COMPLIANCE TO FOOD HYGIENE PRACTICE STANDARDS AMONG FOOD HANDLERS IN SELECTED RESTAURANTS IN NAIROBI CITY COUNTY, KENYA.

LILIAN K. MOSOTA (BSC. EVH)
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DECLARATION

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

Signature..... Date..12/02/2024.....

Lilian Kerubo Mosota
Department of Community Health and Epidemiology

Supervisors: This thesis has been submitted with our approval as University Supervisors.

1. Signature..... Date..12/2/2024.....

Dr. George Orinda
Department of Biochemistry, Microbiology & Biotechnology
Kenyatta University

2. Signature..... Date..12/02/2024.....

Prof. Judith Waudo
Department of Food, Nutrition & Dietetics
Kenyatta University

DEDICATION

This thesis is dedicated to my parents Kennedy and Ruth. Thank you for your encouragement and support.

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DEFINITION OF OPERATIONAL TERMS

Cleaning: Refers to removal of soil, food residues, dust, grease or other objectionable matter from food contact surfaces (CAC, 2020).

Compliance to food hygiene practice standards: Refers to implementation of KS 2573:2015 standard requirements.

Contaminant: Refers to biological or chemical agent, foreign matter or other substances not intentionally added to food that may compromise food safety or suitability (KEBS, 2015).

Contamination: Refers to introduction or occurrence of a contaminant in food (KEBS, 2015).

Critical control point (CCP): A step at which a control measure or control measures, essential to control a significant hazard, is/are applied in a HACCP system (CAC, 2020).

Disinfection: Refers to reduction, by means of chemical agents and/or physical methods, of the number of micro-organisms in the environment to a level that does not compromise food safety (KEBS, 2015).

Food handler: Refers to restaurant staff who prepares food and directly handles packaged or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to comply with food hygiene requirements.

Food handling: Refers to any operation in the preparation, processing, cooking, packaging, storage, and service of food.

Food hygiene practice standards: Refers to Kenya standard KS 2573:2015 Hygiene requirements in food service establishments and catering operations.

Food hygiene: Refers to all conditions and measures necessary to ensure the safety and suitability of food at all stages of food handling.

Food safety: Refers to assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (KEBS, 2015).

Food: Refers to any substance consumed for body nourishment or pleasure other than drugs and includes any ingredients of such substance intended for human consumption (KEBS, 2015).

HACCP: Refers to hygienic food handling requirements system that identifies, evaluates and controls hazards that are specific and inherent to the food and its preparation rather than on the food preparation environment.

Hazard: Refers to biological, chemical or physical agent in, or condition of food with the potential to cause an adverse health effect (KEBS, 2015).

Indicators of compliance to food hygiene practice standards: Refers to implementation of prerequisite programmes, HACCP system implementation, acceptable food hygiene knowledge and practice among food handlers as per KS 2573:2015 requirements.

Prerequisite programmes (PRPs): Refers to general establishment hygiene requirements and interventions relative to people, facilities, and the work environment that create an environment in which the food can safely flow from receiving to service with a minimum risk of being contaminated by environmental conditions.

Restaurant: Refers to food service establishment licensed as a restaurant under category C of Food Drugs and Chemical Substances Act Cap 254 laws of Kenya, serving local cuisine.

ABBREVIATIONS AND ACRONYMS

CAC:	Codex Alimentarius Commission
CDC:	Centre for Disease Control
CXC 1-1969:	General Principles of Food Hygiene
CXC 39-1993:	Code of hygienic practice for precooked and cooked foods in mass catering
FAO:	Food and Agriculture Organization
FBD:	Food Borne Disease
FDA:	Food and Drug Administration
GOK:	Government of the Republic of Kenya
HACCP:	Hazard Analysis and Critical Control Points
KEBS:	Kenya Bureau of Standards
KDHS:	Kenya Demographic and Health Survey
KNBS:	Kenya National Bureau of Statistics
KS 2573:2015:	Kenya Standard for Hygiene Requirements in food service establishments and catering operations
MOTW:	Ministry of Tourism and Wildlife
MOH:	Ministry of Health
NFSCC:	National Food Safety Coordination Committee
PRPs:	Prerequisite Programmes
SDG:	Sustainable Development Goal
UNICEF:	United Nations International Children's Emergency Fund
WHO:	World Health Organization

ABSTRACT

Like any other food establishment or catering operation, there is a risk of getting food borne diseases after consuming contaminated restaurant foods. Food service establishments are expected to implement food hygiene practice requirements in all food handling processes including receiving, storage, preparation, processing, cooking and service of food. Restaurants which operate as food establishments therefore have a responsibility in ensuring food is protected from contamination or deterioration and should implement food hygiene practice requirements that will ensure food safety to the consumer. In efforts to mitigate the risk of food borne diseases, food handlers should observe food hygiene practice and should also have food hygiene knowledge since they are involved in all food handling processes. The already developed Kenya Standard - KS 2573:2015 outlines hygiene requirements for food service establishments including restaurants. The broad objective of the study was to establish compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County. This was a descriptive, cross-sectional study design. The study targeted 39 purposively and proportionately sampled restaurants and 316 food handlers in the selected restaurants in Nairobi City County. Data was collected using observation checklist, interview guide and questionnaire on self-reported practices measured using a 4-point Likert scale. Data to establish the food hygiene knowledge by food handlers was collected using a knowledge score questionnaire. Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the data and these findings are reported in a descriptive and inferential manner. Qualitative method was used to analyze content from interviews for themes. The gap identified in restaurant food hygiene practice standards was on maintenance of building and facilities in matters cleanliness, repair of damaged building and facilities and compliance to personnel hygiene requirements. Major gaps were noted in food time and temperature control practices for high risk foods. Food handlers consistently reported poor food hygiene practice in aspects analyzed under food time and temperature control. The mean knowledge score of all food handlers was 55.33%. Food handlers' knowledge was significantly lower than the minimum acceptable score of 70%. In accordance with food hygiene practice standards requirements, restaurants should implement prerequisite programmes regarding maintenance and repair of established restaurant building and facilities and adhere to personnel hygiene requirements. Restaurants should also implement food hygiene requirements regarding food time and temperature monitoring in all food handling critical control points. Restaurant food handlers should be continuously trained by qualified food hygiene trainers and their practice monitored in order to realize improvement in food hygiene knowledge and practice thus reduced transmission of food borne diseases.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

People across the globe get diseases, disability and die from consumption of contaminated food from the findings of the first ever study conducted by WHO to determine the burden of foodborne diseases globally (WHO, 2015). Approximately 600 million people in the world develop a food borne illness resulting in 420,000 deaths each year (WHO, 2015). Diarrheal illnesses contribute to over half of the food borne disease burden leading to 550 million illnesses and 230,000 people dying each year (WHO, 2015). The study also recorded a high burden of foodborne illnesses in the African region with 91 million illnesses and 137,000 deaths every year (WHO, 2015). Diarrhoea, accounts for about 8 per cent of all deaths among children below age 5 worldwide translating to approximately 480,000 children dying a year (UNICEF, 2018a). In Kenya, young children fall ill and some die due to dehydration caused by severe diarrhea. Unhygienic practices in food preparation largely contributes to exposure to pathogens that can cause diarrhea. In the 2022 Kenya Demographic and Health Survey, 14 percent of children below age 5 had diarrhea within two weeks before the study (KDHS, 2022). Since the start of 2017, Kenya has experienced an increase of cholera cases with Nairobi County as well experiencing waves of cholera outbreaks (WHO, 2017, UNICEF, 2019, WHO, 2019 & MOH, 2022).

Consumption of contaminated food in restaurants presents the risk of getting FBDs similar to any other food service establishments. Studies conducted in food service establishments have reported poor food hygiene practice (Legesse et al., 2017 & Meleko et al., 2015). As such, codes of practice to be applied internationally in ensuring safe food hygiene practice in the food service sector have been developed by the Codex Alimentarius Commission

(CAC). These codes of practice include General Principles of Food Hygiene CXC 1-1969 (CAC, 2020) and Code of hygienic practice for precooked and cooked foods in mass catering CXC 39-1993 (CAC, 1993).

In 2015, KEBS developed a Kenya Standard for Hygiene Requirements in food service establishments and catering operations KS 2573:2015 by making reference to the internationally recognized Codex Alimentarius Commission (CAC) standards for the food service sector. The KS 2573:2015 provides requirements to be implemented by food service establishments in order to ensure food safety through hygienic food handling. All food service establishments irrespective of size and categorization are included in the KS 2573:2015 application scope.

1.2 Problem Statement

Food service establishments inclusive of restaurants contribute significantly to the global and local economy. However, FBDs remain a major cause of illnesses and death worldwide (WHO, 2015). Middle income countries as well as low income counties spend approximately US$ 110 billion to cater for medical expenses and lost productivity caused by the effect of consuming unsafe food (World Bank, 2019). The economic burden of FBDs in Kenya exceeds US$500 million a year (World Bank, 2019). Globally, there has been FBD outbreaks due to contaminated restaurant food consumption (Angelo et al., 2016). Studies conducted in Morocco's Casablanca City have shown contamination load in catering establishments food samples (El Kadmiri et al., 2016). Nairobi City County, which is the study area has experienced waves of FBD outbreaks (WHO, 2017, UNICEF, 2019, WHO 2019 & MOH, 2022). Nairobi county has also recorded FBD outbreak traced back to restaurant food source (MOH, 2017). These FBD outbreaks and food

contamination load are linked to the gaps in implementation of food hygiene requirements and poor hygiene practice among food handlers. Food service establishments inclusive of restaurants are expected to implement food hygiene requirements in all food handling processes including receiving, storage, preparation, processing, cooking and service of food (KEBS, 2015).

As a mitigation factor to food contamination in food service establishments and to ensure food hygiene practice is implemented and maintained by food handlers, KS 2573:2015 has been developed (KEBS, 2015). The standard outlines hygiene requirements for food service establishments including restaurants irrespective of size and other categorization. Food handlers were targeted in the study because they handle food meant for consumption and are therefore required to observe good food handling and hygiene practice. The study therefore sought to establish compliance to food hygiene practice requirements standards among restaurant food handlers.

1.3 Justification

Restaurants which operate as food service establishments have a moral and legal obligation to provide safe food to consumers by observing food hygiene requirements. Therefore, food handlers involved in food handling processes including receiving, storage, preparation, processing, cooking, packaging and service play an integral role in ensuring that food is handled safely and hygienically so as to prevent any form of food contamination and subsequent FBD outbreaks. Yet, a wave of FBD outbreaks have been reported in Nairobi City County (WHO, 2017, UNICEF, 2019, WHO 2019 & MOH, 2022) indicating lack of compliance to food hygiene practice in restaurants.

1.4 Research Questions

1. What is the extent of prerequisite programmes implementation in restaurants in Nairobi City County?
2. What is the extent of HACCP system implementation in restaurants in Nairobi City County?
3. What is the level of food hygiene knowledge of food handlers in restaurants in Nairobi City County?
4. How is the food hygiene practice among food handlers in restaurants in Nairobi City County?

1.5 Objectives

1.5.1 Broad Objective

To establish compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County.

1.5.2 Specific Objectives

1. To assess the extent of prerequisite programmes implementation in restaurants in Nairobi City County
2. To examine the extent of HACCP system implementation in restaurants in Nairobi City County
3. To evaluate the level of food hygiene knowledge of food handlers in restaurants in Nairobi City County
4. To determine food hygiene practice among food handlers in restaurants in Nairobi City County

1.6 Research Hypothesis

H_{01}: There is no significant difference between food hygiene knowledge mean score of food handlers and acceptable minimum mean score of 70%.

1.7 Significance and Anticipated Outcome

The findings on compliance to food hygiene practice standards among restaurant food handlers identifies gaps in the implementation of the Kenya Standard (KS 2573:2015). Identified gaps will inform development of strategies relevant to improving food hygiene practice in the food service sector, in particular, restaurants. This study findings also provide information to restaurant operators on identified gaps in compliance to food hygiene requirements standard and provides recommendations for improving food hygiene practice in restaurant operations.

1.8 Limitations of the Study

This study did not involve food and environmental sampling for laboratory testing/analysis but only investigated compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County. The study was conducted in Nairobi City County thus the limited scope to urban restaurants. Therefore the study findings may not apply to countryside restaurants.

1.9 Conceptual Framework

This study was guided by the conceptual model in Figure 1.1. Five main factors have been identified to have an effect on compliance to food hygiene practice standards in restaurants, namely; implementation of prerequisite programmes, implementation of HACCP system,

food handlers' socio-demographic factors, food handlers' food hygiene knowledge and food handlers' food hygiene practice (CAC, 2020 & KEBS, 2015).

