show significant improvements only in four parameters in the intervention group hospitals. These were; documentation of standard food safety operating procedures (45% -54%); development of personal hygiene procedures for food service staff (51% -91%); Inspection of raw materials (64% – 100%); identification of critical control points regarding food safety (64% - 73%) and inspection of the kitchen facilities (45% - 64%).

Table 4.8: Compliance to HACCP in Control and Intervention Hospitals before & after Training

Category		Food Safety Practice Score	
		Before Training, n (%)	After Training, n (%)
Have documented standard food safety operating procedures	Intervention Group (N=22)	10 (45)	12(54)
	Control Group (N=20)	11(55)	11(55)
Have adopted food safety storage procedures	Intervention Group	12(54)	12(54)
	Control Group	8(10)	8(10)
Have developed personal hygiene for food service staff	Intervention Group	13(59)	20(91) ^a
	Control Group	11(55)	14(70) ^a
Have developed cleaning and disinfecting procedures	Intervention Group	10(45)	10(45)
	Control Group	13(65)	13(65)
Have developed temperature monitoring of food	Intervention Group	4(18)	4(18)
	Control Group	0 (0)	0(0)
Do hazard analysis of food practices	Intervention Group	4(18)	4(18)
	Control Group	0(0)	0(0)
Do inspection of raw materials	Intervention Group	14(64)	22(100) ^a
	Control Group	12(60)	12(60)
Identify critical points regarding food safety	Intervention Group	14(64)	16(73)
	Control Group	11(55)	13(59)
Do microbial testing of foods	Intervention Group	4(18)	4(18)
	Control Group	3(15)	3(15)
Do microbial testing of surfaces	Intervention Group	4(18)	4(18)
	Control Group	0(0)	0(0)
Have had public health food safety Inspections	Intervention Group	10(45)	14(64) ^a
	Control Group	12(60)	16(80) ^a
Have continuous educational training on HACCP/food hygiene for staff	Intervention Group	2(9)	2(9)
	Control Group	5(25)	8(40) ^a

^aSignificant change ($P < .05$)

Development of temperature monitoring systems in food, microbial testing of food and surfaces did not show any improvements in both intervention and control groups. Some positive changes were also observed in the control groups especially in development of food safety manuals (55% - 70%), identification of critical control points (55% - 59%), food safety inspections (60% - 80%) and educational training on HACCP (25% - 40%) perhaps because of the contamination by sensitization though visitations done by the researchers to the control hospitals. Generally the results indicate that aspects that did not require large capitation generally improved. Only physical infrastructure did not show improvement.

4.5.2 Food Safety Knowledge

Results in Table 4.9 shows the scores and paired t-test analysis of food safety knowledge before and after the training. Overall, knowledge scores increased significantly between pre- (50.6±16.5) and the post-training (76.4±15.5) assessments ($P \leq 0.05$) in the intervention group. When mean composite scores for the separate categories were compared between pre- and post training, knowledge increased significantly in personal hygiene, food handling and environmental hygiene.

Table 4.9: Effects of Food Safety Training on Food Safety Knowledge Scores

Category		Before Training	After Training	t-value
Personal Hygiene	Intervention Group (N=129)	13.2 ±5.3	17.0 ±5.0	-2.821 ^a
	Control Group (N=141)	12.2 ±4.3	11.9 ±4.0	1.144
Food Handling	Intervention Group	17.9 ±11.6	35.7± 10.0	-2.073 ^a
	Control Group	18.1 ±9.4	19.7 ±7.4	1.762
Food Storage	Intervention Group	7.6 ±5.3	8.2 ± 5.0	0.730
	Control Group	8.5 ±2.7	8.8 ± 4	1.002
Cleaning & Sanitation	Intervention Group	4.9 ±4.8	6.6± 4.1	-0.752 ^a
	Control Group	5.6 ±4	5.1 ±3.5	2.624
Environmental Hygiene	Intervention Group	7.3± 4.8	8.9 ±4.2	-3.333
	Control Group	7.4 ±4.8	7.9 ±4.8	0.216
Total	Intervention Group	50.6 ±16.5	76.4 ±15.5	-3.438 ^a
	Control Group	51.8 ±15.1	53.4 ±17.8	1.816

^aSignificant Change ($P < .05$) Intervention group df: 128; Control group df: 140

4.5.3 Comparison of Food Handlers Knowledge before and after Food Safety Training

Table 4.10 shows individual scores for individual questions within each category. The results show that the number of correct responses increased significantly between pre and post training in all categories ($P \leq .05$) except for questions related to temperature in food (Q10), food labeling requirements (Q6) and the control of insect vectors (Q18).

Table 4.10: Comparison of food handlers' hygiene knowledge scores before and after training

Category		Before	Total After	t-value
PH	Q1. When washing your hands, you should rub your hands together with soap for at least	63.0± 42.9	82.0±41.9	- 2.030 ^a
	Q2. Which of the following the most common cause food borne illness?	60.2 ±33.6	87.3 ±47.1	-2.237 ^a
	Q3. Good personal hygiene practices include all of the following EXCEPT	58.0 ±48.5	73.4± 48.8	-2.235 ^a
	Q4. What will you avoid to do when you develop a fever and severe cough before going to work?	71.3±37.3	97.6 ±15.6	-2.794 ^a
	Sub - total (20 points)	13.2 ±5.3	17.0 ±5.0	-3.544 ^a
FS	Q5. In the refrigerator, where should cooked foods be stored?	83.1 ±50.1	86.0 ±41.9	-0.148
	Q6. Which of the following is not a food labeling requirement?	71.9 ±50.3	78.3 ±41.9	1.148 ^a
	Sub - total (10 points)	7.6 ±3.5	8.2 ±3.3	-0.730 ^a
FH	Q7. Which of the following is necessarily needed for wearing disposable gloves?	38.8 ±44.8	77.6 ±42.2	-5.036 ^a
	Q8. Which of the following is the temperature affecting the most rapid growth of bacteria	32.0 ±31.7	88.0± 41.3	-5.001 ^a
	Q9. Which of the following is the proper internal temperature in cooking?	45.3± 33.4	71.7 ±48.3	-2.223 ^a
	Q10. Which of the following is the proper holding temperature in cooked foods?	48.5 ±42.0	53.5 ±41.9	0.000
	Q11. The safest way to thaw (defrost) foods is:	21.5 ±32.5	81.3 ±41.4	-5.153 ^a
	Q12. Potentially hazardous foods are:	52.3 ±45.3	81.5 ±38.2	-3.719 ^a
	Q13. What is cross-contamination?	36.8 ±36.6	90.5 ±30.2	-2.913 ^a
	Q14. What is usually the riskiest step in food preparation?	52.4 ±41.5	73.2 ±54.0	-2.615 ^a
	Q15. Which of the following is not a proper cleaning method of vegetables and fruits?	24.0 ±39.9	62.4± 55.3	-3.621 ^a
	Sub - total 45points	17.9±11.6	35.7± 10.0	-2.073 ^a
CS	Q16. Which is the correct way to wash dishes, utensils and equipment?	33.1± 42.0	56.1± 50.2	-2.040 ^a
	Q17. What are some of the food contact surfaces that must always be washed and sanitized?	60.5 ±43.4	75.7 ±42.2	-1.150 ^a
	Sub – total 10points	4.9 ±4.8	6.6± 4.1	-0.752 ^a
EH	Q.18. Which of the following is best way to control insect vectors and rodents in the kitchen?	61.0 ±49.0	62.5 ±51.3	0.222 ^a
	Q.19. Where must you store chemicals such as cleaners and sanitizers?	32.0 ±41.4	43.8 ±44.6	1.170 ^a
	Q. 20. What must be at hand washing sinks at all times?	52.8 ±49.4	73.6 ±43.1	-2.054 ^a
Sub - total 15 points	7.3 ±5.2	8.9 ±4.8	-3.333 ^a	
Total (100points)		50.6±16.5	76.4±15.5	-3.438 ^a

^aSignificant change ($P < .05$)

T value was not computed because the standard error of the difference was zero.

df 128

PH: Personal Hygiene; FH: Food Hygiene; EH: Environmental Hygiene; Personal Hygiene; FS: Food Supply & Storage; HS: Handling of Food and Serving; CS: Cleaning & Sanitation; WE: Working Environment

Multiple linear regression was used to examine the relationship between the post-training total knowledge score (dependent variable) and the employees' characteristics (gender, age, education, and years of experience), as the independent variables. The stepwise regression model showed that the overall model was significant ($F = 14.798$, $P \leq .001$). The significant independent variable in the model was the employees' educational level

($\beta = .334, P \leq .001$); as an employee's educational level increased, so did his or her food safety knowledge.

4.5.4 Food Safety Practices

Table 4.11 shows the scores of food handler's food safety practices before and after the educational intervention. The results show that before the educational intervention the control and the interventional groups showed similar levels on food safety. Food safety practices of the control group in the post-test did not improve, compared to that of the pretest ($P > 0.05$). In total it appeared that there was improved reported food safety practices in the intervention group, showing 101 points in the pre-test and 105 in the post-test though not statistically significant (0.021).

Table 4.11: Effects of Food Safety Training on Food Safety Practices

Category		Food Safety Practice Score			
		Before Training	After Training	t value	
Personal Hygiene	Intervention Group	14.1± 2.5	14.3± 2.3	0.032	
	Control Group	14.2± 2.0	13.8 ±3.0	2.044	
Food hygiene	Food Supply & Storage	Intervention Group	22.2 ±5.0	24.4± 5.4	0.827 ^a
	Control Group	22.1 ±7.8	21.6 ±5.9	-0.601	
Serving	Food Handling &	Intervention Group	27.6 ±5.5	29.9 ±5.3	0.307 ^a
	Control Group	28.3 ±4.5	26.6 ±5.8	0.482	
Env hygiene	Cleaning & sanitation	Intervention Group	17.7 ±2.7	19.0 ±4.3	0.197 ^a
	Control Group	22.1 ±2.5	21.4 ±3.8	1.938	
	Working environment	Intervention Group	19.6 ±4.4	20.7 ±4.1	-0.555
	Control Group	21.3 ±4.0	19.3± 3.5	1.364	
Total	Intervention Group	101.3±11.6	105.3±12.2	0.021	
	Control Group	110.7	102.7	0.407	

^a Significant change ($P < .05$) Intervention df: 128; Control df: 140

4.5.4.1 Comparison of hospital food handlers' hygiene practices before and after training

Table 4.12 shows the individual scores of practices before and after the educational intervention. The results show that various practices were reported to have some significant improvements: which were indicated as 'health checking before work (4.7,

t=0.801), washing hands before work (5.1, t=0.352), separate handling of raw materials and cooked foods (4.5, t=1.391), handling methods of cooked foods (5.4, t=1.952), proper storage of sanitizer and cleaner (4.3, t=1.376), and cleaning and maintaining toilet facilities (4.4, t=0.4733). No significant improvements on individual items for thermometer use were found, as thermometers were often not available for employees to use, which is a concern because such unavailability is a health code violation.

