Compliance to Food Hygiene Practice Standards Among Food Handlers in Selected Restaurants in Nairobi City County, Kenya

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ABSTRACT

There has been food borne disease (FBD) outbreaks due to contaminated restaurant food consumption. These FBD outbreaks and food contamination load are linked to the gaps in implementation of food hygiene practice standards. The already developed Kenya Standard - Hygiene requirements in food service establishments and catering operations KS 2573:2015 outlines food hygiene practice requirements for food service establishments including restaurants. KS 2573:2015 was developed as a mitigation factor to food contamination in food service establishments and to ensure food hygiene practice is implemented and maintained in Kenya. The broad objective of the study was to evaluate compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County. A descriptive, cross-sectional study design was used. The study targeted 39 purposively and proportionately sampled restaurants and 316 food handlers in the selected restaurants in Nairobi City County. The dependent variables were implementation of HACCP system and food handlers' food hygiene practice, and the independent variable was compliance to food hygiene practice standards in restaurants. Data was collected using a structured interview guide and structured questionnaire. SPSS version 26 was used to analyze the data and these findings are reported in a descriptive manner. Gaps were identified in food temperature control for high-risk foods in all food handling stages. Low proportion of food handlers consistently reported good food hygiene practice in aspects analyzed under food time and temperature control. The study recommends monitoring capacity strengthening by Public Health Inspectorate to ensure food hygiene practice standards especially regarding food temperature control requirement in restaurants and among food handlers is adhered to.

Keywords: *Food handlers, Hygiene Practice, HACCP, Standards.*

I. INTRODUCTION

People throughout the world get diseases, disability and die from consumption of contaminated food from the findings of the first ever study conducted by World Health Organization [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). The African region has the highest risk of FBDs as compared to other continents (WHO, 2015). Middle income countries as well as low income countries 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).

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. A study conducted by Hoffmann & Baral (2019) estimates 1,328 deaths among children in Kenya as a result of 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 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, 2018). The Ministry of Health [MOH] (2022) Kenya disease outbreak situation report, recorded 138 Cholera cases and 4 deaths in seven different counties, with Nairobi City County accounting for more than half of the total number of cholera cases and deaths. 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).

There has been FBD outbreaks globally, due to contaminated restaurant food consumption (Angelo et al., 2016 & Gould et al., 2013). A study conducted in Morocco's Casablanca City showed contamination load in catering establishments food samples (El Kadmiri et al., 2016). Other 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 Kenya 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.

The Kenya Standard - Hygiene requirements in food service establishments and catering operations KS 2573:2015 was developed in line with principles of HACCP which 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 food handling

stages in food service establishments may include purchasing, receiving, storage, preparation, cooking, cooling, reheating, hot holding and serving of food (KEBS, 2015). Poor food hygiene practices related to lack of HACCP implementation that contribute to transmission of FBDs include advance preparation where food remains in the danger zone temperatures for a long time, improper cooling and improper hot holding (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.

Poor handling practices by food handlers that contribute to transmission of FBDs include poor personal hygiene, food handling by infected persons, advance preparation where food remains in the danger zone temperatures for a long time, improper hot holding and cross-contamination (CAC, 1993). 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. A study carried out by Hamed & Mohammed (2020) in Egypt urban setting identified poor hand hygiene practice among food handlers in food service establishments. 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 properly cleaned and sanitized food contact surfaces and utensils.

FBD outbreaks due to contaminated restaurant food consumption (Angelo et al., 2016 & Gould et al., 2013) are linked to the gaps in implementation of food hygiene practice standards. The already developed Kenya Standard - Hygiene requirements in food service establishments and catering operations KS 2573:2015 outlines food hygiene practice requirements for food service establishments including restaurants in Kenya. The main objective of the study was to evaluate compliance to food hygiene practice standards among food handlers in selected restaurants in Nairobi City County.