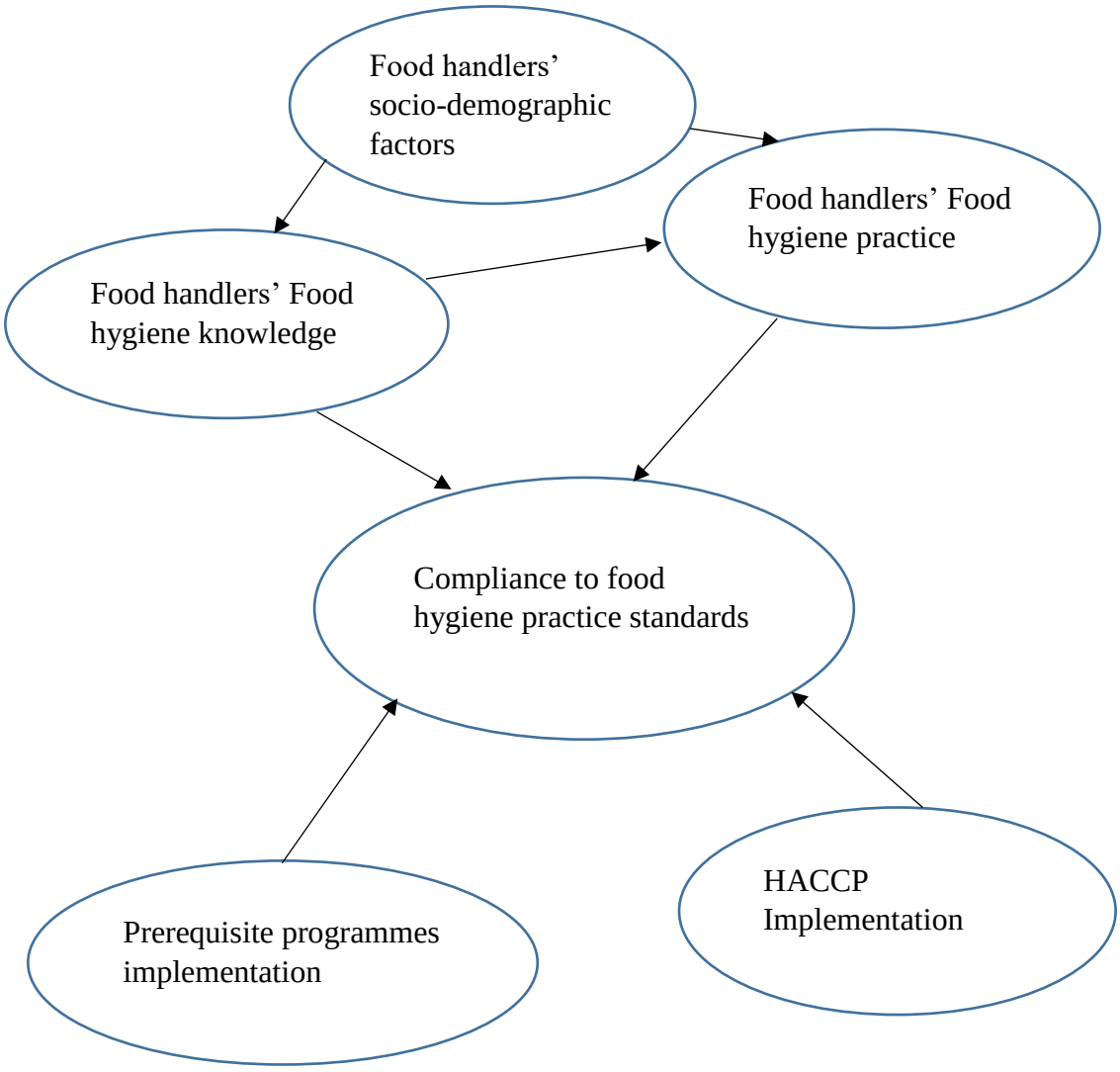

Figure 1.1: Conceptual Framework

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

A literature review on food hygiene highlighting global and national situation of food borne diseases (FBDs); food safety regulatory bodies, laws and standard in Kenya; food hygiene management in food service; and food hygiene knowledge and practice among food handlers is explored.

2.1 Global Situation of Food Borne Diseases

The first ever study conducted by WHO to determine the burden of foodborne diseases globally indicated that approximately 600 million people in the world develop a food borne illness resulting in 420,000 deaths each year. The approximation of the burden of foodborne diseases is possibly an underestimation according to WHO (2015). About 125,000 children below 5 years die each year from foodborne illnesses accounting for 30% of all deaths from FBDs (WHO 2015). Over half of the global burden of FBDs is caused by diarrheal diseases leading to 550 million illnesses and 230,000 people dying each year. Approximately 220 million illnesses and 96,000 deaths are recorded each year among children due to foodborne diarrhoeal diseases (WHO, 2015). According to UNICEF (2018a), diarrhea accounts for about 8 per cent of all deaths among children below age 5 worldwide translating to approximately 480,000 children dying a year. Preventative interventions inclusive of safe food hygiene practice will help stop disease transmission.

Approximately US$ 110 billion is spent yearly by middle income countries as well as low income countries as a cost incurred in catering for medical expenses and lost productivity caused by the effect of consuming unsafe food (World Bank, 2019). These huge costs can be avoided by implementing food safety requirements and standards across the food chain.

World bank (2019) also advocates for a shift from traditional end product laboratory testing and heavy penalties on noncompliance to a motivational and empowering approach. The world bank places more focus on developing countries which require evidence-based improvement on food hygiene management systems through provision of infrastructure and facilities, food handlers food hygiene awareness creation though training and implementation of regulations and standards relevant to food safety and hygiene. Advocacy for better management of food safety will significantly contribute to achievement of SDG 2 which focuses on improving nutrition by ensuring access to not only nutritious but also safe food; and SDG 3 which seeks to promotes good health combating communicable diseases including foodborne illnesses (UN, 2015).

2.2 National Situation of Food Borne Diseases

According to WHO (2015), the African region has the highest risk of FBDs as compared to other continents. The constitution of Kenya demands that all persons should access food that is safe for human consumption. However, FBDs remain to be a major cause of illness and death in Kenya. In the 2022 Kenya Demographic and Health Survey, 14 percent of children below age 5 had diarrhea (KDHS, 2022). A study conducted in Kenya by Hoffmann & Baral (2019) estimates 1,328 deaths among children caused by food borne diarrhea. The study also estimates that 134 children die each year in Nairobi City County from food borne diarrheal disease. Since the beginning of 2017, Kenya has recorded increased cases of cholera associated with ingestion of contaminated water and/or food in different counties including Nairobi County. According to the year 2018 UNICEF Kenya Humanitarian Situation Report, Kenya reported 4,551 cholera cases and 74 deaths (UNICEF, 2018b). Nairobi City County has experienced waves of FBD outbreaks (WHO,

2017, UNICEF, 2019 & WHO 2019). Nairobi county has also recorded FBD outbreak traced back to restaurant food source (MOH, 2017). The MOH (2022) Kenya disease outbreak situation report, recorded 138 Cholera cases and 4 deaths in seven different counties, with over half the number of cholera cases and deaths having been recorded in Nairobi City County. The economic burden of FBDs in Kenya exceeds US$500 million a year as a cost incurred in catering for medical expenses and lost productivity caused by the effect of consuming unsafe food (World Bank, 2019).

2.3 Food Safety Regulatory Bodies, Laws and Standards in Kenya

The constitution of Kenya (GOK, 2010), stipulates the right to safe food for every individual as prescribed in article 43. Implementation of food safety standards, laws and regulations are among the major pillars that the National Food Safety Policy (2021) considers as an indicator towards attaining public health promotion. The Kenyan food safety control system is regulated by different ministries and regulatory bodies such as the Ministry of Health and Kenya Bureau of Standards among other regulatory bodies. Laws of Kenya relevant to food safety and hygiene include the Public Health Act Cap 242, Food, Drugs and Chemical Substances Act Cap 254 and the Standards Act Cap 496.

The Kenya food hygiene and safety standards are majorly developed through making reference to recommended international codes of practice by Codex Alimentarius Commission (CAC). General Principles of Food Hygiene CXC 1-1969 (CAC, 2020) and Code of hygienic practice for precooked and cooked foods in mass catering CXC 39-1993 (CAC, 1993) were referenced in developing the Kenya Standard - Hygiene requirements in food service establishments and catering operations KS 2573:2015. The standard KS 2573:2015 was developed in 2015 to ensure food safety through establishing prerequisite

programmes and HACCP requirements to be implemented in all food service establishments (KEBS, 2015).

National Food Safety Coordination Committee (NFSCC) plays a key coordination role for various institutions and agencies by increasing awareness and harmonization of laws relevant to food safety, hygiene and quality (GOK, 2021). The NFSCC is however ineffective since it carries out coordination functions for the various institutions and agencies without any legal backing. Further, the current food safety laws and regulations have not been reviewed since their commencement resulting in inadequacies in food safety monitoring and coordination efforts.

2.4 Food Hygiene Management in Food Service

Implementation and adherence to food hygiene management system in food service industry is crucial for promoting public health and mitigating economic consequences resulting from FBDs. According to CAC (2020), a food hygiene management system should have in place the pre-requisite programmes which provide good hygiene practice foundation for establishing and implementing the principles of HACCP. Food service establishment operators have an obligation to develop procedures based on this in order to conform to food hygiene standards.

2.4.1 Prerequisite Programmes (PRPs): The Foundation of an Integrated Food Safety Programme

Prerequisite programmes are general food establishment hygiene requirements essential and fundamental in any food hygiene management system. The term prerequisite denotes a precondition and thus prerequisite programmes serve as the foundation for implementing food hygiene requirements. General food establishment hygiene requirements or

Prerequisite programmes create a safe food handling environment through defining interventions relative to work environment, facilities and people, that should be practiced consistently regardless of the food being handled or prepared to ensure minimum risk of food contamination. Each food service operation should provide the conditions necessary to protect the food from contamination (CAC,2020).

Various studies have identified gaps in the implementation and maintenance of prerequisite programmes. A study conducted in Brazilian restaurants showed average adequacy of hygienic-sanitary conditions (de Souza et al., 2018). Study findings by Idris et al. (2020) in Eritrea, showed that most catering establishments did not maintain general prerequisite hygiene standards with regards to provision of both cold and hot running water supply required for proper cleaning of utensils. Personnel hygiene gaps were identified by Teferi (2021) in a study carried out in Ethiopia where only 52.8% of personnel handling food restrained the hair with head cover. Verrill et al. (2021), reported that provision and maintenance of materials required for appropriate cleaning of hands increased observance of appropriate hand washing procedures by food handlers.

2.4.2 HACCP Principles and its Application to Food Service

HACCP is a recognized food hygiene management system applicable to any business in the food supply chain to manage good practice in food handling (FAO 2017). HACCP system is used in identifying critical points in food handling stages and hazard controls to be applied at these critical points. The stages may include purchasing, receiving, storage, preparation, cooking, cooling, reheating, hot holding and serving of food (KEBS, 2015). The process approach to HACCP is normally used in the food service establishments (FDA, 2022). The first preparation process example is where food flows from receiving to

service without cooking which commonly applies to preparation, cold holding and service of foods such as salads. The second preparation process example involves cooking step where food is prepared and hot held for same day service. The third preparation process example involves rapid cooling of cooked food for cold storage and later reheating for service at a later time or day (FDA, 2022).

Poor food handlers' hygiene practice that contribute to transmission of FBDs include advance preparation where food remains in the danger zone temperatures for a long time, improper cooling, improper hot holding and cross-contamination (CAC, 1993). A study conducted in Pakistan's second largest city by Shehbaz (2016) revealed that only 23% of food establishments had criteria for monitoring cooking temperature of food in cooking process by use of a calibrated thermometer.