Table 4.12: Comparison of hospital food handlers' hygiene practices before and after training

Category		Total		t-value	
		Before	After		
PH	Q1. Checking self-health condition (fever, diarrhea, injury) every working day.	4.5 ±0.7	4.7 ±0.6	-0.801	
	Q2. Checking cleanness of clothes, hair restraints and shoes before work	4.8 ± 0.8	4.5 ±0.9	0.713	
	Q3. Washing hands before handling food	4.9 ±1.1	5.1 ±0.8	- 0.352 ^a	
	Sub - total (15 points)	14.2±2.5	14.3± 2.3	0.000	
FH	Q4. Receiving foods right after delivery and storing them in store area after removing their package	4.3 ±1.0	4.1 ± 0.8	0.514	
	Q5. Checking temperatures of the frozen/refrigerated foods and having problems rejecting them	3.1 ±0.6	4.3 ±0.8	0.482	
	Q6. Checking and verifying whether temperatures of refrigerators and freezers are appropriate	4.0 ± 0.9	4.4 ±0.9	-0.172	
	Q7. Recording the temperature log of refrigerators and freezers for managing temperature control	3.9 ±1.1	4.1 ±1.1	0.012	
	Q8. Taking temperature of the foods in cooking/reheating process with thermometer	2.4 ±1.3	3.1 ±1.1	0.561 ^a	
	Q9. Storing separately raw foods and cooked foods in refrigerator and freezers	4.5 ±0.9	4.4 ± 0.8	0.451	
	Sub - total (30 points)	22.2 ±5.0	24.4±5.4	1.031^a	
	HANDLING & SERVING	Q10. Thawing food, as much as a need	2.8 ± 0.3	3.5 ±1.0	1.733 ^a
		Q11. Cooking it immediately, if not, storing it in refrigerator after thawing	3.9 ± 0.7	4.4 ±0.7	1.306
Q12. Washing and sanitizing fresh vegetables and fruits before use		4.6 ±0.9	4.2 ±0.8	-1.141	
Q13. Labeling foods with use-by date in storing the RTE foods and processed foods		4.2 ±0.9	4.8 ±1.5	1.232	
Q14. Using separately the equipment and supplies of the raw food and RET food		3.7 ±0.9	4.2 ±0.8	-1.206 ^a	
Q15. Not handling RTE foods with bare hands		4.3 ±0.7	4.5 ±0.4	- 1.391	
Q16. Not holding foods or utensils on the kitchen floor		4.1 ± 0.6	4.3 ±0.6	- 0.548	
Sub - total 35points	27.6 ± 5.5	29.9±5.3	0.345^a		
CLEANING & SANITIZATION	Q17. Labeling cleaning and sanitizing chemicals and storing them at safer place away from foods	4.2 ±1.0	4.0 ±0.8	0.660	
	Q18. Screening all windows and vents for controlling pest, and verifying if there are gaps and cracks in walls and ceilings.	4.3 ±0.7	4.8 ±0.9	0.698	
	Q19. Cleaning and sanitizing knives, cutting boards and wiping clothes	4.5 ±0.8	4.8 ± 0.9	0.578	
	Q20. Clean and sanitize properly storing sanitized/cleaned equipment and utensils using shelving unit.	4.7 ±1.0	5.4 ±0.9	-1.952 ^a	
Sub - total 20points	17.7 ±2.7	19.0 ±4.3	0.152		
EH	Q21. Verifying if the plumbing system installed well and maintained it properly	4.3 ±0.8	4.8 ±0.8	-1.473	
	Q22. Seeing if equipments and facilities work well and maintaining them properly	4.7 ±0.9	4.4 ±0.9	0.621	
	Q23. Verifying heat and water vapor in the kitchen are removed immediately through hood exhaust system and maintaining it properly	2.1 ±1.0	2.5 ±0.8	- 0.784	
	Q24. Verifying if lightness and illumination of working area are appropriate and managing them properly	4.3 ±1.4	4.6 ± 1.0	-0.176	
	Q25. Cleaning and maintaining toilet facility regularly	4.2 ±0.9	4.4 ±1.1	- 0.473	
Sub - total 25 points	19.6 ±4.4	20.7 ±4.1	- 0.543		
Total (100points)		101.3±11.6	105.3±12.2	0.268^a	

^aSignificant change (P<.05)

Intervention group df: 128;

PH: Personal Hygiene; FH: Food Hygiene; EH: Environmental Hygiene

4.5.5 Sanitation Rated by the On-site Inspection

Table 4.13 shows the result of observational inspection on sanitation management. Results show that the score of the sanitation performance of the intervention group improved from 48.8 to 54.6 points out of 100 points. Before training, the scores were in particular, low in the items of “proper hand washing/hand washing facilities supplied (3.5)” in personal hygiene; in the dimension of food storage, “food properly labeled and stored (3.3)”, checking and recording temperatures of food (0.0)” and preventing contamination by holding foods off the floor (3.3)” were needed to improve the practices. On food preparation service: of most importance, the items “Appropriate utensils are used to minimize bare hand contact with food (2.1)” “gloves changed after soiling (1.7)”, “Separate cutting boards are used for ready to eat foods and food being prepared (2.6)” were needed to improve. Again, the results also show a lack of monitoring of temperature in food in all hospitals and food handlers observed.

Table 4.13: Effects of training on sanitation performance

Dimensions	Practices	Possible Score	Score		t-value
			Before	After	
Personal Hygiene					
1	Food handlers wash their hands after contaminating them	5	4.2 ± 0.9	4.7 ± 0.9	-1.000
2	Hand-wash facilities are operable, accessible and supplies with soap and utensils	5	3.5 ± 0.8	3.5 ± 0.8	0.000
3	Food handlers dress code and personal hygiene	5	4.7 ± 0.7	5.0 ± 0.0	-0.987 ^a
4	Food handlers wear clean clothes	5	4.1 ± 0.8	4.8 ± 0.6	-1.628
5	Health examination of food handlers	5	4.0 ± 0.2	4.1 ± 0.4	0.000
6	Food handlers hygiene education	5	2.1 ± 0.9	2.2 ± 0.6	0.005
Sub – total score		30	23.1 ± 4.3	24.3 ± 4.0	-1.722
Food Storage					
1	Raw meats and poultry are stored below ready to eat foods in refrigeration units	5	3.2 ± 0.8	3.4 ± 0.7	-1.058
2	Food is covered to protect from overhead contamination	5	4.3 ± 1.1	4.7 ± 0.0	-1.054
3	Food and beverages are stored at least 6" of the floor	5	3.3 ± 1.0	4.2 ± 0.0	-1.352
4	Food is properly labeled and stored	5	2.0 ± 0.0	2.0 ± 0.0	0.000
5	Storage facilities are kept clean and in good order	5	3.4 ± 0.9	4.3 ± 0.7	-0.043
6	Chemicals/toxic materials stored in an area separate from food, utensils and food contact surfaces	5	2.2 ± 0.8	3.1 ± 0.0	-1.724 ^a
Sub-total score		30	18.4 ± 5.6	21.7 ± 6.1	-1.623 ^a
Food preparation service					
1	Appropriate utensils are used to minimize bare hand contact with food	5	2.1 ± 0.8	3.3 ± 0.0	-1.832 ^a
2	Gloves are changed after soiling	5	1.7 ± 0.8	2.0 ± 0.7	-1.510
3	Separate cutting boards are used for ready to eat foods and food being prepared	5	2.6 ± 1.1	2.3 ± 0.7	-1.414
4	Sneeze guards are used in food preparation areas	5	0.9 ± 0.0	1.0 ± 0.0	0.000
Sub-total score		20	7.3 ± 2.3	8.6 ± 2.5	-0.522 ^a
Time/Temperature Control					
1	Food handlers take temps of reheated foods	5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
2	Employees take internal temps of hot & cold food items	5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
3	Employees temperatures were observed being taken during preparation	5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
4	Employee maintain food temperature logs	5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sub-total score		20	0.00	0.00	0.00
Total Score		100	48.8 ± 6.5	54.6 ± 6.8	-1.438

^aSignificant change (P<.05); df: 128

CHAPTER FIVE: DISCUSSION OF THE FINDINGS

5.0 Introduction

This chapter will discuss the findings of the study. Section one provides a discussions on the extent to which hospitals conform to food safety standards. The second section discusses perceived barriers to compliance to food safety standards amongst hospital food handlers. And finally, the last section (3) discusses findings of the evaluation of food safety training.

5.1 Extent to which Hospitals Conform to Food Safety Standards

5.1.1 Kitchen Conditions

The quality of depends on the facilities or equipment provided in the kitchen environment such as proper disposal of waste products, water supply, ventilation, vector and rodent control and hand washing facilities. Contact with the poor sanitary surrounding environment might be a major reason for microbial contamination of food and various organizations have shown through research that many infections of human beings are spread through inadequate sanitation (UNO, 1985). In general, the results of the present study revealed poor sanitation conditions in the hospital kitchens. Based on observations, most of the hospitals did not meet the required facility standards to provide safe food to the patients. This study has similar results with other studies conducted in different parts of the country (Kenya) in commercial settings which showed the poor sanitary conditions of catering establishments and presence of pathogenic organisms (Muinde and Kuria, 2005; Mensah *et al.*, 2002). These indicate a mediocre or even scanty food handling facilities and/or cross contamination during distribution or in the kitchen.

General hygiene of food handlers, personal hygiene sanitary facilities of food establishments, physical conditions of food catering establishments, waste disposal services, and environmental hygiene were identified as the major sanitary deficiencies. Therefore, the probability of food contamination in these establishments is likely to be high due to poor sanitary conditions of the establishments. Thus, health hazards from hospital kitchens may be minimized by avoiding poor handling and awareness of

personal hygiene and care in preparation, storage and dispensing of foods in all procedures necessary to maintain the safety and suitability of food from the establishments, appropriate solid and liquid waste collection and disposal should be planned and implemented and periodic sanitary-hygienic evaluation and inspection of the hospital kitchen establishments should be strengthened to reduce food borne nosocomial infection hazards to patients associated with food-borne pathogens by using systems such as HACCP.

5.1.2 Routine Inspections

Routine restaurant inspections are intended to prevent food-borne illness by ensuring safe food handling and preparation. It was established from this study that the hospital kitchen facilities were not inspected often. Only 52% of the hospital reported to have had kitchen inspections at the baseline survey. This can be detrimental because most food handlers and the management are likely to ignore pertinent food safety standards when not inspected and this can lead to foodborne disease outbreaks. Although the effectiveness of food service facility inspections and food handler education are not known, the optimal frequency of neither has been determined. Mathias and colleagues (1995) conducted a study in thirty randomly selected restaurants from seven health units in three provinces that were inspected by one of three senior inspectors. The violation score worsened when the time since last inspection was greater than 12 months, but did not worsen when the interval was shorter, additionally, those restaurants in which supervisors and food handlers had completed food handler education courses had better inspection scores than those without (Mathias *et al.*, 1995). Other studies carried in US in 1987 and 2001 indicated that restaurants with poorer results on inspections were more likely to have food-borne disease outbreaks (Irwin *et al.*, 1989, Miguel *et al.*, 2001).

5.1.3 HACCP Implementation

The results of this study found that overall behavioral compliance with respect to HACCP remained low even after food safety training. It was established that only 9.5% (4) of the hospital were using HACCP system. Additionally, only 22.7% of the study participants reported to have attended any educational courses on food hygiene and

HACCP. The need for more information regarding food hygiene through educational courses has been well established by this study. Ninety two percent (92.7%) of all the food handlers felt the need for more information. Lack of formal training or education regarding food hygiene among the majority of the food handlers in this study could be the result of laxity on the part of the hospital management or even the government, which should ensure training and certification of individuals working in food service in the hospital establishments. Such lack of training is also reported elsewhere (Oteri and Ekanem, 1989, Cunningham, 1993) may increase the likelihood of food contamination leading to outbreaks (WHO, 1994).

From these findings, there is clear indication that the application of and adherence to HACCP has not been widely used and that this is likely to have a negative impact on the general knowledge and food handling practices of food handlers. This supports the notion that the HACCP approach, when adopted by and administered in the hospital, is a useful teaching tool that provides useful information about food-hygiene practices to food handlers through continuous training and refinement of proper hygienic technique and the involvement of each individual at each operation, step by step. Previous studies have emphasized that food handlers are more willing to be involved with HACCP if they have already experienced it (Richards *et al.*, 1993). Moreover, it was realized that most hospitals do not carry out hygienic procedures such as cleaning schedules and personal hygiene, which are required by the model HACCP plans. These prerequisite practices are the foundation to any successful eventual transition to the HACCP system. Additionally, of concern is that only 9% of the hospitals performed microbial sampling of food, this is probably because the rest of the hospitals had not implemented HACCP system and considering it is one of the ways of verifying the efficacy of the HACCP plan.