II. METHODOLOGY

Research Design

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

Study Population

There are approximately 354 licensed restaurants serving local cuisine in Nairobi City County according to the Nairobi City County food hygiene licensing office records (Government of Kenya, 2021). A sample size of 39 restaurants serving local cuisine within Nairobi City County was selected using the 10% formula by Mugenda & Mugenda (2019). The study population included one restaurant manager from each of the 39 selected restaurants serving local cuisine (n=39) and all willing and available food handlers (n=316) in the selected restaurants who consented to the study.

Sampling Technique & Sample Size

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). A sample size of 39 restaurants serving local cuisine within Nairobi City County was selected using the 10% formula by Mugenda & Mugenda (2019) out of the target population of approximately 354 licensed restaurants serving local cuisine in Nairobi City County (GoK, 2021). As shown in Table 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 1:

Sample Size Determination for Restaurants

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

Study Instruments

A structured interview guide and structured questionnaire were used in data collection in the study. A structured interview guide was used to collect data on implementation of HACCP in restaurants in Nairobi City County. The structures interview guide was customized based on KS 2573:2015 (Kenya Bureau of Standards [KEBS], 2015). The structured interview guide was used by the researcher to interview restaurant managers and allowed for collection of information on HACCP implementation status regarding important hazard control points, that is, food receiving, storage, thawing, cooking/food preparation, holding and thermometer provision for food temperature monitoring. The structured interview guide provided for quantitative approach to data analysis and interpretation of HACCP implementation status in restaurants.

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. A 4-point Likert scale questionnaire was used which allowed for food hygiene practice determination where respondents reported to perform a specified food hygiene practice either always, most of the time, sometimes or never. The structured questionnaire also provided for quantitative approach to analysis of data and interpretation of food hygiene practice findings.

Data Collection Procedures

Data to establish implementation status of HACCP system in restaurants was collected using a structured interview guide administered to the restaurant managers. Data to determine the food hygiene practice by food handlers was collected using a questionnaire on self-reported practices measured using a 4-point Likert scale as administered to the food handlers.

Data Analysis

SPSS version 26 was used to analyse the data and findings reported in a descriptive manner. Descriptive statistics was used to describe the study variables characteristics and findings depicted through frequency distribution tables and proportions.

Ethical Considerations

Ethical approval was obtained from Kenyatta University Ethics Review Committee. A research permit (*NACOSTI/P/22/18257*) was sought from the Kenya National Commission for Science, Technology and Innovation (NACOSTI). Participation in the research was voluntary whereby informed consent was sought from respondents.

III. RESULT

Socio-Demographic Characteristics of the Study Population

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. 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.

Table 2:

Socio-Demographic Characteristics of the Study Population

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)

Hazard Analysis Critical Control Points (HACCP) Implementation in Restaurants

As depicted in Table 3, shelf-life checks, packaging integrity, sensory evaluation/organoleptic tests were carried out by all (100%) restaurants during receiving process of incoming food items. 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).

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. 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. 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℃). 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.

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. About 73.3% of the restaurants observed appropriate holding method for salads prepared in advance by cold holding in the refrigerator. 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℃).

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

Table 3:

HACCP Implementation 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
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°C)	1	16.7
Thawing		
Thaw frozen food before cooking	29	100
Appropriate thawing method (in refrigerator or under running potable water)	7	24.1
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 hotbath/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
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

Food Hygiene Practice of Food Handlers

As summarized in Table 4, crucial food hygiene practice aspects analysed 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 analysed 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 analysed 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:
Frequencies of Responses (%) to Food Hygiene Practice Questions among Restaurant Food Handlers in Nairobi County (n=316)

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

IV. DISCUSSION

Hazard Analysis Critical Control Points (HACCP) Implementation in Restaurants

Inadequacies in monitoring critical control points were noted in HACCP implementation. At the initial food receiving step of high risk frozen and chilled foods, 12.8% of the restaurants cited 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 on 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). Research findings by Garayoa et al. (2016) conducted in Spain revealed that only 20% of food establishments monitored proper food storage temperatures. 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. A study conducted in Zimbabwe by Ncube et al. (2020) among food handlers in restaurants revealed a common poor food hygiene practice where food was thawed under room temperature or using hot water.

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 food thermometers and difficulties in selecting the type of food thermometers was identified as barriers to thermometer use among food handlers in a study conducted by Feng & Bruhn (2019).