2.5 Food Hygiene Knowledge and Practice among Food Handlers

2.5.1 Food Hygiene Knowledge among Food Handlers

The Codex standard CXC 1-1969 and Kenya Standard KS 2573:2015 stipulate that food hygiene knowledge and understanding is a fundamental requirement in food hygiene management. Food handlers should therefore have knowledge on precautionary measures necessary to prevent food contamination. Various studies have reported findings on food hygiene knowledge among food handlers. A research by Hasan et al. (2022) conducted in Bangladesh identified poor food hygiene knowledge among restaurant food handlers. A study conducted by Hamed & Mohammed (2020) in food service establishments in Egypt also identified food handlers' hygiene knowledge gaps. Food hygiene knowledge study findings among institutional food handlers in Ghana was satisfactory (Akabanda et al., 2017). Knowledge on food safety lacked among food handlers working in food

establishments in a study conducted by Alemayehu et al. (2020) in Ethiopia. Research findings by Akabanda et al. (2017) conducted among institutional food handlers in Ghana, showed that food handlers performed well in knowledge items. A research conducted in a developing country in western Asia; showed overall hygiene requirements knowledge gaps among restaurant food handlers in three different Oman city Districts (Al-Ghazali et al., 2020). A study conducted by Derso et al. (2017) in Ethiopia identified low knowledge scores for food temperature control among food handlers. A study carried out in India by Manes (2016) among restaurant workers also showed knowledge gaps in food temperature control and proper handling to avoid cross contamination.

2.5.2 Food Hygiene Practice among Food Handlers

Poor handling practices by food handlers that contribute to transmission of FBDs include poor personal hygiene, food handling by infected persons, inadequate cooking, advance preparation where food remains in the danger zone temperatures for a long time, improper cooling, inadequate reheating for hot holding, improper hot holding and cross-contamination (CAC, 1993 & KEBS, 2015). Food handlers have revealed poor food hygiene practice in different studies, for instance, those conducted in Ethiopia by Legesse et al. (2017) in food service establishments and Meleko et al. (2015) in university students' cafeterias. Food contamination can result from introducing extraneous matter such as hair, jewellery and microbial contaminants such as *Staphylococcus aureus* from the skin, mouth and nose of the personnel handling food. A study carried out by Hamed & Mohammed (2020) in Egypt urban setting identified poor hand hygiene practice in food service sector and food handlers also handled food with hand jewellery. According to Legesse et al. (2017), food handlers showed relatively poor food hygiene practice in wearing clean

protective clothing and head covering. Cross-contamination which could occur as a result of transfer of pathogens from food handling utensils and equipment to food was identified in study findings by Akabanda et al. (2017) in Ghana where only 61.7% of food handlers observed proper cleaning and sanitization procedures of food handling utensils and equipment. Various studies among food service establishments food handlers have shown that food handlers with good hygiene knowledge did not necessarily observe good food hygiene practice (Putri & Susanna, 2021, de Souza et al., 2018 & Akabanda et al., 2017).

2.6 Summary of Literature Reviewed

From the literature review, it is evident that there is a global burden of FBDs identified by the first ever study conducted by WHO (2015). The African region records a high burden of foodborne diseases (WHO 2015). Low- and middle-income countries have to deal with high medical expenses and lost productivity caused by effects of consuming unsafe food; this can be mitigated by implementing food hygiene standards across the food chain. KS 2573:2015 was developed to ensure food hygiene is observed when handling food in all food service establishments including restaurants. The Kenya standard specifies general food establishment hygiene requirements or Prerequisite programmes relative to work environment, facilities and people, that should be practiced consistently to ensure minimum risk of food contamination. The Kenya standard has also identified critical control points (HACCP) in food service establishments which include purchasing, receiving, storage, preparation, cooking, cooling, reheating, hot holding and serving of food. KS 2573:2015 also outlines. KS 2573:2015 also stipulates that food hygiene knowledge and understanding is a fundamental requirement in food hygiene management. Nonadherence

to food hygiene requirements standards by food handlers translates to poor handling practices by food handlers which leads to transmission of FBDs.

Gaps identified from the literature review include limited data on compliance to the Kenya food hygiene requirements standard KS 2573:2015 among restaurant food handlers. There are also inconsistencies in food hygiene knowledge scores among food handlers where some studies established food hygiene knowledge gaps among food handlers while other studies identified satisfactory food hygiene knowledge. Food handlers also revealed poor food hygiene practice in different studies.

CHAPTER THREE: MATERIALS AND METHODS

3.0 Introduction

The research methodology used is described in details in this chapter, that is, the study design, the study location, study population, sampling techniques and methods used in determining the sample size, research instruments used for data collection, pretesting, validity and reliability of instruments, data collection and analysis, and ethical and logistical considerations.

3.1 Research Design

The cross-sectional descriptive study design was used in the research involving both quantitative and qualitative methods to establish compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County. This design is suitable as it is used to describe a sample of a population at a specific point in time (Mugenda & Mugenda, 2019).

3.2 Study Variables

As shown in the conceptual framework (Figure 1.1), five main variables were identified to have an effect on compliance to food hygiene practice standards in restaurants, namely; implementation of prerequisite programmes, implementation of HACCP system, food handlers' socio-demographic factors, food handlers' food hygiene knowledge and food handlers' food hygiene practice.

3.3 Location of the Study

This study was conducted in restaurants within Nairobi City County (Appendix VI). considering the County enjoys the highest number of multi cuisine restaurants (MOTW, 2020). The population of people in Nairobi City County is 4,397, 073 according to the 2019

census (KNBS, 2019). Nairobi City County is divided into 11 sub-counties. There are approximately 354 licensed restaurants in Nairobi City County according to the Nairobi City County food hygiene licensing office records (GOK, 2021).

3.4 Study Population

The study population comprised food handlers in the selected restaurants and of restaurant managers within Nairobi County.

3.5 Sampling Techniques

A multistage sampling strategy was used to select the participating restaurants in Nairobi City County. Purposive sampling was used to select 3 participating sub counties out of the 11 sub counties in Nairobi City County. Embakasi subcounty was purposively sampled considering it is the most populated subcounty while Langata subcounty was sampled since it has the least population density (KNBS, 2019). Starehe subcounty which has the most number of licensed restaurants was also purposively sampled (GOK, 2021). Proportionate sampling was used to select 39 participating restaurants in the 3 purposively sampled sub-counties, that is, Langata, Embakasi and Starehe Sub-Counties as shown in Table 3.1. In a selected restaurant, all willing and available food handlers were involved in the study thus an exhaustive sample of food handlers in the three subcounties were targeted.

3.6 Sample Size Determination

A sample size of 39 (11%) restaurants serving local cuisine within Nairobi City County was selected out of the target population of approximately 354 licensed restaurants in Nairobi City County (GOK, 2021). Gay et al. (2014) suggests that a minimum sample size of ten percent of the population is acceptable for descriptive studies. As shown in Table 3.1, the 39 participating restaurants were proportionately selected from 3 purposively sampled sub-counties and two

purposively sampled wards from each of the selected sub-counties. Random sampling method was used to select participating restaurants in the selected wards. One restaurant manager from each of the 39 selected restaurants (n=39) were selected to participate in the study. All willing and available food handlers (n=316) in the 39 selected restaurants participated in the study.

Table 3.1: Sample Size Determination for Restaurants

Subcounty	No of Restaurants	Proportion	Sample size
Starehe	69	49%	19
Embakasi	44	31%	12
Langata	28	20%	8
Total	141	100%	39

3.7 Research Instruments

Observation checklist, interview guide and researcher-administered questionnaires were used in data collection in the study.

3.7.1 Observation Checklist

An observation checklist was used to establish implementation of Prerequisite Programmes (PRPs) in restaurants in Nairobi City County using a customized checklist (Appendix II) based on KS 2573:2015 (KEBS, 2015). Photos were obtained to complement the observation checklist findings.

3.7.2 Interview Guide

A semi-structured interview guide was used for restaurant managers to establish the implementation of HACCP in restaurants in Nairobi City County using a customized interview guide (Appendix III) based on KS 2573:2015 (KEBS, 2015).

3.7.3 Questionnaires

Food handlers participation entailed responding to the researcher-administered questionnaires, to eventually collect socio-demographic data and data on food hygiene knowledge (Appendix IV) and food hygiene practice (Appendix V).

Food hygiene knowledge was measured using a knowledge scores questionnaire, to assess knowledge on crucial food hygiene aspects; that is, personal hygiene, food hygiene and handling, food time and temperature control, cleaning, sanitization and environmental hygiene (FAO, 2017 & KEBS 2015).

Food handlers responded to food hygiene practice questionnaire on self-reported practices regarding crucial food hygiene aspects; that is, personal hygiene, food hygiene and handling, food time and temperature control, cleaning, sanitization and environmental hygiene. Food hygiene practice was determined from responses to a 4-point likert scale questionnaire where respondents reported to perform a specified food hygiene practice either always, most of the time, sometimes or never (Hamed & Mohammed, 2020).

3.8 Pre-Testing

The research tools were pre-tested on a simple random sample of four non-participating restaurants in a non-participating Kasarani Sub-County in Nairobi City County. Any errors and omissions that occurred during development of the instruments were identified during pretesting. The suitability of the research instruments in achieving research objectives was assessed. Research instruments were reviewed and improved by considering the pretest study findings thus enhancing final data collection tools validity and reliability.

3.9 Validity

Validity of this study was achieved through pre-testing research instruments on non-participating restaurants in a non-participating Sub-County in Nairobi City County. Supervisors' review of the instruments also ascertained validity.

3.10 Reliability

Reliability is the degree to which data generated from a particular data collection tool is consistently similar on repeated trials (Mugenda & Mugenda, 2019). Food hygiene practice questionnaire reliability was ascertained through Cronbach's alpha reliability for questionnaires. The Cronbach's Alpha (α) value was .790 which is good and acceptable since the value was greater than .70 (Hair et al., 2013).

3.11 Data Collection Techniques

As shown in the conceptual framework (Figure 1.1), five main variables have been identified to have an effect on compliance to food hygiene practice standards in restaurants, namely; implementation of prerequisite programmes, implementation of HACCP system, food handlers' socio-demographic factors, food handlers' food hygiene knowledge and food handlers' food hygiene practice.

The research instrument used to collect data on implementation of Prerequisite Programmes (PRPs) in restaurants in Nairobi City County was an observation checklist. A semi-structured interview guide was used to collect data on implementation of HACCP in restaurants. Researcher-administered questionnaires were used to collect data on food handlers' socio-demographic factors, food hygiene knowledge and food hygiene practice of food handlers.

3.11.1 Observation Checklist

Data on implementation of Prerequisite Programmes (PRPs) in restaurants in Nairobi City County was obtained through an observation checklist (Appendix II). The observation checklist was customized based on KS 2573:2015 (KEBS, 2015). Prerequisite programmes implementation was observed by the researcher at the time of the visit by checking the status and maintenance of restaurant building and facilities, lighting, ventilation, water supply, hand washing facilities, personnel hygiene, waste management and pest control. Photos were obtained to complement the observation checklist findings.

3.11.2 Interview Guide

A semi-structured interview guide was used to collect data on implementation of HACCP in restaurants in Nairobi City County (Appendix III). The interview guide was customized based on KS 2573:2015 (KEBS, 2015). The stractured interview guide was used by the researcher to interview restaurant managers and collect in-depth information on HACCP implementation regarding important hazard control points, that is, food receiving, storage, thawing, food preparation, cooking, hot/cold holding of prepared food and thermometer provision for food temperature monitering.

3.11.3 Questionnaires

Two different types of Researcher-administered questionnaires were used to collect data on food hygiene knowledge (Appendix IV) and food hygiene practice (Appendix V) of food handlers. The questionnaires were issued to consented restaurant food handlers. Research assistants under close supervision by the researcher distributed the questionnaires.

The food hygiene knowledge questionnaire (Appendix IV) consisted of two sections. Section I meant for collecting food handler's socio-demographic data and section II for collecting food handler's food hygiene knowledge. Section II of the questionnaire had 20 questions essential for obtaining data on crucial food hygiene aspects (FAO, 2017 & KEBS 2015), that is, personal hygiene (6 items), food hygiene and handling (6 items), food time and temperature control (5 items), cleaning, sanitization and environmental hygiene (3 items). Questions were in multiple choice format with every question having only one possible correct answer. The food handler indicated the answer by ticking the appropriate choice from the multiple choices. Each question with a correct response garnered a single (1) point while each question with an incorrect response garnered zero (0) points. The total of 20 questions used to measure knowledge amounted to a possible maximum score of 20. Scores were converted to percentages, and scores of 70% and over was classified as satisfactory (Ahmed et al., 2021).

Food hygiene practice questionnaire (Appendix V) was used to collect data on self-reported practice by food handlers. Food hygiene practice was determined from responses to a 4-point likert scale questionnaire with a total of 20 questions where respondents reported to perform a specified food hygiene practice either always, most of the time, sometimes or never as adopted from a study by Hamed & Mohammed (2020) published in a WHO peer reviewed journal. Self-reported practice information on important food hygiene factors, that is, personal hygiene (6 items), food hygiene and handling (6 items), food time and temperature control (5 items), cleaning, sanitization and environmental hygiene (3 items) was collected using the food hygiene practice questionnaire.