5.1.4 Food Service Managers Awareness on HACCP and Food Safety Standards

This study established that the majority (71%) of the hospital administrators in charge of food services were not adequately aware of HACCP system. Various studies have shown that lack of sufficient education to food safety managers can lead to poor food safety standards and lead to detrimental health effects to the consumers. Food service managers who view safe food handling practices as important may be more likely to encourage safe

food handling practices among employees (Mortlock *et al.*, 2000). Cochran-Yates *et al.* (1996) examined differences between restaurants with excellent environmental health code records and those having difficulty with food safety. Restaurants with favorable health code records had managers with a significantly higher level of concern and knowledge regarding food safety. Other studies (Burch and Sawyer, 1991) conducted in-store observations of food preparation areas in 13 convenience stores, show that managers' knowledge of sanitation correlated positively with sanitary condition of the convenience store ($r=0.65$, $P<0.001$). Such findings are consistent with comments of Clayton *et al.* (2002) that “the effectiveness of a training program and implementation of food safety systems is dependent on the attitude of managers and the hygiene culture of an organization.”

However, some studies assessing the effect of food manager training programs on the sanitary conditions of food service establishments have produced inconsistent and inconclusive results (Wright & Feun, 1986; Julian, 1996). Two studies reported that sanitation inspection scores significantly improved when managers attended a training program, but because there was no control group it is difficult to attribute the changes to training. Cook and Casey (2002), reported increases over baseline in inspection scores with and without manager training, suggesting that training was unlikely to be responsible for the improvement in scores (Cook and Casey, 2002).

5.2 Perceived Barriers to Compliance to Food Safety standards

While investigating perceived barriers to compliance to food safety operating procedures among food handlers in the hospital environment through FGDs, it was established that food handlers are aware of the role they play in patient recovery. Providing safe food for patients to them is very important. A majority reported to have been practicing safety food safety behavior. Previous research, however, suggests that food workers report engaging in food safety practices more frequently than they actually engage in those practices (Prianka *et al.*, 2012). This phenomenon is likely the result of the social desirability bias, which is the tendency for people to report greater levels of socially desirable behavior such as safe food preparation practices than they actually engage in, or to report their best behavior rather than their typical or worst behavior. Although it is not

possible to determine the extent to which our participants over-reported their safe food preparation practices, it is likely that they do not engage in these practices as frequently as they have reported.

Nevertheless, participants in this study identified a number of factors that impacted their ability to engage in safe food preparation practices; such as lack of training, poor working conditions, ill functioning equipments, lack of water, lack of recognition by the hospital administration and insufficient supervision which prevent them from prevents them from performing their duties adequately. Studies from other developing countries show similar results; studies by (Clayton *et al.*, 2002, Walker *et al.*, 2003) show that food handlers in hospitals in their countries faced barriers such as lack of time, inadequate staff and resources, education and training, sink accessibility, availability of properly working equipment, and management concern for and attention to food safety. From the aforementioned findings, the food handler's motivation to enhance food safety could be achieved through the improvement of working conditions, being recognized, educational training and frequent supervision. Hospital management action, such as investment in intermediary management so that managers have the capacity to provide supportive supervision, better use of performance appraisal and access to training, may help to overcome the identified problems. However, other studies have shown that improved human resources management alone cannot compensate for the lack of investment and the structural deficits that characterize health systems in many developing countries (Cilce *et al.*, 2009).

5.3 Evaluation of Food Safety Training

While the contribution of food mishandling and faulty practices in the epidemiology of food-borne diseases underscores the rationale for hygiene training of food handlers, there is uncertainty concerning the beneficial effects of such training to food safety, and there is a need to evaluate current practice. In an effort to elucidate this issue, an evaluation of food hygiene training was undertaken in this study. The objective was to examine the effectiveness of food hygiene training in terms of its impact on food hygiene knowledge, and practices. There are many studies on healthcare training and the training of food handlers. This study is different in that it was on staff working in a healthcare institutions

(hospitals). The participants' level of knowledge regarding food hygiene was evaluated before, and after training.

5.3.1 Knowledge

Results from the evaluation of the effectiveness (food safety knowledge Pre- and posttest) of food safety training demonstrated that the curriculum was used successfully to improve food safety knowledge for the participants overall (50.6 ± 16.5 vs. 76.4 ± 15.5). Food safety training resulted in significant differences in the mean score percentages of all the different knowledge parameters after training ($P < 0.05$) and in an improvement in their overall food safety knowledge. The highest knowledge improvement was in food handling (71%). The lowest improvement was in food storage (50%).

The positive impact of the food safety education on knowledge of the food handlers in this study is similar to results from several previous studies (Campbell *et al.*, 1998, Mathias *et al.*, 1995, Sastry, 1997, Singh, 2004, Soneff *et al.*, 1994, Viedma *et al.*, 2000). However, some studies have reported no significant impact of food safety education on the knowledge of food handlers (Danchaivijitr *et al.*, 2005). This could be partly due to variation in the methodology of health education (Ribben *et al.*, 1994). At the same time, the demographic and professional profile of food handlers could also influence the outcome of the health education interventions. Other studies (Kassa *et al.*, 2010, Malhotra *et al.*, 2007) have also found that food safety training and/or certification have a positive impact on food handlers' knowledge on food safety. Jenkins-McLean, Skilton, & Sellers (2004) and Lin and Sneed (2005) found that enhancing knowledge can change behavior and practice.

It may be contended that improvement in knowledge in this study could be due to the influence of personal and food hygiene messages communicated to the food handlers through other sources such as mass media. It should be noted that there were neither other educational campaigns nor an increased focus in the mass media, other than routine, on personal and food hygiene during this study. Though this reduces the possibility of extraneous sources of learning in influencing knowledge and practices of the food handlers, the role of such sources cannot be ruled out completely. In addition, a study by

Dharod *et al.* (2004) found that food safety knowledge, attitudes, and behaviors could be positively affected by culturally relevant media.

5.3.2 Practice

Lack significant change positive change amongst the food handlers practices after the food safety education was observed in this study (101 ± 11.6 Vs. 105.3 ± 12.2). This could be attributed to self-report other than actual observation in both the baseline and interventional stages. The reported harmful practices have the potential to transfer pathogenic organisms to food and merit attention. In spite of the food handlers being aware and have a positive attitude towards food safety practices, the reported lack of safe practices highlights a gap between knowledge and attitude and actual food safety practice. Other studies (Azanza and Zamora-Luna, 2005) have shown similar findings; Azanza and Zomora-Luna (2000) found a significant discrepancy between reported food safety knowledge and actual food safety practice. Meer and Misner's (2000) research showed that although participants in a US Food and Nutrition Education program with previous food safety education scored higher than those without it on 11 food safety knowledge questions, there were no significant differences in their practices (Meer and Misner, 2000).

Other factors in the work place that were highlighted through FGDs that could have contributed to the observed gap is availability of appropriate equipments and facilities. Other studies have also shown similar factors (Green *et al.*, 2007). However it should be noted that this study did not assess their roles in food safety and no conclusion has been made on the same.

5.3.3 On-site Sanitation Inspection

Without actually going into the facility and observing the workers' food handling behaviours, it is hard to determine if, as a result of the food safety training, the participants will adopt safe food handling behaviours. This study employed an onsite inspection program to assess whether the knowledge showed by food handlers was put into practice, little improvement was observed (48.8 ± 6.5 Vs 54.6 ± 6.8). These findings are in concurrence with previous studies (Meers & Misner, 2000) which showed that food

safety knowledge scores had a small positive effect on food safety practices. In a review of food safety studies, Redmond & Griffith (2003) showed that food safety knowledge, attitudes, intentions, and self reported practices did not correspond to observed behaviours, suggesting that observational studies provide a more accurate indication of the food safety practices actually uses in food preparation (Redmond and Griffith, 2003).

Another study by Clayton and colleagues (2002) reported that food safety training does not necessarily guarantee that the workers carry out the safe food handling behaviours. The study suggested that barriers preventing the workers from always practicing safe food handling included lack of time, lack of staff and lack of resources. These results were based on the food handlers' self reported practices, like the food safety practices survey in this study. Additionally, similar relevant reports such as USDA (2002) also showed that consumers were knowledgeable about food safety, but this knowledge was not always reflected in their food handling behavior when they were observed. Another study by McIntosh and his colleagues found out that knowledge on specific food borne pathogens and food safety practices had no effect on the food handlers' willingness to change their behavior (McIntosh *et al.*, 1994). In another study conducted in school food service employees' food handling and practices and food safety knowledge and attitudes, it was established that the food safety knowledge was high, but when handling behaviours were observed, the safe food handling was not practiced (Henroid and Sneed, 2004).

In contrast, some studies demonstrate increased food safety practices as a result of food safety education when food handlers are observed. Studies have reported that food safety education helped to increase sanitary conditions in restaurants (Cotterchio *et al.*, 1998, Mathias *et al.*, 1995, Soneff *et al.*, 1994). These studies suggest that food safety did lead to increased adoption of safe food handling practices as evidenced in an adult in an care facility audit (Soneff *et al.*, 1994) and restraint inspection scores (Cotterchio *et al.*, 1998; Mathias *et al.*, 1995).

Even though the actual foods served to patients in the hospitals studies were not sampled for microbial analysis in this study to more definitively determine their safety, reported lack of food sufficient food hygiene practices can theoretically put the patients in the hospital environment at risk of developing food borne illnesses.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

The goal of any hospital food handlers/caterer's services should be to provide food that meets nutritional requirements and is microbiologically safe. Food preparation and distribution to hospital patients plays a critical role in the safety of hospital food. Moreover, for immunocompromised patients, the potential for food to cause infection is even greater. In view of the findings of this study the following conclusions can be made:

6.1 Extent of Hospital Conformance to Food Safety Standards

- On the basis of the findings of this study, it is concluded that assessment of the good hygienic practices and good kitchen practices has identified gaps with regard to status of the hospital kitchen, status and storage of equipments, some aspects of personal hygiene and sanitation and vector control. It is a well known fact that a well designed premises and reliable equipments are the foundations for the prevention and control of food safety hazards and thus, improvements in these areas should also be done.
- The majority of the hospitals have no standard food safety systems in place. Food handlers and their supervisors in the hospitals studied have insufficient knowledge regarding the HACCP and other food safety operating systems. HACCP system has only been implemented in four (4) out of forty two (42) hospital studied. This lack of food safety systems can lead to poor food safety standards and lead to detrimental health effects to the patients. Further, the hospital kitchen facilities were not inspected often.

6.2 Barriers to Compliance to Food Safety Standards

- This study's findings indicate lack of food safety training, poor working conditions, high turnover amongst hospital food handlers, lack of properly functioning equipments, lack of water, lack of recognition by the hospital administration and insufficient supervision as the major perceived barriers

hindering compliance to food safety standards and prevent them from performing their duties adequately.

6.3 Evaluation of Food Safety Training

- The results of this study support the assumption that the development and delivery of a food safety education program for participating food handlers and their supervisors would increase food safety knowledge, an indication of adoption of safe food handling behaviors. This can presumably decrease the risk and incidence of food-borne illness in patients in the hospital environment. However, food safety knowledge does not always translate to safer food safety practices.
- The study findings showed that food safety knowledge and handling practices in the hospital that had implemented HACCP hospitals studied were unsatisfactory before training. However, the training programme improved most of the aspects of food safety issues assessed in all the hospitals, although practice still lagged behind knowledge.
- It is also concluded from this study, that due to the limitation on the training time and frequency of training, education could affect the improvement of hygiene knowledge, but the food safety practice and hygiene management performances were not improved. However, considering the fact that there were some significant increases in knowledge, it is concluded that practicing continual and repetitive hygiene education could be effective even in improving the sanitation management level as well as the hygiene knowledge and sanitation practices. To do this, the frequency of food safety training reinforced through specific goal setting, and more concrete training programs suitable for the employees' educational background should be designed. In addition, designing the program to motivate employees to maintain and self-regulate proper practices is warranted.