Food Hygiene Practice of Food Handlers

Among the Crucial food hygiene practice aspects analysed, 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 hygiene 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 only 0.6% of food handlers always use a thermometer to check food temperature in cooking process. 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.

Conclusion

Gaps in HACCP implementation were identified especially regarding food temperature monitoring at all food handling stages/critical control points. Low proportion of food handlers consistently reported good food hygiene practice in food time and temperature control aspects. Therefore, there is need to enhance food temperature control in restaurants by monitoring food handlers' food hygiene practice and ensuring HACCP system is implemented in restaurants in order to attain compliance to food hygiene practice standards requirements.

Recommendations

The Ministry of Health in conjunction with Nairobi City County Public Health Inspectorate should enhance monitoring of HACCP implementation requirements regarding food temperature control in restaurants. The Nairobi City County Public Health Inspectorate should also strengthen monitoring capacity and frequencies to ensure food hygiene practice among food handlers in restaurants is satisfactory.
Further research involving food and environmental sampling for laboratory testing/analysis to determine microbial load in relation to HACCP implementation and food handlers' practice in restaurants in Nairobi County should be carried out. A similar study needs to be carried out in other categories of food service establishments such as hotels and catering service providers.

Conflict of Interest

No conflict of interest

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Author Contributions

Lilian MOSOTA : Data Collection, analysis, interpretation of results and manuscript preparation
Judith WAUDO : Proofreading
George ORINDA : Proofreading

V. REFERENCES

Akabanda, F., Hlortsi, E., & Owusu-Kwarteng., J (2017). Food safety knowledge, attitudes and practices of institutional food-handlers in Ghana. *BMC Public Health,* 7. doi:10.1186/s12889-016-3986-9.

Al Banna, M. H., Khan, M., Rezyona, H., Seidu, A. A., Abid, M. T., Ara, T., Kundu, S., Ahinkorah, B. O., Hagan, J. E., Jr, Tareq, M. A., Begum, M. R., Chowdhury, M., & Schack, T. (2022). Assessment of Food Safety Knowledge, Attitudes and Practices of Food Service Staff in Bangladeshi Hospitals: A Cross-Sectional Study. *Nutrients*, 14(12), 2540.

Allafi, A. R., Al-Kandari, D., Al-Abdeen, J., & Al-Haifi, A. R. (2020). Cross-cultural differences in food safety knowledge, attitudes and practices of food handlers working at restaurants in Kuwait. *Acta bio-medica: Atenei Parmensis*, *91*(4), e2020181.

Angelo, K., Nisler, A., Hall, A., Brown, L., & Gould, L. (2016). Epidemiology of restaurant associated foodborne disease outbreaks, United States, 1998–2013. *Epidemiology and Infection*, *145*(3), 1-12. doi:10.1017/S0950268816002314.

Bhattacharya, A., Shantikumar, S., Beaufoy, D., Allman, A., Fenelon, D., Reynolds, K., Normington, A., Afza, M., & Todkill, D. (2020). Outbreak of Clostridium perfringens food poisoning linked to leeks in cheese sauce: an unusual source. *Epidemiology and infection*, *148*, e43.

Codex Alimentarius Commission (1993). Code of hygienic practice for precooked and cooked foods in mass catering (CXC 39-1993).

Codex Alimentarius Commission (2020). General Principles of Food Hygiene (CXC 1-1969).

El Kadmiri, N., Bakouri, H., Bassir, F., Barmaki, S., Rachad, L., Nadifi, S., Kadmiri, O. E., & Amina, B. (2016). Food hygiene assessment in catering establishments in Hay Hassani District-Casablanca. *The Pan African medical journal*, *24*, 335.

FAO (2017). Food handlers manual. Instructor. Washington, D.C.: FAO.

Feng, Y., & Bruhn, C. M. (2019). Motivators and Barriers to Cooking and Refrigerator Thermometer Use among Consumers and Food Workers: A Review. *Journal of food protection*, *82*(1), 128–150.