3.12 Selection and Training of Research Assistants

Three Research assistants with a minimum of diploma in environmental health and fluent in English and Kiswahili languages were selected for the study. Nairobi city county residents were prefered because they were farmiliar with the study area. The research assistants were taken through research procedures, instruments and ethical guiding principles for five days before commencing data collection under close supervision by the researcher.

3.13 Data Analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS version 26) tool and findings presented in a descriptive and inferential manner. Descriptive analysis was done on all study variables; the variables being the implementation extent of PRPs and HACCP, food handlers' socio-demographic factors, food hygiene knowledge and food hygiene practice of food handlers. Descriptive statistics such as proportions, frequencies, and mean was used to describe the study variables charachteristics; This was depicted through frequency distribution tables, charts and graphs. The total of 20 questions used to measure knowledge amounted to a possible maximum score of 20. Scores were converted to percentages, and scores of 70% and over was classified as satisfactory (Ahmed et al., 2021). Analytical analysis using inferential statistical methods was used to examine whether the food hygiene mean knowledge score of food handlers was significantly different from the test value (minimum satisfactory score) using one sample t-test acceptble for non-normal large samples (Poncet et al., 2016 & Mugenda & Mugenda, 2019). One sample t-test was therefore used to test the null hypothesis; there is no significant difference

between food hygiene knowledge mean score of food handlers and acceptable minimum mean score of 70%.

Qualitative method was applied in analyzing data on HACCP implementation by scanning primary data content from interviews for words and phrases repeatedly used by respondents and a search for expected information ommission by participants.

Table 3.2: Data Analysis Summary of Variables, Indicators and Means of Analysis

Variable	Indicator	Means of Analysis
Implementation of prerequisite programmes in restaurants	Compliance to restaurant building and facilities requirements	Descriptive (Frequencies and proportion)
	Compliance to restaurant water supply and hand washing facilities requirements	Descriptive (Frequencies and proportion)
	Compliance to restaurant personnel hygiene requirements	Descriptive (Frequencies and proportion)
	Compliance to restaurant waste management and pest control requirements	Descriptive (Frequencies and proportion)
Implementation of HACCP system in restaurants	HACCP awareness among restaurant managers	Descriptive (Frequencies and proportion)
	Receiving of incoming food Items practice in restaurants	Descriptive (Frequencies and proportion)
	Storage of food items practice in restaurants	Descriptive (Frequencies and proportion)
	Thawing of food items practice in restaurants	Descriptive (Frequencies and proportion)
	Cooking/food preparation and holding practice in restaurants	Descriptive (Frequencies and proportion)
	Thermometer provision for food temperature monitoring in restaurants	Descriptive (Frequencies and proportion)
Food handlers' socio-demographic factors	Distribution of respondents by gender	Descriptive (Proportion)
	Age distribution of participants	Descriptive (Proportion)
	Distribution of participants by education level	Descriptive (Proportion)
Food handlers' food hygiene knowledge	Food handlers' food hygiene knowledge score on crucial food hygiene aspects	Descriptive (Proportion, Mean) Inferential (One sample t test)
Food handlers' food hygiene practice	Food handlers' food hygiene practice likert scale responses on crucial food hygiene aspects	Descriptive (Proportion)

3.14 Logistical and Ethical Considerations

Prior to data collection from study population, research approval was sought from Kenyatta University graduate school. Ethical approval was also obtained from Kenyatta University Ethics Review Committee. A research permit was sought from the Kenya National Commission for Science, Technology and Innovation (NACOSTI) (Appendix VII). Permission was sought from restaurant managers/supervisors to conduct the study in their restaurants. Participants informed consent was sought and study respondents were made aware of importance, procedures and instruments used in the research to collect information. The overall guiding principles of the study was made known to participants where participation in the research was completely voluntary by seeking informed consent. Participants were informed that findings of this study were to be used for academic purposes only. Participants were also assured confidentiality by not indicating their names in data collection tools. Three research assistants were also taken through research procedures, instruments and ethical guiding principles before commencing data collection under close supervision by the researcher.

CHAPTER FOUR: RESULTS

4.0 Introduction

This chapter details research results from analysis of data collected using observation checklist as well as questionnaires and interview guide administered to restaurant food handlers and managers respectively. Presentation of the results is in line with the objectives of the study, that is; results on implementation extent of prerequisite programmes in restaurants, implementation extent of HACCP system in restaurants, food hygiene knowledge level of food handlers in restaurants and food hygiene practice among food handlers in restaurants in Nairobi City County.

4.1 Response Rate of Questionnaires

A total of 358 questionnaires were administered to participating food handlers. However, only 316 participants completed responding to the questionnaire as the remaining 42 did not complete responding to the questionnaires due to the busy nature of restaurant operations. This therefore gave a study response rate of 88.3%. A response rate greater than 70% is considered quite adequate according to Mugenda & Mugenda (2019). The high response rate was as a result of effective training of research assistants and use of researcher administered questionnaires data collection method.

4.2 Socio-Demographic Characteristics of the Study Population

As shown in table 4.1, an analysis of distribution of respondents by gender showed that 24.1% of the food handlers in restaurants were female while 75.9% of the food handlers were male. Study findings on age distribution of participants showed that a majority of the restaurant food handlers were between the ages of 26-35 years (45.3%). A very small proportion of participants were between the ages of 46-55 years (7.0%). Majority of the

restaurant food handlers had middle-level college education (53.8%) and the least percentage of respondents (18.0 %) had a university bachelor's degree education. Majority of the food handlers with tertiary education had undertaken a food production course (37.4%) with a minority (5.3%) having undertaken a food service course.

Table 4.1: Socio-Demographic Characteristics of the Study Population (n=316)

Socio-Demographic Characteristic	n(%) of food handlers
Gender	
Male	240 (75.9)
Female	76 (24.1)
Age	
18-25	65 (20.6)
26-35	143 (45.3)
36-45	86 (27.2)
46-55	22 (7.0)
Education level	
Secondary	89 (28.2)
Middle level College	170 (53.8)
University	57 (18.0)
Course studies in college/university	
Catering	22(9.7)
Food production	85 (37.4)
Hospitality	64 (28.2)
Food service	12 (5.3)
Other	44 (19.4)

4.3 Prerequisite Programmes Implementation in Restaurants

4.3.1 Compliance to Restaurant Building and Facilities Requirements

Observations made on compliance to restaurant building and facilities are summarized in Plate 4.1 to 4.6. All restaurants had plastered floors and walls with tiles. Table 4.2 shows that 66.7% of the restaurants had undamaged floors without crevices and 74.4% had clean floors. Restaurants with undamaged walls and with a smooth tile finish were 82.1% while 92.3% had clean walls. Plate 4.5 particularly shows a damaged unrepaired wall crevice. Maintenance of clean overhead hood structure was observed by 56.4% of the restaurants.

Most restaurants had both adequate lighting (97.4%) and ventilation (94.9%). An overhead ventilation hood is shown in Plate 4.6 as provided for restaurant kitchen ventilation. Toilet facilities hygiene and cleanliness was observed by 65.1% of the restaurants.

Table 4.2: Compliance to Building and Facilities Requirements by Restaurants (n=39)

Items	Frequency	% of restaurants
Floor		
Floor plastered with non-absorbent material	39	100.0
Floor without crevices	26	66.7
Floor clean	29	74.4
Walls		
Walls tiled	39	100.0
Walls without crevices	32	82.1
Walls clean	36	92.3
Overhead structures		
Clean overhead structures including hood	22	56.4
Toilets		
Toilets clean	25	65.1
Lighting		
Adequate lighting	38	97.4
Ventilation		
Adequate ventilation	37	94.9

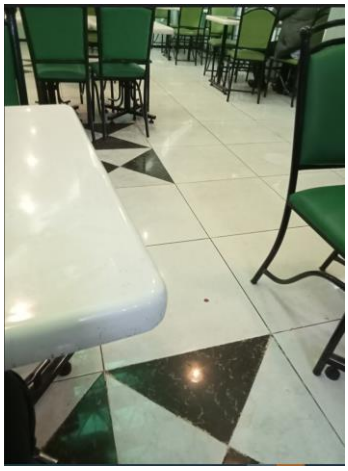

Plate 4.1: Tiled Floor

Plate 4.2: Tiled Floor with crevices

Plate 4.3: Floor Cleanliness not Maintained

Plate 4.4: Tiled Wall

Plate 4.5: Tiled Wall with Crevices

Plate 4.6: Overhead Ventilation Hood

4.3.2 Compliance to Restaurant Water Supply and Hand Washing Facilities Requirements

Although all (100%) restaurants had portable tap water supply, only 23.1% had hot portable water supply. Plate 4.8 shows an installed water heater for hot water supply. All restaurants had hand washing stations with handwashing detergent. Provision of hand drying material such as hand dryer and paper towel at the hand washing station was observed in 30.8% of the restaurants. Observations made on provision of hand washing facilities is summarized in Plate 4.9 which shows soap and hand dryer provided at a restaurant hand washing station while Plate 4.10 shows provision of soap only with no hand drying material at a handwashing station.

Table 4.3: Compliance to Water Supply and Hand Washing Facilities Requirements by Restaurants (n=39)

Items	Frequency	% of restaurants
Water Supply		
Provision of portable water supply	39	100
Provision of hot portable water supply	9	23.1
Hand washing facilities		
Hand washing facility with handwashing detergent	39	100
Hand washing facility with hand dryer/paper towel	12	30.8

Plate 4.7: Portable Cold Tap Water Supply

Plate 4.8: Portable Water Supply with Installed Water Heater

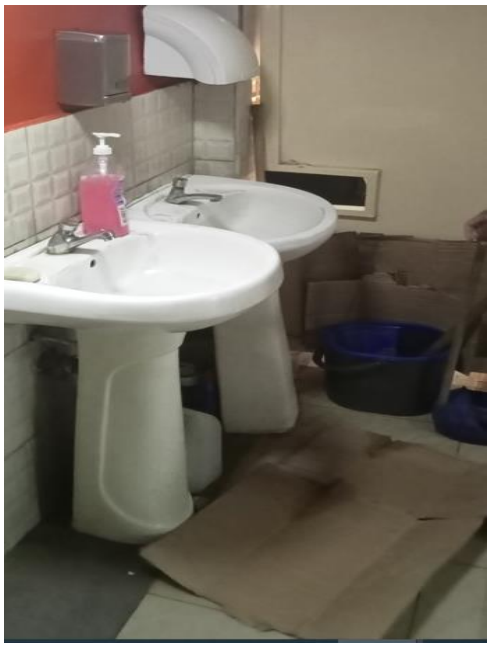

Plate 4.9: Hand Washing Facility with Soap and Hand Dryer

Plate 4.10: Hand Washing Facility with Soap and no Hand Drying Material

4.3.3 Compliance to Restaurant Personnel Hygiene Requirements

Food handlers in 56.4% of the restaurants were in appropriate protective clothing including head cover and closed footwear. Plate 4.11 shows food handlers in appropriate protective clothing. About 89.7% of restaurants had food handlers with clean protective clothing. Most restaurants (94.8%) had food handlers who were wearing jewellery and ornament such as rings and bracelets when handling food.

Table 4.4: Compliance to Personnel Hygiene Requirements by Restaurants (n=39)

Items	Frequency	% of restaurants
Personnel hygiene		
Food handlers with appropriate protective Clothing (head cover, clothing, footwear)	22	56.4
Food handlers with clean clothing	35	89.7
Food handlers wearing jewellery/ornaments	37	94.8

Plate 4.11: Food Handlers in Appropriate Protective Clothing

4.3.4 Compliance to Restaurant Waste Management and Pest Control Requirements

All restaurants (100%) had provision of adequate solid waste bins and adequate waste water drainage system. Most of the restaurants (89.7%) had waste bins that were emptied regularly thus not overfilled as shown in Plate 4.12. However, Plate 4.13 shows an overfilled waste bin not emptied regularly as required. Signs of pest infestation especially with cockroaches was observed in 10.3% of the restaurants.