6.4 RECOMMENDATIONS

In view of the findings of this study the following recommendations can be made:

6.4.1 Recommendations for Policy

- The current study shows that food handlers in the hospitals in Kenya have insufficient knowledge regarding the basics of food hygiene. Providing education about the HACCP system or/and other appropriate standard food safety operation procedures may help. Implementation of the HACCP system, universally adopted as a proactive method to prevent foodborne diseases, does require a team approach and an understanding of the rationale for monitoring procedures by food handlers. Furthermore, it underscores the need for continuous training.
- Food services staff in hospitals represent a potential source of nosocomial foodborne outbreaks since they can contaminate food with pathogens at any stage of the food chain purchasing, preparing and distributing process. Therefore to prevent unintentional contamination due to lack of adequate knowledge, educational/training programs need to be established in order to continually strengthen food safety principles.
- Although the present food safety standards laid down by the Public Health Act 242 of Kenya with regard to functioning of food service establishments and maintenance of food hygiene state that every person employed in a food service establishment should be medically examined at the time of joining work and at least once a year thereafter, they do not mandate pre-employment or in-service education of food handlers in food and personal hygiene. The findings of the present study and previous studies (Githingi, 2009; Muinde and Kuria, 2005) highlight the importance of incorporating regular education of food handlers in food and personal hygiene in the standards and guidelines for food establishments.

- In a country where adequate foodborne disease surveillance system lacks, adoption of the Hazard Analysis and Critical Control Points (HACCP) approach is probably the most cost effective approach and will definitely ensure the quality and safety of the served meals. It follows that sound approaches to food safety management in hospital foods must be implemented by the government and relevant stakeholders.

6.4.2 Recommendations for Further Studies

- It may be contended that the improvement in knowledge and to a lesser extent practices observed in the present study is reflective of a temporal trend rather than the health education intervention. This is contested as this study is limited by having only 2 measures of knowledge and practices 3 months apart, and not repeated measures. But the magnitude of the change observed is unlikely to be due to a temporal trend. The validity of the results can be improved by inclusion of repeated measures in future studies.
- Furthermore, the results of the present study are limited to only the hospital environment, the nature and extent of the impact of a similar health education intervention among food handlers having different demographic and professional profile in different settings could be different. Further studies looking at varied groups of food handlers working in varied and larger settings are warranted.
- Food laws, legal requirements which include regular sanitary inspection should practice; these should be followed with strict enforcement to improve sanitary conditions in health care kitchen setting in case where insanitary conditions prevail. Food facility inspections are required by food sanitation codes throughout Kenya have been recommended in model food codes and sanitation ordinances in Public Health Act 242 of Kenya. Although restaurant inspections are based on scientifically sound principles of food safety, they have not been evaluated to determine whether they actually prevent food-borne outbreaks. Studies in this area are warranted.

- Without microbial analyses and time/temperature checks of the food, it is impossible to determine if the food safety curriculum and delivery of the program made the food served by food handlers to patients. Further exploration and testing the safety of the food is needed.

REFERENCES

- AARNISALO, K., TALLAVAARA, K., WIRTANEN, G., MAIJALA, R. & RAASKA, L. 2006. The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. *Food Control*, 17, 1001-1101.
- ABILA, R. D. 2003. Food Safety in Food Security and Food Trade. Case study: Kenya fish exports. 2020 Vision for Food, Agriculture and the Environment, Focus 10, Brief 8 of 17 [Accessed 2/11/2010].
- ANGELILLO, F., VIGGIANI, N., RIZZO, L. & BIANCO, A. 2000. Food handlers and foodborne diseases knowledge, attitudes, and reported behavior in Italy. *Journal of Food Protection* 63, 381 - 3855.
- ANGELILLO, I. F., VIGGIANI, N. M., GRECO, R. M. & RITO, D. 2001. HACCP and food hygiene in hospitals: knowledge, attitudes, and practices of food-service staff in Calabria, Italy *Infection Control Hospital Epidemiology*, 22, 363 - 369.
- ASKARIAN, M., KABIR, G., AMINBAIG, M., MEMISH, Z. & JAFARI, P. 2004. Knowledge, attitudes, and practices of food service staff regarding food hygiene in Shiraz, Iran. *Infection Control Hospital Epidemiology*, 25, 16-20.
- ATANASSOVA, V., MEINDI, A. & RING, C. 2001. Prevalence of Staphylococcus aureus and Staphylococcal enterotoxins in raw pork and uncooked smoked ham – a comparison of classical culturing detection and RFLP – PCR. *International Journal of Food Microbiology* 68, 105 - 113.
- AYLIFFE, G. A. 1992. *Control of hospital infection*, London, Chapman & Hall Medical.
- AZANZA, M. P. & ZAMORA-LUNA, M. B. 2005. Barriers of HACCP team members to guideline adherence. *Food Control*, 16, 15 - 22.
- AZZIZ-BAUMGARTNER, E., LINDBLADE, K., GEISEKER, K., ROGERS, H., KEISZAK, S., NJAPAU, H., SCHLEICHER, R., MCCOY, L., MISORE, A., DECOCK, K., RUBIN, C. & SLUTSKER, L. 2005. Case - Control Study of an acute Aflatoxicosis Outbreak, Kenya, 2004. *Environmental Health Perspective*, 113, 1779-1783.
- BAGGE-RAVN, D., HJLEM, M., CHRISTIANSEN, J. N., JOHANSEN, C. & GRAM, L. 2003. The microbial ecology of processing equipment in different fish industries-analysis of the microflora during processing and following cleaning and disinfection. *International Journal of Food Microbiology* 87, 239 - 250.

- BARRIE, D. 1996. The provision of food and catering services in hospital. *Journal of Hospital Infection*, 33, 13 - 33.
- BAS, M., ERSUN, A. & KIVANC, G. 2006. The evaluation of food hygiene knowledge, attitudes, and practices of food handlers in food businesses in Turkey. *Journal of Food Control*, 17, 317 - 322.
- BEURCHART, L. R. 1998. Surface decontamination of fruits and vegetables eaten raw: a review. Geneva: World Health Organization, Food Safety Unit.
- BORCH, E. & ARINDA, P. 2002. Bacteriological safety issues in red meat and ready to eat meat products as well as control measures. *Meat Science*, 62, 381-390.
- BROUGHAM, P. 1998. Hygiene Practices. *Journal of food processing*, 67, 142.
- BUBZY, J. C. 2001. Children and microbial foodborne illness. *Food Reviews*, 24.
- BUBZY, J. C. 2002. Older Adults at risk of complications from microbial foodborne illness. *Food Reviews*, 25, 30 - 35.
- BURCH, N. L. & SAWYER, C. A. 1991. Food handling in convenience stores. *Journal of Environmental Health*, 54, 23-27.
- CAC. 1999. Codex Alimentarius: General requirements 1A.
- CAMPBELL, M. E., GARDNER, C. E., DURYER, J. J., ISACS, S. M., KRUGER, P. D. & YING, J. Y. 1998. Effectiveness of public health interventions in food safety: a systematic review. *Canadian J Public Health*, 89, 197-202.
- CDC. 2002. National Antimicrobial Resistance Monitoring Systems for Enteric Bacteria - Annual Report for 2000.
- CDC. 2004. 2002 Summary Statistics: The Total Number of Foodborne Disease Outbreaks by Etiology. *Outbreak Response and Surveillance Unit* [Online].
- CECILIA, B., ALESSANDRA, C., SANTO, G., MARCO, G., MAURIZIO, G. & GATERINA, M. 2007. Food safety in hospital: knowledge, attitudes and practices of nursing staff of two hospitals in Sicily, Italy. *BMC Health Services Research*, 7.
- CHANG, H. J., LEE, J. S. & KWAK, T. K. 2003. Effectiveness of HACCP-based training on the food safety knowledge and behavior of hospital foodservice employees. *Nutritional Sciences* 6:118-26, 6, 118 - 126.
- CHITNIS, U., GANGULI, S., TANEJA, R. & SS, G. 1986. An evaluation of health status of workers of eating establishments in Pune Contonment. *Medical Journal Armed Forces*, 42, 39 - 42.

- CILCE, H., MAGDA, A., DIRCE, M. & TANIA, B. 2009. Hurdles at work: perceptions of hospital food handlers. *Human Resource for Health*, 7, 63 - 70.
- CLAYTON, D. A., GRIFFIN, C. J., PRICE, P. & PETERS, A. C. 2002. Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research* 12, 25 - 39.
- CLAYTON, D. A. & GRIFFITH, C. 2004. Observation of food safety practices in catering using notational analysis. 106:211– 227. *British Food Journal*, 106, 211-227.
- CLAYTON, D. A. & GRIFFITH, C. J. 2008. Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices. *International Journal of Environmental Health Research*, 18, 83-98.
- COOK, C. & CASEY, R. 2002. Assessment of a foodservice management sanitation course. *Journal of Environmental Health*, 41, 281-284.
- COOLS, I., UYTENDAELE, M., CERPENTIER, J., D'HAESE, E., NELIS, J. H. & DEBEVERE, J. 2005. Persistence of *Campylobacter jejuni* on surfaces in a processing environment and on cutting boards. *Letters in Applied Microbiology*, 40, 418-432.
- COTTERCHIO, M., GUNN, J., COFFILL, T., TORMEY, P. & ANITA, M. 1998. Effect of a manager training program on sanitary conditions in restaurants. *Public Health Rep*, 113, 353-358.
- CUNNINGHAM, C. 1993. A survey of the attitudes and perceptions of food service operators in the Hamilton-Wentworth region. *Canadian Journal of Public Health*, 84, 107 - 111.
- CUSTOVIC, A. & IBRAHIMAGIC, O. 2005. Prevention of food poisoning in hospitals. *Medicinski arhiv*, 9, 303 - 305.
- DALTON, C. E. A. 2004. Foodborne disease outbreaks in Australia, 1995 to 2000. *Communicable diseases intelligence*, 28, 211 - 224.
- DANCHAIVIJITR, S., RONGRUNGRUANG, Y., KACHINTORN, U., TECHASATHIT, V., PAKAWORAVUTHI, S. & KACHINTORN, K. 2005. Prevalence and effectiveness of an education program on intestinal pathogens in food handlers. *Journal of Medical Association Thailand*, 88, 31-35.