Garayoa, R., Yánez, N., Díez-Leturia, M., Bes-Rastrollo, M., & Vitas, A. I. (2016). Evaluation of Prerequisite Programs Implementation and Hygiene Practices at Social Food Services through Audits and Microbiological Surveillance. *Journal of food science*, *81*(4), M921–M927.

Gould, L., Rosenblum, I., Nicholas, D., Phan, Q., & Jones, T. (2013). Contributing Factors in Restaurant-Associated Foodborne Disease Outbreaks, FoodNet Sites, 2006 and 2007. *Journal of Food Protection*, *76*(11), 1824–1828. doi:10.4315/0362- 028X.JFP-13-037.

Government of Kenya (2021). Nairobi City County food hygiene licensing records, Nairobi, Kenya.

Hamed, A., & Mohammed, N. (2020). Food safety knowledge, attitudes and self-reported practices among food handlers in Sohag Governorate, Egypt. *Eastern Mediterranean health journal*, *26*(4), 374–381.

Hoffmann, V., & Baral, S. (2019). Foodborne Disease in Kenya: County level Cost Estimates and the Case for Greater Public Investment. International Food Policy Research Institute. Retrieved from https://doi.org/10.2499/p15738coll2.133525.

Kenya Bureau of Standards [KEBS] (2015). Kenya Standard: Hygiene Requirements in Food Service Establishments and Catering Operations (KS 2573: 2015). Kenya Bureau of Standards.

KNBS (2019). 2019 Kenya Population and Housing Census: Population by County and Sub-County. Nairobi: KNBS.

Legesse, D., Tilahun, M., Agedew, E., & Haftu, D. (2017). Food Handling Practices and Associated Factors among Food Handlers in Arba Minch Town Public Food Establishments in Gamo Gofa Zone, Southern Ethiopia. Epidemiology (Sunnyvale), 7(2), 302. doi: 10.4172/2161-1165.1000302.

Meleko, A., Henok, A., Tefera, W., & Lamaro, T. (2015). Assessment of the Sanitary Conditions of Catering Establishments and Food Safety Knowledge and Practices of Food Handlers in Addis Ababa University Students' Cafeteria. *Science Journal of Public Health, 3*(5),733743. doi: 10.11648/j.sjph.20150305.30.

Ministry of Health [MOH] (2022). Disease Outbreak Situation: Report as of 28th Oct 2022 - Epi Week 42 2022. Ministry of Health Kenya.

Mugenda, O., & Mugenda, A. (2019): Research Methods: Quantitative and Qualitative Approaches (3rd ed); Nairobi, Kenya: CLIG.

Ncube, F., Kanda, A., Chijokwe, M., Mabaya, G., & Nyamugure, T. (2020). Food safety knowledge, attitudes and practices of restaurant food handlers in a lower-middle- income country. *Food science & nutrition, 8*(3), 1677–1687.

Nizame, F. A., Alam, M. U., Masud, A. A., Shoab, A. K., Opel, A., Islam, M. K., Luby, S. P., & Unicomb, L. (2019). Hygiene in Restaurants and among Street Food Vendors in Bangladesh. *The American journal of tropical medicine and hygiene, 101*(3), 566–575.

Shehbaz, M. (2016). Evaluation of Current Food Safety Practices at Various Food Establishments in Lahore. *Journal of Food Processing & Technology, 7*:3. doi:10.4172/2157-7110.1000559.

UNICEF (2018). Kenya Humanitarian Situation Report. Retrieved from https://www.unicef.org/appeals/files/UNICEF_Kenya_Humanitarian_Situation_Report_31_May_2018.pdf.

World Bank. (2019). *The Safe Food Imperative: Accelerating Progress in Low- and middle-Income Countries.* The World Bank Publications.

World Health Organisation. (2015). WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015.

Ziegler, M., Kent, D., Stephan, R., & Guldimann, C. (2019). Growth potential of Listeria monocytogenes in twelve different types of RTE salads: Impact of food matrix, storage temperature and storage time. International journal of food microbiology, 296, 83–92. https://doi.org/10.1016/j.ijfoodmicro.2019.01.016.