Table 4.5:Compliance to Waste Management and Pest Control Requirements by Restaurants (n=39)

Items	Frequency	% of restaurants
Waste management		
Adequate solid waste bin provided	39	100
Waste bins well maintained, not overfilled	35	89.7
Waste water drainage system provided	39	100.0
Pest control		
Evidence of pest infestation	4	10.3

Plate 4.12: Waste Bin Well Maintained, not Overfilled

Plate 4.13: Overfilled Waste Bin

4.4 HACCP Implementation in Restaurants

4.4.1 HACCP Awareness Among Restaurant Managers

Only a small percentage of restaurant managers (20.5%) out of 39 interviewed restaurant managers had heard of HACCP system used in identifying and controlling hazards at all food handling and processing stages giving assurance of safe food provision to consumers. Majority of the restaurant managers (79.5%) were not aware of HACCP system and the use thereof.

4.4.2 Receiving of Incoming Food Items Practice in Restaurants

Shelf life checks, packaging integrity, sensory evaluation/organoleptic tests were carried out by all (100%) restaurants during receiving process of incoming food items as explained by participants, for instance: *"The colour, odour and texture of meat is checked, weevil infestation in cereals is also checked when receiving food items from our suppliers."* Majority of the restaurants (76.9%) receive high risk chilled foods of animal origin, for instance: *"We do not receive frozen food items since frozen foods are not fresh and could have been stored for long periods by the supplier. We however receive chilled food such as raw chicken from our suppliers."* About 12.8% of the restaurants mentioned temperature check of high-risk food items as a receiving monitoring criterion at their restaurant. However, none of the restaurants observed appropriate receiving temperature monitoring criteria for chilled and frozen high-risk food items such as raw foods of animal origin (below 8℃ and below -12℃ respectively): *"Temperature for chilled milk is sometimes checked with an infrared thermometer when receiving, the temperature should be below 18*℃*."*

Table 4.6: Receiving of Incoming Food Items Practice in Restaurants (n=39)

Items	Frequency	% of restaurants
Receiving of incoming food items		
Food receiving monitoring criteria- shelf life, packaging, sensory evaluation/organoleptic test	39	100
Receive high risk chilled foods of animal origin	30	76.9
Receive high risk frozen foods of animal origin	15	38.5
Check the temperature of chilled and frozen foods during receiving	5	12.8
Appropriate receiving temperature monitoring criteria for chilled foods (below 8℃)	0	0
Appropriate receiving temperature monitoring criteria for frozen foods (below -12℃)	0	0

4.4.3 Storage of Food Items Practice in Restaurants

All restaurants (100%) had cold storage facilities (chillers and/or freezers) for cold storage of high risk raw and cooked foods. About 28.2% had chillers with inbuilt digital temperature monitoring gauge and only 15.4% had freezers with inbuilt digital temperature monitoring gauge for cold storage facility temperature monitoring. Plate 4.14 shows a restaurant cold storage fridge with an inbuilt digital temperature monitoring gauge while Plate 4.15 shows a cold storage freezer without a digital temperature monitoring gauge: About 79.5% used sensory checks by feeling product and fridge/freezer temperature through sense of touch for the cold storage facilities that did not have an inbuilt digital temperature monitoring gauge: "*Staff always report when the fridge is not working, one can always tell the fridge is not working when they feel the fridge and food items are not cold"*. Only 27.3% of the restaurants observed appropriate temperature monitoring criteria for chill storage (below 5℃) while 16.7% observed appropriate temperature monitoring

criteria for frozen storage (below -18℃): *"The fridge temperature is set at 4 ℃ to keep food items in the fridge cold."*

Table 4.7:Storage of Food Items Practice in Restaurants (n=39)

Items	Frequency	% of restaurants
Storage of food items		
Availability of refrigerators/freezers for storing chilled/frozen foods	39	100
Cold storage facility (chiller) with inbuilt digital temperature monitoring gauge	11	28.2
Cold storage facility(freezer) with inbuilt digital temperature monitoring gauge	6	15.4
Cold storage temperature check by feeling product and fridge/freezer temperature through sense of touch	31	79.5
Appropriate temperature monitoring criteria for chill storage (below 5℃)	3	27.3
Appropriate temperature monitoring criteria for frozen storage (below -18℃)	1	16.7

Plate 4.14: Cold Storage Fridge with Digital Temperature Monitering Gauge

Plate 4.15: Cold Storage Freezer without Digital Temperature Monitering Gauge

4.4.4 Thawing of Food Items Practice in Restaurants

All restaurants which had frozen storage of high-risk foods (100%) thawed/defrosted food before cooking. However, only 24.1 % of the restaurants practiced appropriate thawing method (in refrigerator/under running potable water). About 75.9% of the restaurants practiced inappropriate thawing methods of thawing on food preparation tables at room temperature or submerging in hot water: "*Frozen raw meat is always removed from the freezer early morning at around 6 am to thaw at room temperature before we start meal preparation/cooking."*

Table 4.8: Thawing of Food Items Practice in Restaurants (n=39)

Items	Frequency	% of restaurants
Thawing		
Thaw frozen food before cooking	29	100
Appropriate thawing method (in refrigerator or under running potable water)	7	24.1

4.4.5 Cooking/Food Preparation and Holding Practice in Restaurants

Cooking food in advance, that is, at most two hours prior to service time was a common practice in 100% of the restaurants while 38.5% prepared salads in advance before service time. 79.6% of the restaurants observed appropriate holding method for high risk food cooked in advance by holding hot food in hot bath/bain-marie. Plate 4.16 shows restaurant cooked food held in hot bath/bain-marie while Plate 4.17 shows cooked food held on top of other food containers and not hot held in hot bath/bain-marie as required. About 73.3% of the restaurants observed appropriate holding method for salads prepared in advance by cold holding in the refrigerator: "*Vegetable salad is normally prepared in mass quantities one hour before service time and kept in the fridge for individual order service."* However,

none of the restaurants observed cooking and holding time-temperature monitoring criteria (4 hours for high risk foods held below 5℃ and above 60℃): "*Lunch meals such as githeri, beef and rice are prepared two hours before service time and kept in hot bath/bain marie, lunch hours service time is between 11pm to 3pm."*

Table 4.9: Cooking/Food Preparation and Holding Practice in Restaurants (n=39)

Items	Frequency	% of restaurants
Cooking/food preparation and holding		
Cook food early in advance (at most 2 hours before service time)	39	100
Cook food as per order	31	79.5
Salads prepared early in advance (at most 2 hours before service time)	15	38.5
Salads prepared as per order	7	17.9
Appropriate holding method for high risk food cooked early in advance (in hot bath/bain marie)	30	76.9
Appropriate holding method for salads prepared early in advance (refrigeration)	11	73.3
Appropriate holding time/temperature monitoring criteria	0	0

Plate 4.16: Cooked Food Held in Hot Bath/Bain-Marie

Plate 4.17: Cooked Food Held on Top of Other Food Containers (Not in Hot Bath/Bain-Marie)

4.4.6 Thermometer Provision for Food Temperature Monitoring in Restaurants

None of the restaurants provided food handlers with probe thermometers suitable for measuring the core temperature of food items as shown in Plate 4.18. However, 10.26% of the restaurants provided food handlers with infrared thermometers for temperature monitoring during food handling.

Table 4.10: Thermometer Provision for Food Temperature Monitoring in Restaurants (n=39)

Items	Frequency	% of restaurants
Thermometers provision		
Food handlers provided with infrared thermometer for temperature monitoring during food handling	4	10.26
Food handlers provided with probe thermometer for temperature monitoring during food handling	0	0

Plate 4.18: Digital Probe Thermometer

4.5 Food Hygiene Knowledge among Restaurant Food Handlers

The mean knowledge score of all food handlers (n=316) was 55.33% (SD = 10.59). The scores ranged from 15% to 80%. The one sample t-test was used to analyse whether the mean knowledge score was significantly different from the 70% minimum satisfactory score. The sample mean of 55.33% (SD = 10.59) was significantly lower than 70% by -14.67%, t (315) = -24.669, p = 0.000, 95% CI [-15.84, -13.50] as shown in Table 4.12. Generally, food handlers' knowledge was significantly lower than the minimum acceptable score of 70%. Therefore the null hypothesis that stated; 'there is no significant difference between food hygiene knowledge mean score of food handlers and acceptable minimum mean score of 70%' was rejected.

Table 4.11: Mean Knowledge Score of Restaurant Food Handlers (n=316)

N	Minimum	Maximum	Mean	Std. Deviation
316	15.00	80.00	55.33	10.59

Table 4.12: One Sample T-Test Analysis of Mean Knowledge Score of Restaurant Food Handlers (n = 316)

One-Sample Test						
	Test Value = .70					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Knowledge score of food handlers	-24.634	315	.000	-14.668	-15.84	-13.50

The food hygiene knowledge questionnaire had 20 questions to obtain information on crucial food hygiene aspects, that is, personal hygiene (6 items), food hygiene and handling (6 items), food time and temperature control (5 items), cleaning, sanitization and environmental hygiene (3 items). An analysis of the crucial food hygiene aspects, that is, personal hygiene, food hygiene and handling, food time and temperature control, cleaning sanitization and environmental hygiene gave a mean score of 70.73% (*SD* = 16.65), 55.49% (*SD* = 16.90), 38.80% (*SD* = 17.67), and 51.79% (*SD* = 24.49), respectively as shown in Table 4.13.

Table 4.13: Mean Knowledge Score for Crucial Food Hygiene Aspects among Restaurant Food Handlers (n=316)

Crucial food hygiene aspect	Mean	Std. Deviation
Personal hygiene	70.73%	16.65
Food hygiene and handling	55.49%	16.90
Food time and temperature control	38.80%	17.67
Cleaning sanitization and environmental hygiene	51.79%	24.49

Food handlers' knowledge of food hygiene aspects is detailed in Table 4.14 as a percentage of correct and incorrect responses. The aspect with the least score was cleaning and sanitization aspect with a mean of 10.4% correct answers, and the aspect with the highest score was a personal hygiene aspect with a mean of 97.8% of correct answers.

Table 4.14: Food Hygiene Knowledge among Restaurant Food Handlers (n=316)

Question (Answer)	N (%Correct)	N (%Incorrect)
Personal hygiene		
Which one of the following jewellery is acceptable for a food handler to wear? (Plain wedding ring)	48.7	51.3
As a food handler, it is important that you wash your hands: (All of the above)	97.8	2.2
What is a substitute for proper hand washing? (None of the above. There is no substitute for hand washing)	35.1	64.9
When you develop diarrhoea before going to work, you should: (Call your boss and report that you are sick)	57.6	42.4
If you cut yourself in the food handling area, what actions would you take? (Cover the wound in a waterproof dressing and report it immediately)	96.5	3.5
What are the steps for proper hand washing? (Use warm water and soap to wash your hands, rub your hands together for 20 seconds, rinse your hands and dry your hands with a disposable paper towel)	88.6	11.4
Food hygiene and handling		
How could the bacteria Staphylococcus aureus be a risk when handling food? (By handling the food, you increase the risk of cross-contamination from the bacteria from your hands to the food)	62.0	38.0
Which one of these statements about bacteria is true? (Bacteria grow fastest when they are warm)	13.3	86.7
Give one example of a chemical hazard (Washing up soap solution not rinsed off properly)	81.6	18.4
From the below list which in NOT a High-Risk Food item? (Cookies and biscuits)	75.9	24.1
Where should raw meat be stored in a refrigerator with other cooked food items? (At the bottom, below all other food)	85.4	14.6
How can you tell if food has enough bacteria to cause food poisoning? (You can't, it will appear normal)	14.6	85.4
Food time and temperature control		
What is the Temperature Danger Zone? (The temperature danger zone for food products is 5 ºC to 60 ºC)	31.6	68.4
The proper way to thaw frozen chicken is: (Place in the refrigerator)	17.4	82.6
A refrigerator operating below 5 ºC (Slows down bacterial multiplication)	74.7	25.3
Which of the following is the proper serving temperature in cooked foods? (Above 60° C)	24.1	75.9
Cooked rice was left at room temperature overnight. What should you do with the rice? (Throw the rice away; it may not be safe to eat)	46.2	53.8
Cleaning, sanitization and environmental hygiene		
Which is the correct way to wash dishes, utensils and equipment? (wash, rinse and sanitize; then air dry)	10.4	89.6
The most important reason to wash, rinse and sanitize cutting boards is to: (Prevent contamination from one food to another)	66.1	33.9
What must you use to sanitize tables and work surfaces that come into direct contact with food (A wiping cloth that has been soaked in a solution of water and an approved sanitizer at proper concentration)	78.8	21.2

4.6 Food Hygiene Practice among Restaurant Food Handlers

As summarized in table 4.15, Crucial food hygiene practice aspects analyzed were personal hygiene, food hygiene and handling, food time and temperature control, cleaning sanitization and environmental hygiene. Most respondents consistently reported to always adhere to good hygiene practice in personal hygiene aspects; 89.6% of the food handlers always wash hands before beginning work in the food production area, 77.8% never wear jewellery/ornaments when handling food, 86.1 % check cleanliness of clothes and shoes before work, 71.5% always report to their supervisor when suffering from fever or severe cough and 83.9% always cover open wounds with water proof plaster before handling food. The personal hygiene aspect with the least score was 23.4% of food handlers who never used a handkerchief in food handling area when suffering from a cold.