- DUFF, S. B., SCOTT, E. & MALFIOS, M. M. 2003. Cost effectiveness of a targeted disinfection program in household kitchens to prevent foodborne illness in the United States, Canada and United Kingdom. *Journal of Food Protection*.
- EFFLER, P., LEONG, M. C., KIMURA, A., NAKATA, M., BURR, R., CREMER, E. & SLUTSKER, L. 1999. Sporadic *Campylobacter jejuni* infections in Hawaii: associations with prior antibiotic use and commercially prepared chicken. *The Journal of Infectious Diseases*, 183, 1152-1155.
- EGAN, M., RAATS, M., GRUBB, S., EVES, A., LUMBERS, L., DEAN, M. & ADAMS, M. 2007. A Review of food safety and food hygiene training studies in the commercial sector. *Journal of Food Control*, 18, 1180-1190.
- EHIRI, J. & MORRIS, G. 1996. Hygiene training and education of food handlers: Does it work? *Ecological Journal of Food and Nutrition*, 243-251.
- EHIRI, J. E., MORRIS, G. P. & MCEWEN, J. 1997. Evaluation of a food hygiene training course in Scotland. *Journal of Food Control*, 8, 137-147.
- EL DEREHA, H., SALEM, E., FAWZI, M. & ABDEL, A. M. 2008. Safety of patient meals in 2 hospitals in Alexandria, Egypt before and after training of food handlers. *Eastern Mediterranean Health Journal*, 14.
- EVANS, J. A., RUSSELL, S. L., JAMES, C. & CORRY, J. E. 2004. Microbial contamination of food refrigeration equipment. *Journal of Food Engineering*, 62, 225-232.
- FAO/WHO 2005a. National Food Safety Situation in Kenya, Regional Conference on Food Safety for Africa. Harare, Zimbabwe.
- FAO/WHO 2005b. National Food Safety Situation in Kenya, Regional Conference on Food Safety for Africa. *Document 22. WHO, Harare Zimbabwe, 3-6 October, 2005.*
- FAO/WHO 2006. Prevention of Food borne Diseases: The Five Keys to Safer Food International Food Safety Authorities Network (INFOSAN), 18 October. *INFOSAN Information Note No. 5/2006.*
- FPEAK. 2007. Quality Assurance in Competitive Export Business: Making Kenyan Horticulture the Global Choice 2004.
- FRENCH, M. R. 2001. A survey of the use of low microbial diets in pediatric bone marrow transplant programs. *Journal of American Dietetic Association*, 101, 1194-1198.

- FRIEDMAN, C., HOEKSTRA, M., SAMUEL, R., MARCUS, J. & BENDER, B. 2004. Emerging Infections Program Food-Net Working Group. Risk factors for sporadic *Campylobacter* infection in the United States: A case-control study in FoodNet sites. *Clin. Infect. Dis.* 38:S285–S296.
- FROHBERG, K., GROTE, U. & WINTER, E. 2006. EU Food Safety Standards, Traceability and Other Regulations: A Growing Trade Barrier to Developing Countries' Exports? Invited Paper Prepared for Presentation at the International Association of Agricultural Economists Conference. Gold Coast Australia. August 12 – 18 2006.
- FUSTER-VALLS, N., HERNANDEZ-HERRERO, M., MARIN-DE-MATEO, M. & RODRIGUEZ- JEREZ, J. 2008. Effect of different environmental conditions on the bacteria survival on stainless steel surfaces. *Food Control*, 19, 308-314.
- GAIN. 2005. Kenya, Food and Agricultural Import Regulations and Standards United States Department of Agriculture (USDA) Foreign Agricultural Service. GAIN Report No. KE 5011. November 2005.: Global Agricultural Information Network.
- GEBREHIWET, Y., NGQANGWENI, S. & KRISTEN, J. 2007. Quantifying the Trade Effect of Sanitary and Phytosanitary Regulations of OECD Countries on South African Food Exports. *Agrekon*, 46, 23-39.
- GIKAS, A. 2007. A Nosocomial, Foodborne Outbreak of *Salmonella* Enterica serovar Enteritidis in a University Hospital in Greece: the Importance of Establishing HACCP Systems in Hospital Catering. *The Hospital Infection Society*, 194-196.
- GITHIRI, M., OKEMO, P. & KIMINYWE, J. 2009. Hgiene practices and occurrence of coliform and staphylococcus on food at a public hospital in Kenya. *Journal of applied biosciences*, 27, 1727 - 1731.
- GOH, K. 1997. Information related to food and water-borne disease in Penang. *Medical Journal Penang Hosp*, 2, 42 - 47.
- GOK. 2007a. The Laws of Kenya. Food, Drugs and Chemical Substances Act Cap 254
- GOK. 2007b. The Laws of Kenya. Public Health Act Cap 242. . [Accessed 15th May 2011].
- GREEN, L., RADKE, V. & MASON, R. 2007. Factors related to food worker hand hygiene practices. *Journal of Food Protection*, 70, 661-666.
- GREIG, J. D., TODD, E. C., BARTLESON, C. A. & MICHAEL, B. S. 2007. Outbreaks where food workers have been implicated in the spread of foodborne disease. *Journal of food protection*, 70, 1752 - 1761.

- GRIFFITH, C., LIVESEY, K. & CLAYTON, D. 2010. Food safety culture: The evolution of an emerging risk factor. *British Food Journal*, 112, 426-438.
- GRIFFITH, C. J., FARBER, J. M. & TODD, E. C. 2000. Food safety in catering establishments. *Safe Handling of Foods*, 235-256.
- GUALLAR, C., ANZA, J., DOMINGUEZ, M. A., PEN, C., GRAV, I. & VERDAGUER, R. 2004. An isidious nosocomial outbreak due to salmonella Enteriditis. *Infection Control Hospital and Epidemiology*, 25, 10 - 15.
- GUDETA., D. 2007. *Sanitary Survey of Food and Drinking Establishments in Ambo Town West Showa Zone Oromia Region*. MSc. Thesis, Addis Ababa University.
- HAYES, C., ELLIOT, E., KRALES, E. & DROWNER, G. 2003. Food and water safety for persons infected with HIV. *CID*, 36, 106 - 109.
- HEDBERG, C., MACDONALD, K. & OSTERHOLM, M. 1994. Changing epidemiology of food-borne disease: A minesota perspective *Clin Infe Dis*, 18, 671 - 82.
- HENDRY, C., JONES, A. & ARTHUR, M. 1992. Skill supply, training and development in the small-medium enterprise. *International Small Business Journal*, 10, 68-72.
- HENROID, D. & SNEED, J. 2004. Readiness to implement hazard analysis and critical control point (HACCP) systems in Iowa schools. *Journal of American Diet Assoc*, 104, 180-185.
- HINE, S., THILMANY, D., KENDALL, P. & SMITH, K. 2003. Employees and food safety: Is training important to service managers? . *Journal of Extension*, 41.
- HOFSTEDE, G. 1998. A case for comparing apples with oranges: International differences in values. *International Journal of Comparative Sociology* 39.
- HOWES, M., MCEWEN, M., GRIFFITHS, P. & HARRIS, L. 1996a. Food handler certification by home study: Measuring changes in knowledge and behavior. *Dairy Food Environmental Sanitation*, 16, 737-744.
- HOWES, M., MCEWEN, S., GRIFFINS, M. & HARRIS, L. 1996b. Food handler certification by home study: Measuring changes in knowledge and behaviour *Food and Environmental Sanitation*, 16, 737 - 744.
- HUGHES, C., GILLESPIE, I. & O'BRIEN, S. 2007. Foodborne transmission of infectious intestinal disease in England and Wales, 1992-2003. *Food Control* 18, 766-722.

- IRWIN, K., BALLARD, J., GRENDON, J. & KOBAYASHI, J. 1989. Results of routine restaurant inspections can predict outbreaks of foodborne illness: the Seattle–King County experience. *American Journal of Public Health*, 79, 586-590.
- JACOB, M. 1989. *Safe Food Handling: A Training Guide fo Managers of Food Service Establishments*, Geneva, Switzerland, World Health Organization.
- JAFFEE, S. & MASAKURE, O. 2005. Strategic use of private standards to enhance international competitiveness : vegetable exports from Kenya and elsewhere. *Food Policy*, 30, 316-333.
- JARVIS, W. R. 2004. Controlling healthcare-associated infections: the role of infection control and antimicrobial use practices. *Semin Pediatr Infect Dis*, 15, 30-40.
- JEVS'NIK, M., HLEBEC, V. & RASPOR, P. 2006. Meta-analysis as a tool for barriers identification during HACCP implementation to improve food safety. *Acta Alimentaria*, 35, 319-353.
- JONES, P. & LOCKWOOD, A. 2009. Hospitality operating systems. *International Journal of Contemporary Hospitality Management* 7, 17-20.
- JONES, S. L., PARRY, S. M., O'BRIEN, S. J. & PALMER, S. R. 2008. Are staff Management practices and inspection risk ratings associated with foodborne disease outbreaks in the catering industry in England and Wales? *Journal of Food Protection*, 71, 550-557.
- JONES, T. F. & ANGULO, F. J. 2006. Eating in Restaurants: a risk factor for food borne disease. *Clinical Infection Diseases*, 43, 1324 -1328.
- JONGEN, W. M. 2002. Food Supply Chains from Productivity Towards Quality. In: IN PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON PERFORMANCE MEASUREMENT AND MANAGEMENT, B., USA AT JULY 17–19TH, (ed.). CranWeld: Centre for Buisness Performance.
- KAFERSTEIN, F. 2003. Actions to reverse the upward curve of foodborne illness. *Food Control*, 14, 101 - 109.
- KAFERSTEIN, F. 2006. Foodborne disease in developing countries: Aetiology, Epidemiology and strategies for prevention. *International Journal of Environmental Res*, 13.
- KAM. 2007. *Kenya Association of Manufacturers* [Online]. [Accessed accessed on 23/8/2008].
- KANDELA, D. 2004. Hospital food. *Lancet*, 353 - 763.

- KASSA, H., SILVERMAN, G. & BAROUDI, K. 2010. Effect of a Manager Training and Certification Program on Food Safety and Hygiene in Foodservice Operations. *Environmental Health Insights*, 4, 13-20.
- KEBS 2005. Kenya Standard Tomato Products – Specification Part 2: Tomato Concentrate (Puree and Paste). In: 39–2:2005, K. (ed.) 3 ed.
- KIRBY, M. P. & GARDINER, K. 1997. The effectiveness of hygiene training for food handlers. *International Journal of Environmental Health Research*, 7, 251-258.
- LASZTITY, R., PETRO-TURZA, M. & FOLDES, T. 2004. History of Food Quality Standards, In Food Quality Standards [Lasztity R Ed.] In Encyclopedia of Life Support Systems (EOLSS).
- LOBDELL, D. T., GILBOA, S., MENDOLA, P. & HESSE, B. W. 2005. Use of focus groups for the environmental health researcher. *Journal of Environmental Health*, 67, 36-42.
- LYNCH, M., PAINTER, J., WOODRUFF, R. & BRADEN, C. 2006. Surveillance for foodborne-disease outbreaks in United States, 1998 - 2002. *MMWR Surveill Summ*, 55, 1 - 42.
- MACAUSLAN, E. 2003. The boss, the owner, the proprietor, the food hygiene manager? *The Journal of the Royal Society for the Promotion of Health*, 123, 229-232.
- MACKENZIE, A. A., ALLARD, D. G., PEREZ, E. & HATHAWAY, S. 2004. Food systems and changing patterns of foodborne zoonoses. *Rev Sc Tech*, 23.
- MAGUIRE, H. 2000. Hospital outbreak of Salmonella virchow possibly associated with a food handler. *Journal of hospital infection*, 44, 261 - 266.
- MALHOTRA, R., LAL, P., PRAKASH, S., DAGA, M. & KISHORE, J. 2007. Study of handhygiene and enteric parasite infestation among food handlers working in a medical college of North India. *Public Health*, 121, 455-461.
- MANNING, C. & SNIDER, S. 1993. Temporary public eating places: Food safety knowledge, attitudes, and practices. *Journal of Environmental Health* 56, 24-28.
- MATHIAS, R. G., SIZTO, R., HAZLEWOOD, A. & COCKSEGE, W. 1995. The effects of inspection frequency and food handler education on restaurant inspection violations. *Canadian Journal of Public Health*, 86, 46-50.

- MAUSCH, K., MITHOFER, D., ASFAW, S. & WAIBEL, H. 2006. Impact of EurepGAP Standard in Kenya: Comparing Smallholders to Large – scale Vegetable Producers, Conference Paper on International Agricultural Research and Development. University of Bonn. October 11 – 13, 2006.
- MCEVOY, J. M., SHERIDAN, J. J., BLAIR, I. S. & MCDOWELL, D. A. 2004. Microbiological contamination of beef carcasses in relation to hygiene assessment based on criteria used in EU Decision 2001/47/EC. *International Journal of Food Microbiology*, 92, 217-225.
- MCINTOSH, W. A., CHRISTENSEN, L. B. & ACUFF, G. R. 1994. Perceptions of risks of eating undercooked meat and willingness to change cooking practices. *Appetite*, 22, 83-96.
- MEAKINS, S. M., ADAK, G. K., LOPMAN, B. A. & O'BRIEN, S. J. 2003. General outbreaks of infectious intestinal diseases (IID) in hospitals, England and Wales, 1992 - 2000 *The Journal of Hospital Infection*, 53, 1-5.
- MEER, R. R. & MISNER, S. L. 2000. Food safety knowledge and behavior of expanded food and nutrition education program participants in Arizona. *Journal Food Protection* 63, 725-1731.
- MENSAH, P. D., K., Y.-M., OWUSU, D. & ABLORDE, A. 2002. Street Foods in Accra Ghana: how safe are they? *Bull (WHO)*, 80, 546-554.
- MIGUEL, A., CRUZ, H., DOLORES, J., KATZ, J. & SUAREZ, B. 2001. An Assessment of the Ability of Routine Restaurant Inspections to Predict Food-Borne Outbreaks in Miami–Dade County, Florida. *American Journal Public Health*, 91, 821-823.
- MOH. 2005. Ministry of Health. Nairobi: Government Printers.
- MOHAN, V., MOHAN, U., DASS, L. & LAL, M. 2001. An evaluation of health status of food handlers of eating establishments in various educational and health institutions in Amristsar City. *Indian Com Med*, 26, 80 - 85.
- MORTLOCK, M. P., PETERS, A. C. & GRIFFITH, C. 2000. A national survey of food hygiene training and qualification levels in the UK food industry. *International Journal of Environmental Health Research*, 10, 111-123.
- MOSSEL, D. A. & STRUIJK, C. B. 1995. Escherichia coli, other Enterobacteriaceae and additional indicators as markers of microbiologic quality of food: advantages and limitations. *Microbiologia*, 11, 75-90.

- MOTARJEMI, Y. & KAFERSTEIN, F. K. 1997. Global estimation of foodborne diseases. *World Health Stat* 50, 5-11.
- MOTARJEMI, Y. & MORTIMORE, S. 2005. Industry's need and expectations to meet food safety, 5th International meeting: Noordwijk food safety and HACCP forum 9e10 December 2002. *Food Control*, 16, 523-529.
- MUINDE, O. K. & KURIA, E. 2005. Hygiene and sanitary practices of vendors of street food in Nairobi, Kenya. *African journal of food agriculture nutrition and development*, 5, 1 - 14.
- MWANGI, A., ARIMI, S. M., MBUGUA, S., KANGETHE, E. K. & OMORE, A. O. 2000. Assurance of Marketed Milk Quality in Kenya, . *Faculty of Veterinary Medicine Biennial Scientific Conference University of Nairobi*.
- MWANGI, P., NAMBIRO, E. & MURITHI, F. 2004. Safe and High Quality Food Supply Chains and Networks (SAFEACC) project Vegetable and Fruits, Fish and Beef products: The Kenya Component. *KARI/Global Food Network*.
- NCST 2009. A Proposed Coordination Structure for Biosafety Regulatory Agencies in Kenya. March 2009.: The National Council for Science and Technology.
- NELSON, M. B. 2005. International Rules, Food Safety and the Poor Developing Country Livestock Producer, Pro-Poor Livestock Policy Initiative Working Paper No. 5. FAO: Rome.
- NGUZ, K. 2007. Assessing Food Safety System in Sub-Saharan Countries: An Overview of Key Issues. *Food Control*, 18, 131-134.
- OLIVEIRA, A. M., GONÇALVES, A. M., SHINOHARA, N. K. S. & STAMFORD, T. L. M. 2003. Manipuladores de Alimentos: Um fator de risco. *Higiene Alimentar.*, 17, 114-115.
- OLOO, J. E. O. 2010. Food safety and quality management in Kenya: An overview of the roles played by various stakeholders. *African journal of food agriculture nutrition and development*, 10, 4379 - 4397.
- OLSEN, S. J., HANSEN, G. R., BARTLETT, L., FITZGERALD, C., SONDER, A. & MANJREKAR, R. 2001. An outbreak of *Campylobacter jejuni* infections associated with food handler contamination: the use of pulsed-field gel electrophoresis. *Journal of Infectious Disease*, 183, 164-167.
- OTERI, T. & EKANEM, E. 1989. Food hygiene behaviour among hospital food handlers. *Public Health*, 84.

- PATIL, S. R., CATES, S. & MORALES, R. 2005. Consumer food safety knowledge, practices, and demographic differences: findings from a meta-analysis. *Journal of Food Protection* 68, 1884-1894.
- PILLING, V. K., BRANNON, L. A., SHANKLIN, C. W., HOWELLS, A. D. & ROBERTS, K. R. 2008. Identifying specific beliefs to target to improve restaurant employees' intentions for performing three important food safety behaviors *American Dietetic Association*, 108, 991-997.
- PITTET, D., ALLEGRANZI, B., SAX, H., DHARAN, S., PESSOA-SILVA, C. L., DONALDSON, L. & BOYCE, J. M. 2006. Evidence-based model for hand transmission during patient care and the role of improved practices. *Lancet Infect Dis*, 6, 641-652.
- PRIANKA, M., GAUTAM, K., KANAD, B., AMRITA, S., SONALI, S. & SESADRI, K. 2012. Identifying key risk behaviours regarding personal hygiene and food safety practices of food handlers working in eating establishments located within a hospital campus in Kolkata. *Al Ammen journal of medical science*, 5, 21 - 28.
- PRZYBYLSKA, A. 2001. Outbreak of foodborne and waterborne infections and intoxications in hospitals and sanatoria in Poland *Przegląd epidemiologiczny*, 55, 217 - 229.
- REDMOND, E. C. & GRIFFITH, C. J. 2003. Consumer food handling in the home: A review of food safety studies. *Journal of Food Protection*, 66, 130-161.
- REGAN, C., SYED, Q. & TUNSTALL, P. 1995. A hospital outbreak of *Clostridium perfringens* food poisoning—implications for food hygiene review in hospitals. *Journal of Hospital Infection*, 29, 69-73.
- RENNIE, D. 1994. Evaluation of food hygiene education. *British Food Journal*, 96, 20-25.
- RIBEN, P. D., MATHIAS, R. G., CAMPBELL, E. & WIENS, M. 1994. The evaluation of the effectiveness of routine restaurant inspections and education of food handlers: Critical appraisal of the literature. *Canadian Journal of Public Health*, 85, S56-S60.
- RICHARDS, J., PARR, E. & RISEBOROUGH, P. 1993. Hospital food hygiene: the application of Hazard Analysis Critical Control Points to conventional hospital catering. *Journal of Hospital Infection*, 24, 273-282.
- ROBERTS, K., BARRETT, B., HOWELLS, A., SHANKLIN, C., PILLING, V. & BRANNON, L. 2008. Food safety training and foodservice employees' knowledge and behaviour. *Food Protection Trends*, 28, 252-260.

- ROZIN, P., FISCHER, C., IMADA, S., SURABIN, A. & WRZESNIEWSKI, A. 1999. Attitude to food and the role of food in life in the USA, Japan, Flemish, Belgium & France: Possible Implications for the diet-health debate *Appetite*, 33, 163 - 180.
- SASTRY, N. 1997. What explains rural-urban differentials in child mortality in Brazil? *Social science & medicine*, 44, 989-1002.
- SCHARFF, R. 2009. Health related costs from foodborne illness in the United States.
- SCHLUNDT, J., TOYOFUKU, H., JANSEN, J. & HERBST, S. 2003. Emerging food-borne zoonoses. *Rev SciTech* 23, 513-533.
- SEAMAN, P. & EVES, A. 2006. The management of food safety—the role of food hygiene training in the UK service sector. *Hospitality Management*, 25, 278-296.
- SHOJOEI, H., SHOOSHTARIPOOR, J. & AMIRI, M. 2006. Efficacy of Simple Hand-Washing in Reduction of Microbial Hand Contamination of Iranian Food Handlers. *Food Research International*, 39, 525-529.
- SILVA, C. S., GERMANO, M. I. S. & GERMANO, P. M. L. 2003. Condições Higiênico-Sanitárias dos Locais de Preparação da Merenda Escolar, da Rede Estadual de Ensino em São Paulo, SP. *Higiene Alimentar*, 17(110), 49–55., 17, 49-55.
- SINGH, S. 2004. Effect of structured teaching programme on knowledge and practices related to hand washing technique among food handlers. *Nursing Journal of India*, 95, 125-126.
- SOMWANG, D., YONG, R., UDOM, K., VICHAI, T., SUMALEE, P. & KANCHANA, K. 2005. Prevalence and effectiveness of an education program on intestinal pathogens in food handlers. *journal of medical association Thailand*, 88, S31 - S35.
- SONEFF, R., MCGEACHY, F., DAVISON, K. & MCCARGAR, L. 1994. Effectiveness of two training methods to improve the quality of foodservice in small facilities for adult care. *Journal of America Diet Association*, 94, 869-873.
- SOUZA, E. L., SILVA, C. A. & SOUZA, C. P. 2004. Qualidade Sanitária de Equipamentos, Superfícies, água e mãos de manipuladores de alguns estabelecimentos que comercializam alimentos na cidade de João Pessoa, PB. *Higiene Alimentar*, 18, 98-102.
- SPERBER, W. H. 1998. Future developments in food safety and HACCP. *Food Control*, 9, 129-130.

- STRATTON, R., KING, C., STROUND, M., JACKSON, A. & ELIA, M. 2006. 'Malnutrition universal screening tool' predicts mortality and length of hospital stay in acutely elderly. *British journal of nutrition*, 95, 325 - 330.
- TAYLOR, C. L. 2004. Data gathering designs to evaluate educational programs. Institute of Food and Agricultural Services. University of Florida Cooperative Extension.
- TAYLOR, E. 2001. HACCP in small companies: benefit or burden? *Food Control*, 12, 217-222.
- TAYLOR, E. & KANE, K. 2005. Reducing the burden of HACCP in SMEs. *Food Control*, 16, 833-839.
- TOMOHIDE, Y. 2010. Food safety regulation in the united states: an empirical and theoretical examination. *In Independent Review*, 15, 210-226.
- TOMPKINS, R. B. 2001. Interactions Between Government and Industry Food Safety Activities. *Food Control*, 12, 203-277.
- TSALO, E., DROSINOS, E. H. & ZOIPOULOS, P. 2007. Impact of poultry slaughter house modernisation and updating of food safety Management Systems on the microbiological quality and safety of products *Food Control*, 19, 423-431.
- UNCTAD 2007. Private Sector – Set Standards and Developing Countries' Exports of Fresh Fruits and Vegetables: Synthesis of Country Case Studies in Africa (Ghana, Kenya, Uganda), Asia (Malaysia, Thailand, Vietnam), and Latin America (Argentina, Brazil, Costa Rica). Background Paper by UNCTAD Secretariat. *United Nations Conference on Trade and Development*.
- UNO, W. 1985. Sanitation without water revised and enlarged edition, Swedish international development Authority.
- VAN DUYNHOVEN, T. 2005. A study of one year intensified study of outbreaks of gastroenteritis in The Netherlands. *Epidemiology and infection*, 133, 9 - 21.
- VELA, A. R. & FERNÁNDEZ, J. M. 2003. Barriers for the developing and implementation of HACCP plans: results from a Spanish regional survey. *Food Control*, 14, 333-337.
- VIEDMA, G. V., REVUELTA, C. & MAJEM, L. 2000. Assessment of the effectiveness of health training courses offered for food handlers in a health care district of Gandia, Valencia. *Revista Española de Salud Pública*, 74, 299-307.
- WALKER, E., PRICHARD, C. & FORSYTHE, S. 2003. Food handler's hygiene knowledge in small businesses. *Food Control*, 14, 339 - 343.