Most food handlers reported to always observe good food hygiene practice in aspects analyzed under food hygiene and handling. Checking of the expiration date/shelf life of food items was always practiced by 84.5% of food handlers, 71.5 % always label processed foods with use-by date before storing in the refrigerator, 81.3% always store raw foods and cooked foods separately in refrigerator and freezers, 82.3% always use separate utensils when preparing raw and cooked foods, 93% always wash fresh vegetables thoroughly before use and 78.5% never handle ready to eat foods with bare hands.

Low proportion of respondents consistently reported good food hygiene practice in aspects analyzed under food time and temperature control where 65.5% always check the temperature of refrigerators and freezers on a daily basis, 57.6% always check the temperatures of chilled and frozen foods during receiving process, 28.8% never return thawed meats to the freezer, 0.6% always use a thermometer to check food temperature in

cooking process and 29.7% never thaw frozen meats on preparation tables at room temperature.

Analysis of cleaning, sanitization and environmental hygiene aspects showed poor practice by food handlers where 74.4% always use kitchen towels to dry utensils. However good hygiene practice was reported by 96.2% who store cleaning detergents away from foods and 67.7% who wash and disinfect chopping boards after each use.

Table 4.15: Frequencies of Responses (%) to Food Hygiene Practice Questions among Restaurant Food Handlers (n=316)

Food hygiene practice	Always	Most of the time	Sometimes	Never
Personal hygiene				
Wash hands before beginning work in the food production area	89.6	7.0	2.8	0.6
Wear jewellery/ornaments when handling food	3.8	4.4	13.9	77.8
Check cleanliness of clothes and shoes before work	86.1	7.3	6.3	0.3
Report to supervisor when suffering from fever or severe cough	71.5	14.2	10.1	4.1
Use a handkerchief in food handling area when suffering from a cold	51.9	13.6	11.1	23.4
Cover open wounds with water proof plaster before handling food	83.9	7.3	6.3	2.5
Food hygiene and handling				
Check the expiration date/shelf life of food items	84.5	7.0	6.3	2.2
Label processed foods with use-by date before storing in the refrigerator	71.5	14.6	10.1	3.8
Store raw foods and cooked foods separately in refrigerator and freezers	81.3	4.7	9.8	4.1
Use separate utensils when preparing raw and cooked foods	82.3	10.8	6.3	0.6
Thoroughly wash fresh vegetables before use	93.0	3.8	2.2	0.1
Handle ready to eat foods with bare hands	4.7	9.8	7.0	78.5
Food time and temperature control				
Check the temperature of refrigerators and freezers on a daily basis	65.5	18.0	13.3	3.2
Check the temperatures of chilled and frozen foods during receiving process	57.6	14.6	21.5	6.3
Return thawed meats to the freezer	38.0	17.1	16.1	28.8
Use a thermometer to check food temperature in cooking process	0.6	0.9	2.2	96.2
Thaw frozen meats on preparation tables at room temperature	38.6	19.6	12.0	29.7
Cleaning, sanitization and environmental hygiene				
Wash and disinfect chopping boards after each use	67.7	24.1	4.4	3.8
Use kitchen towels to dry utensils	74.7	10.8	7.0	7.6
Store cleaning detergents away from foods	96.2	2.5	0.9	0.3

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio-Demographic Characteristics of the Study Population

The study finding showed that there are more male (75.9%) food handlers than female food handlers. The results were similar to those of demographic statistics by Hamed & Mohammed (2020) that showed 81.0% of food handlers were male attributed to the nature of work that demands flexibility favourable to male workers and unfavourable to their female counterparts. Most respondents were in the 26-35 years age bracket (45.3%). A similar study by Ahmed et al. (2021) showed that most food handlers (79.2%) were in the 19-35 years age bracket. The findings of this study illustrate that the restaurants industry is predominantly male and consists of a young generation. Majority of the food handlers had middle-level college education (53.8%). A study by Ahmed et al. (2021) showed that level of education among food handlers was significantly associated with food hygiene knowledge and food hygiene practice.

5.1.2 Prerequisite Programmes Implementation in Restaurants

Prerequisite programmes are a foundation for implementing food hygiene requirements which create a safe food handling environment through establishing hygienic working environment, facilities and personnel hygiene standards among food handlers. Implementation of prerequisite programmes ensures minimum risk of food contamination and provides conditions necessary to protect the food from contamination (CAC, 2020). The findings revealed gaps in prerequisite programmes implementation in Nairobi County restaurants especially on building and facility construction, maintenance and cleanliness,

provision of portable water at adequate temperature, and compliance to restaurant personnel hygiene requirements.

The study findings revealed that maintenance of required standards of some aspects of the building and facility was wanting where 66.7% of the restaurants had undamaged floors without crevices. Damaged floors with cracks and crevices cannot be properly cleaned and can harbor microbes and pests such as cockroaches in the cracks and crevices which could contaminate surfaces and equipment in direct contact with food items (Agüeria et al., 2021). Maintenance of cleanliness especially of overhead hood structures and toilets was inadequate as this was observed by 56.4% and 65.1% of the restaurants respectively. Maintaining cleanliness of kitchen hood structures in restaurants is essential to prevent gathered dust and grease from dripping onto and contaminating prepared food. Studies have revealed that many enteric pathogens important to food safety are found in toilets making cleaning and disinfection of toilets a necessity for preventing cross contamination and pathogen transmission among food handlers (Abney, 2021). A research study by de Souza et al., et., al (2018) recorded similarity in findings where implementation of prerequisite programmes in Brazilian restaurants was found to be inadequate.

Restaurants were compliant with provision of portable tap water. However, provision of portable water at adequate temperature was implemented by only 23.1% of restaurants which had both cold and hot running water supply. Similar study finding by Idris et al. (2020) showed inadequate availability of hot water in most catering establishments required for proper cleaning of catering establishments utensils. Restaurants provided hand washing sinks with portable running water and soap. However, the identified gap was with provision of means to hygienically dry hands such as use of paper towel or a hand drier as

this was adhered to by only 30.8% of the restaurants. Studies have shown that proper hand drying with paper towel or hand drier after thorough handwashing is effective in removing potential pathogenic microorganisms (Gammon & Hunt 2019). Maintenance of hand washing sink with handwashing materials increases the likelihood of food handlers washing hands correctly (Verrill et al., 2021).

The study identified personnel hygiene gaps where only 56.4% of the restaurants provided food handlers with appropriate protective clothing including head cover. These results were similar to findings by Teferi (2021) in a study conducted in Ethiopia where 52.8% of workers handling food in food service sector restrained their hair with head cover. A major personnel hand hygiene gap was identified in jewellery and ornament adornment by food handlers as 94.8% of the restaurants had food handlers observed wearing jewellery and ornaments such as bracelets and rings when handling food. Yeshanew et al. (2021) associated poor hand hygiene and head cover status with food borne disease infection among food handlers.

5.1.3 HACCP Implementation in Restaurants

Implementation of HACCP identifies and controls hazards at all food handling and processing stages giving assurance of safe food provision to consumers. The findings revealed gaps in HACCP implementation in Nairobi County restaurants especially on HACCP awareness among restaurant Managers and time- temperature monitoring in all critical food handling stages and food flow process steps.

Restaurant managers play an immense role in ensuring set food hygiene standards are adhered to in all food handling steps thus the importance of HACCP system awareness. The study however established that most restaurant managers (79.5%) were not aware of

the HACCP system used in identifying and controlling hazards at all food handling and processing stages giving assurance of safe food provision to consumers. This was a major gap since management knowledge on HACCP is fundamental for identification, evaluation and control of hazards that are specific and inherent to food and its preparation. A study conducted by Alrasheed et al. (2021) among hospital food handlers in Saudi Arabia showed similar HACCP knowledge gaps among food service supervisors. Research findings by Waseem et al. (2022) identified basic knowledge gaps among food establishment supervisors with regards to food temperature monitoring which is a requirement in HACCP implementation.

Inadequacies in monitoring control points were noted in HACCP implementation especially in temperature control in all food flow process steps. At the initial food receiving step of high risk frozen and chilled foods, 12.8% of the restaurants mentioned temperature check as a receiving monitoring criterion at their restaurant. However, none of the restaurants observed appropriate receiving temperature monitoring criteria for chilled and frozen high-risk food items (below 8℃ and below -12℃ respectively). Lack of receiving temperature monitoring criteria meant that there was a risk of receiving food transported in danger zone temperatures (above the required limits) for long periods of time which could result to pathogen proliferation during transportation. Restaurants performed well in provision of cold storage facilities such as refrigerators and freezers. However, only a small percentage of the restaurants (27.3%) observed appropriate temperature monitoring criteria for chill storage and only 16.7% observed appropriate temperature monitoring criteria for frozen storage (below 5℃ and below -18℃ respectively). Only 20% of food establishments monitored proper food storage temperatures according to a research carried

out in Spain (Garayoa et al., 2016). Results from a study conducted by Ziegler (2019) showed that storage of ready to eat food at a temperature below 5℃ mitigates the growth of pathogens. Inappropriate thawing methods such as thawing food on food preparation tables at room temperature were identified in 75.9% of the restaurants. A lack of temperature control during thawing could result in pathogen growth on high risk foods. Food handlers in restaurants revealed a common poor food hygiene practice where food was thawed under room temperature or using hot water as per Ncube et al. (2020) research carried out in Zimbabwe.

Cooked food prepared early in advance was held in hot bath/bain-marie in 79.6% of the restaurants to keep food hot during service. Salads prepared early in advance were stored appropriately in refrigerators in 73.3% of the restaurants. However, none of the Restaurants had implemented holding time-temperature monitoring criteria of high-risk food prepared early in advance. Bhattacharya et al. (2020) identified significant lapses in food temperature control during hot holding in a study conducted in West Midlands, England. Lack of holding time-temperature monitoring criteria poses a risk of pathogen proliferation in high risk cooked or salad foods.

The type of thermometer provided for temperature monitoring was not sufficient for measuring the core temperature of food items since 10.26% of the restaurants provided food handlers with infrared thermometers for measuring food surface temperature. None of the restaurants provided food handlers with probe thermometer suitable for measuring the core temperature of food items. Measuring the core temperature of food during cooking is essential in ensuring that internal temperature required to kill most harmful microorganisms is attained. Availability of thermometers and lack of knowledge regarding

the suitable thermometer for food temperature monitoring are identified as barriers to thermometer use (Feng & Bruhn, 2019).

5.1.4 Food Hygiene Knowledge among Restaurant Food Handlers

The mean knowledge score of all food handlers (n=316) was 55.33% (SD = 10.59). Food handlers' knowledge was significantly lower than the minimum acceptable score of 70%. The study results were similar to research findings by Manes et al. (2016) who established a mean knowledge score of 49% among restaurant food handlers in India. Research findings by Hasan et al. (2022) conducted in Bangladesh also identified food hygiene knowledge gaps among restaurant food handlers. A study conducted by Hamed & Mohammed (2020) in Egypt similarly identified food handling hygiene requirements knowledge gaps in food service. Inadequacies in safe food handling knowledge were also established among food establishments staff in a study conducted by Alemayehu (2020) in Ethiopia. A research carried out in Oman, a developing country in western Asia; showed overall knowledge results of 58.6%, 52.1% and 53.2% in three different Muscat city District restaurants exhibiting food hygiene knowledge gaps in all the three districts (Al-Ghazali et al., 2020).

Crucial food hygiene aspects, that is, personal hygiene, food hygiene and handling, food time and temperature control, cleaning sanitization and environmental hygiene were analyzed and gave a mean score of 70.73%, 55.49 %, 38.80 %, and 51.79% respectively. The highest score was on personal hygiene aspects. Allafi et al. (2020) had similar findings where food handlers scored satisfactorily in personal hygiene knowledge aspects in a research carried out among restaurant food handlers in Kuwait. Research findings among institutional food handlers in Ghana as well identified high scores in personal hygiene

knowledge aspects (Akabanda et al., 2017). The least score was on food time and temperature control aspects. Similar inadequacies were noted in the monitoring of temperature control points in all food flow process steps in HACCP implementation. Several studies have identified low knowledge scores in food temperature control aspects among food handlers. A study carried out in India by Manes (2016) identified knowledge gaps among food handlers working in restaurants related to proper food holding temperatures. Similarly, Derso et al. (2017) identified poor knowledge among food handlers regarding safe food refrigeration temperatures in restaurants in Ethiopia. However, study findings by Putri & Susanna (2021) conducted in Indonesia showed contrary results where by food handlers were aware of crucial food temperature monitoring requirements in food service sector.