- WANGALACHI, A. & OIYE, C. 2010. Role of major stakeholders in food quality and safety in Kenya accessed on [Accessed 13th July, 2010].
- WHEELOCK, V. 2006. Food Safety in Perspective. *British Food Journal*, 93, 31 - 36.
- WHO 1994. *Hygiene in food service and mass catering establishments. Important rules*, Geneva: WHO.
- WHO 2001. *Foodborne Diseases: A Focus for Health Education.*, Geneva, Switzerland, World Health Organization.
- WHO 2002. Prevention of hospital-acquired infections: A practical guide. (2nd Ed). Department of Communicable Disease, Surveillance and Response, 12.
- WHO 2007a. Consultation to Developm a Strategy to Estimate the Global Burden of Foodborne Diseases
- WHO. 2007b. Food safety and food-borne illness. Fact sheet No. 237.
- WHO 2008. World Health Organization (WHO) Initiative to Estimate the Global Burden of Food-borne Diseases: A Summary Document. Geneva. 2008.
- WHO/AFRO. 2007. Country Profile – Kenya. *International Competitiveness* [Online]. [Accessed 17th May 2010].
- WICKSTROM, G. & BENDIX, T. 2000. The Hawthorne effect: what did the original Hawthorne studies actually show? . *Scandinavian Journal of work, environment and health*, 26, 363-367.
- WILL, M. & GUENTHER, D. 2007. Food Quality and Safety Standards as required by EU Law and the Private Industry with special Reference to MEDA Countries' Exports of Fresh and Processed Fruits and Vegetables, Herbs and Spices: A Practitioners' Reference Book. (2nd ed.) GTZ – Division 45.
- WORSFOLD, D. & GRIFFITH, C. J. 2003. A survey of food hygiene and safety training in the retail and catering industry. *Nutrition & Food Science*, 33, 68-79.
- YIANNAS, T. 2009. Food Safety Culture: Creating A Behavior Based Food Safety Management System. *Springer, NY*.
- ZOTERMANS, S., ZWIETERING, M. H. & MEAD, G. C. 1994. Identification of Potentially Hazardous Microorganisms. *Food Microbiology*, 11, 203 - 214.

APPENDICES

Appendix I: Questionnaire for Hospital Manager in Charge of Food Services

HACCP AND FOOD-HYGIENE SURVEY

Please read the questions carefully and respond in the manner clearly indicated for each (for example, check all that apply)

1. Number of beds in your hospital _____
2. Estimated number of meals distributed daily to the patients in your hospital _____
3. Indicate the number of food-services staff in your hospital for each of the following:
 - ___ Cooks
 - ___ Nurses
 - ___ Dietitians
 - ___ Domestic staff
 - ___ Other (please specify)

Regarding the service catering organization in your hospital:

4. Are the meals prepared in the hospital kitchen? ___ Yes ___ No
5. Has the HACCP system been implemented? ___ Yes ___ No
6. Has any food-hygiene operating procedure been documented? ___ Yes ___ No

Indicate which of the following guidelines have been developed in your hospital (check all that apply)

7. ___ Food-storage procedures
8. ___ Procedures for personal hygiene of food-services staff
9. ___ Cleaning and disinfection of surfaces and equipment
10. ___ Temperature monitoring of foods

Indicate which of the following food-hygiene practices are carried out in your hospital (check all that apply)

11. ___ Hazard analysis of food practices
12. ___ Inspection of raw materials
13. ___ Identification of critical points regarding food safety
14. ___ Microbiological testing of foods
15. ___ Microbiological testing of surfaces
16. Have you ever heard of HACCP or any other food safety standards? ___ Yes ___ No
17. If yes, do you use Critical Control Points Tree? _____
18. Have continuing education courses on HACCP and food hygiene for food-services staff been implemented? ___ Yes ___ No

Appendix II: Scoring Scheme for Evaluation of Kitchen Conditions

Customized Scoring Scheme Designed for Comparing Standards that Evaluate Kitchen Conditions and if Control Measures Exist and are Implemented as Observed by the Researcher at the Time of Visit.

Kitchen condition

Floors, walls and ceilings

1. Type of floor: ___ Concrete/ cement ___ Earthen ___ Brick ___ Plastered ___ Wooden
_____ Other(specify)
2. Is the floor clean at time of visit? ___ Yes ___ No
3. Floor status: ___ In good condition ___ Average condition ___ Bad condition
4. Is the wall free from visible dust, soot, dirt or spider web? ___ Yes ___ No
5. Is the wall free from holes and cracks? ___ Yes ___ No
6. Does the kitchen space serve for other additional purpose? _____ Yes (specify)
_____ No

Lighting and ventilation

7. Is the kitchen provided with adequate lighting systems? ___ Yes ___ No
8. Is the kitchen provided with adequate ventilation systems? ___ Yes ___ No

Insect and vermin protection

9. Is any infestation of kitchen observed at time of visiting? _____ Yes (specify) ___ No

Kitchen equipments and food handlers

10. Are the equipments kept clean and free from visible dirt and filth? ___ Yes ___ No
11. Are equipments free from cracks? ___ Yes ___ No
12. Are equipments easily cleanable? ___ Yes ___ No
13. Is there basin for washing utensils used for food preparation? ___ Yes ___ No
14. If present, how many compartments does it have? _____
15. What type of basin is it? ___ fixed smooth surface with water tap ___ dish bowls/bucket
_____ fixed rough concrete with water tap _____ other (specify)
16. Cleanness of the basin and its surrounding area: _____ kept ___ not kept
17. Modes of cleaning and sanitizing of utensils:
_____ Hot and cold water and detergent used for cleaning
_____ Only cold water with detergent used
_____ Only hot and cold water used
_____ Only cold water used
_____ Only local soap and cold water used

_____Sanitization of equipments & utensils soaked in detergent

18. Are there drying racks for sanitized and cleaned utensils? ____Yes ____No

19. Are utensils and equipments stored in containers or on shelves under conditions which prevent

contaminations? ____Yes ____No

20. Do all food handlers wear appropriate clothes? ____Yes ____No

21. Are food handlers' clothing clean? ____Yes ____No

22. Are food handlers' nails short trimmed and clean? ____Yes ____No

23. Do food handlers have discharges from nose and eye and cough during visit? ____Yes
____No

24. Is any kind of visible skin rash, boil, cut and wound observed at time of visit? ____Yes
____No

25. If any visible cut and wound has been observed, is it:

_____Plastered with water impermeable bandage _____ Openly left _____Other (specify)

26. Do handlers wear any type of jewelry at time of visit? ____Yes ____No

27. Do managers supervise workers on their normal work? ____Yes ____No

28. Is cooked food handled properly in kitchen/ kept in sealed conditions to prevent access to insect and

environment? ____Yes ____No

Waste management

Solid waste

29. Are appropriate refuse receptacles present in the kitchen? ____Yes ____No

30. Are the receptacles properly covered and tight? ____Yes ____No

31. Are the receptacles overfilled at the time of visit? ____Yes ____No

32. Are the refuse transported to final disposal before over filling? ____Yes ____No

33. Final disposal of the refuse is: _____ Supplied to municipal service _____Burnt at site (open
burn)

_____Disposed on street or in o rivers _____Other (specify)

Liquid waste

34. Is there a drainage system for collection and handling of liquid waste? ____Yes ____No

35. What type of drainage system is it?

_____ Closed type which can collect all generated liquid waste

_____ Open trench that can collect fraction of generated waste

_____Other (specify)

36. Where is the liquid waste disposed finally?

Open dumping in the area Septic tank Dumped in latrine
 Discharged into the river Other (specify)

37. Is there any stagnation of liquid waste due to blockage or careless handling? Yes No

Storage and refrigeration

38. Is a refrigerator available for storage of perishable foods? Yes No

39. Are highly perishable and non perishable foods stored together? Yes No

40. Is the refrigerator over filled in such a way that it limits circulation of air? Yes No

41. Storage of cooked foods and raw foods:

a. Separate refrigerators for raw and cooked foods.

b. Same refrigerator (cooked food in different compartment).

c. Same refrigerator (raw and cooked side by side).

d. Other (specify)

42. Does the refrigerator have a fixed thermometer reading? Yes No

43. If present, what is the reading of temperature at time of visit? _____

44. Is there a separate storage room? Yes No

45. If yes, type of floor: Concrete/ cement Plastered Bricks Wooden
 Earthen Other (specify)

46. Is the storage room free from moisture and dust? Yes No

47. Do stored chemicals come in contact with equipments and/or foods? Yes No

Sanitary facilities and water supply

48. Source of the water: privately installed from municipal supply
 from communal distribution buy from privately installed pipe
 others (specify)

49. Is there any tanker for storage of water for shortage time? Yes No

50. Type of toilet: flush type dry pit latrine other (specify) no
 latrine

51. Its services at time of visit: giving service locked and not giving service
 out of service as failed other (specify)

52. Separation for male and female toilets? Yes No

53. Is the latrine clean & comfortable to use at time of visit? Yes No

54. Fly infestation at time of visit? ____Yes ____No

55. Is hand wash basin provided to use after toilet near toilet? ____Yes ____No

Cloak room

56. Is there separate room for clothing, resting and placing of clothes for workers? ____Yes
____No

Appendix III: Focus Group Discussions Guide

Focused Food Safety Discussion Group Questions

1. Are foodborne diseases of concern in our country?
2. As food handlers what is your biggest food safety concern?
3. What causes foodborne diseases?
 - a). Sanitation
 - b). Storage
 - c). Food Handling
 - d). Equipment
4. How much control do you have over the control of foodborne diseases?
5. What are some of the challenges facing you in your profession? Barriers in ensuring food safety
6. How do you think these challenges can be tackled?
7. Do you have any question for me?

Appendix IV: Food Safety Knowledge Pre-Test and Posttest Questionnaire

This questionnaire is prepared to assess food hygiene practices of the food handlers and their knowledge of HACCP (Hazard Analysis and Critical Control Points). You are kindly requested to read the questions carefully and respond in the manner clearly indicated for each. The information you provide is very crucial for the success of the study. You are, therefore, kindly requested to be honest towards all the items provided. Your responses will only be used for research purpose and therefore be kept confidential.

Demographic and practice characteristics

1. ___Female ___Male
2. Age_____
3. Indicate your work activity:
 ___Cook
 ___Nurse
 ___Dietitian
 ___Domestic staff
 ___Other (please specify)_____
4. How many years of education have you completed?
 ___>5
 ___5
 ___6-8
 ___9-13
 ___>13

Personal Hygiene

1. When washing your hands, you should rub your hands together with soap for at least.
 - a). 5 seconds.
 - b).10 seconds.
 - c). 20 seconds.
 - d). 1min
2. Which of the following the most common cause food borne illness?
 - a). *Listeria monocytogens*
 - b). *Salmonella ssp*
 - c). Norovirus
 - d). *Campylobacter ssp*
3. Good personal hygiene practices include all of the following EXCEPT
 - a).Proper hand washing.
 - b).Daily bathing.
 - c).Getting regular dental check-ups.
 - d).Short fingernails

4. What will you avoid to do when you develop a fever and severe cough before going to work?
 - a. Take some medicine before going to work.
 - b. Go to work but only handle food while wearing gloves.
 - c. Go to work only if you feel good.
 - d. Stay home as you may potentially get people sick.

Food Storage

5. In the refrigerator, where should cooked foods be stored?
 - a). Above raw foods
 - b). Below raw foods
 - c). Where its most convenient
 - d). It does not matter
6. Which of the following is not a food labeling requirement?
 - a). The amount of an ingredient which is named or associated with the food
 - b). An appropriate durability indication (e.g. 'best before' or 'use by')
 - c). Any special storage conditions or instructions for use
 - d). The name and address of the manufacturer, packer or retailer
 - e). All of the above
 - f) None of the above

Food Hygiene, Handling & Serving

7. Which of the following is necessarily needed for wearing disposable gloves?
 - a). Wash your hands and then put on gloves.
 - b). Put on gloves and then wash your gloved hands.
 - c). Put on gloves without washing your hands.
8. Which of the following is the temperature affecting the most rapid growth of bacteria?
 - a). 25° C
 - b). 37° C
 - c). 50° C
 - d). 60° C
9. Which of the following is the proper internal temperature in cooking?
 - a). 25°C - 50° C
 - b). 80° C-92° C
 - c). 60° C-77° C
 - d). 50° C-60° C

10. Which of the following is the proper holding temperature in cooked foods?
 - a). Above 75° C at all times.
 - b). Between 23° C and 75° C at all times.
 - c). Above 23° C at all times.
 - d). At any temperature if the food is already completely cooked.

11. The safest way to thaw (defrost) foods is:
 - a). In a container at room temperature.
 - b). In a sink with hot running water.
 - c). In the sink at room temperature over night.
 - d). In the refrigerator.

12. Potentially hazardous foods (time/temperature control for safety foods) are:
 - a). Dry, protein-rich foods that support the rapid growth of bacteria.
 - b). Dry, fat-rich foods that support the rapid growth of bacteria.
 - c). Moist, fat-rich foods that support the rapid growth of bacteria.
 - d). Moist, protein-rich foods that support the rapid growth of bacteria.

13. Cross-contamination is:
 - a). When germs spread from one place to another.
 - b). Nothing to be concerned about.
 - c). When you wipe blood in a cross motion.
 - d). Protein-rich foods that support the rapid growth of harmful bacteria.

14. What is usually the riskiest step in food preparation?
 - a). Cooling.
 - b). Cold holding.
 - c). Thawing.
 - d). Hot holding.
 - e). Reheating

15. Which of the following is not a proper cleaning method of vegetables and fruits?
 - a). Firm fruits and vegetables, such as apples, pears, tomatoes, peppers, cucumbers, and avocados, should be washed in water between 45 and 60°C (that is, slightly warm water).
 - b). Fragile greens and berry fruits, such as spinach, leaf lettuce can be washed under running water (spray washing)
 - c). Firm fruits and vegetables can be washed with antibacterial soaps or dish detergents
 - d). If a sink is not available, berries, other soft fruit and leafy greens should be placed in a wire basket. Move the basket in and out of the water several times. Change the water until the water remains clear.

Cleaning and Sanitation

16. Which is the correct way to wash dishes, utensils and equipment?
- Pre-scrape wash, rinse and sanitize; then air dry.
 - Pre-scrape, wash, rinse and air dry them completely with a cotton towel.
 - Pre-scrape, wash, sanitize and rinse; then dry with paper towels.
 - Pre-scrape, wash and rinse, then air dry.
17. What are some of the food contact surfaces that must always be washed and sanitized?
- Bathrooms, floors, and walls in the kitchen.
 - Break room, the surface of the griddle, and dining room tables.
 - Cutting boards, knives, utensils, and equipment.
 - Floor of the service area, the outside of equipment and display cases, and counter tops.

Environmental Hygiene

18. Which of the following is best way to control insect vectors and rodents in the kitchen?
- Apply pesticide every day.
 - Just sweep the floor.
 - Pour chlorine in the sink drain.
 - To keep the establishment and garbage area clean, and eliminate hiding places and routes of entry.
 - All of above.
19. Where must you store chemicals such as cleaners and sanitizers?
- Away from any food or clean equipment and utensils.
 - At least 6 inches above the floor.
 - With equipment and clean utensils.
 - On the shelf above food and utensils
20. What must be at hand washing sinks at all times?
- Hot and cold running water, soap, and single-use paper towels.
 - Hot running water, nailbrush, paper towels, and hand sanitizer.
 - Hot and cold running water, nailbrush, and single-use paper towels.
 - Hot running water, soap, and hand sanitizer.

Information

21. From where do you get information regarding HACCP and food hygiene in the hospital?

Nowhere

Continuing education courses on food hygiene and hospital foodborne diseases

Audio or visual materials

Mass media

Other (please specify) _____

22. Do you think you need more information about HACCP and food hygiene in hospitals? Yes No

E. Information

39. From where do you get information regarding HACCP and food hygiene in the hospital?

Nowhere

Continuing education courses on food hygiene and hospital foodborne diseases

Audio or visual materials

Mass media

Other (please specify) _____

40. Do you think you need more information about HACCP and food hygiene in hospitals? Yes No

Appendix V: Food Safety Practices Pre-Test and Posttest Questionnaire

I follow these recommended foods safety practices [please tick the most appropriate for you]

Personal Hygiene

1. Checking self-health condition (fever, diarrhea, injury) every working day.
 Always Most of the Time Sometimes Never
1. Checking cleanness of clothes, hair restraints and shoes before work
 Always Most of the Time Sometimes Never
2. Washing hands before handling food
 Always Most of the Time Sometimes Never
3. Receiving foods right after delivery and storing them in store area after removing their package
 Always Most of the Time Sometimes Never

Food Supply and Storage

5. Checking temperatures of the frozen/refrigerated foods and having problems rejecting them
 Always Most of the Time Sometimes Never
6. Checking and verifying whether temperatures of refrigerators and freezers are appropriate
 Always Most of the Time Sometimes Never
7. Recording the temperature log of refrigerators and freezers for managing temperature control
 Always Most of the Time Sometimes Never
8. Taking temperature of the foods in cooking/reheating process with thermometer
 Always Most of the Time Sometimes Never

9. Storing separately raw foods and cooked foods in refrigerator and freezers

Always Most of the Time Sometimes Never

Handling of Food and Serving

10. Thawing food, as much as a need

Always Most of the Time Sometimes Never

11. Cooking it immediately, if not, storing it in refrigerator after thawing

Always Most of the Time Sometimes Never

12. Washing and sanitizing fresh vegetables and fruits before use

Always Most of the Time Sometimes Never

13. Labeling foods with use-by date in storing the ready to eat (RTE) foods and processed foods

Always Most of the Time Sometimes Never

14. Using separately the equipment and supplies of the raw food and RTE food

Always Most of the Time Sometimes Never

14. Not handling RTE foods with bare hands

Always Most of the Time Sometimes Never

15. Not holding foods or utensils on the kitchen floor unit.

Always Most of the Time Sometimes Never

Cleaning and Sanitation

16. Labeling cleaning and sanitizing chemicals and storing them at safer place away from foods

Always Most of the Time Sometimes Never

17. Screening all windows and vents for controlling pest, and verifying if there are gaps and cracks in walls and ceilings.

Always Most of the Time Sometimes Never

19. Cleaning and sanitizing knives, cutting boards and wiping clothes
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never
20. Clean and sanitize properly storing sanitized/cleaned equipment and utensils using shelving
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never

Working Environment

21. Verifying if the plumbing system installed well and maintained it properly
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never
22. Seeing if equipments and facilities work well and maintaining them properly
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never
23. Verifying heat and water vapor in the kitchen are removed immediately through hood exhaust system and maintaining it properly
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never
24. Verifying if lightness and illumination of working area are appropriate and managing them properly
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never
25. Cleaning and maintaining toilet facility regularly.
◇ Always ◇ Most of the Time ◇ Sometimes ◇ Never

Appendix VI: Food Safety Curriculum Outline

Lesson 1: What Causes Food-borne Illness?

Objective: To understand the causes of foodborne diseases/illnesses

Food-borne illness is caused by harmful substances that make food unsafe to eat. The harmful substances are called food safety hazards.

Types of Food Safety Hazards:

1. Biological hazards
2. Physical hazards
3. Chemical hazards

Lesson 2: Preventing Food-borne Illness

Objectives: To understand factors contributing to the occurrence of foodborne diseases

To practically demonstrate and apply foodborne disease control strategies

Follow three rules to prevent food-borne illness:

1. Control time and temperature abuse.
2. Practice good personal hygiene.
3. Prevent cross contamination.

Activity: Bacteria Multiplication

Lesson 3: Keeping Food Out of the Temperature Danger Zone

Objective: To understand the role of temperature in food safety

To understand how to measure temperature in food

To understand the role of cold storage in food preservation and safety

The temperature danger zone is 23°C to 75 °C. Bacteria grow and multiply quickly in the temperature danger zone. Use a calibrated thermometer to check food temperatures regularly.

Activity: Taking temperature of food

Lesson 4: Personal Hygiene and Hand washing Procedures

Objectives: To understand the roles of food handlers in food safety

To understand food handlers requirements in handling food

Food handlers can contaminate food by failing to wash hands properly when necessary, coughing or sneezing on food, or handling food after touching sores or cuts.

Activity: Standard hand washing methods

Lesson 5: Cleaning and Sanitizing

Objectives: To understand food equipment cleaning procedures

To understand the role of equipments in cross contamination

Cleaning and sanitizing are not the same. Cleaning is removing food or other types of soil from a surface, such as a plate or counter. Sanitizing is reducing the number of microorganisms to a safe level.

Activity: Sanitization methods

Lesson 6: Handling and Serving Food Safely

Objectives

- Practice good personal hygiene.
- Control time and temperature.
- Prevent cross contamination.
- Cook food to the required internal temperature.

Activity: How to control and determine temperature

Lesson 7: Food Storage

Objective: To understand safe food storage methods for various foods

Use products closest to their expiration date first. Store perishable foods at the correct temperature. Store raw meat, poultry, and fish separately from cooked and prepared food.

Activity: Identifying hazardous foods in the kitchen

Lesson 8: Transporting Food Safely

Objective: To identify and understand safety food transport systems

Transport food at recommended temperatures. Protect food during pick-up and delivery.

Practice good personal hygiene.

Activity: Transporting Food Safely

Lesson 9: HACCP for Control of Food Safety

Objective: To understand role of HACCP in prevention of foodborne diseases

To demonstrate understanding in the use of HACCP tree

HACCP food system identifies food safety hazards at specific points in a food's flow to prevent, eliminate, or reduce them to safe levels.

Activity: Driving Situation

Lesson 10: Cleaning and Inspecting Fresh Fruits and Vegetables

Objective: To understand how to inspect and clean fresh fruits and vegetables

Fresh fruits and vegetables may carry pathogens (disease-causing organisms) or contain insects and other materials.

Activity: Commonly used vegetable and fruits and methods of cleaning.

Appendix VII: Research Permit

PAGE 2

THIS IS TO CERTIFY THAT:

Prof./Dr./Mr./Mrs./Miss..... JACKIM
..... NYAMARI

of (Address) KENYATTA UNIVERSITY
..... P.O. BOX 43844 NBI


has been permitted to conduct research in.....
..... KENYA.....**Location,**
.....**District,**
.....**Province,**

on the topic..... ENHANCING COMPLIANCE
TO FOOD SAFETY STANDARDS AMONGST
FOOD HANDLERS IN SELECTED
HOSPITALS IN KENYA

.....
for a period ending..... JUNE20 12

PAGE 3

Research Permit No...... NCST/13/003/R/446 /
Date of issue..... 26/11/2010
Fee received..... SHS 2,000



[Signature]
.....
**Applicant's
Signature**

[Signature]
.....
**Secretary
National Council for
Science and Technology**