According to an integrative review of various studies by Zanin et al. (2017), knowledge assessment among food handlers is a crucial input to determining food hygiene training needs. Food handlers are interested in undertaking food hygiene training to enhance their food hygiene knowledge if presented with the opportunity according to research findings by Hashanuzzaman et al. (2020) among food handlers in Bangladesh. Periodic trainings programmes focusing on crucial food hygiene aspects are of importance to alleviate food hygiene knowledge gaps among food handlers. Research findings by Raji et al. (2021) showed food handlers' hygiene training is fundamental to food hygiene knowledge improvement.

The study conclusion regarding food hygiene knowledge among restaurant food handlers was that food handlers' knowledge was significantly lower than the minimum acceptable score of 70%. The null hypothesis that stated; 'there is no significant difference between

food hygiene knowledge mean score of food handlers and acceptable minimum mean score of 70%' was therefore rejected.

5.1.5 Food Hygiene Practice of Food Handlers

Among the crucial food hygiene practice aspects analyzed, most food handlers consistently reported to always adhere to good food hygiene practice in personal hygiene and food hygiene and handling aspects. Study findings by Allafi et al. (2020) among restaurant food handlers in Kuwait reported similar findings where food handlers performed well in personal hygiene practice aspects. Similar study results by Al Banna (2022) showed high levels of food handling practices among food handlers in Bangladeshi, India.

Low proportion of food handlers consistently reported good food hygiene practice in aspects analyzed under food time and temperature control. Poor food hygiene practice was recorded in thawing temperature control practices; 29.7% never thaw frozen meats on preparation tables at room temperature, 28.8% never return thawed meats to the freezer. A similar study conducted by Ncube et al (2020) identified poor food hygiene practice where restaurant food handlers thawed frozen foods at room temperature or using hot water. The lowest proportion was recorded in usage of thermometers to check food temperature where 0.6% always use a thermometer to check food temperature in cooking process. Low proportion of respondents consistently reported good food hygiene practice in aspects analyzed under food time and temperature control. The poor food hygiene practice as analyzed under food time and temperature control aspects were also noted in HACCP implementation where inadequacies were identified in provision of thermometers to food handlers and in monitoring of temperature control points in all food flow process steps. Similar studies that revealed poor food hygiene practice among food handlers are those

conducted in Ethiopia by Legesse et al. (2017) in public food establishments and Meleko et al. (2015) in university cafeterias. Study findings by Akabanda et al. (2017) in Ghana also reported a lack of strict food hygiene practice observance by food handlers. Study findings by Nizame et al. (2019) in Bangladesh similarly showed poor food hygiene practice among restaurant cooks.

Several studies have recommended food hygiene trainings as a measure for enhancing appropriate food hygiene practice. A study conducted by Al-Ghazali et al. (2020) among restaurant food handlers in Oman showed an association between good hygiene knowledge and good hygiene practice thus advocating for food handlers hygiene training for a resultant improvement in food hygiene practice. Several studies in food service establishments that showed food handlers with good hygiene knowledge did not necessarily observe good food hygiene practice advocate for continuous food hygiene awareness trainings for food hygiene practice improvement (Putri & Susanna, 2021, de Souza et al., 2018 & Akabanda et al., 2017). A study conducted by Hamed & Mohammed (2020) in Egypt recommended implementation of hygiene requirements awareness programmes among food handlers as a measure to promote good hygiene practice. Research findings by Tran et al. (2018) conducted in Vietnam similarly identified continuous training as a fundamental requirement for improving food handling and hygiene practice in food service sector.

5.2 Conclusion

Compliance to hygiene practice standards requirements in restaurants and among food handlers involved in food handling in all process steps is crucial in controlling food safety hazards thus assuring safe food to consumers. The following conclusions are therefore derived from the study findings:

1. The study identified gaps in prerequisite programmes implementation in restaurants especially in maintenance of building and facilities in matters cleanliness and repair of damaged building and facility areas. Gaps were also identified in provision of some hygiene facilities including hot portable running water and hand drying effects required for effective handwashing. Noncompliance to provision of hairnets to food handlers and poor hand hygiene as a result of jewellery and ornaments adornment by food handlers was also noted.
2. Major gaps in HACCP implementation in restaurants were identified regarding temperature monitoring criteria in all food time-temperature control points, that is, gaps in observing appropriate receiving temperature monitoring criteria for chilled and frozen high-risk food items; gaps in observing appropriate temperature monitoring criteria for chill and frozen storage; and gaps in observing holding time-temperature monitoring criteria of high-risk food prepared early in advance.
3. Restaurant food handlers' mean food hygiene knowledge score (55.33%) was significantly lower than the minimum acceptable score of 70%. Analysis of crucial food hygiene aspects showed that food time and temperature control aspect had the least score.

4. Restaurant food handlers consistently reported good food hygiene practice in personal hygiene and food hygiene and handling aspects. However, food handlers consistently reported poor food hygiene practice in aspects analyzed under food time and temperature control.

5.3 Recommendations

5.3.1 Recommendations from the Study

The following recommendations are suggested based on the study findings:

1. Restaurants operators should fully implement prerequisite programmes requirements as outlined in KS 2573:2015 standard especially regarding maintenance and repair of established restaurant building and hygiene facilities and adherence to personnel hygiene requirements as implementation of all prerequisite requirements will create a safe food handling environment with minimum risk of contamination.
2. Restaurants operators should fully implement HACCP requirements as outlined in KS 2573:2015 standard especially regarding food temperature monitoring in all critical control points as implementation of all HACCP requirements will ensure control of hazards inherent and specific to the food being handled.
3. Restaurant food handlers should be trained on food hygiene requirements by qualified food hygiene trainers approved by the Ministry of Health.
4. Food hygiene practice improvement among food handlers should be realised through continuous training by qualified food hygiene trainers especially regarding food time and temperature control aspects, coupled with food handlers food hygiene practice monitering.

5.3.2 Recommendations for Further Research

Further research in the following three areas is recommended:

1. The study was carried out in Nairobi County which is an urban setting. A similar study should be carried in countryside restaurants to establish if findings in a rural setting will be comparable.
2. A similar study needs to be carried out in other categories of food service establishments such as hotels and catering service providers.
3. Further research involving food and environmental sampling for laboratory testing/analysis to determine microbial load in relation to food handlers' practice in restaurants in Nairobi County should be carried out.

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APPENDICES

Appendix I: Consent Information Form

My name is Lilian Kerubo Mosota. I am a Master's student from Kenyatta University. I am conducting a study titled " **Compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County**" The information will be used to establish compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County.

Procedures to be followed
Participation in this study will require that I ask you some questions. I will record the information you provide in a questionnaire.

Voluntarism
Your participation in the study is completely voluntary.

Reward
There are no rewards or any payment to you if you participate.

Confidentiality
Your name will not be recorded on the questionnaire. Your information will be kept confidential to the researcher. Your information will be added to responses from other participants and shared in aggregate forms.

Contact Information
If you have questions about the study you may contact Principal Investigator phone number 0732295140 or contact Co-investigators/Supervisors at rudevsol@gmail.com and waudojudith@yahoo.com

However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you choose not to participate, answer or decide to stop.

I agree to participate in this research study: Yes [ ] No [ ]

Participant printed name: _____

Participant signature: _____ Date: _____

I certify that I have consented the participant

Name of Interviewer: _____

Signature: _____Date: _____

Appendix II: Observation Checklist on Implementation of Prerequisite Programmes (PRPs) in Restaurants

Buildings and facilities	**Yes**	**No**	**Comment**
Are floors made of waterproof, non-absorbent, material that is easy to clean and disinfect? Type of floor: cement/concrete ☐, Tile ☐, Terrazzo ☐ Other____			
Floor without crevices			
Is the floor clean at time of visit?			
Are walls made of waterproof, non-absorbent material that is, easy to clean and disinfect? Type of wall: Painted cement/concrete ☐, Tile ☐ Other____			
Wall without crevices			
Are the walls clean at time of visit?			
Are overhead structures clean (free from accumulation of dirt, condensation and flaking)			
Are toilets clean?			
Lighting	**Yes**	**No**	**Comment**
Is adequate natural or artificial lighting provided throughout the establishment?			
Ventilation	**Yes**	**No**	**Comment**
Is the kitchen provided with adequate ventilation systems to prevent excessive build-up of heat, steam condensation, dust and contaminated air?			
Water supply	**Yes**	**No**	**Comment**
Is there supply of portable water?			
Is there supply of hot portable water?			

Hand washing facilities	**Yes**	**No**	**Comment**
Are hand washing facilities provided with a suitable hand-cleaning detergent?			
Are hand washing facilities provided with hand dryer/paper towel?			
Personnel hygiene	**Yes**	**No**	**Comment**
Are all food handlers' wearing suitable protective clothing including head covering and closed footwear?			
Are all food handlers wearing clean protective clothing?			
Are food handlers wearing any type of jewellery or ornaments at time of visit (except plain wedding ring)?			
Waste management	**Yes**	**No**	**Comment**
Are adequate number of waste bins provided?			
Are the waste bins well maintained, not overfilled?			
Is waste water drainage system provided?			
Pest control	**Yes**	**No**	**Comment**
Is there evidence of pest infestation?			

Appendix III: Semi-structured Interview Guide on Implementation of HACCP system in Restaurants

I am a Master's student from Kenyatta University. I am conducting a study titled " **Compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County".**

This interview guide is prepared to assess the implementation of HACCP in restaurants. 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 will therefore be kept confidential.

1 Are you aware of the Hazard Analysis Critical Control Point (HACCP) system used in identifying and controlling hazards at all food handling and processing stages?

___Yes ____No

2 Receiving of incoming food items

2.1 What is the monitoring criteria during receiving of incoming food items?

- ☐ Expiration date
- ☐ Packaging integrity
- ☐ Appearance, odour, colour
- ☐ Temperature for chilled and frozen food

Other specify____

2.2 Do you receive high risk chilled foods such as raw foods of animal origin? ____Yes ____No

2.3 Do you receive high risk frozen foods? ____Yes ____No

2.4 Do you check the temperature of chilled and frozen foods during receiving? ____Yes ____No

2.5 If yes in 3.4 above what is your receiving temperature monitoring criteria for:

Chilled foods_____.

Frozen foods_____.

3 Storage of food items

3.1 Do you have refrigerators/freezers for storing chilled/frozen foods? ___Yes ____No

3.2 How do you monitor fridge/freezer temperature?

- ☐ By checking fridge temperature monitoring gauge
- ☐ By checking freezer temperature monitoring gauge
- ☐ Using a thermometer to check fridge/freezer temperature
- ☐ By feeling product and fridge/freezer temperature through sense of touch
- ☐ Other specify ____

3.3 What is the temperature monitoring criteria for chill storage? ____

3.4 What is the temperature monitoring criteria for frozen storage? ____

4 Thawing

4.1 Do you thaw frozen foods before cooking? ___Yes ____No

4.2 Which method is used in thawing food?

- ☐ In a refrigerator/purpose built thawing cabinet
- ☐ Under running potable water
- ☐ Food is immersed in a water container
- ☐ In food preparation area at room temperature
- ☐ a commercial microwave oven as part of a continuous cooking process
- ☐ Food is cooked without thawing

Other specify ____

5 Cooking/food preparation and holding

5.1 How does your establishment prepare food for service?

- ☐ Food is cooked early in advance
- ☐ Food is cooked as per order
- ☐ Salads are prepared early in advance
- ☐ Salads are prepared as per order

Other specify ____

5.2 If you cook/prepare food early in advance before service,

How early in advance do you cook/prepare food? …….(minutes/hours) before service

5.3 How do you hold food cooked/prepared early in advance?

☐ At room temperature ☐ Refrigerated

☐ In hot baths ☐ In holding oven

Other specify ____

5.4 What is the holding time/temperature monitoring criteria for cooked/prepared food?

____

6 Are food handlers provided with thermometers for temperature monitoring during handling? ____Yes ____No.

6.1 Type of thermometer provided

☐ Probe thermometer

☐ Infrared thermometer

Other specify ____

Appendix IV: Food Hygiene Knowledge Questionnaire

I am a Master's student from Kenyatta University. I am conducting a study titled **"Compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County"**

This questionnaire is prepared to assess the food hygiene knowledge among restaurant food handlers. 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 will therefore be kept confidential.

Section 1

Place a tick [√] in the box next to your answer choice.

Socio-demographic characteristics of food-handler

1. What is your Gender?
   Female [ ] Male [ ]

2. What is your Age?
   18 – 25 [ ] 26 – 35 [ ] 36– 45 [ ] 46 – 55 [ ] Over 55 [ ]

3. What is your education level?
   Primary [ ] Secondary [ ]
   Middle-level College [ ] University bachelor's degree [ ]

   Other, specify_____.

4. If you have a college or university education, what course did you study?
   Catering [ ] Food production [ ] Hospitality [ ]
   Food service [ ] Other, specify_____.

Section 2

Answer the following questions to best describe your knowledge on food hygiene. For each of the following questions, please place a tick [√] on the appropriate answer.

Personal hygiene

1. Which one of the following jewellery is acceptable for a food handler to wear?
    a) Plain wedding ring
    b) Arm ring
    c) Bracelet
    d) A ring that is a symbol of religious faith
2. As a food handler, it is important that you wash your hands:
    a) After using the toilet
    b) After smoking or eating
    c) After handling raw eggs or meat
    d) After touching any part of your body
    e) All of the above
3. What is a substitute for proper hand washing?
    a) Hand sanitizers
    b) Gloves
    c) Tongs
    d) All of the above
    e) None of the above. There is no substitute for hand washing
4. When you develop diarrhea before going to work, you should:
    a) Go to work and tell your coworkers to be careful around you
    b) Call your boss and report that you are sick
    c) Take medicine to stop the symptoms and go to work
    d) Not tell anyone and continue working

5. If you cut yourself in the food handling area, what actions would you take?
    a) Suck the blood off your wound and carry on
    b) Tie your handkerchief round the wound
    c) Just leave the wound open so the air can get to it to heal it quicker
    d) Cover the wound in a waterproof dressing and report it immediately
6. What are the steps for proper hand washing?
    a) Use warm water and soap to wash your hands, rub your hands together for 20 seconds, rinse your hands and dry your hands with a disposable paper towel
    b) Use warm water and soap to wash your hands, rub your hands together for 1 minute, rinse your hands and dry your hands with a cloth
    c) Rinse your hands under warm water for 20 seconds, dry your hands with a disposable paper towel
    d) Dip your hands in a solution of water and chlorine for at least 30 seconds and dry your hands with a disposable paper towel

Food hygiene and handling

7. How could the bacteria Staphylococcus aureus be a risk when handling food?
    a) It is in the air and can land on food items not covered
    b) By handling the food, you increase the risk of cross-contamination from the bacteria from your hands to the food
    c) It can fly from one surface to another and contaminate food items
8. Which one of these statements about bacteria is true?
    a) All types of bacteria give food poisoning
    b) Freezing makes food last longer by killing bacteria
    c) Bacteria grow fastest when they are warm
    d) All bacteria need air to survive
9. Give one example of a chemical hazard
    a) Washing up soap solution not rinsed off properly
    b) Piece of Jewellery found in some food
    c) Hair found on a piece of chicken

10. From the below list which in NOT a high-risk food item?
    a) Cooked rice
    b) Cookies and biscuits
    c) Cooked meat and poultry
    d) Dairy products
11. Where should raw meat be stored in a refrigerator with other cooked food items?
    a) At the top.
    b) In the middle.
    c) At the bottom, below all other food
12. How can you tell if food has enough bacteria to cause food poisoning?
    a) It will smell
    b) You can't, it will appear normal
    c) It will have a different colour
    d) It will taste different

Food time and temperature control

13. What is the Temperature Danger Zone?
    a) The temperature danger zone for food products is -18ºC
    b) The temperature danger zone for food products is 5 ºC to 60 ºC
    c) The temperature danger zone for food products is 65 ºC to 80 ºC
14. The proper way to thaw frozen chicken is:
    a) Let it thaw at room temperature or the counter
    b) Thaw in a sink at room temperature
    c) Place in the refrigerator
    d) Let it thaw in stagnant warm or hot water
15. A refrigerator operating below 5 ºC
    a) Slows down bacterial multiplication
    b) Allows you to cool hot food
    c) Stops bacteria from multiplying
    d) Uses less electricity

16. Which of the following is the proper serving temperature in cooked foods?
    a) Above 60° C
    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
17. Cooked rice was left at room temperature overnight. What should you do with the rice?
    a) Throw the rice away; it may not be safe to eat
    b) Reheat the rice before it is served
    c) Put the rice immediately in the refrigerator for later use
    d) Smell the rice to see if it is safe to serve

Cleaning, sanitization and environmental hygiene

18. Which is the correct way to wash dishes, utensils and equipment?
    a) Wash, rinse and sanitize; then air dry
    b) Wash, rinse and dry them completely with a cotton towel
    c) Wash, sanitize and rinse; then dry with paper towels
    d) Wash and rinse, then air dry
19. The most important reason to wash, rinse and sanitize cutting boards is to:
    a) Eliminate odors and tastes from getting into other foods
    b) Make the cutting board look better and last longer
    c) Prevent contamination from one food to another
    d) Prevent flavours and garlic or onion juices from getting onto other foods
20. What must you use to sanitize tables and work surfaces that come into direct contact with food
    a) A wiping cloth that has been soaked in a solution of water and an approved sanitizer at proper concentration
    b) A wiping cloth that has been soaked in a solution of water, soap and chlorine
    c) It is not necessary to sanitize things that cannot be completely submerged in the dish sink compartments
    d) You must pour liquid chlorine on the equipment at the end of the workday when all the food is put away

Appendix V: Food Hygiene Practice Questionnaire

I am a Master's student from Kenyatta University. I am conducting a study titled **"Compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County"**

This questionnaire is prepared to assess food hygiene practice among restaurant food handler's. 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 will therefore be kept confidential.

INSTRUCTION: Please place a tick [√] in the appropriate box to indicate whether you carry out these activities always, most of the time, sometimes or never.

Personal hygiene

1. Do you wash your hands before beginning work in the food production area?
   Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

2. Do you wear jewellery/ornaments when handling food ?
   Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

3. Do you check cleanliness of clothes and shoes before work?
   Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

4. Do you report to your supervisor when suffering from fever or severe cough?
   Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

5. Do you use a handkerchief in food handling area when suffering from a cold?
   Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

6. Do you cover open wounds with water proof plaster before handling food?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

Food hygiene and handling

7. Do you check the expiration date/shelf life of food items?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

8. Do you label processed foods with use-by date before storing in the refrigerator?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

9. Do you store raw foods and cooked foods separately in refrigerator and freezers?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

10. Do you use separate utensils when preparing raw and cooked foods?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

11. Do you thoroughly wash fresh vegetables before use?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

12. Do you handle ready to eat foods with bare hands?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

Food time and temperature control

13. Do you check the temperature of refrigerators and freezers on a daily basis?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

14. Do you check the temperatures of chilled and frozen foods during receiving process?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

15. Do you return thawed meats to the freezer?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

16. Do you use a thermometer to check food temperature in cooking process?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

17. Do you thaw frozen meats on preparation tables at room temperature?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

Cleaning, sanitization and environmental hygiene

18. Do you wash and disinfect chopping boards after each use?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

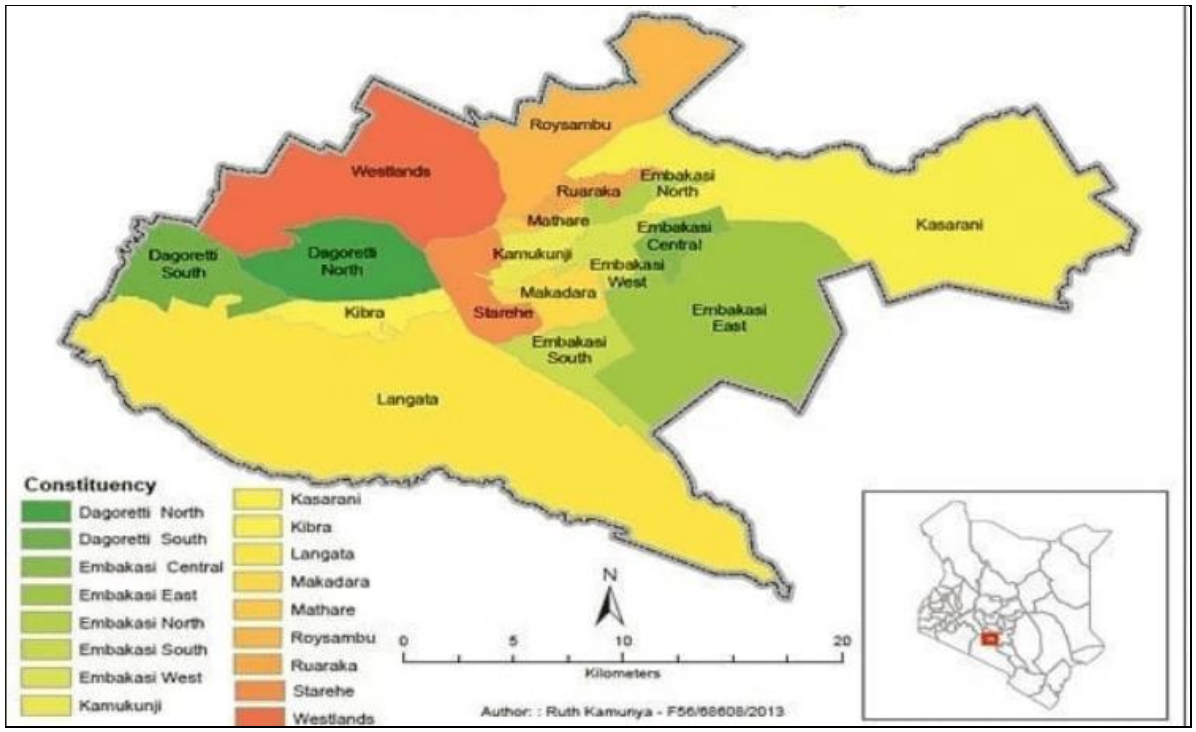
19. Do you use kitchen towels to dry utensils?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

20. Do you store cleaning detergents away from foods?

Always [ ] Most of the time[ ] Sometimes [ ] Never[ ]

Appendix VI: Map of Nairobi City County



Appendix VII: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 399975

Date of Issue: 25/June/2022

RESEARCH LICENSE

This is to Certify that Ms.. Lilian Kerubo Mosota of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: COMPLIANCE TO FOOD HYGIENE PRACTICE STANDARDS AMONG FOOD HANDLERS IN SELECTED RESTAURANTS IN NAIROBI CITY COUNTY for the period ending : 25/June/2023.

License No: NACOSTI/P/22/18257

399975

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

Fax: 8711242/8711575 **P. O. Box 43844,**
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: **KU/ERC/APPROVAL/VOL.1** Date: 2nd /06/2022

Lilian K.Mosota
P.O Box 43844, 00100
Nairobi.

Dear Ms. Mosota,

APPLICATION NUMBER: PKU/2324/I1463 COMPLIANCE TO FOOD HYGIENE PRACTICE STANDARDS AMONG FOOD HANDLERS IN SELECTED RESTAURANTS IN NAIROBI CITY COUNTY

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2324/I1463.** The approval period is **2nd /06/2022 to 2nd /06/2023**

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be

reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours

v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link; ;(https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGdlDzMXFWNDsMrRPQ/edit?usp=sharing

Yours sincerely

KENYATTA UNIVERSITY
OFFICE OF THE CHAIRMAN
02 JUN 2022
ETHICS REVIEW COMMITTEE
P.O. BOX 43844 - 00100 NAIROBI

Prof. Judith Kimiywe

Director: Centre for Research Ethics and Safety

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q57/CTY/PT/37285/2016 **DATE: 23rd June, 2021**

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MS. LILIAN KERUBO MOSOTA REG. NO. Q57/CTY/PT/37285/16

I write to introduce Ms. Lilian Kerubo Mosota who is a Postgraduate Student of this University. She is registered for M.P.H. degree programme in the **Department of Community Health & Epidemiology.**

Ms. Mosota intends to conduct research for a M.P.H. thesis Proposal entitled, **"Compliance to Food Hygiene Practice Standards among Food Handlers in Selected Restaurants in Nairobi City County."**

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY
OFFICE OF DEAN
23 JUN 2021
GRADUATE SCHOOL
P.O. BOX 43844-00100 NAIROBI

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL