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Hygiene and Safety of Food Prepared for Patients at Khartoum Hospitals 2015-2017

A thesis submitted in accordance with the requirements of the University of Shendi for the degree of Doctor of Philosophy of Public Health (Food Hygiene)

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Dedication

To

My mother and my father, & my brothers & sisters, and all public health specialists with much love & thanks.

Zeinab

Acknowledgement

This research work has been made possible due to the contributions of many people I would like to acknowledge. I am extremely grateful to all those individuals who contributed directly or indirectly towards the completion of this dissertation.

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I thank you all. God bless you all.

Abstract

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Introduction: Across sectional descriptive study was conducted at Khartoum public hospitals of Khartoum Locality, Khartoum State during 2015 to 1017.to determine the status of food safety and hygiene prepared to patients Twelve out of 16 hospitals were selected on criteria that they have kitchen building where food was prepared and served to the patients.

Materials and Methods: Two questionnaires were designed, One for the medical directors and or head departments of nutrition of the hospitals, the other for the food service staff. In addition another two observational checklists were used, one constitutes the interior building of the hospital kitchen conditions with the supplementary health facilities in the hospital kitchens and the food handlers while processing, the other one was used for the quality of raw and packed food. Microbiological testing were used for food contact surfaces and ready to eat food for patients. Statistical analysis used chi squire to determine the association of the sociodemographic criteria and knowledge, attitudes and practices of the food service staff.

Results: Five out of ten (50%) of the standard measures of food safety and hygiene were not adopted in all hospitals. For the building of the hospital kitchens the floor were cracked in 4(33.3%). Basins for washing hands, equipments and utensils were available but not cleaned with their surrounding areas. The food service staff show correct knowledge for 8 out of fourteen statements with percentage range from 59.1% to 88.9% whereas incorrect knowledge of the other 6 statements show percentage range from 15.9% to 37.0%.The food service staff show improper attitudes and practices towards direct contact with food while processing and distribution with percentage range from 28.8% to 100% for 7 different statements of control measures of food borne diseases. Statistical analysis showed significant differences of $P\leq$ o.o5 that determine the relationship of the soci-odemographic characters with knowledge attitudes and practices of the food service staff. Microbiological testing revealed contamination of 84% of the food contact surfaces and 52.8% of ready to-eat-food. Out of 19 contaminated ready to- eat-food, 13 had APC of a mean 3×10^2 CFU/gm and 6 revealed the presence of

Staphyllococcus aureus coagulase positive with a mean of 3×10 in legumes and 3×10^2 for both vegetables and amylaceous.. The APC is within the limits of SMS ready to eat food but the presence of *Staphyllococcus aureus coagulase positive* is a risk for food poisoning since it is a potential pathogen. *Coliform, Escherichia coli* and *Salmonella Species* were not detected in all types of to-eat ready food tested.

Discussion: The interpretation results revealed the absence of 50% of the main standard measures of food safety and hygiene in all hospitals have been reflected on food safety prepared to patients in the hospitals and was considered as risk factors for food borne diseases. Multiple defects were detected in the buildings conditions of the hospital kitchen. Defects of the hospital kitchen involved dirty wall 5(41.7%), cracked floor 4(33,3%), no use of drying racks for the cleaned and sanitized equipments and utensils, no method used to keep utensils contamination and absence of fixed thermometer reading for the refrigerator in the hospital kitchens. Such defects were considered as risk factors that affect safety of food prepared for patients in the hospitals. Other supplementary health facilities concerning food safety in the hospital kitchen and the surrounding area revealed deviations for improper covering of the refuse receptacles in all hospitals and the obstacles of transportation of refuse before overfilling in7 (58.3%) hospitals. These two defects represent environmental contaminants in the hospitals and were considered as high risk factors for food safety. Though that the presence of toilets were useful as they facilitate the workers to access best sanitary practices, yet their improper health status represent great hazard for safety and hygiene of food. The food service staff knowledge attitudes and practices concerning food safety and hygiene were not well .The significant variance of $p \leq 0.05$ proved the association of the socio-demographic criteria and knowledge, attitudes and practices of the food services staff of the hospitals. The role of the food service staff was considered as one of the most important part in safety of food. The high percentage of bacterial contamination of the food contact surfaces (84, %) was an indication of of inadequate cleaning and sanitation. For ready to eat- food the bacterial contamination was (52.8%) and the possible sources of contamination were the different contaminated contact surfaces. About 13 (68.4%) of ready to eat food that encountered with bacterial contamination revealed APC in the range of 3×10^2 This APC were found to be within the limits of the SMS for acceptable ready to eat food but indicated some hygiene problems. The detection of *Staphylococcus aureus Coagulase positive* in 6 (31.6%) samples of ready to eat food may be due to

improper personal hygiene practices and that handlers do not used wearing gloves or masks during food preparation and or distribution of wrapped and unwrapped food.Their presence in ready-to-eat food to patients were potentially hazardous.

Conclusions: The study screened food safety and hygiene standard measures and conditions presented and applied in Public hospitals of Locality of Khartoum. Many deviations were determined and were considered as risk factors for food borne diseases. These deviations have been lead to (52.8%) contamination of ready to eat- food and possible infection with pathogens.

Recommendations: Immediate corrective actions for the deviations detected and endeavors towards direct approach for development and adoption of standard measures for safety food prepared for patients in the hospitals. The procured of raw and packed food product from certified sources and the inspection procedure adopted, the developed food storage procedures, personal hygiene procedures and developed cleaning and disinfection procedures can be taken as prerequisites for successful implementation of HACCP system in the hospitals.

المستخلص

المقدمة: أجريت هذه الدراسة الوصفية المقطعية على المستشفيات العامة بمحلية الخرطوم - ولاية الخرطوم خلال الفترة من 2015 ــ 2017 بغرض تحديد حالة صحة وسلامة الغذاء المجهز للمرضى في عدد 12 مستشفى بها مبنى للمطبخ من أصل 16 مستشفى بالمحلية.

المواد والطرق: تم تصميم 2 من الاستبيانات أولهما للمدراء الطبيين أو رؤساء أقسام التغذية بالمستشفيات، وثانيهما لطاقم العاملين في الخدمات الغذائية بالمستشفى. بالإضافة لقائمتي تحقق أولهما لتحديد حالة المطبخ والتسهيلات المرفقة المساعدة له وحالة طاقم الخدمات الغذائية بالمطبخ أثناء أداء عملهم وأخراهما لتحديد جودة الغذاء الخام ومنتجات الغذاء المحزموالذي يستخدم في إعداد وتجهيز الأغذية المقدمة للمرضى.

أجريت اختبارات جرثومية علي الأسطح الملامسة للغذاء والغذاء الجاهز لاستهلاك المرضى. تم إجراء تحليل إحصائي لتحديد الارتباط بين الخصائص الاجتماعية الديموغرافية مع المعرفة والسلوكيات والممارسات لطاقم العاملين في الخدمات الغذائية بالمستشفيات.

النتائج: 5 من 10(50%) من المقاييس المعيارية لسلامة وصحة الغذاء غير معتمدة في كل المستشفيات، حيث وجد أن نسبة تشقق أرضيات مطابخ المستشفيات (33.3%)، اتساخ الجداران (41.7%)، أحواض غسيل الأيادي وأحواض غسيل المعدات والأواني متوفرة لكنها غير نظيفة وكذلك المناطق المجاورة لها، عدم استخدام طريقة لتجفيف الأواني والمعدات المغسلة والمطهرة، عدم وجود طريقة لحفظ الأواني من التلوث، وعدم وجود ثيرموميتر ثابت لقراءة ثلاجات المطبخ بالمستشفى.

تبين ان فريق الخدمات الغذائية بالمطبخ مقدار معرفتهم الصحيحة فى 8 من أصل 14 من البيانات المتعلقة بصحة وسلامة الغذاء فى مدى بنسبة تعادل 88.9-59.1% بينما مقدار المعرفة غير الصحيحة لـــلبيانات الأخرى المتبقية تعادل من 37.0- 15.9%. كذلك تبين إن فريق الخدمات الغذائية بالمطبخ لديهم ممارسات وسلوكيات غير سلمية تجاه التماس المباشر مع الغذاء إثناء تجهيزه وتوزيعه في مدى من 28.8 إلي 100% لسبعة بيانات مختلفة من مقاييس التحكم في الأمراض المنقولة عن طريق الغذاء.

التحليل الإحصائي اظهر اختلافات مهمة لــ 0.05 ≥ التي تحدد العلاقة ما بين الخصائص الاجتماعية اليدموغرافية مع المعرفة والممارسات والسلوكيات لفريق الخدمات الغذائية بالمطبخ. الاختبارات الجرثومية أدركت التلوث في 252 (84%) من عينات الأسطح الملامسة للغذاء و19 (52.8%) منعينات الغذاء الجاهز للاستهلاك. عد البكتريا الهوائية بالأطباق في 13() من عينات الغذاء الملوثة تراوح من0 1×3 الى3^2× 10 كما أظهرت 6 من عينات الغذاء الملوثة وجود العنقودية الذهبيةالمخثرة الموجبة وتراوح عدها الهوائي بالإطباق من 3×10 في البقوليات إلى 3×10^2في الخضروات والنشويات وذلك لكل جرام من الغذاء. عد البكتريا الهوائية بالإطباق وجدت في الحد المسموح في المواصفة السودانية للغذاء الجاهز للاستهلاك، لكن وجود العنقودية الذهبية المخثرة الموجبة عامل خطر كبير ومهدد لحدوث التسمم الغذائي.

المناقشة: النتائج التي تم عرضها كشفت عن غياب 50% من المقاييس المعيارية الرئيسية لصحة وسلامة الغذاء لكل المستشفيات وانعكس ذلك في صحة الغذاء المجهز للمرضى في المستشفيات ويعتبر ذلك من العوامل الخطرة لنقل الإمراض عن طريق الغذاء. وجد عديد من الإخفاقات في حالة مباني مطابخ المستشفيات والتسهيلات الصحية المرفقة بها،. البيئة حول المطبخ كشفت عدة انحرافات متمثله في التغطية الغير لائقة لسلات النفايات في كل المستشفيات ووجود عقبات في نقل هذه السلات قبل امتلاءها في 7(58.3)%، على الرغم من وجود دورات مياه متاحة لمساعدة طاقم العاملين في حصولهم علي أفضل ممارسه صحية إلا إن نظافتها غير مكتملة.طاقم العاملين فيخدمات الغذاء بالمستشفيات اظهر ضعف في المعرفة والممارسات والسلوكيات وبنسب متفاوتة في البيانات المتعلقة بخصوص صحة وسلامة الغذاء. قيمة (0.05≥) الاحتمالية أوضحت وجود فروق معنوية أظهرت الارتباط ما بين الحالة الاجتماعية الديموغرافية والمعرفة والسلوكيات والممارسات لطاقم الخدمات الغذائية بالمستشفيات، التلوث البكتيري بلغ 84.7% للأسطح الملامسة للغذاء و52.8% للغذاء الجاهز المعد للمرضى يعتبرا مؤشر واضح للقصور في التقيد بالمعايير والمقاييس الرئيسة المتعلقة بصحة وسلامة الغذاء ودلالة لعدم كفاءة النظافة والإصحاح وضعف المعرفة والسلوك والممارسة لدى طاقم العاملين في خدمات الغذاء، 13 (68.4%) من عينات الغذاء الجاهز للاستهلاكوالذي أدرك فيه التلوث اظهر عد البكتيريا الهوائية بالأطباق مدى في حدود الصلاحية المسموح به في المواصفة السودانية للوجبات الجاهزة لكنها مؤشر لوجود

مصادر تلوث. الفحص الجرثومي عن أنواع البكتيريا الممرضة في هذه العينات كشف عن وجود بكتيريا العنقودية الذهبية المخثرة الموجبة في 6 (31.6%) من عينات الغذاء الملوثة الجاهزة للاستهلاك ويشير تواجدها بصورة أساسية إلى فقدان الصحة الشخصية والسلوك والممارسة غير اللائقة من قبل طاقم العاملين في خدمات الغذاء.

الخاتمة: الدراسة قامت بتحديد المقاييس والمعايير التي تتعلق بصحة وسلامة الغذاء والاشتراطات الموجودة والمطبقة بالمستشفيات العامة بمحلية الخرطوم. تم التعرف على عديد الانحرافات والتي أدت إلي تلوث 52.8% من الغذاء الجاهز لاستهلاك المرضي مما يجعل حدوث عدوى بواسطة جراثيم ممرضة، أمر وارد ومحتمل بدرجة كبيرة.

التوصيات: التصحيح الفوري للانحرافات الموجودة والسعي المباشر في اتجاه اعتماد المقاييس والمعايير الخاصة بصحة وسلامة الغذاء المجهز للمرضى في المستشفيات وتنمية وتطوير المطبق منها والمتمثل في شراء الغذاء الخام والمغلف من مصادر موثوق بها وفحصها، تخزين الغذاء، الصحة الشخصية والغسيل المتطور وإجراءات عدم وجود العدوى حيث انه يمكن أخذها نقاط تمهيدية وأساسية لنجاح تطبيق نظام تحليل مخاطر نقاط التحكم الحرجة.

List of Abbreviations

Abbreviation	
MOH	Ministry of Health
HACCP	Hazard Analyses Critical Control Point
FAO	Food And Agriculture Organization
CDC	Communicable Diseases Control
E. Coli	Escherichia Coli
FSMS	Food safety management system
SOP	Standard operation procedure
FSE	Food service establishments
KAP	Knowledge, Attitudes, and Practices
CCP	Critical Control Points
CUF	Colony forming units
WHO	World Health Organization
GMP	Good manufacturing procedure
NSF	National sanitation foundation
ISO	International organization standardization
TI	Technical Specifications
BSI	British Standard Institution
PHF	Potentially hazardous foods
P A	Presence Absence
MPN	Most Probable number
MF	Membrane filtration
IMVIC	Indol methyl red voges proskaucr citrate
MDGs	Millennium development
FSOs	Food safety objective
PHLs	Public health laboratory service
NSW	New south weles
GHP	Good hygiene procedure

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CHAPTER ONE
1. INTRODUCTION

1.1. Background

Food safety and hygiene is an important public health issue. It contributes to public health by prevention and control of food borne diseases to human. Food borne diseases are of world wide distribution and with variable prevalence. Occurrence of these diseases is due to consumption of contaminated food and water from different sources.The World Health Organization received great attention to food hygiene and safety and established basic standards and measures that will approach to provide safe food. Legislation of food hygiene and safety were formed in developed and well developed countries to govern processing of food from farm to table. Hospital food is an essential part of patients care as safe food can encourage patients to be well. Hospitals have been identified as high food safety risk institutions because they serve potentially hazardous foods to vulnerable people.(**South Australia Department of Health, 2008 and Bertin *et al*., 2009**) stated that

These people are more susceptible to food-borne illnesses than the general population and consequently food contamination by pathogens could be particularly harmful.

Hospitals of poor hygienic conditions and that lack the basic standard measures of food safety and hygiene can be responsible for food borne diseases and hence can serve as reservoir of pathogens. The role of contaminated foodstuffs with potentially pathogenic microorganisms have been established as one of the most common causes of food borne diseases.The prevention and control can be made through strict implementation offood hygiene and safety systems. Great efforts are being made worldwide to improve food safety at all levels of the food

chain.(**Angelillo *et al.*, 2001**) stated that in many countries, like European countries' legislation has mandated that all food operators adhere to the HACCP system. HACCP is a structured and rational approach to the analysis and prevention of potential hazards point at every stage of food operation. It requires operators to enumerate and identify all steps in their activities that are critical to achieving food safety and to identify and evaluate safety measures.

1.2. Statement of the problem:

Food safety in healthcare facilities poses a great challenge as potential risks of food are countless from preparation to the patient's tray. This is mainly due to that guidelines of the standard measures were not properly abided. Such situation lead to contamination of food prepared to inpatients so large numbers of them can be exposed to infections and possible complications. More aggravated situations and challenges prevail in hospitals of Khartoum state and other states of SUDAN where food safety and hygiene have received little attention and are not well understood. Though there are few indicative studies in Hospital Food Catering Services regarding the status of food quality, food safety and hazards. No doubt food borne illnesses resulted from improper food handling and lack of HACCP based food catering practices could increase the risk of increased illness in hospitalized patients. This study will be conducted to answer questions on the current food safety and hygiene status of the hospitals, knowledge of the food service staff with regard to food safety, hygiene and HACCP and finally to know the microbial quality of food served to patients.

1.3. Justification:

- Food safety and hygiene is an important public health issue as it plays a noteworthy role in human health and great efforts have been made to improve it at all levels of the food chain.

- Hospitals as part of the food chain, are required to give more detailed attention to food hygiene in order to minimize food hazards considering that the prepared food in the hospital kitchens were exposed to many sources of contamination before given to patients who were at high risk of food borne diseases.The proposed study it might benefits us as follows;
- It will increase knowledge and awareness of the public on potential food hazards and related food safety problems
- It will help hospitals to develop, implement and maintain an effective food quality and food safety management system.
- It will have an important implication for future development of hygiene legislations.
- It will provide information on the current status of hospital food quality and food safety.
- It can help policy and decision makers to create and implement training programs for food service staff.
- It can help in safeguarding the health of the nation and the reduction of healthcare costs.
- It can help in the development of a risk-based food strategy by governments.
- It can be used as a yardstick for future researchers interested in further studies

1-4- Objectives:

1-4-1- General Objective:

To study the basic hygienic measures and conditions implemented for food prepared to patients at public hospitals of Khartoum locality.

1-4-2- Specific Objectives:

1-4-2-1- To determine the level of application of standard measures and health facilities concerning hospital kitchens.

1-4- 2-2-To identify and assess knowledge, attitudes and practices of food services staff at Khartoum locality hospitals.

1-4-2-3-To determine the association of patterns of knowledge, attitude and practice of the food service staff with their socio-demographic features.

1-4-2-4-To determine and identify the microbial contamination of food contact surface inthe hospital kitchens.

1-4-2-5-To determine the level of microbial contamination of food prepared and served to patients in hospitals of Khartoum Locality, Khartoum State, Sudan.

CHAPTER TWO

2-LITREATURE REVIEW

2.1 Characteristics of safe food:

The World Health Organization defines food safety as the conditions and measures that are necessary during production, processing, storage, distribution andpreparation of food to ensure that it is safe, sound, wholesome and fit for human consumption (**WHO, 1984**). Food safety is an important health issue that contribute to human health by control of food borne diseases .These diseases represent the high percentage of affections among visits to outpatients clinics in hospitals all round the world.Occurrence of such diseases is rarely reported and exchange of information between regulatory bodies is virtually absent. As a result, the prevalence and magnitude of the problem inflicted by food-borne illnesses is not known (**FAO/WHO, 2005**). Food safety remains a critical issue nowadays among professionals in the food service sector as well as consumers (**Badrie *et al*., 2006**).The World Health Organization (WHO) has long been aware of the need to educate food handlers about their responsibilities for food safety. In the early 1990s, WHO developed the Ten Golden Rules for Safe Food Preparation, which were widely translated and reproduced. However, it became obvious that something simpler and more generally applicable was needed. After nearly a year of consultation with food safety experts and risk communicators, WHO in 2001introduced the Five Keys to Safer Food poster.The Five Keys to Safer Food poster in corporate all the messages of the Ten Golden Rules for Safe Food Preparation under simpler headings that are more easily remembered and also provides more details on the reasoning behind the suggested measures.The core messages of the Five Keys to Safer Food are: (1) keep clean; (2) separate raw and

cooked; (3) cook thoroughly; (4) keep food at safe temperatures; and (5) use safe water and raw materials. The poster has been translated into more than 40 languages and is being used to spread WHO's food hygiene message throughout the world (**WHO, 2006)**

2.2Management of food safety and hygiene:

Foodborne diseases are recognized as an important cause of morbidity and mortality worldwide. Even in developed countries, up to one third of the population is affected by a foodborne illness each year (**WHO, 2002**).

Thus food safety is an issue of fundamental public health concern and achieving a safe food supply poses major challenges for national food safety officials. Surprisingly, at present there is no clear connection between government policy and a reduction in foodborne illness (**Todd, 2003**). The most important reason for this is the difficulties governments facing in setting clear public health targets in the form of Acceptable Levels of Protection (ALOPs) and to link them with maximum frequencies and/or concentrations of hazards in food at the point of consumption (Food Safety Objectives, FSOs) or at other specified steps in the food chain (Performance Objectives, PO). Using the concept of ALOP and FSO, ideally directly linked, would be valuable because it offers a means to make the stringency in food safety management that is required of the relevant industry by competent authorities both transparent and quantitative.

2.3 Food safety management system:

FSMSmeans the adoption of GMP**,** GHP**,** HACCPand other such practices to be followed by FBOs to ensure food safety. Food Safety Management System (FSMS) cannot be separated from food safety because food safety is the reason that there is an FSMS program. The FSMS program helps FBOs to ensure that food is safe for human consumption. FSSAI has chalked out the FSMS program in the

regulations and FBOs are required to follow it. It is not possible to get a license unless the FBO provides details of the FSMS program to FSSAI.

According to the (**International Standard ISO 2003),** FSMS is defined as a set of interrelated elements that establish policy and objectives. With the aim to achieve objectives some policies are used to direct and control the organization so that food safety is maintained.

These interactive elements are:

- Good Practices/ PRPs
- Hazard Analysis /HACCP
- Management Element / System
- Statutory and regulatory requirements
- Communication (**http://foodsafetyhelpline.com/2014/11/definition-fsms/).**

2.4Food management system foundations:

Food safety is a global concern, not only because of the importance for public health, but also because of its impact on international trade. Globalization of food production and procurement makes food chains longer and more complex and increases the risk of food safety incidents. Effective and harmonized food safety systems shall manage and ensure the safety and suitability of food in each link of the supply chain. For this reason ISO developed the standard for food safety management systems ISO 22000, which applies to all organizations in the food chain and thus ensures integrity of the chain. Parallel to this development there is an increasing need for harmonized certification of the food safety systems in order to create justified confidence that all necessary measures are taken to ensure food safety in previous links of the chain. ISO developed the technical specification ISO/TS 22003 that contains requirements for bodies providing certification of the food safety management systems. These developments were triggered by the increasing need of food manufacturers for a generally accepted food safety

certificate that meets with the requirements of the subsequent customers in the chain and may incorporate the requirements of the different certification schemes of the retail organizations.

As a follow up the Confederation of the Food and Drink Industry of the EU (CIAA) took the initiative to develop a technical specification that specifies the requirements for good practices in food manufacturing and that meets customer requirements.Implementation of these good practices is an essential part of the food safety system and creates confidence in trade. The British Standard Institution, BSI issued these requirements as the publicly available specification BSI-PAS 220. As a next step CIAA initiated the development of a certification scheme for food safety systems of food manufacturers that incorporates the standards ISO 22000, BSI-PAS 220 and guidance on the application of ISO 22000, ISO/TS 22004. The aim of this scheme is to harmonize the certification requirements and methods for food safety systems in the food chain and to ensure the issue of trustworthy food safety certificates that are comparable as regards content and scope. The Foundation was commissioned by CIAA to develop this scheme and retains the legal ownership and the license agreements for the certification bodies (**GFSI Guidance Document. 2007**).

2.5Good Manufacturing Practices (GMP):

GMP is short for good manufacturing practices and forms an important part of the overall HACCP food safety system in a food business. Good manufacturing practices (GMP) can be defined as the operational requirements necessary to enable a food business to produce food safely. There is a heavy emphasis on compliance with Good manufacturing practices (GMP) in all relevant food legislation and customer certification standards.

Good manufacturing practices (GMP) are important in order to produce safe food. The food business has a legal and moral responsibility to produce and prepare food

that will not harm the consumer. There can be a high cost to the food business if it does not implement adequate Good manufacturing practices (GMP). All staff should be trained in the food businesses GMP procedures.

Goodmanufacturing practices (GMP) include many basic operational conditions and procedures that are required to be met by the food business. These can include the following:

- The correct construction and layout of the food premises.
- The condition of the external environment of the food premises.
- The adequate maintenance of equipment and utensils used within the food business.
- The use of suitable chemicals within and around the food premises including cleaning chemicals, pest control chemicals and machine lubricants.
- The identification and storage of waste within and by the food business.
- The cleanliness of the food premises, equipment, utensils, floors, walls and ceilings.An effective pest control program implemented within the food premises and surrounds lead tothe avoidance of foreign matter within the finished product. Sources of foreign matter can include wood, glass, metal, plastic, pests, paper, string and tape.

To assist in the effective implementation of Good manufacturing practices (GMP) within the food business, it is advisable to document procedures on how the food business is going to implement relevant Good manufacturing practices (GMP). Equally important is to maintain records to support that any Good manufacturing practices (GMP) have been implemented.

To ensure the effective implementation of Good manufacturing practices (GMP), it is beneficial for the food business to undertake its own internal GMP inspection. This generally involves reviewing the site visually to see if it is complying to

customer expectations and regulatory requirements. This inspection should be a comprehensive assessment of the site to determine the level of GMP compliance. A record of any GMP inspection undertaken is required to be kept as evidence in a third-party certification audit. Any issues identified during the GMP inspection should be quickly rectified and a root cause analysis performed to avoid reoccurrence (**Dunkelberger and Edward, 1995**).

2.6 Hazard Analysis Critical Control Points (HACCP):

HACCP is a structured and rational approach to the analysis and prevention of potential hazard points at every stage of food operation. It requires operators to enumerate and identify all steps in their activities that are critical to achieving food safety and to identify and evaluate safety measures. (**Gazetta Ufficale della Repubblica Italiana, 1997**) Especially in hospitals,

HACCP is a systematic approach to indentify, assess and control hazards. It seeks to identify hazards associated with any step of food production, preparation, and handling, assess the related risks and forecast control procedures needed. It is composed of 7 steps, **Bryan** (**1992**); however five preliminary steps are needed to meet the conditions of its implementation (**NSF, 2006**).

2.6.1Five preliminary steps before HACCP:

Assemble the HACCP Team:

The HACCP team is a group of professionals who understand both HACCP and the domain of

the study and decide to conduct a HACCP plan (**NSF, 2006**).

The HACCP team establishes the scope of the HACCP by identifying what product and processes it covers.

Describe product:

This description includes: Raw materials and ingredients, preparation processes and storage.

Identify product intended use

Regarding the expected use of the prepared foods, information needed is mainly: importance of foods in the diet of the target group and handling practices.

Construct a flow diagram:

This is a flow chart for each selected food, representing each operation by a rectangle with arrows to indicate direction of flow, **Bryan** (**1992**).

Each step in the process covered by the HACCP plan must be outlined and process and physical location listed (**NSF, 2006**).

On-site confirmation of the flow diagram:

These are the processes to confirm that all steps are identified and accurately described by the flow diagram.

2.6.2 Seven steps of HACCP process itself

Conduct a hazard analysis:

This aims to identify the hazards and assess their severity and risks associated with them. It is the process of identifying significant risks relative to the food product or handling processes. It takes into consideration the hazards associated with the intended end use of the food.

This step is critical to the success of the HACCP plan I because it serves as the basis for the rest of the HACCP activities (**NSF, 2006**)

Identify the Critical Control Points (CCP):

A critical control point (CCP) is an operation at which action (control) must be exercised over one or more factors to eliminate prevent or minimize a hazard, (**Bryan, 1992**).

Establish critical limits:

A critical limit is a measurement or observation that separates what is acceptable from what is not acceptable (e.g. > 60°C for at least 12 min).

This critical limit cannot be violated if the hazard has to be controlled at that CCP.

Critical limits must be effective at keeping the hazard under control.

Critical limits can be quantitative (numerical) or qualitative (descriptive).

Monitoring:

This involves systematic observation, measurement and/or recording of the significant factors for control of the hazard. Procedures chosen must permit action to be taken before the food is made available to the consumer.

Establish corrective actions:

These are actions to be implemented when monitoring indicates that criteria set for safety and quality at a particular critical control point are not met (**Bryan, 1992**).

Verification: The WHO defines verification as "the application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance with the HACCP plan"

(**NSF, 2006**).

It encompasses collection of information and tests to ensure that the system is working as planned (**Bryan, 1992**).

Record keeping

The record keeping consists of the compilation of all data related to the scope of the HACCP plan.

2.7. Operation control and standard operation procedures: Standard Operating Procedure (SOP) is a set of directions that should (must) be followed to ensure food safety when completing certain tasks such as cooking chicken, cooling a food, or sanitizing a work surface. These SOP's should be used as a guide to establishing a food safety program for your operation.

The National Food Service Management Institute (NFSMI) has developed food safety SOPs in conjunction with USDA and FDA. Although the NFSMI SOPs

include HACCP-based principles, you should remember that SOPs are only one component of an overall food safety program.

Food safety SOPs include the following principles:

- Corrective actions
- Monitoring procedures
- Verification procedures
- Record keeping procedures

This resource provides sample food safety Standard Operating Procedures (SOPs) and worksheets which contain the minimum elements that can assist you when developing your food safety program. Print the food safety SOPs and complete the worksheets which have been included in this resource and you will see a model for developing your food safety program **(Western Upper Peninsula.2014)**.

Verification Procedures: In the past 20 years, verification activities have been expanded, definitions have been modified and expectations have increased, even though principle 6 reads "Establish verification procedures." In the original concept of verification, validation is classified as a subcomponent, making things difficult since, in other areas of the quality and food safety field, experts define validation and verification as separate activities. The basic role of verification is to ensure that the FSMS or HACCP plan is functioning as designed and is effective. **Gombasand Stevenson, 2000**. Stated that *"Verification is to the HACCP plan what monitoring is to the critical control point (CCP)."* Thus, CCPs look at individual points in the system and verification looks at the entire food safety system, including the HACCP plan, prerequisite programs (PRPs) and other system components.

PRPs are defined as the foundation for HACCP in the harmonized Codex Food Hygiene document, the NACMCF document and ISO 22000. (**International Organization for Standardization, 2009**) PRPs can be compared to the old Sunday school parable that talks of the wise man who built his house upon the rock and the foolish man who built his house upon the sand. The "house" in this case, the food safety program ith the strong foundation is more likely to do its job, protecting public health. Additionally, there should be a program to verify that the PRPs are effective. In 2008, the Codex Alimentarius Commission adopted a new position with regard to validation and verification (**Codex Alimentarius, 2008**).

Self inspection or audit:

There are two types of self-inspection. The first type is the daily inspection conducted by each supervisor in his or her area of responsibility, such as a production line or other plant area for which the supervisor is responsible. The Plant Sanitarian/Hygiene Manager, Quality Assurance Manager/ Supervisor, and other designated personnel should inspect the entire plant daily for hazards before start-up and during manufacturing. A short list of defects noted should be recorded for immediate follow-up, as required. The second type should be the periodic formal plant inspection by the multidisciplinary management team, supervisors, and employees in their areas of responsibility (**AIB, 2000**).

The inspection time should be short and focused for maximum benefit. An inspection that is two hours long and is highly focused on one area is preferable to a more time-consuming inspection that interferes with team members' other duties or causes team members to lose focus or interest. As previously noted, the team should include supervisors in their areas of responsibility. The inspection should also be used to train employees in good procedures and practices for food safety. It must be documented and list noted discrepancies. For each discrepancy, provide the course of corrective action required, person(s) responsible, estimated date of

correction, and actual completion date. Upper level management is responsible for reviewing and providing resources to correct inspection findings that pose a program failure or food safety risk in the marketplace (**AIB, 2000**).

Government inspection or audit:

Inspections of food firms, carried out by State and Federal agencies, are an essential component of the national food safety system intended to prevent foodborne illnesses. The 1997 report to the President entitled, Food Safety from Farm to Table: A National Food Safety Initiative, cited food inspections as one of six key components of a national food safety system. (**United States Environmental Protection Agency, 1997**)

Recall/ traceability:

Food businesses should define the scope of their traceability system before starting to develop it. The traceability system should be capable of efficiently and accurately following products through the food chain. Businesses involved in all sectors of the food chain from farm to retail sale will require traceability systems composed of the following elements, depending on the nature of the food or business:

1. Supplier Traceability: traceability of food, and packaging suppliers and their goods entering the food business operator's establishment;
2. Process Traceability: traceability of foods, and packaging, where applicable, through the operations within the food business operator's establishment (whether new products are produced or not);
3. Customer Traceability: traceability of food via distribution to the immediate customers.

Attention must be given to the interface between the three areas to ensure that the traceability system is seamless (**ABU DHABI FOOD CONTROL AUTHORITY, 2011**).

Food business operators operating in different sectors of the food chain may develop traceability systems that differ in their scope. The following examples can be considered as guidelines to the scope of traceability systems in different types of food business but should not be regarded as comprehensive:

a. Businesses solely engaged in catering and supply of food direct to the final consumer may only need to include supplier traceability; b. Businesses engaged in catering and supply of food to other catering or retail businesses may need to include supplier traceability, process traceability and customer traceability; c. Businesses solely engaged in retail supply of food to the final consumer may only need to include supplier traceability and process traceability; d. Businesses solely engaged in manufacture and supply of food to other food businesses may need to include supplier traceability, process traceability and customer traceability. However, very small businesses with single product lines may only need to include supplier and customer traceability; e. Businesses solely engaged in wholesale supply of food to other food businesses may need to include supplier traceability, process traceability and customer traceability. The process, in this case, may be re-palletisation of goods inwards or breakdown of pallets for onward distribution. For the purposes of this document there are only two levels of product recall. These are:

1. Recall: This is the removal of unsafe food from the market and extends to food distributed to the final consumer and therefore involves communication with consumers. A recall should be initiated when a foodstuff is identified as potentially injurious to health and has been supplied to consumers.

2. Withdrawal: This is the removal of an unsafe food from the market up to and including the point of retail sale. A withdrawal should be initiated when a food is identified as unsafe but can be demonstrated to remain wholly in the distribution chain and not to have reached the final consumer. The above classification should

always be used in communication with other businesses and the Authority to avoid confusion (**ABU DHABI FOOD CONTROL AUTHORITY, 2011**).

2.8. Types of food contamination:

Contamination is the state of being impure or unfit for use due to the introduction of unwholesome or undesirable elements. Food can be contaminated by insects, rodents, chemicals, microbes, or other foreign particles **(Doyleand Erickson, 2006**).

The addition of microbes is not necessarily bad; adding microbes to foods can result in many new food products. You could say that baked apples are contaminated if juice from a peach pie drips in from the rack above. Fortunately, the baked apples are still safe to eat unless you are allergic to peaches. However, the baked apples are no longer pure. They have been contaminated by, inoculated with, or mixed with peach juice. This has made them impure but not unfit or harmful. Contamination occurs when something not normally found in the food is added. Contamination implies the addition is not intended or planned. The substance added may or may not cause problems. Three main sources of contamination are from physical, chemical, and microbial sources **(Doyleand Erickson, 2006**).

Microbial contamination:

Microbiological sources stand out for posing a great risk to public health because of the severity of the clinical symptoms and the large number of foods and microorganisms that can be involved (**Silva *et al.*, 2003**).

Historically, pathogenic bacteria have been the most prevalent food safety hazard, with viral cases following closely behind according to a CDC report on the etiology of foodborne illness (**CDC, 2004**). Such pathogens cannot be detected organoleptically (seen, smelled or tasted) but can cause disease of varying severity, which may result in death. Generally, microbial sources account for upwards of

95% of all reported foodborne disease outbreaks (**CDC, 2004**). Surveys of microbial pathogens and toxins have been published in several useful compilations (**CDC, 2002, Lynch *et al.*, 2006**). Overall, most of the summaries agree in their conclusion that bacterial pathogens are responsible for the majority (>80%) of outbreaks cases. Members of the *Enterobacteriacea,* particulary *Salmonella serovas,enterophathogenicE.coli* and *Shigella ssp* and members of the *Campylobacteraceae, Campylobacter jejuni* and *C.coli*, are responsible for the majority (>70%) of foodborne bacterial illnesses. Of secondary importance are toxicoinfections by *Clostridium perfringens* and *Bacillus cereus*, intoxications by *Staphylococcal* enterotoxin, *Bacillus cereus* and Botulinum neurotoxin, and infections by *Vibrio ssp.*, *Streptoccoccus spp* and *Listeria monocytogenes*.

Physical Contaminants:

Physical contaminants are substances that become part of a food mixture. They may not change or damage the food itself. However, their presence can create health hazards for the consumer. For instance, metal filings or broken pieces of glass have occasionally gotten into foods. These materials would not spoil food, but they could cause injury if swallowed. Other examples of physical contaminants stage. Their presence is less acceptable and can be affordably controlled by the food manufacturer. The FDA examines food products for insect parts. FDA inspectors want to identify the types of insects present. To do this, the inspectors must be able to recognize insects from fragments, such as antennae. Inspectors also need to know about the habits of insects and the processes used to produce foods. This helps the inspectors determine the amount of contamination and the point at which the contamination occurred **(Doyleand Erickson, 2006**).

Chemical Contaminants

Keeping insects and other pests under control can lead to chemical contamination. Insecticides

are chemicals used to improve crop yields by reducing losses due to insects. Herbicides are used for the same reasons to control weeds. Both types of substances are pesticides. If pesticide residues remain on food, they enter the food supply. The United States Department of Agriculture (USDA) monitors all pesticides. Any substance used on crops must undergo thorough testing to see how effective it is. Foods are examined for residues. Tests are conducted to determine whether residues pose a health hazard. A second way chemical contaminants can enter the food supply is in water. Water is used in the processing of nearly every food product. Water is an excellent solvent. Therefore, many poisonous substances will dissolve in and pollute water supplies. The term toxic is used for substances that are harmful in low concentrations. Mercury, cadmium, lead, chloroform, benzene, and polychlorinatedbiphenyls (PCBs) are among the toxic substances that may get into water supplies. Whether a substance is considered toxic or nutritious is often a matter of volume. Everyone needs very small amounts of zinc for good health. However, in high levels, zinc can lead to death. Too much of a good thing may not be a good thing! City and industrial water supplies are often checked for toxic substances. However, there are no requirements for checking most private well water sources. Homeowners are advised to test well water routinely to protect their families from pollution (**Doyleand Erickson, 2006**).

2.9. Sources of food contamination:

Food provides an ideal nutrition source for microorganisms and generally has a pH value in the range needed to contribute to proliferation. During harvesting, processing, distribution, and preparation, food is contaminated with soil, air, and waterborne microorganisms. Extremely high numbers of microorganisms are found in meat animals' intestinal tracts, and some of these find their way to the carcass surfaces during harvesting. Some apparently healthy animals may harbor various microorganisms in the liver, kidneys, lymph nodes, and spleen. These

microorganisms and those from contamination through slaughtering can migrate to the skeletal muscles via the circulatory system. When carcasses and cuts are subsequently handled through the food distribution channels, where they are reduced to retail cuts, they are subjected to an increasing number of microorganisms from the cut surfaces (**Norman and Marriott, 2006)**.

The fate of these microorganisms and those from other foods depend on several important environmental factors, such as the ability of the organisms to utilize fresh food as a substrate at low temperatures. In addition, oxygenated conditions and high moisture will segregate the microorganisms most capable of rapid growth under these conditions. Refrigeration, one of the most viable methods for reducing the effects of contamination, is widely applied to foods in commercial food processing and distribution. Its use has prevented outbreaks of foodborne illness by controlling the microbes responsible for this condition. However, correct techniques for cold storage frequently are not followed, and food contamination may result. The growth rate of microorganisms may sustain a large increase in an environment slightly above the minimal temperature required for growth. Generally, foods cool slowly in air, and the cooling rate decreases with increased container size. Therefore, it is difficult to properly cool large volumes of food. Many of the Clostridium *perfringens* foodborne illness outbreaks have been caused by the storage of a large quantity of food or broth in slowly cooling containers (**Norman and Marriott, 2006)**.

Identification of contamination sources in a food production facility impacts directly the ultimate effectiveness of an establishment's sanitation control strategies. Both direct and indirect food-contact surfaces, water, air, and personnel are primary areas of concern as contamination sources in a food plant. Food products may transmit certain microorganisms, causing foodborne illness from infections or intoxications. Foodborne infections can result in two ways:

1. The infecting microorganism is ingested and then multiplies, as is true for *Salmonella*, *Shigella*, and some enteropathogenic *Escherichia coli*.

2. Toxins are released as the microorganisms multiply, sporulate, or lyse. Examples of such infections are: *C. perfringens* and some strains of enteropathogenic *E. coli* s produced, processed, or prepared to the food itself.

2. A source and a reservoir of transmission for each agent.

3. Transmission of the agent from the source to a food.

4. Growth support of the microorganism through the food or host that has been contaminated (**Norman and Marriott, 2006)**

2.10Food borne-diseases:

Foodborne illnesses comprise a broad spectrum of diseases and are responsible for substantial morbidity and mortality worldwide. It is a growing public health problem in developing as well as developed countries. It is difficult to determine the exact mortality associated with foodborne illnesses (**Helms *etal*., 2003**). However, worldwide an estimated 2 million deaths occurred due to gastrointestinal illness, during the year 2005 (**Fleury *et al*., 2008**). More than 250 different foodborne illnesse s are caused by various pathogens or by toxins (**Linscott, 2011**). Foodborne illnesses result from consumption of food containing pathogens such as bacteria, viruses, parasites or the food contaminated by poisonous chemicals or bio-toxins (World Health Organization (**WHO , 2011c**). Although majority of the foodborne illness cases are mild and self-limiting, severe cases can occur in high risk groups resulting in high mortality and morbidity in this group. The high risk groups for foodborne diseases include infants, young children, the elderly and the immunocompromised persons (**Fleury *et al*., 2008**).

There are changes in the spectrum of food borne illnesses along with demographic and epidemiologic changes in the population. A century ago, cholera and typhoid fever were prevalent foodborne illnesses, globally. During last few decades, other

foodborne infections have emerged, such as diarrheal illness caused by the parasite *Cyclospora*, and the bacterium *Vibrio parahemolyticus*. The newly identified microbes pose a threat to public health as they can easily spread globally and can mutate to form new pathogens. In the United States, 31 different pathogens are known to cause foodborne illness; however, numerous episodes of foodborne illnesses and hospitalizations are caused by unspecified agents (Centers for Disease Control and Prevention (**CDC, 2011a**).

Although foodborne illnesses cause substantial morbidity in the developed countries, the main burden is borne by developing countries. These illnesses are an obstacle to global development efforts and in the achievement of the Millennium Development Goals (MDGs) (**WHO, 2011c**). There is an impact of foodborne illnesses on four out of the eight MDGs. These include MDG 1(Eradication of extreme e poverty); MDG 3 (Reduction in child mortality); MDG 5 (Improvement of maternal health); MDG 6 (Combating HIV/AIDS and other illnesses). The population in developing countries is more prone to suffer from foodborne illnesses because of multiple reasons, including lack of access to clean water for food preparation; inappropriate transportation and storage of foods; and lack of awareness regarding safe and hygienic food practice s (**WHO, 2011c**). Moreover, majority of the developing countries have limited capacity to implement rules and regulations regarding food safety. Also, there is lack of effect ive surveillance and monitoring systems for foodborne illness, inspection systems for food safety, and educational programs regarding awareness of food hygiene (**WHO, 2011a**). Foodborne illnesses have an impact on the public health as well as economy of a country (**Helms et al., 2003**). They have a negative impact on the trade and industries of the affected countries. Identification of a contaminated food product can result in recalling of that specific food product leading to economic loss to the industry. Foodborne outbreaks may lead to closure of the food outlets or food

industry resulting in job losses for workers, affecting the individuals as well as the communities. Moreover, local foodborne illness outbreaks may become a global threat. The health of people in many countries can be affected by consuming contaminated food products, and may negatively impact a country's tourist industry. The foodborne illness outbreaks are reported frequently at national as well as international level underscoring the importance of food safety.

Increasing commercialization of food production has resulted in the emergence and dissemination of previously unknown pathogens, and resulted in diseases such as bovine spongiform encephalopathy (BSE). BSE is a variant of Creutzfeldt-Jakob disease (vCJD) which affected human population in UK during the 1990s (**WHO, 2011c**).

During last few decades there are advances in technology, regulation, and awareness regarding food safety but new challenges have emerged because of mass production, distribution, and importation of food and emerging foodborne pathogens (**Scallan, 2007**). One of the major issues of public health importance is the increasing resistance of foodborne pathogens to antibiotics (**WHO, 2011c**).

2.11Venerable groups for food contamination:

People who are particularly susceptible to foodborne disease include the very young, the elderly, and the immune compromised. These people may form nearly 20% of the population in the United States and the United Kingdom (**LundandO'Brien, 2011**).

Factors that lead to increased susceptibility are discussed by **Acheson, 2013.** Solid organ transplant patients are particularly susceptible to infections (**Obayashi, 2012**). The extent to which vulnerability is increased differs greatly between these groups. An estimate of the relative susceptibility of groups to listeriosis, based on incidence in France has been published (**FAO/WHO, 2014**). **Goulet et al.** (**2012**) estimated that patients with chronic lymphocytic leukemia were the most

vulnerable to listeriosis, with an incidence more than 1000 times greater than that in the population with no risk factors, and listed 14 underlying conditions associated with greater than 100-fold increase in susceptibility. Vulnerable groups may show a similar range of susceptibility to other pathogens. The number of susceptible people will increase with the increase in number of elderly people, many of whom are affected by chronic illnesses, and also with the increasing sophistication of treatments. Many people with increased susceptibility to foodborne disease will be in hospitals, nursing or residential homes. Others will be living in their own homes, and with increasing emphasis on movement of care from hospitals to the community (care in the community) the number of susceptible people in the community is likely to increase (**Goulet *et al*.,2012**).

2.12Prevention and control of food borne disease:

The contamination of food is influenced by multiple factors and may occur anywhere in the food production process (**Newell *et al*., 2010**). However, most of the foodborne illnesses can be traced back to infected food handlers. Therefore, it is important that strict personal hygiene measures should be adopted during food preparation. To prevent foodborne infections in children, educational measures are needed for parents and care-takers. The interventions should focus on avoiding exposure to infectious agents and on preventing cross-contamination (**Marcus, 2008**).

Good agriculture practice and good manufacturing practice should be adopted to prevent introduction of pathogens into food products (**Koopmans & Duizer, 2004**). In order to control foodborne viral infections, it is important to increase awareness of food handlers regarding the presence and spread of these viruses. In addition, standardized methods for the detection of foodborne viruses should be utilized and laboratory-based surveillance should be established for early detection of outbreaks (**Koopmans & Duizer, 2004**).

To prevent food-related zoonotic diseases, collaboration between public health, veterinary and food safety experts should be established. This collaboration will help in monitoring trends in the existing diseases and in detecting emerging pathogens. It will help in developing effective prevention and control strategies (**Newell *et al*., 2010**). The control strategies should be based on creating awareness among the consumer s, farmers and those raising farm animals. The improvement of farming conditions, the development of more sensitive methods for detection of pathogens in slaughtered animals and in food products, and proper sewage disposal are other intervention strategies (**Pozio, 2008**). Hygienic measures are required throughout the continuum from "farm to fork". Further research is also required to explore pathways of the foodborne illness and to determine the vehicles of the greatest importance (**Unicomb, 2009**).

In a study conducted in Turkey, knowledge, attitudes, and practices about food safety among food handlers, were explored. The study revealed that food handlers in Turkish food industry often lacked knowledge regarding basic food hygiene. The authors concluded that the food handlers must be educated regarding safe food handling practices (**Bas**, **Safak Ersun, & KIvanç, 2006**). For the prevention of foodborne outbreaks, training of food handlers, regarding appropriate preparation and storage of food is required. In addition, effective environmental cleaning and disinfection, excluding infected staff, implementing hand hygiene principles, and preventing cross-contamination are recommended (**Greig & Lee, 2009**).

Proper processing of food is necessary to ensure the reduction or elimination of the growth of harmful microorganisms. Pasteurization of milk and dairy products and hygienic manufacturing processes for canned foods will help reduce the cases of food-borne illnesses. Food irradiation is a recent technology for prevention of food-borne illnesses. The food irradiation methods include Gamma irradiation, Electron beam irradiation, and X-irradiation. Irradiation destroys the organism's

DNA and prevents DNA replication. Food irradiation could eliminate *E. coli* in ground beef, *Campylobacter* in poultry, *Listeria* in food and dairy products, and *Toxoplasma gondii* in meat. However, all food products cannot be irradiated (**Linscott, 2011**).

The consumers should also take precautions to prevent foodborne illnesses. These include cooking meat, poultry, and eggs at appropriate temperatures; proper refrigeration and storage of foods at recommended temperatures; prevention of cross-contamination of food; use of clean slicing boards and utensils while cooking; and washing hands often while preparing food (**Linscott, 2011**).

2.13Hospital food services:

Traditionally, there were four types of foodservice systems used in healthcare facilities: (a) cook-serve, (b) assembly-serve, (c) cook-freeze -serve, and (d) cook-chill-serve. The cook-serve production system, also known as conventional or "traditional," was the common system used in hospital foodservice operations .The raw foods were purchased, prepared on the premises, and served directly after preparation, either plated or in bulk (**Hartwell *et al.*, 2006**). Although, food preparation in this system was classified as on-site, not all foods were prepared from scratch. In hospital facilities, meal assembly was another step between production and service in the foodservice system. Using centralized or decentralized meal assembly, food was served to the patients on trays. In centralized meal assembly, before the food was delivered to the patients, the trays were assembled close to the production area and distributed by carts or conveyors to patient units. Food was delivered in bulk for decentralized meal assembly (**Hartwell *et al.*, 2006**). **Schirg** (**2007**) described a cook-serve system as one in which, using a 1- or 2-week standard cycle menu, food is assembled and served immediately, with a specific type of temperature control to the patients. Hospitals

and some healthcare institutions were noted as prime users of assembly-serve systems in their respective foodservice operations (**Payne-Palacio & Theis, 2001**). **Sullivan and Atlas** (**1998**) described assembly-serve as a convenience production system that requires minimal cooking. Basically, most of the foods are outsourced from commercial establishments, bought in a prepared frozen state in bulk form, and packaged in disposable pans. **Spears and Gregoire** (**2006**) noted that the food is purchased in three forms: bulk, preportioned, and preplated (requiring less preparation). Processed food items are purchased, stored, assembled, heated, and served (**Payne-Palacio & Theis; 2001**). Related to the assembly-serve production system, entrée meals require thawing, plating, and assembling processes. Moreover, frozen dessert items require only minimal food preparation process: food is thawed and portioned before delivery to patients (**Sullivan & Atlas, 1998**). However, for patients who require special diets, some of the readily available items may not always fit with their dietary requirements. Therefore, for hospitals utilizing this system, a combination system may be needed such that some of the menu items are prepared using conventional methods (**Spears & Gregoire, 2006**).

Spears and Gregoire (**2006**) stated that ready-prepared foodservices in hospitals consist of cook-freeze-serve and cook-chill production systems. In these systems, menu items are not produced for immediate service. Fundamentally, in a cook-freeze-serve system, food is prepared on-site, is bulk packaged (although sometimes individual-portion packaging is used), blast frozen, preserved, stored in a frozen state, thawed in advance, assembled, distributed cold-plated to wards, rethermalized on wards, and delivered to patients as meals (**Payne-Palacio & Theis, 2001**).

In the cook-chill meal system, the cooks prepare the food in a traditional way in advance of service, then bring the food down to the appropriate temperature, and store it under refrigeration until ready for use. A rethermalization system is used to

reheat the food before serving to the patients (**Payne-Palacio & Theis; Schirg, 2007**).

Studies have been done on several aspects of foodservice systems. **Hwang,etal** (**1999**) determined the quality of food texture would deteriorate due to the freezing or thawing process in a cook-freeze system. They added that, when utilizing a cook-chill system, lack of temperature control would also have an effect on the safety and nutritional content of the food. **McClelland and Williams** (**2003**) explored differences between cook-serve and cook-chill systems in a study of 80 hospitals in Australia. They reported hospitals using a cook-chill system provided a greater choice of hot menu items than did those using a cook-serve system. However, hospitals with cook-chill systems were less likely to offer the patients a choice of serving size and also the nutritional information was not included in their menu. In a study by **Mibey and Williams** (**2002**), 93 hospitals utilizing either cook–serve or cook–chill systems reported using a fixed-cycle menu; none of them reported using a restaurant-style menu. Little research has been completed on different types of meal distribution systems in hospital foodservice specifically related to patients' satisfaction. **Lambert, etal** (**1999**) explored the levels of satisfaction among patients, employees, and foodservice directors with food and service quality in hospitals using different types of meal distribution systems. Meal delivery service, for this study, comprised four types: (a) meals directly served to patients by foodservice employees, (b) meals directly served to patients by nursing service employees, (c) meals served to patient s by foodservice employees with specific training on meal-service procedures, and (d) meals served to patients by hospital employees focused on patient-care services.

2.14 Food safety control in hospitals:

Food safety in the hospital can acquire peculiar features: indeed, many patients could be more vulnerable than healthy subjects to microbiological and nutritional

risks; large numbers of persons can be exposed to infections and possible complications; gastroenteritis can impair digestion and absorption of nutrients and the perception or fear about poor food hygiene practices might result in patients rejecting the meals supplied by the hospital catering (**Barrie, 1996**). In nosocomial outbreaks of infectious intestinal disease, the mortality risk has been proved to be significantly higher than the community outbreaks and highest for foodborne outbreaks (**Meakins *et al*., 1992**).

Nosocomial infections are a common problem that increases the length of hospital stay, hospital cost and often affects patients' quality of life, survival and response to treatment (**Burke, 2003**).

To prevent nosocomial infection, the maintenance of a high degree of hygiene in hospital settings is necessary. Poor hygiene in the system of preparation and distribution of food, poor personal hygiene of food handlers as well as food safety pose significant risk of the development of food borne infections in hospital settings (**Vonberg *et al*., 2011**).

Data from the literature indicated that poor hygiene practice in hospital kitchens may be the cause of outbreaks of infections in hospitals, some of them resulting in death of patients (**U.S. Food and Drug Administration, 2004**).

Almost all of cases (88%) and deaths in outbreaks of listeriosis in Canada were people from the hospital or older people who were living in a long- term care home, because deli meats contaminated with *listeria* was distributed to hospitals. Listeria was found in niches deep inside two slicing machines (**Toronto, 2008**).

The most common reasons of food borne infection in hospitals are: improper holding time or temperature, contaminated equipment, poor personal hygiene, and food from unsafe sources (**Lund and O'Brien, 2009**).

2.15 Food hygiene practice in hospital:

Food hygiene requires attention to detail in relation to all preventive measures to minimize the hazards of food poisoning, particularly given the presence of "consumers" (hospitalized patients at risk) who often are more vulnerable than healthy subjects. In hospital catering, food-services staff are the main food handlers, although nurses and other domestic staff may distribute or serve meals. Food-services staff in (**Barrie, 1996**) hospitals represent a potential source of nosocomial foodborne outbreaks, since they may possibly introduce pathogens into foods during every phase from purchase to distribution. (**Dryden *et al*., 1994**)

2.16 Basic kitchen standard measures: The quality of depends on the facilities or equipment provided in the kitchen environment such as proper disposal of waste products, water supply, ventilation, vector and rodent control and hand washing facilities. Contact with the poor sanitary surrounding environment might be a major reason for microbial contamination of food and various organizations have shown through research that many infections of human beings are spread through inadequate sanitation (**UNO, 1985**). Based on observations, most of the hospitals did not meet the required facility standards to provide safe food to the patients. These indicate a mediocre or even scanty food handling facilities and/or cross contamination during distribution or in the kitchen.**The design and construction of the hospital kitchen buildings:** mustbe:

(a) Appropriate for the activities for which the premises are used;

(b) Provide adequate space for the activities to be conducted on the food premises and for the fixtures, fittings and equipment used for those activities;

(c) Permit the food premises to be effectively cleaned and, if necessary, sanitized;

(d) to the extent that is practicable:

(i) exclude dirt, dust, fumes, smoke and other contaminants;

(ii) Not permit the entry of pests;

(iii) Not provide harborage for pests.

Water supply

Food premises must have an adequate supply of water if water is to be used at the food premises for any of the activities conducted on the food premises.

Sewage and waste water disposal

Food premises must have a sewage and waste water disposal system that:

Will effectively dispose of all sewage and waste water; is constructed and located so that there is no likelihood of the sewage and waste water polluting the water supply or contaminating food.

Storage of garbage and recyclable matter

(A)Food premises must have facilities for the storage of garbage and recyclable matter that:

Adequately contain the volume and type of garbage and recyclable matter on the food premises;

(b) Enclose the garbage or recyclable matter, if this is necessary to keep pests and animals away from it;

(c) are designed and constructed so that they may be easily and effectively cleaned.

Ventilation

Food premises must have sufficient natural or mechanical ventilation to effectively remove fumes, smoke, steam and vapors from the food premises.

Lighting

Food premises must have a lighting system that provides sufficient natural or artificial light for the activities conducted on the food premises.

Floors, walls and ceilings

The requirements for floors, walls and ceilings specified in this Division apply to the floors, walls and ceilings of all areas used for food handling, cleaning, sanitizing and personal hygiene except the following areas:

(A) Dining areas;

(b) Drinking areas;

(c) Other areas to which members of the public usually have access.

Floors

Floors must be designed and constructed in a way that is appropriate for the activities conducted on the food premises.

Subject to subclause, floors must:

(a) be able to be effectively cleaned;

(b) be unable to absorb grease, food particles or water; (**A GUIDE TO THE FOOD SAFETY STANDARDS SECOND EDITION, 2001**).

Walls and ceilings

(1) Walls and ceilings must be designed and constructed in a way that is appropriate

for the activities conducted on the food premises.

(2) Walls and ceilings must be provided where they are necessary to protect food from contamination

(3) Walls and ceilings provided in accordance with subclause (2) must be:

(a) sealed to prevent the entry of dirt, dust and pests;

(b) unable to absorb grease, food particles or water;

(c) able to be easily and effectively cleaned.

Walls and ceilings must:

(a) be able to be effectively cleaned;

(b) to the extent that is practicable, be unable to provide harbourage for pests.

Fixtures, fittings and equipment

General requirements

(1) Fixtures, fittings and equipment must be:

(a) adequate for the production of safe and suitable food;

(b) fit for their intended use.

(2) Fixtures and fittings must be designed, constructed, located and installed, and equipment must be designed, constructed, located and, if necessary, installed, so that:

(a) there is no likelihood that they will cause food contamination;

(b) they are able to be easily and effectively cleaned;

(c) adjacent floors, walls, ceilings and other surfaces are able to be easily andeffectively cleaned;

d) to the extent that is practicable, they do not provide harborage for pests.

(3) The food contact surfaces of fixtures, fittings and equipment must be:

(a) Able to be easily and effectively cleaned and, if necessary,sanitized if thereis a likelihood that they will cause food contamination

(b) Unable to absorb grease, food particles and water if there is a likelihood that they will cause food contamination; and

(c) Made of material that will not contaminate food (**A GUIDE TO THE FOOD SAFETY STANDARDS SECOND EDITION, 2001**).

(3) Eating **and drinking utensils must be able** to be easily and effectively cleaned and sanitized.

Connections for specific fixtures, fittings and equipment

(1) Fixtures, fittings and equipment that use water for food handling or other activities and are designed to be connected to a water supply must be connected to an adequate supply of water.

(2) Fixtures, fittings and equipment that are designed to be connected to a sewage and waste water disposal system and discharge sewage or waste water must be connected to a sewage and waste water disposal system.

(3) Automatic equipment that uses water to sanitize utensils or other equipment must only operate for the purpose of sanitation when the water is at a temperature that will sanitize the utensils or equipment.

Hand washing facilities:

(1) Subject to subclasses, food premises must have hand washing facilities that arelocated where they can be easily accessed by food handlers:

(a) within areas where food handlers work if their hands are likely to be a source of contamination of food.

(b) if there are toilets on the food premises immediately adjacent to the toilets or toilet cubicles.

(2) Subject to the following subclasses, hand washing facilities must be:

(a) permanent fixtures;

(b) connected to, or otherwise provided with, a supply of warm running potable water;

(c) of a size that allows easy and effective hand washing;

(d) Clearly designated for the sole purpose of washing hands, arms and face (**A GUIDE TO THE FOOD SAFETY STANDARDS SECOND EDITION, 2001**).

2. 17.Food handlers:

Knowledge:

A study conducted to evaluate knowledge, attitudes, and practices of nursing staff concerning food safety in two hospitals in Palermo, Italy, has documented a frequent unawareness of foodborne disease hazards, prevention, and control measures. A general lack of knowledge about etiologic agents and food vehicles associated with foodborne diseases and proper temperatures of storage of hot and cold ready to eat foods was reported (**Buccheri et al., 2007**).

Giritlioglu et al. (**2011**) assessed knowledge and practice of food safety and hygiene among students in university cookery programs in Turkey which showed

that although the students regarded the issue of food safety and personal hygiene as important, they had inadequate knowledge in this area. In another study by **McIntyre et al.** (**2013**) in British Columbia, Canada, there was significant decrease in knowledge score in trained workers over a 15 year period after certification. Knowledge scores were significantly higher in trained food handlers than for those who had not been trained. This shows that continuous training is very important to ensure that food handlers' knowledge on food safety and hygiene is up to date and maintained.Another study, that was done among 200 food handlers in 7 military hospitals, in Jordan (one from the capital Amman and two from the three provinces Northern, Middle and Southern provinces), found that food handlers' knowledge was high with a mean percentage score of 84.83% ± 11.71%. They found that food handlers demonstrated excellent knowledge in the categories of high risk foods, foodborne diseases, food storage temperature and sources of food contamination (**Sharif, Obaidat & Al-Dalalah, 2013**). In contrast, a study by **Siow and Sani** (**2011**) at two residential cafeterias and a canteen of the University Kebangsaan, Malaysia, found that the knowledge level of food handlers was moderate with a mean value of 57.8%. Their knowledge on food storage and preparation temperatures was poor with only 28.0%.

Jianu and Chris (**2012**) revealed gaps related to microbiological risks, cross-contamination and temperature control which also demonstrated the need for the re-training of food handlers. **Gaungoo and Jeewen** (**2013**) in their study for effectiveness of training among food handlers ("A review on the Mauritian Framework") recommended that it should be mandatory for food handlers to undergo a refresher food safety training course prior to renewal of their Food Handler Certificate after its expiry after three years. Therefore, there is a need for continuous training of food handlers on food hygiene and food safety; this might

assist in improving knowledge and maintaining the standard of hygiene practices in food service units.

Attitudes:

World health organization defined food safety as the inverse of food risk -the probability of not suffering some hazard from consuming a specific food (**WHO, 2000**). Food safety is considered as a concept of central importance because it plays an essential public health function (**WHO, 2000**).

The attitude of consumers also has a big important impact on food safety issue s, which are themes of interest to food producer s and retailers, public authorities and health educators. This interest has been reflected in discussions about how food safety should be defined and how consumers perceive food safety and choose food. The comparatively lower number of studies conducted on consumer attitudes towards food safety in the third world countries suggests that this issue may not be of as much interest (**Wilcock, 2004**).

This reduced interest towards food safety may be due to a lack of consumer education and training, and a low consumer impact on food safety. In general, it is assumed that the majority

of consumers probably do not understand the crucial role of food safety regulations. In order to offer supportive benefits to consumers, it is important to first examine their attitudes toward food safety. An American multistate survey conducted in 1995/1996 found that men were more likely to report risky practices than women (**Altekruseet al. 1999**). The survey results also indicated that the prevalence of risky behaviors increased with increasing socio-economic status.

Practices:

In a study by **Tokuc et al. (2009),** self-reported hygiene practices showed that 84.9% of personnel always use gloves while touching and distributing unwrapped foods. Some 94.5% agreed that washing hands before handling food reduces the

risk of contamination. The same findings were observed in the study by **Sharif et al. (2013)** where the food handlers in the military hospitals practiced good hygiene level with a mean percentage score of 89.4% ± 9.1%.

In another study on the knowledge and practice of food safety and hygiene of cookery students in Turkey, it was found that almost all students (97.6%) showed a high level of attention to personal hygiene, while 86.6% of students were aware that hand or finger injuries can cause serious foodborne illnesses (**Giritlioglu et al., 2011**). When responding to the questions regarding touching food with cuts on hands or fingers that are not properly covered, of the food handlers at primary schools in the Hulu Langat District, Selangor, 97.6% indicated that they never engage in that negative behaviour (**Tan et al., 2013**).

The general food hygiene regulations place a responsibility on each food handler who knows or suspects that he or she is suffering from certain diseases which may be transmitted through food or is afflicted with an infected wound, skin infection, sores, diarrhea etc. to report that to the proprietor of the food business in which they are working (**Annon, 1995**).

The results by **Green, Selman, Banerjee et al.** (**2005**) indicate that risky food preparation practices are commonly reported by foodservice workers; 60% of food service workers (EHS-Net study) reported not to always wear gloves while touching ready-to-eat food; 23% and 33% did not always wash their hands or change their gloves between handling raw meat and ready-to-eat food while 53% did not use thermometer to check food temperature and 5% worked while sick with diarrhea or vomiting.

In a study to assess personal hygiene and practices of food handlers in municipal public schools of Natal, Brazil, it was found that 100% of food handlers did not practice proper hygiene (**Aycicek et al., 2004**).

2.18. Personal hygiene procedures in hospitals:

Food hygiene is concerned with the hygiene practices that prevent food poisoning. The five key principles of food hygiene, according to WHO, are: (**WHO, 2012**)

- Prevent contaminating food with mixing chemicals, spreading from people, and animals.
- Separate raw and cooked foods to prevent contaminating the cooked foods.
- Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
- Store food at the proper temperature.
- Use safe water and raw materials
- Hygiene in the kitchen, bathroom and toilet

Routine cleaning of (hand, food, & drinking water) sites and surfaces (such as toilet seats and flush handles, door and tap handles, work surfaces, bath and basin surfaces) in the kitchen, bathroom and toilet reduces the risk of spread of germs. (**Beumer*et al.*, 2008**) The infection risk from flush toilets is not high, provided they are properly maintained, although some splashing and aerosol formation can occur during flushing, particularly where someone in the family has diarrhea. Germs can survive in the scum or scale left behind on baths and wash basins after washing and bathing.

Water left stagnant in the pipes of showers can be contaminated with germs that become airborne when the shower is turned on. If a shower has not been used for some time, it should be left to run at a hot temperature for a few minutes before use.

Thorough cleaning is important in preventing the spread of fungal infections. (**Scott, 2010**) Molds can live on wall and floor tiles and on shower curtains. Mold can be responsible for infections, cause allergic responses, deteriorate/damage surfaces and cause unpleasant odors. Primary sites of fungal growth are inanimate

surfaces, including carpets and soft furnishings. (**Cole, 2000**) Air-borne fungi are usually associated with damp conditions, poor ventilation or closed air systems.

2.19. Faulty practice of food handlers in hospitals:

Food handlers play an important role in food safety and in the transmission of food poisoning, because they may introduce pathogens into foods during production, processing, distribution and even presentation (**Angelilo et al., 2000**). An understanding of food safety procedures and potential factors that cause food borne illness is very important for all food handlers. **Cohen et al**

2001 stated "only knowledgeable and skilled employees who are trained to follow the proper procedures together with management that effectively monitors employees' performances can ensure food safety". Hands are one of the principle vehicles for the cross contamination of infectious agents onto ready to eat food. Effective hand washing is therefore of great importance in terms of successful hygienic food preparation, as it prevents the spread of infectious diseases (**Restinoand Wind, 1990**). A study in the U.S.A. suggested that improper food handlers' practices contributed to approximately 97% of food borne illness in food service establishments (**Howe et al., 1996**).

2.20 Cleaning and disinfection procedures in hospitals:

The hospital’s Housekeeping Department is responsible for the regular and routine cleaning of all surfaces and maintaining a high level of hygiene in the facility in collaboration with the Infection Control Committee. The Housekeeping Department’s charge is: Classifying the different hospital areas by varying need for cleaning;

1. Developing policies for appropriate cleaning techniques:procedures, frequency, agents used, etc. for each type of room, from highly contaminated to the most clean and ensuring that these practices are followed;

2. Providing appropriate training for all departmental staff, both initially and periodically to assess competencies are maintained or when a new technique, product or piece of equipment are introduced;
3. Establishing methods for the cleaning and disinfection of the patient's bed, mattress and pillow;
4. Determining the frequency for the washing/disinfection of privacy curtains, walls, floors and furniture.There should be a continuing program for staff training. This program should stress personal hygiene, the importance of frequent and careful washing of hands, and cleaning methods (e.g., sequence of rooms, correct use of equipment, dilution of cleaning chemicals and disinfectants, etc.) Staff should also understand some basic microbiology including the transmission of disease, as well as understanding the causes of surface contamination and how to limit the cross-transmission of organisms (**Scott, 2010**).

2. 21 Raw and packed food:

A food is considered raw if it has never been heated over 104–118°F (40–48°C). It should also not be refined, pasteurized, treated with pesticides or otherwise processed in any way. Instead, the diet allows several alternative preparation methods, such as juicing, blending, dehydrating, soaking and sprouting. Similar to veganism, the raw food diet is usually plant-based, being made up mostly of fruits, vegetables, nuts and seeds. While most raw food diets are completely plant-based, some people also consume raw eggs and dairy. Less commonly, raw fish and meat may be included as well. Additionally, taking supplements is typically discouraged on the raw food diet. Food packaging is packaging for food. A package provides protection, tampering resistance, and special physical, chemical, or biological

needs. It may bear a nutrition facts label and other information about food being offered for sale.

Packaging and package labeling have several objectives (**Bix *et al*., 2003**):.

 Physical protection - The food enclosed in the package may require protection from, among other things, shock, vibration, compression, temperature, bacteria, etc.

 Barrier protection - A barrier from oxygen, water vapor, dust, etc., is often required. Permeation is a critical factor in design. Some packages contain desiccants or oxygen absorbers to help extend shelf life. Modified atmospheres or controlled atmospheres are also maintained in some food packages. Keeping the contents clean, fresh, and safe for the intended shelf life is a primary function.

 Containment or agglomeration - Small items are typically grouped together in one package to allow efficient handling. Liquids, powders, and granular materials need containment.

 Information transmission - Packages and labels communicate how to use, transport, recycle, or dispose of the package or product. Some types of information are required by governments.

 Marketing - The packaging and labels can be used by marketers to encourage potential buyers to purchase the product. Aesthetically pleasing and eye-appealing food presentations can encourage people to consider the contents. Package design has been an important and constantly evolving phenomenon for several decades. Marketing communications and graphic design are applied to the surface of the package and (in many cases) the point of sale display.

 Security - Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering. Packages can be engineered to help reduce the risks of package pilferage; some package constructions are more resistant to pilferage and some have pilfer-indicating seals. Packages may include authentication seals to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices, such as dye packs, RFID tags, or electronic article surveillance tags, that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of retail loss prevention.

 Convenience - Packages can have features which add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, and reuse.

 Portion control - Single-serving packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable size for individual households. It also aids the control of inventory: selling sealed one-liter bottles of milk, rather than having people bring their own bottles to fill themselves

2.22Indication of microbial testing:

There are three different laboratory methods used to test for microbiological indicators:

(1) presence/absence (P/A),(2)most probable number (MPN), and(3) membrane filtration (MF). The handbook Standard Methods for the Examination of Water and Wastewater (**APHA/AWWA/WEF, 1998**) provides detailed laboratory procedures for each method, and is the standard reference for microbiological testing.

All three laboratory methods include:

1) Sample collection; 2) sample processing including addition of a specific growth media; and 3) sample incubation for 24-72 hours to await indicator growth.

Presence / Absence (P/A) testing: Isthe simplest testing method for microbiological indicators, which, concurrently, provides the least amount of data. As the name implies, this method provides information on whether the bacteria are present in a sample or not. The procedure involves adding a liquid or powdered media to 100 mL of water and incubating for 24-72 hours at 25-35°C.Acolor change (for total *coliform* or *fecalcoliform* bacteria) or UV-fluorescence (for *E. coli*) indicates the presence ofbacteria.

"P/A testing was developed for and is applicable where most tests provide a negative result. Where a significant proportion of tests provide a positive reaction quantitative testing is preferred in order to determine relative health risk and therefore relative priority of need for correction, such as by improved or greater treatment or by finding a higher quality source water for supply" (**Sobsey and Pfaender, 2002**).

Most probable number (MPN) testing uses statistical tables to provide quantitative microbiological data by completing multiple presence/absence tests. In this method, multiple vials or wells are filled with the sample water and media. The vials or plates are incubated for 24-48 hours, and each vial or well is assessed for color change (for total *coliform/fecal coliform*) or UV-fluorescence (for *E. coli*) The number of positive and negative vials or wells is compared to a table and a numerical contamination value (in MPN/100 mL) is assigned. The number of vials or wells determines the range of the test - for example, five tubes can have a results range of 0-84 MPN/100 mL. Some commercial tests have significantly higher ranges, up to 2,419 MPN/100 mL.

Membrane filtration (MF) testing has traditionally been the gold standard for microbiological Testing and provides quantitative data on the number of colony

forming units (CFU) of the indicator bacteria in sample water. To complete the test, a measured sample water volume is filtered through a 0.45 micron (0.00000045 meter) filter. The filter is placed in a petri dish over a pad impregnated with a specific growth media and incubated at a specific temperature for 18-24 hours. Colonies grow in specific colors, and are manually counted.

2.23 Microbial testing of food:

Microbiologic testing of foods is an increasingly important aspect of microbiology. The microbiologic examination of food focuses on one of two principal techniques:

•Enumeration of bacteria present in a food

• Detection of specific bacteria or bacterial end

Products in a food sample (**Thatcher and Clark, 1988**)

Enumeration usually is a quality index, relating either to the number of spoilage bacteria or the

Presence of indicator bacteria. Indicator bacteria are groups of bacteria that are associated with the presence of pathogenic bacteria. They are used to indicate potential contamination because they are detected more easily and rapidly than specific pathogenic bacteria. Detection usually involves that of a potential human pathogen. For many foodborne pathogens, the presence of a single cell of a pathogenic organism indicates a potential health problem. (**National Research Council, 1985**)

Sampling food for microbiologic testing involves an analysis of the following:

• For what analyses are you sampling?

• Why are you sampling?

• How will you use the results?

Statistical methods exist for sampling foods and food products, but a discussion of these methods

is beyond the scope of this article. When sampling foods for microbiologic analysis, it is important to assess the hazard properties of the food and the categories of foods based on these hazard properties **Adams and Busta (1970), International Commission on Microbiological Specifications for Foods(1986**) . The greater the hazard associated with a food, the greater the frequency with which it should be sampled. The following types of sampling plans are used for separate purposes:

• Investigational

• Routine

• Reduced

Investigational sampling is the most intensive type of plan and usually is part of a study initiated by a specific event, that is, a report of food-borne illness, (**Bryan 1980**) use of a new food supplier, or a response to an unusual event, such as a power failure in a refrigeration unit. Routine sampling is

the "standard" sampling plan, designed to maintain compliance with standards or guidelines ensuring that foods are being handled, processed, and stored under acceptable conditions. (**Oblinger and Koburger 1975**)

Finally, reduced sampling involves a low sampling frequency that applies to testing foods with an exceptional product history or those with process control that substantially reduces associated risks.

Food samples should be collected as individual units in their original containers; when feasible, consumer-ready products (eg, a pint carton of milk) should be used. In food preparation areas, most samples are obtained from large containers, such as bulk packages of meats or vegetables.

During sampling from these large containers, all equipment, such as scoops, knives, and forceps, must be sterile. Samples then must be transferred aseptically to sterile, leak proof containers and sealed immediately. As with any other

microbiologic analysis, additional contaminants should not be introduced into the sample. Frozen samples should remain frozen until analysis, while perishable samples immediately must be cooled to 0° to 4°C, and held at these temperatures, with analysis within 36 hours of collection. (**Hartman and Huntsberger 1961**)

.2.24 (a). Microbial testing of food in hospitals:

HACCP is an ideal, proactive approach and a management system. It is applied to the food chain from purchase to consumption. This program was first developed for the National Aeronautic and Space Administration (NASA) food space program HACCP is interested seriously in keeping the potentially hazardous foods (PHFs) safe PHFs are food items that require temperature control because they are capable of supporting the rapid and progressive growth of infectious or toxin-producing microbes (**Hanekom *et al,* 2010**) If PHFs are held in the temperature danger zone between (5C) and (57C) for 4 hours or more, infectious and toxin-producing microbes can grow to dangerous levels. PHFs have been associated with most food- borne disease outbreaks. It is critical to control the handling and storage of PHFs to prevent bacterial growth (**Leistner and Gould, 2001**).

Many hospitals advise Low Microbial Diets (LMDs) for patients with a low neutrophil count and these diets are termed neutropenic diets. LMDs reduce ingestion of bacterial and fungal contaminants by exclusion of uncooked fruits, vegetables, cold cuts, undercooked eggs and meat, unsterilized water, unpasteurized milk products and soft cheeses. LMDs and general HACCP guidelines can ensure that all sick patients in hospitals get the advantage of receiving safe food (**Lund, 2014**).

All test samples have been analyzed for total aerobic plate count, total fecal coliforms, total coliform count, E.coli type I and Coagulase positive staphylococci. Food samples have been analyzed based on the methods described in the Manual

of Food Quality Control of FAO (**Andrews, 1992**). Microbial safety standards for specific types of foods have been taken from international regulations, like the public health laboratory service guidelines for the microbiological quality of ready to eat foods (**Andrews, 1992**) and NSW Food Authority microbiological quality guide for ready-to-eat foods (**Andrews, 1992**) .

2.24(b).Categories microbial quality of food:

A microbiological criterion should include the following:

1. a statement describing the identity of the food or food ingredient,
2. a statement of the contaminant of concern, i.e., the microorganism or group of microorganisms and/or its toxin or other agent,
3. the analytical method to be used for the detection, enumeration, or quantification of the contaminant of concern,
4. the sampling plan,
5. The microbiological limits considered appropriate to the food and commensurate with the sampling plan used.

   Advisory criteria often serve as an alert to deficiencies in processing, distribution, storage, or marketing. They are not mandatory but permit judgments to be made when limits are not met (**Codex Alimentarius Commission 1980**).

2.25. Food temperature monitoring in hospitals:

Temperature monitoring units supplied by Data Acquisition Networks provide alarms when things go wrong. When temperature strays outside parameters set by you, you WILL RECEIVE an ALARM NOTIFICATION that will enable you to take immediate action to resolve the problem. Whether it is as complex as the failure of a refrigeration unit or as simple as a staff member has left a door open, you will know straight away and you will be able to fix the cause.

It is after the failure that the temperature monitoring unit provides its second valuable function. Let's say the product you were storing was perishable food and you were storing it at or below 4DegC. Food spoilage is a function of time and temperature. Temperature monitoring units supplied by Data Acquisition Networks will continue to record the actual temperature during the failure as well as the duration**.** After the event, a microbiologist will be able to use the temperature monitoring information to provide an assessment of the risk. This may result in a 'disposal recommendation' or very often, to a recommendation to 'reduce shelf life' which avoids the need to write off and throw away the food (**NHS, 2015**).

Food must be delivered, stored, cooked and served at the correct temperatures to ensure the minimum risk of food poisoning.

At various "critical points" the temperature of the food must be monitored and recorded, to ensure the maintenance of standards.

Digital Probe Thermometers must be used where a built in device is not supplied. When testing incoming high risk food the points to bear in mind are that the temperature immediately below the surface of the food (not wrappings) should be taken as well as core temperature. The higher of the two temperatures should be recorded on the monitoring sheet (**NHS, 2015**).

Refrigerator temperatures (1°C - 4°C,)

Routine monitoring of fridge units will be taken minimum twice daily by using the fridge thermometer provide or built in display.

Freezer temperatures (-18°C)

Where freezers have their own built -in temperature recording devices these will be recorded minimum twice daily. Probe thermometers should be used once a week to verify these results. When the probe is used its use should be highlighted in the remarks column of the temperature monitoring sheet (**NHS, 2015**).

2.26. Food storage procedures in hospitals:

The high priority that must be given to temperature control and has adopted the following cool storage procedures:

- Perishable food are held at temperatures at or below 5°C.
- To ensure fridges operate at optimal temperatures the following steps are taken:
    - Opening and closing of doors is kept to a minimum.
    - Door seals are kept in good condition.
    - Not over-crowded with product.
    - Products are not stacked in front of motors or fans.
    - Hot food is cooled prior to refrigeration.
- A thermometer is used to determine the temperature of cool storage units. Temperatures are recorded three times daily on the Fridge Temperature Record. If storage temperature exceeds 5°C, the frequency of checking is increased to once every 30 minutes to ensure that the temperature returns to at or below 5°C within 1 hour.
- In the event of refrigeration failure, all food is removed immediately and transferred into another suitable refrigerator until repair or replacement has been organized.
- The following policy exists for foods, formula and supplements found to be above 5°C:
    - If held above 5°C for less than 2 hours they can be transferred to an alternative refrigeration unit or used immediately.
    - If held above 5°C for between 2 and 4 hours they are used immediately.
    - If held above 5°C for more than 4 hours they are discarded.

- Raw and cooked/ready-to-eat foods are stored separately to eliminate the risk of cross contamination.
- Cooked and ready-to-eat foods are stored above raw foods.
- All opened food packages are stored on clean, sanitized surfaces and are protected against contamination by covering them with plastic wrap of foil or by placing them in food grade containers with fitted lids. These items and any other items removed from their original packaging are clearly labeled with name and use by date.
- Ready-to-eat foods are not spiked with labels or tags. Labels are placed on trays or plastic wrap (**Royal Children's Hospital Integrated Mental Health Program, 2000**).
- In relation to eggs they are always stored refrigerated in their original packaging and treated as a "raw" food and therefore store below cooked foods.
- All stored foods are covered, clearly labeled and marked with the use by date.
- Products are stored to prevent cross contamination from physical, chemical and biological contaminates.
- Products are rotated on a first-in first-out basis.
- Daily checks are made of perishable products. Spoiled, contaminated or out-of-date items are discarded. Prepared or perishable foods are discarded after each meal or mid-meal or when the use by date is expired unless otherwise stated by the Manufacturer.

2.27. Education training of food handlers in hospitals:

The food hygiene training was conducted in February 2005 by an infection control officer. Education about food borne disease hazards and appropriate preventive measures in hospitals included:

- •how to avoid foods from unsafe sources – to obtain food from safe and approved sources: food produced and processed in institutions with implemented Hazard Analysis and Critical Control Points (HACCP) or ISO 22000 and with food safety certificates complying with the Serbian law on food safety (**Law on food safety, 2009**), and never use home prepared food in hospitals;
- •proper food handling: reception of food, storage (keeping food at a safe temperature), preparation (avoiding cross contamination: raw and ready to eat foods), cooking and serving of food (various times and temperatures required for production and safekeeping of ready to eat meals);maintenance of personal hygiene (proper hand washing and hand drying) according to recommendations (**Boyce and Pittet, 2002**) and methods used for cleaning kitchen.

CHAPTER THREE

Materials and METHODs

3.1. Study design:

The study was designed as across sectional descriptive hospital based study to stand on the main measures and conditions of food safety and hygiene of prepared food that served to patients in hospitals of Khartoum Locality.

3.2. Study area and population: This study was conducted at Khartoum Locality hospitals in Khartoum State, from 2015 to 2017 The population of the study was consisted of all that are of concerned to food safety and hygiene in the selected hospitals and hence included: The medical director of each hospital, hospital kitchens, food services staff, food contact surfaces, raw and packed food product and food served to patients.

3.3 sampling and sample size:

3.3.1. The hospitals:

The hospitals selected were Ibrahim Malik Hospital, IBN Synna, Dental Hospital, ENT, Alzara, Gafer IBN Aouf, Alshaab, -Turkish Hospital,Dermal Hospital, Kharoum Hospital, Alswaidy Hospital and Alacademy Hospital.

3.3.2. The food service staff

The total number of food service staff in the selected hospitals were 180 and the sample size was calculated according to the following formula;

$$\mathbf{M= N/ 1+ N (e)^{2}}$$

Where;

m = minimal required sample size

N= Total population = 180

e= level of precision =0.05

The sample size was 124 rounded to 132 considering the refusal rate; therefore the final sample size was **132**.

A cluster random sample size was applied

3.3.3. Medical directors or head departments in the hospital:

The medical directorfrom a list of head departments in each hospital was randomly selected..

3.3.4. Food contact surfaces swabs:

Three hundred swabsamples were takenfrom the surface area that were in contact to food while processing. The food contact surfaces included food shelves, benches, food utensils, knives and hands of food workers .Twenty five swab specimen was taken from each hospital kitchen with frequency of five samples per each surface area.

The swab was inserted in normal saline and then rotating on the targeted surfaces area .The areas within the template were swabbed by rubbing the swab over the surface. The surface were swabbed (whilst rotating the swab between the thumb and forefinger) in two directions at right angles to each other,i.e. horizontally and vertically. The area was swabbed for approximately 20 seconds. The swab container was labeled clearly with sample reference number, site, date and time.The samples then were placed into a cool box maintained between 1°C and 4 °C and transported to the laboratory within 4 hours where possible to be inoculated into three medium plates (blood agar, MacConkey agarand chocolate agar.) then incubated at 37°C for 24 hour (National Microbiological Survey 2006)

3.3.5. Ready to eat food:

According to **Andrews, 1992,** A total of 36 samples of food were taken under aseptic conditions with a frequency of 3food samples from each selected hospital kitchen. The three samples of each hospital kitchen were taken from breakfast,

dinner and supper meals. Each food sample being 100 grams were placed in sterilized plastic bags andkept in ice box during transport to Food and Water Microbiology Department the National Health Laboratory-Khartoum-Sudan. The main types of food dishes served to patients are Sudanese traditional meals prepared with red meat, legumes and seasonal vegetables. The food samples were typed as the material sources consisted of into (12) legume based sauces (12) vegetable based foods and (12) amylaceous. For transportation of samples, the breakfast and dinner were sent to the laboratory in the same day while the samples of supper were put in a deep freezer and sent to laboratory the second day early morning for immediate investigation.

3.4. Microbiological investigations methods: The microbiologicalmethods usedwere the generalization of statutory test in the National Laboratory Health-Department of Food and Water3.4.1.**Culture media** Different types of culture media were prepared and used according to the instructions of the company of manufacture.(Appendix1)

3.4.2. Preparation of food samples for microbiological testing:

Tow types of dilutions were made from each prepared food sample:

1- One dilution type where50g of each food sample was added to 450 ml of Buffered phosphate and was homogenated by Stomacher machine.

2- Second dilution type where 10 ml of first dilution was added to 90 ml Buffered phosphate Buffer was homogenate by Stomacher machine.

3.4.3.Cultural and microbiological testing methods: All food contact surfaces were tested for the presence of bacterial growth and identification of the isolates meanwhile all food samples were tested for the presence of bacterial growth, total aerobic plate count, total *Coliform* and detection for the presence of *Coliforms, E.coli,Salmonella species*and S*taphylococcus auresCoagulase positive* .The main microbial testing methods included were performed as follows:

3.4.3.1: Detection of bacterial growth (Presence or Absence of bacteria):

Cultural methodswere used forcultivation of food contact surfaces swab samples and ready to eat food amples The bacterial growth was indicated and enumerated on Blood Agar, Mac Conkey agar, Baird and Parker agar, Desoxycholate agar and Plate count agar respectively. The aerobic plate count or total count was performed on plate count agar. The total *Coliform* count was performed on Mac Conkey agar. The detection of *Coliform and E.coli* was performed on Lauryl Tryptose broth,Mac Conkey agar and Eosin Methlene Blue Medium.The detection of *Staphylococcus aures*was performed on Baird Parker agar, Blood agar and Chocolate agar.For detection of *Salmonella species* several media were used such asRappaport vassiliadis enrichment salmonella broth ,Tetrathionate broth ,Desoxy cholate agar (DCA),Xylose lysine Desoxycholate (XLD) agar and Brilliant Green..

3.4.3.2Aerobic Plate Count (APC):1ml from the first dilution of each food sample was put in sterile petri dish, then 15 ml of prepared sterile plate count agar medium was added and mixed at temperature of 45oc .Culture plates were incubated at 37for 48hors- Culture plates of colonies 30- 300 were counted as colony forming units per gram of food (C.F.U per gram)

3.4.5.3. Total *Coliform:*

1- 50g form sample to 450ml form Buffered phosphate Buffer (first dilution

2- 10 ml firstdilution to 90ml Buffered phosphate Buffer (second dilution)

Liquid sample:

1_Ten ml form of direct sample was inoculated into thefirst tubes form (three tube Lauryl Tryptose broth (LTB)(double strength)

2- One mlfrom of direct sample was inoculated into the second tubes form (three tubes Lauryl Tryptose broth (LTB)(single strength) 3-From the direct sample 0.1

ml was inoculated into third tubes form (three tubes Lauryl Tryptose broth (LTB) (single strength).

Solid sample: 1_ Ten ml form of first dilution was inoculated into three tubes (LTB)(double strength) and incubated at 37c for 24 hours then changed to tubes that contain BG and incubated at 37c for 24 to 48hours.

2- One ml form of first dilution was inoculated into three tubes (LTB) (single strength)

3- One ml of the dilutionwas inoculated into three second tubes (LTB) (single strength) and the six tubes were incubated at 37c for 24- 48 hours

4- For tubes with appearance of opacity or gas in step 2 or 3, they were changed to tubes that contain BG and were incubated at 37 C for 24 – 48 hours.

5-*Coliforms* were Confirmed by appearance of gas in step 4and the results were recorded and refereed to the table MPN(ISO 7218 – 2007 page 60 to give C*oliforms*countin gram form sample or divided on 10 to be MPN result of *Coliform* in ml form sample..

3.4.3.4. Detection of the presence of certain species ofbacteria:

Selective and differential media were substituted for the non inhibitory, non selective media.Prior todetermine if certain species of bacteria were present, an enrichment procedure was used to increase the probability of detection .After these enrichment processes, the organism were detected on selective medium agar.Various tests were used to differentiate organisms isolated from selective ordifferential media. The usualGram stain reaction andmorphological characteristics were determined. The required biochemicaltests, the production of pigments and immunological tests were performed depending upon the species of the bacteria

3.4.3.4.1. Coliform:

1- Fifty grams from sample to 450 ml Buffered phosphate Buffer (first dilution).

2- Ten ml first dilution to 10 ml Buffered phosphate Buffer (double strength and incubated 37oC for 24 hour then changed them to tubes contain BG and incubated at 37C for 24 – 48 hour. 3-The appearance of gas was registered as presence of *Coliform* .

3.4.3.4.2. *E.Coli*:

1- 50ml form first dilution or 50ml liquid sample to (LTB) (double strength)

2- Incubated 37oc for pried 24 – 48 hours

3- Any appear opacity or gas to change MacConkey broth.

4-The culture was incubated in water bath at 44oc for 24 – 48 hour.

5-When any appearance of gas change to .EMB, if appearance of suspected colonies, change to IMVIC tests.

6. The result was- registered as present or absent of*E, coli* in gram or ml form sample. (ISO 7251 – 2005

3.4.3.4. 3. *Staphylococcus aureus* Coagulase positive

1 –To 1ooml form Base medium (Baird-Parker) was put on water bath at 45oc.

2 – 5ml yolk (putting in equipment control to added starlit water and putted in water bath 47oc for 2 hour after that putted in refrigerator period 18 – 24 hour and took enter sterilized container and useful during part of upper solution 72 hour).

3 – 1ml potassium tellurite (addition 1. 2 and 3 sterilized container 37oc.

-15ml plant unrsery of paste in petri dish until dry

-From liquid culture, 0.1 ml was plated on Baird-Parker medium plate and incubated at 37oc for 24 – 48 hour. , Using sterilized piped (L) shaped of

- Culture black and grey colonies enter 5 tubes in Brain- Heart infusion broth 37oc for 18 – 24 hour -0.1 ml to 0.3 plasma in sterilized tube 37oc observed clot 4 -6 hour if result negative contest to clot 24 hour .

Control test: 0.5ml plasma to 0.5ml (*coagulase positive staphylococci*) for predication coagulase enzyme.

3.4.3.4.*4. Salmonella species*:

Pre enrichment: Twenty five gram of each food sample was added to 225 ml Buffer peptone water in container bag and then was put on Stomacher machine at 7oc for 16 – 20 hour.

Enrichment:

a- From the culture on the pre enrichment 0.1 ml was added to 10 ml from Ruppaport Vassiliadis medium and incubated at $41c^0$ for 24 hour.b- 1ml form trathiunet incubator 37oc for 24 hour.

c-After 24 hour fertilize form Ruppaport Vassiliadis and tetra-thionate broth on XLD and Brilliant green appearance single colonies and incubated 37oc for 24 hour .

d- Appearance of colonies on XLD point yellow contain black it pink

3.4.3.5. Biochemical tests:

Different biochemical tests were made according to Cowan and Steel (1974) to identify different isolates of bacteria. Tests included were: 1-indole test 2-methyl red test 3-Voges Proskauer test 4- citrate test 5- Triple sugar iron agar (TSI) 6-Detection of Acid and Gas in MacConkey broth 7- nutrient or sensitivity test agar 8- ONPG (β-galactosidase) 9 -coagulase test 10-Catalase test.

3.5. Methods of data collection:

3.5.1. The observationchecklists: The twelve selected hospitals were taken for2 types of observation checklists as follows:

3.5.1.1. Kitchens conditions, control measures existed and implemented: This involves the application of a comparing standards that evaluate kitchen conditions (GKP and GHP) based on the Codex Alimentarius General Principles of Food Hygiene, as observed at the time of visits. All the kitchens of the hospitals under study were checked for the status of cleanliness and maintenance of the premises (floors, walls, ceilings, lighting, ventilation, insect and vermin protection),

conditions and cleanliness of kitchen equipment, sanitary facilities and water supply, waste management, storage and refrigeration and personal hygiene of the food handlersand practices while food processing. The full contents of the checklists were included in Appendix2.

3.5.1.2. Raw and packed food product inspection and quality:

The observation checklist included the safe source and criteria of the raw and packed food product. This observational check-list intended to ensure that raw materials or products are free from any physical impurities (e.g. dirt, dust, stones, wood, signs of infestation, pest or their remains, metal pieces or any other foreign matter). The full contents of the checklists were included in Appendix 3.

3.5.2. The designed questionnaires:

3.5.2.1. Questionnaire for the hospital medical directors and or the head department of nutrition: The questionnaire deals with the capacity of the hospital and the main food hygiene and safety measures.(Appendixex 4)

3.5.2.2. Questionnairefor the food services staff: The questionnaire designed was based on some of the previous studies (Byrd-Bredbenner, *et al*. (**2007**), (Angelillo *et al.* **2001**). The Questionnaires was intended for the food service staff. The questionnaire addressed to the food service staff focused on describing their socio-demographic characteristics, knowledge and practice of food hygiene, knowledge of commonly occurring food-borne diseases, practices regarding the use of preventive measures against food cross-contamination and knowledge of HACCP (Hazard Analysis and Critical Control Points). The full content of the questionnaires are included in Appendix 5.

3.5.3. Microbiological findings: The bacteriological findings of the different methods and biochemical tests performed were recorded and organized Food

samples were analyzed based on the methods described in the Manual of Food Quality Control of FAO (**Andrews, 1992**). Microbial safety standards for specific types of foods were taken from some international regulations, e.g. the public health laboratory service guidelines for the microbiological quality of ready to eat foods (**PHLS, 2000**) and NSW Food Authority microbiological quality guide for ready-to-eat foods (**NSW,2009**) .

3.6. Data Analysis and presentation:

The data was organized, entered and put in frequencies and percentages. Chi-square test was used to determine the relationship of the socio-demographic characters and food hygiene knowledge, attitudes and practices of foodservices staff of the hospitals. P Values less than0.05 ($p<0.05$) were taken significant.

3.7. Ethical consideration:

Ethical clearance was obtained from Khartoum State Ministry of Health. Formal letters was given to each hospital medical director informing the purpose of the study and consent were obtained. Confidentiality of the respondents and the hospitals was maintained.

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CHAPTER FOUR

4-RESULTS

4-1 General Hospital Characteristics concerning capacity and food safety:

4-1-1 Capacity of the hospitals: The number of food service staff was 132 and the mean number of hospital beds was 179.7 , mean cooks was 7.3, mean nurses was 1.0, mean dietitians was 2.8 and the estimated mean number of meals served was found 535.2.

Table (1): General Hospitalscapacity concerning food hygiene and safety

General Hospital Characteristics	Mean	Std. Error Mean
Beds	179.7	21.2
Cooks	2.0	0.30
Nurses	1.0	0.5
Dietitians	2.8	0.31
Other domestic staff	4.9	1.62
Meals served daily to patients.	535.2	58.3

4-1-2 Hospitals measures and facilities concerning food safety and hygiene: All of the studied hospitals have developed food storage, cleaning and disinfection procedures, inspection of raw food materials, personal hygiene procedures of food service staffand managerial supervision of workers was conducted in all hospitals.

None of the studied hospitals under the study adopted HACCP system, or educational courses or trainings on HACCP for food service staff. None of the hospitals adopted a food hygiene practice manual. Microbial testing of surfaces orfood and temperature monitoring for food was not carried out.

Table (2): Food safety and hygiene standard measures in the hospitals **(n=12)**

General Hospital Characteristics	**Exist**	**Not exist**
	Yes. (%)	**No. (%)**
Adoption of food hygiene practice manual	0 (0.0)	12 (100%)
Hazard analysis critical control pointsadoption	0 (0.0)	12 (100%)
Inspection of raw and packed food	12 (100%)	0 (0.0)
Microbial testing of surfaces and food	0 (0.0)	12 (100%)
Temperature monitoring of food	0 (0.0)	12 (100%)
Developed food storage procedures	12 (100%)	0 (0.0)
Developed personal hygiene procedures of food service staff	12 (100%)	0(0.0)
Developed cleaning and disinfection procedures	12 (100%)	0(0.0)
Educational training on HACCP for food handlers	0 (0.0)	12 (100%)
Managerial supervision of workers	12 (100%)	0(0%)

4-2-The standard measures of the hospitals kitchens and other supplementary health facilities:

4-2-1 the building: The floortype of all hospital kitchens were from concrete/ cement and 8(66.7%) of them were in good condition. The floors of hospital kitchens were found clean at time of visit but not adequate cleaning as observed. More than 40% of kitchen walls were not free from visible dust, dirt or spider webs, while all the walls were free from holes and cracks. Furthermore all the kitchens have not space served for other additional purpose. The entire kitchen provided with adequate lighting system in addition to the adequate ventilation system. However infestation of insects and spiders were observed in8 (66.7%) kitchens.

Table (3) The building conditions of thehospital kitchens

	Type of floor	Observation			
		Yes		No	
		No.	%	No.	%
1	Concrete/ cement	12	100%	0	0.0
2	The floor is clean at time of visit	12	100.%	0	0.0
3	**Floor status**				
	good condition	8	66.7%	4	33.3%
4	The wallis free from visible dust, soot, dirt or spider web	7	58.3%	5	41.7%
5	The wallis free from holes and cracks	12	100.0%	0	0.0
6	The kitchen space serve for other additional purpose	0	0.0	12	100.0%
	Lighting and ventilation				
7	The kitchen is provided with adequate lighting system	12	100.0%	0	0.0
8	The kitchen is provided with adequate ventilation system	12	100.0%	0	0.0
	Insect and vermin protection				
9	Infestation of the kitchen is observed at time of visiting	8	66.7%	4	33.3%

4-2-2 Kitchen equipments, utensils, basins, cleanliness and sanitization.

In all hospitals kitchens easily cleanable equipments were used , kept clean, free from cracks and had basins for washing of utensils and preparation of food.All hospital have fixedsmooth and rough surface basin with tap water . Cleanliness of the basin and surrounding area is detected in 8 (66.7%) of the hospital kitchens. Utensils are cleaned and sanitized by using cold water with detergent in all. None of the hospitals kitchens use drying racks for the cleaned and sanitized equipments.

Table (4) Kitchenequipments, utensils, basins, cleanliness and sanitization.

Statement	Responses out of 12 (percentages)	
	Yes	**No**
Kitchen equipment:		
Equipment's kept are clean and free from visible dirt and filth	12 (100%)	0 (0.0%)
Equipment's are free from cracks	12 (100%)	0 (0.0%)
Equipment's are easily cleanable	12 (100%)	0 (0.0%)
Basin		
Basins for washing utensils were used for food preparation	12 (100%)	0 (0.0%)
Basin for washing were fixed, smooth surface and with water tap	12 (100%)	0 (0.0%)
Cleanliness of basin and surrounding area		
Cleanness of the basin and its surrounding area:	8 (66.3%)	4 (33.3%)
Modes of cleaning and sanitizing of utensils:		
Only cold water with detergent used	12 (100%)	0 (0.0%)
Only local soap and cold water used	12 (100%)	0 (0.0%)
Drying racks for sanitized and cleaned utensils	0 (0.0%)	12 (100%)

4-2-3- Waste management in the studied hospitals: All hospitals had an appropriate refuse receptacle and no overfilling was observed, but all receptacles in all hospitals did not have a proper covering. Transportation of the refuse before overfilling is carried out by 58.3% hospitals. All of the hospitals dispose the refuse by supplying it to municipal services.

As far as liquid wastes are concerned all hospitals have a drainage system for the collection and handling of liquid waste and in all cases it is a closed type drainage system. The liquid waste is finally disposed in municipal sewages and no stagnation of liquid waste was observed in all studied hospitals.

Table (5): Waste management

Statement	Responses out of 12 (percentages)	
	Yes	**No**
Solid waste		
Presence of appropriate refuse receptacles	12 (100%)	0 (0.0%)
Proper covering of the refuse receptacle	0 (0.0%)	12 (100%)
Overfilling of receptacles	0 (0.0%)	12 (100%)
Transportation of refuse before overfilling	7 (58.3%)	5 (41.7%)
Final disposal of the refuse	12 (100%)	0 (0.0%)
Supplied to municipal service	12 (100%)	0 (0.0%)
Liquid waste		
Presence of a drainage system for collection and handling of liquid waste	12 (100%)	0 (0.0%)
Type of drainage system		
Closed type	12 (100%)	0 (0.0%)
Open trench	0 (0.0%)	12 (100%)
Final disposal of liquid waste		
Open dumping in the area	0 (0.0%)	12 (100%)
Septic tank	12 (0.0%)	0 (100%)
Municipal sewage	12 (100%)	0 (0.0%)
Discharged into river	0 (0.0%)	12 (100%)
Presence of liquid waste stagnation	0 (0.0%)	12 (100%)

4-2-4-Water supply and type of toilets in the studied hospitals: Thesource of water in all hospitals is installed from municipal supply. All of the hospitals have a flush type toilet with water. Separation between male and female toilet exists in all of studied hospitals. The latrines weren't all clean and comfortable at the time of visit 58.3%, fly infestation was observed in 66.7% of the hospitals and 80% of the hospitals had hand wash basin present near toilets.

Table (6): Water supply

Items	Responses out of 12 (percentages)	
	Yes	**No**
water supply:		
Installed from municipal supply	12 (100%)	0 (0.0%)
Presence of a storage tanker for water shortage times	12 (100%)	0 (0.0%)
Toilets:		
flush type toilet with water	12 (100%)	0 (0.0%)
Giving services at time of visit:	12 (100%)	0 (0.0%)
Separation for male and female toilets	12 (100%)	0 (0.0%)
The latrine clean	5 (41.7%)	7 (58.3%)
Fly infestation at time of visit	8 (66.7%)	4 (33.3%)
Hand washing basin provided to use after toilets	9 (75%)	3 (25%)

4-2-5 Storage and refrigeration status of the studied hospitals Arefrigerator used to store perishable food items was available in all hospitals. No Overfilling was observed and storage of highly perishable and non perishable food was not observed in all hospitals. A fixed thermometer reading was not available of the studied hospitals.

Storage of cooked and raw foods was in the same refrigerator with cooked and raw separate was not observed in all cases also all hospitals used the refrigerator storing only meat.

There is separate storage room for raw materials in all hospitals and the floor type is ceramics in all cases. No contact between stored chemicals with equipment and/or food was observed. Table 10 shows storage and refrigeration conditions in all studied hospitals.

Table (7): refrigerationand Storage status of the studied hospitals

Statement	Responses out of 12 (percentages)	
	Yes	**No**
Refrigeration		
Availability of a refrigerator	12 (100%)	0 (0.0%)
Storage of perishable and non perishable together	0 (0.0%)	12 (100%)
Overfilling of the refrigerator	0 (0.0%)	12 (100%)
Storage of cooked and raw foods	0 (0.0%)	12 (100%)
Store only meat	12 (100.0%)	0 (00%)
Presence of a fixed thermometer reading	0 (0.0%)	12 (100%)
Storage room		
Presence of a separate storage room	0 (0.0%)	12 (100%)
Type of floor		
Concrete/Ceramic	12 (0.0%)	(00%)
Presence of contact of stored chemicals with equipment and/or food	0 (0.0%)	12 (100%)

4-2-6-Personal hygiene of the food services staff in the studied hospitals:

In 9 hospitals (75%) of the food handlers wear appropriate clothing in the kitchen and in 2 hospitals (10%) clothing were not clean. Food handlers of 8 (66.7%) hospitals had short trimmed and clean nails.In all hospitals none of the food services had discharges from the nose, eyes or seen with visible skin rash, boil, cut or wound at the time of visit meanwhilein all hospitals food handlers were observed wearing jewelry.

Table (8): Personal hygiene offood services staff

Statement	Present	Absent
All food handlers wear appropriate clothes	9 (75%)	3 (25.0%)
Food handlers' clothing clean	10 (90%)	2 (10.0%)
Food handlers' nails are short trimmed and clean	8 (66.7%)	4 (33.3%)
food handlers have discharges from nose , eye and cough	0 (0.0%)	12 (100%)
Visible skin rash, boil, cut and wound are observed	0 (0.0%)	12 (100%)
cut and wound with covered	0 (0.0%)	
Handlers wear jewelry at time of visit	12 (100%)	0 (0.0%)
Managers supervise workers on their normal work	12 (100%)	0 (0.0%)
Cooked food handled properly and kept in conditions that prevent access to insect and environment	8 (66.7%)	4 (33.3%)

4-3-The food service staff of thestudied hospitals:

4-3-1-Socio-demographic characteristic of food service staff:

The majority of food service staff were females 84 (63.6%) while 48 (36.4%0 were males. However most of them 81 (61.4%) were aged 31-45 years where as most of respondents had illiteracy 43(32.6%) and general education 87 (65.9%) . Nearly one third 37 (28%) were dietitians and the majority were 83 (62.9%) were cooks and only 12 (9.1%) were nurses.

Table (9): Socio-demographic characteristics: (n=132)

Variable		Frequency	% Percentage
Gender	Male	48	36.4%
	Female	84	63.6%
Age	16< 30	28	21.2%
	30-44	81	61.4%
	45-59	14	10.6%
	60 and above	9	6.8%
education level	Illiteracy	43	32.6%
	General education	87	65.9 %
	High education	2	1.5%
Type of work	Nurse	12	9.1%
	Cook	24	18.2%
	Dietitian	37	28.0%
	Other domestic staff	59	44,7%

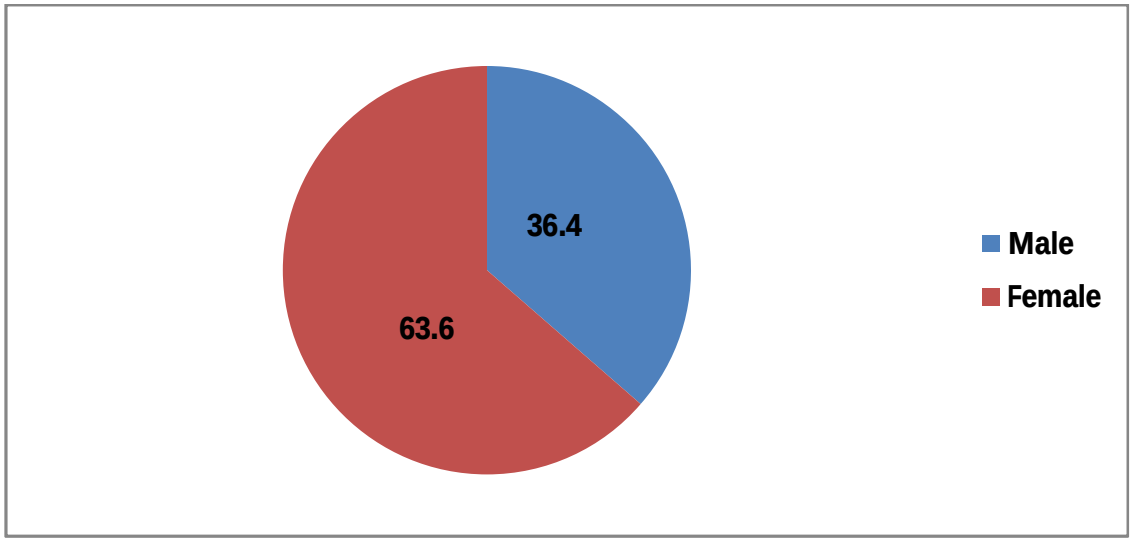

Fig. (1): Distribution of respondents by sex (n=132)

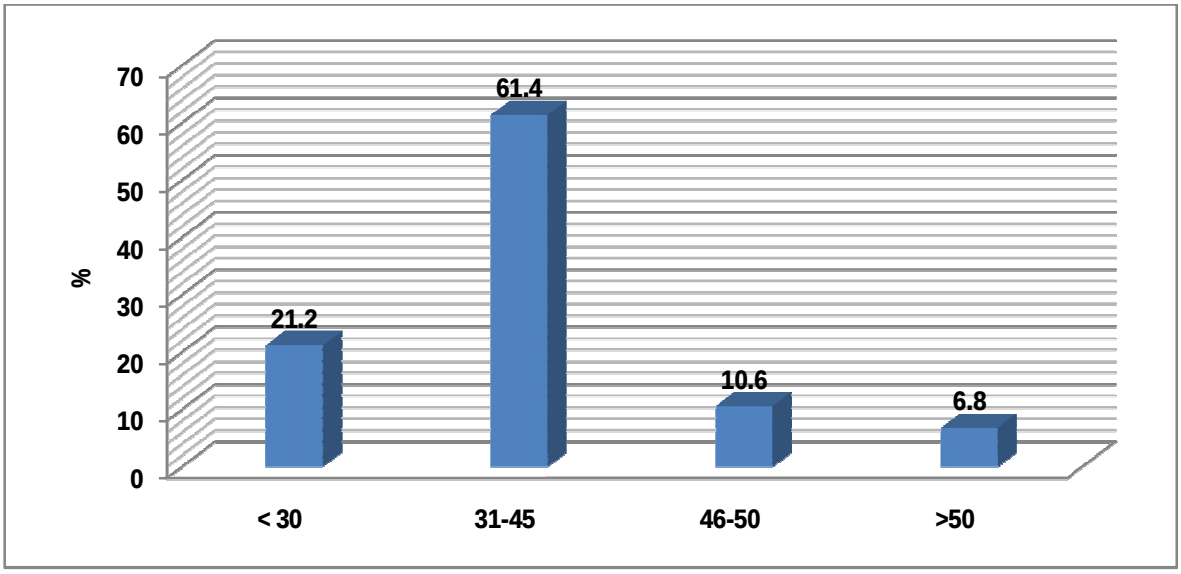

Fig. (2): Distribution of food service staff according to age (n=132)

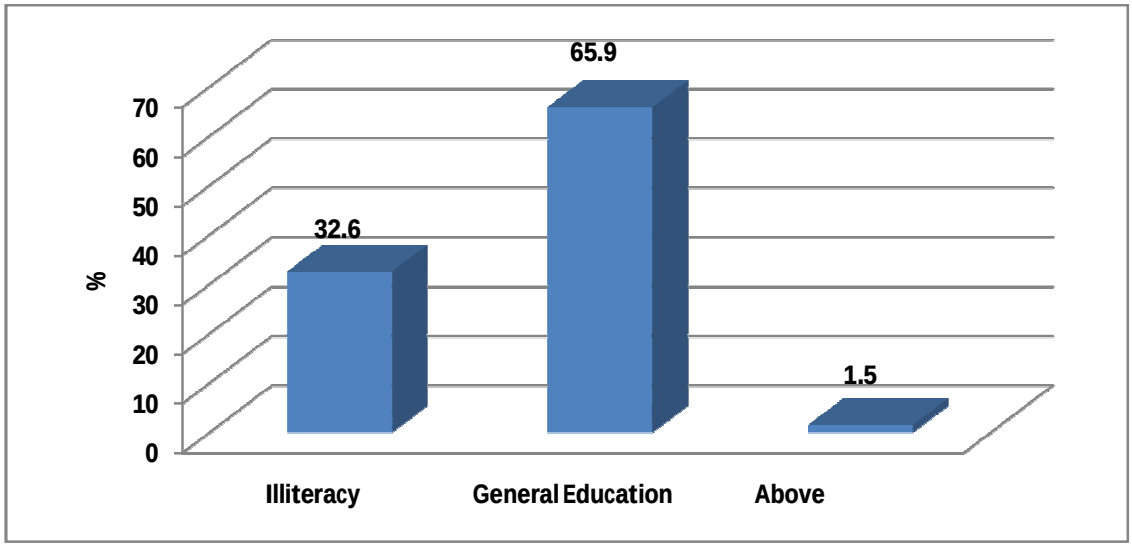

Fig. (3): Distribution of respondents according to education level (n=132)

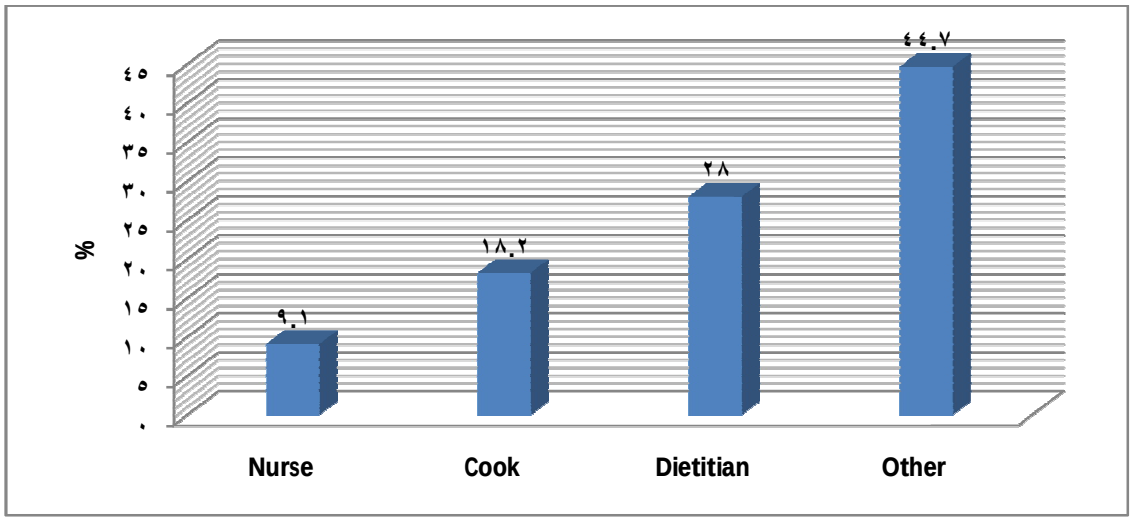

Fig. (4): Distribution of respondents according to type of work (n=132)

4-3-2-Knowledge of food services staff regarding food hygiene:

Responses regarding knowledge on food hygiene are shown in Tables 2. The majority of the food handlers (72.8%) were not aware of the correct temperature for a refrigerator and 62.1% of them thought that chilling and freezing eliminates harmful germs in food. In addition to that, 66.7% of them were unaware of the best

way to wash fresh fruits and vegetables to keep them free from food poisoning microorganisms and only 29.1% of them knew that a sore on the of hand should excluded them from preparing food .Howeveronly 37.9% were aware that they shouldwash their hands after touching objects. Also the majority (84.1%) were not aware that food leftover should be heated and that75% were not aware that exclusion of some infected individuals from the work will prevent others from food poisoning.

Table (10): Food service staff knowledge regarding food hygiene in the studied hospitals

Questionnaire statement	Responses out of 132 (percentages)	
	Correct	Not correct
The correct temperature for a refrigerator	36 (27.2%)	96 (72.8%)
Fresh fruits and vegetables is to washed to prevent food poisoning	44 (33.3%)	88 (66.7%)
The procedures for cleaning kitchen counters that prevent food poisoning	78 (59.1%)	54 (40.9%)
You prepare food for other people when you have a sore on the back of your hand	95 (71.9%)	37 (29.1%)
When preparing food, you should wash your hands after touching these objects	50 (37.9%)	82 (62.1%)
To prevent food poisoning, how long should leftover foods be heated?	21 (15.9%)	111 (84.1%)
Chilling or freezing eliminates harmful germs in food	50 (37.9%)	82 (62.1%)
To prevent food poisoning, the following people should not prepare food	33 (25%)	99 (75%)

4-3-4-Food services staff knowledge regarding contamination and pathogens:

Themajority of the food handlers had adequate knowledge on some hygienic practices such as the correct application of cleaning procedures of equipment decreases the risk of infection transmission to patients (88.6%), washing of hands before handling food reduces the risk of contamination (87.9%), the importance of the use of caps, masks, protective gloves and adequate closing reduce the risk of

food contamination (82.6%) and the importance of the temperature of the refrigerator to reduce the risk of food contamination (67.4%). Moreover, 86.4% of them were aware that raw foods have to be kept separate from cooked foods and that 65.2% of the food service staff with cuts and abrasions on hands should not touch unwrapped foods. Food service staff knowledge concerning diseases linked with foods. Show that high level of awareness about certain food pathogens and a very low awareness about other types. High correct percentage was obtained for *Vibrio cholera* or other *Vibrio spp*. (68.2%), *Salmonella spp*. (66.7%) as pathogens related to food.

Table (11): Respondent's knowledge regarding pathogens, contamination,other risk factors andtheirlinked to food borne diseases

statement	**Percentage**		
The following pathogens are related to food borne diseases**:**	**Yes**	**No**	**Don't know**
Hepatitis A	43 (32.6%)	36 (27.3%)	53 (43.2%)
Clostridium botulinum	33 (25%)	19 (14.4%)	80 (60.6%)
Salmonella spp	88 (66.7%)	10 (7.6%)	34 (25.8%)
Vibrio cholera or other *Vibrio* spp	90 (68.2%)	3 (2.3%)	39 (29.5%)
Staphylococcus aureus	18 (13.6%)	19 (14.4%)	95 (72%)
The correct application of cleaning procedures of equipment reduce the risk of food borne diseases	117 (88.6%)	0 (0.0%)	15 (11.4%)
Washing hands before handling food reduce the risk of food contamination	116 (87.9%)	8 (6.1%)	8 (6.1%)
The use of caps, masks, protective gloves and adequate closing reduce the risk of food contamination	109 (82.6%)	0 (0.0%)	23 (17.4%)
Raw foods have to be kept separate from cooked foods	114 (86.4%)	2 (1.5%)	16 (12.1%)
Knowledge of temperature of the refrigerator reduce the risk of food contamination	89 (67.4%)	1 (0.8%)	42 (31.8%)

4-3-5Food services staff attitudes and practices regarding food safety and hygiene: Fifty eight (43.9%) of the food services staff were either have direct contact andor distribute ready food to patients , No one use gloves while touching andor distributing food. On the other hand, caps are worn by 32.6% of the food service staff during distribution or touching food. 56.1% of the food handlers have

given a positive response about washing their hands before touching unwrapped raw food, 71.2% wash their hands after touching unwrapped raw food, 42,2% of them wash their hands before touching unwrapped cooked foods and only 75.8% of them wash their hands after touching unwrapped cooked food

Table (12): Food services staff attitudes andpractices regarding food safety and hygiene

statement	Responses out of 132 (percentages)	
	Yes	No
You use gloves when you touch or distribute food to patients	0 (0%)	132(100%)
You use a mask when you touch or distribute food to patients	0 (0%)	132 (100%)
You wear a cap when you touch or distribute food to patients	43 (32.6%)	89 (67.4%)
You wash your hands before touching unwrapped raw foods	74 (56.1%)	58 (43.9%)
You wash your hands after touching unwrapped raw foods	94 (71.2%)	38 (28.8%)
You wash your hands before touching unwrapped cooked Foods	56 (42.4%)	76 (57.8%)
You wash your hands after touching unwrapped cooked foods	68 (24.2%)	54 (75.8%)

Table (13) the association between respondents gender and knowledge regarding Hygiene and safety

Knowledge	Gender	Correct	Not correct	Idont know	Total	P-vale
The correct application of cleaning procedures of equipment decrease the risk of infection transmission to patients	Male	47 (35.6%)	(0.0%)0	1(0.8%)	48 (36.4%)	0.011
	Female	70 (53.0%)	(0.0%)0	14 (10.6%)	84 (63.3%)	
	Total	117 (88%)	(0.0%)0	15 (12%)	132 (100.0%)	
Washing hands before handling food reduce the risk of contamination	Male	39 (29.5%)	8 (6.06%)	1(0.8%)	48(36.4%)	0.000
	Female	77 (58.3%)	0 (0.0%)	7 (5.3%)	84 (63.6%)	
	Total	116 (87.9%)	8(6.1%)	8(6.1%)	132(100.0%)	

The use of caps, masks, protective gloves and adequate clothing reduce the risk of food contamination	Male	39 (29.5%)	0 (0.0%)	9 (6.8%)	48 (36.4%)	0.468
	Female	70 (53.0%)	0 (0.0%)	14 (10.6%)	84 (63.6%)	
	Total	109 (82.5%)	0 (0.0%)	23 (17.5%)	132 (100.0%)	
The following is the correct temperature for a refrigerator	Male	12 (9.1%)	36 (27.3%)	0 (0.0%)	48 (36.4%)	0.000
	Female	24 (18.2%)	60 (45.5%)	0 (0.0%)	84 (63.4%)	
	Total	36 (27%)	96 (73%)	0 (0.0%)	132 (100.0%)	

Cont.table (13)

Knowledge	Gender	Correct	Not correct	Idont know	Total	P-vale
Raw foods have to be kept separate from cooked foods	Male	32 (24.2%)	0 (0.0%)	16 (12.2%)	48 (36.4%)	0.000
	Female	82 (62.1%)	2 (1.5)	0 (0.0%)	84 (63.6%)	
	Total	114 (86%)	2 (1.5%)	16 (12.1%)	132 (100.0%)	
Is it important to know the temperature of the refrigerator to reduce the risk of food contamination?	Male	27 (20.6%)	1 (0.8%)	20 (15.1%)	48 (36.4%)	0.066
	Female	62(47.0)	0 (0.0%)	22 (16.7%)	84 (63.6%)	
	Total	89 (67%)	1 (,8%)	42 (32%)	132 (100.0%)	
Food service staff with cuts and abrasions on hands should not touch unwrapped foods.	Male	33 (25.0%)	0 (0.0%)	15 (11.4%)	48 (36.4%)	0.386
	Female	53 (40.2%)	3 (2.3%)	28 (21.2%)	84 (63.6%)	
	Total	86 (67%)	3 (1%)	43 (33%)	132 (100.0%)	
Fresh fruits and vegetables is to be washed to prevent from food poisoning	Male	17 (12.9%)	8 (6.1%)	23 (17.4%)	48 (36.4%)	0.003
	Female	37 (28.%)	26 (19.7%)	21 (15.9%)	84 (63.6%)	
	Total	54(41)	34(25.7)	44 (33.3%)	132(100)	

($P < 0.05$)

Table (14) Association betweenrespondents age and knowledge regarding food hygiene

Knowledge	Age	Correct	Not correct	Idont know	Total	P-vale
The correct application of cleaning procedures of equipment decrease the risk of infection transmission to patients	16< 30	28 (21.2%)	0 (0.0%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	74 (56.1%)	0 (0.0%)	7 (5.3%)	81 (61.4%)	
	45-59	14 (10.6%)	0 (0.0%)	0 (0.0%)	14 (10.6%)	
	60 and above	1 (0.8%)	0 (0.0%)	8 (6.1%)	9 (6.8%)	
	Total	117 (88.6%)	0 (0.0%)	15 (11.4%)	132 (100.0%)	
Washing hands before handling food reduce the risk of contamination	16< 30	28 (21.2%)	0 (0.0%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	74 (56.1%)	0 (0.0%)	7 (5.3%)	81 (61.4%)	
	45-59	13 (9.8%)	0 (0.0%)	1(0.8%)	14 (10.6%)	
	60 and above	1(0.8%)	0 (0.0%)	8(6.1%)	9(6.8%)	
	Total	116(87.9%)	8(6.1%)	8(6.1%)	132 (100.0%)	
The use of caps, masks, protective gloves and adequate clothing reduce the risk of food contamination	< 3016	28 (21.2%)	0 (0.0%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	67 (50.8%)	0 (0.0%)	14 (10.6%)	81 (61.4%)	
	45-59	13 (9.8%)	0 (0.0%)	1(0.8%)	14 (10.6%)	
	60 and above	1 (0.8%)	0 (0.0%)	8(6.1%)	9(6.8%)	
	Total	109 (82.6%)	0 (0.0%)	23 (17.4%)	132 (100.0%)	
The following is the correct temperature for a refrigerator	16< 30	6 (4.5%)	22 (16.7%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	23 (17.4%)	58 (43.9)	0 (0.0%)	81 (61.4%)	
	45-59	7(5.3%)	7(5.3%)	0 (0.0%)	14 (10.6%)	
	60 and above	0 (0.0%)	9 (6.9%)	0 (0.0%)	9 (6.8%)	
	Total	36 (27.3%)	96 (72.7%)	0 (0.0%)	132 (100.0%)	

Knowledge	Age	Correct	Not correct	Idont know	Total	P-vale
Raw foods have to be kept separate from cooked foods	16< 30	28 (21.2.0%)	0 (0.0%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	66 (50.0)	0 (0.0%)	15 (12.1%)	81 (61.4%)	
	45-59	11(8.3%)	2(1.6%)	1(0.8%)	14 (10.6%)	
	60 and above	9 (6.8%)	0 (0.0%)	0 (0.0%)	9 (6.8%)	
	Total					
It is important to know the temperature of the refrigerator to reduce the risk of food contamination	16< 30	26 (19.7%)	0 (0.0%)	2 (1.6%)	21 (21.2%)	0.000
	30-44	41 (31.1%)	1 (0.8%)	39 (29.5%)	81 (61.4%)	
	45-59	13 (9.8%)	0 (0.0%)	1 (0.8%)	14 (10.6%)	
	60 and above	9 (6.8%)	0 (0.0%)	0 (0.0%)	9 (6.8%)	
	Total	89 (67.4%)	1 (0.8%)	42 (31.8%)	132 (100.0%)	
Food service staff with cuts and abrasions on hands should not touch unwrapped foods.	16< 30	27 (20.5%)	1 (0.8%)	0 (0.0%)	28 (21.2%)	
	31-45	47 (35.6%)	0 (0.0%)	34 (25.8%)	81 (61.4%)	
	46-50	11 (8.3%)	2 (1.6%)	1 (0.8%)	14 (10.6%)	
	60 and above	1 (0.8%)	0 (0.0%)	8 (6.1%)	9 (6.8%)	
	Total	86 (65.2%)	3 (2.3%)	43 (32.6%)	132 (100.0%)	
Fresh fruits and vegetables is to be washed to prevent from food poisoning	16< 30	0 (0.0%)	28 (21.2%)	0 (0.0%)	28 (21.2%)	0.000
	30-44	1 (0.8%)	80 (60.6%)	0 (0.0%)	81 (61.4%)	
	45-59	4 (3.2%)	10 (8.4%)	0 (0.0%)	14 (10.6%)	
	60 and above	8(6.1%)	1 (0.8%)	0 (0.0%)	9 (6.8%)	
	Total	13 (9.8%)	119(89.2%)	0 (0.0%)	132 (100.0%)	

($p < 0.05$).

Table (15) Association between respondent's type of work and Knowledge regarding food hygiene

Knowledge	Type of work	Correct	Not correct	don't know	Total	P-value
Thecorrect application of cleaning procedures of equipment decrease the risk of infection transmission to patients	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	9 (6.8%)	15 (11.4%)	0 (0.0%)	24 (18.2%)	
	Dietician	37 (28.0%)	0 (0.0%)	0 (0.0%)	37 (28,0%)	
	Other	59 (44.7%)	0 (0.0%)	0 (0.0%)	59 (44.7)	
	Total	117 (88.6%)	15 (11.4%)	0 (0.0%)	132 (100.0%)	
Washing hands before handling food reduce the risk of contamination	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	16 (12.1%)	0 (0.0%)	8 (6.1%)	24 (18%)	
	Dietician	37 (28%)	0 (0.0%)	0 (0.0%)	37 (28%)	
	Other	51 (38.6%)	8 (6.1%)	0 (0.0%)	59 (44.7%)	
	Total	116 (87.9%)	8 (6.1%)	8 (6.1%)	132 (100.0%)	
The use of caps, masks, protective gloves and adequate clothing reduce the risk of food contamination	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	9 (6.8%)	15 (11.4%)	0 (0.0%)	24 (18.2%)	
	Dietician	37(28%)	0 (0.0%)	0 (0.0%)	37 (28%)	
	Other	51 (38.6%)	8 (6.1%)	0 (0.0%)	59 (44.7%)	
	Total	109 (82.6%)	23 (17.4%)	0 (0.0%)	132 (100.0%)	
The following is the correct temperature for a refrigerator	Nurse	3 (2.3%)	9 (6.8%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	3 (2.3%)	21 (15.8%)	0 (0.0%)	24 (18.1%)	
	Dietician	14 (10.6%)	23 (17.4%)	0 (0.0%)	37 (28%)	
	Other	16 (12.1%)	43 (32.6%)	0 (0.0%)	59 (44.7%)	
	Total	36 (27.3%)	96(73%)	0.0	132(100%)	

Knowledge	Type of work	Correct	Not correct	Idont know	Total	P-vale
Raw foods have to be kept separate from cooked foods	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.01
	Cook	22 (16.7%)	2 (1.6%)	0 (0.0%)	24 (18.3%)	
	Dietician	29 (22.0%)	0 (0.0%)	8 (6.1%)	37(28.1%)	
	Other	51 (38.6%)	0 (0.0%)	8 (6.1%)	59 (44.7%)	
	Total	114 (86.4%)	2 (1.5%)	16 (12.1%)	132 (100.0%)	
It is important to know the temperature of the refrigerator to reduce the risk of food contamination	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.034
	Cook	16 (12.1%)	1 (0.8%)	7 (5.3%)	24 (18.2%)	
	Dietician	27 (20.5%)	0 (0.0%)	10 (7.6%)	37 (28.1%)	
	Other	34 (25.8%)	0 (0.0%)	25 (18.9%)	59 (44.7%)	
	Total	89 (67.4%)	1 (0.8%)	42 (31.8%)	132 (100.0%)	
Food service staff with cuts and abrasions on hands should not touch unwrapped foods.	Nurse	12 (9.1%)	0 (0.0%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	6 (4.5%)	2 (1.6%)	16 (12.1%)	24 (18.2%)	
	Dietician	34 (25.8%)	1 (0.8%)	2 (1.6%)	37 (28.0%)	
	Other	34 (25.8%)	0 (0.0%)	25 (18.9%)	59 (44.7%)	
	Total	86 (65.2%)	3 (2.3%)	43 (32.6%)	132 (100.0%)	
Fresh fruits and vegetables is to be washed to prevent from food poisoning	Nurse	1 (0.8%)	11 (8.3%)	0 (0.0%)	12 (9.1%)	0.000
	Cook	9 (6.8%)	15 (11.4%)	0 (0.0%)	24 (28.1%)	
	Dietician	0 (0.0%)	37 (28%)	0 (0.0%)	37 (28%)	
	Other	3 (2.3%)	56 (42.4%)	0 (0.0%)	59 (44.7)	
	Total	13 (9.8%)	119 (90.1%)	0 (0.0%)	132 (100.0%)	

($p < 0.05$).

Table (16) Association between respondents level of education and knowledge regarding food hygiene in the studied hospitals

Knowledge	Level of education	Correct	Not correct	Idont know	Total	P-vale
Does correct application of cleaning procedures of equipment decrease the risk of infection transmission to patients؟	Illiterate	5 (3.8%)	10 (7.8%)	28 (21.2%)	43 (32.8%)	0.000
	General education	49 (37.1%)	14 (10.6%)	24 (18.2%)	87 (65.9%)	
	Above	1(0.8%)	1 (0.8%)	0 (0.0%)	2 (1.5%)	
	Total	55 (41.7%)	25 (18.9%)	52(39.4%)	132 (100%)	
Does washing hands before handling food reduce the risk of contamination?	Illiterate	28 (21.2%)	5 (3.8%)	10(7.8%)	43 (32.8%)	0.000
	General education	78 (59.1%)	8 (6.1%)	1 (0.8%)	87 (65.9%)	
	Above	2 (1.5%)	0 (0.0%)	0 (0.0%)	2 (1.5%)	
	Total	108 (81%)	13(10%)	11(9%)	132 (100%)	
Does the use of caps, masks, protective gloves and adequate clothing reduce the risk of food contamination?	Illiterate	2 (1.6%)	3 (2.3%)	38(28.8%)	43 (32.8%)	0.000
	General education	61 (46.2%)	26 (19.7%)	0 (0.0%)	87 (65.9%)	
	Above	2 (1.5%)	0 (0.0%)	0 (0.0%)	2 (1.5%)	
	Total	65(49.2%)	29(22%)	38(28.8%)	132(100%)	
Which of the following is the correct temperature for a refrigerator?	Illiterate	2 (1.6%)	3 (2.3%)	38(28.8%)	43 (32.8%)	0.000
	General education	78 (59.1%)	8 (6.1%)	1 (0.8)	87 (65.9%)	
	Above	1 (0.5%)	1 (0.5%)	0 (0.0%)	2 (1.5%)	
	Total	81 (61%)	12(10%)	39(29%)	132 (100%)	

Knowledge	Level of education	Correct	Not correct	Idont know	Total	P-vale
Do raw foods have to be kept separate from cooked foods?	Illiterate	28 (21.2%)	10(7.8%)	5 (3.8%)	43 (32.8%)	0.000
	General education	11 (8.3%)	43 (32.6%)	33 (25.%)	87 (65.9%)	
	Above	2 (1.5%)	0 (0.0%)	0 (0.0%)	2 (1.5%)	
	Total	41 (31%)	53 (40%)	38(29%)	132(100%)	
Is it important to know the temperature of the refrigerator to reduce the risk of food contamination?	Illiterate	7(5.3%)	3 (2.3%)	33 (25.0%)	43 (32.8%)	0.001
	General education	35 (26.5%)	12 (9.1%)	40 (30.3%)	87 (65.9%)	
	Above	2 (1.5%)	0 (0.0%)	0 (0.0%)	2 (1.5%)	
	Total	44 (34%)	15(11%)	73(55%)	132 (100%)	
Food service staff with cuts and abrasions on hands should not touch unwrapped foods.	Illiterate	8 (6.1%)	12 (9.1%)	23 (17.4%)	43 (32.8%)	0.000
	General education	43 (32.8%)	11 (8.3%)	33 (25%)	87 (65.9%)	
	Above	1(0.5%)	1 (0.5%)	0 (0.0%)	2 (1.5%)	
	Total	52 (39%)	24 (19%)	56 (42%)	132 (100%)	
The best way to keep from getting food poisoning from fresh fruits and vegetables is to wash them	Illiterate	10 (7.8%)	28 (21.2%)	5 (3.8%)	43 (32.8%)	0.000
	General education	47 (35,6%)	24 (18.1%)	16 (12.1%)	87 (65.9%)	
	Above	1 (0.8%)	1 (0.8%)	0 (0.0%)	2 (1.5%)	
	Total	58 (43.9%)	53 (40.1%)	21 (16%)	132 (100%)	

($p< 0.05$).

4-4-Raw and packed food product:

All raw and packed foodin the hospital kitchens were procured from authorized certified sources, however the Products are free from any physical impurities (e.g. dirt, dust, free from any off odor, raw materials is Free from any fungal (frothy) growth. Also the Packaging and pack seals are intact and without holes. Hence the pack air/vacuum intact and without leakage, dents, puffing and rusting signsand raw materials products are used under ‘best beforeexpiry date.

Table (17) Raw and packed food product in the hospitals kitchens

CRITERIA	statements	YES	NO
Source	Procured from authorized/ certified sources	12 (100%)	0 (0.0)
Inspection and quality of raw food	RM/ Products are free from any physical impurities (e.g. dirt, dust,	12 (100%)	0 (0.0)
	RM is free from any off odor	12 (100%)	0 (0.0)
	RM is Free from any fungal (frothy) growth	12 (100%)	0 (0.0)
	Packaging and pack seals are intact	12 (100%)	0 (0.0)
Inspection and quality of packaged food products	Pack is without holes	12 (100%)	0 (0.0)
	Pack air/vacuum intact	12 (100%)	0 (0.0)
	Pack is without leakage, dents, puffing and rusting signs	12 (100%)	0 (0.0)
	RM/products are used under 'best beforeexpiry date	12 (100%)	0 (0.0)

4-5-Microbialtesting:

4-5-1- Microbial testing of Food contact surface:

The microbial growth were detected in 254(84.7%) out of 300 swab samples of food contact surfaces. Knives, benches, and utensils show 100% bacterial growth meanwhile hands and shelves show bacterial growth in 38.3% and 85% respectively. More than one bacterial species were shown in samples of Knives benches and utensils meanwhile only one species of bacteria were shown in swabs of hands and shelves.*Staph epidermis* were isolated from (23) workers hands, (41) knives and (56) Food utensils.Coliform were isolated from (37) benches, *Pseudomonas aeruginosum* were isolated from (22) knives, (47) benches (51) food shelves and (23) food utensils..

4-5-2-Microbial testing of food:

The bacterial growth was detected in 19(52.8%) Out of 36 samples of ready to eat food.The Aerobic Plate Count of 13 out of those positive revealed a range

of$3\times10^2$1×10^3CFU/gm. *Staphylococcus aureus coagulase +ve* were recovered from 6 samplesof food with a range of 3×10 in legumes and 3×10^2 for each of vegetables and amylaceous.*Coliform, Escherichia coli and Salmonella Species*were not detected in all types of food material tested

Table (18) the frequency of isolation of species of bacteria from different food contact surfaces

Food contact surface \ species of bacteria	**Knives**	**Benches**	**Shelves**	**Utensils**	**Hands**
Staphylococcus epidermis	41	**0**	**0**	56	23
Pseudomonas aeruginosa	22	47	51	23	0
Coliform	0	37	0	0	0

Table (19): The Aerobic Plate Count of foodsamples positive for bacterial growth

Food material	Number of food samples	CFU gm
Legumes	4	1×10^3
Vegetables	5	3×10^2
Amylaceous	4	3×10^2

SMSF of Vegetables 10^2 to 10^4

SMSF OF Amylaeous ▪10^4 to10^5

Table (20) The frequency of isolation and Aerobic Platel Count of *Staphylococcus aureus coagulase +ve* in ready to eat _ foods samples at the studied hospitals.

Food material	**Number of food samples**	**CFU gm**
Legumes	3	3×10
Vegetables	2	3×10^2
Amylaceous	1	3×10^2

SMSF of (Ready _ to _ eat _ foods) 10^2 to 1×10^3

SMSF Sudanese Microbiological Standard for foods

CHAPTER FIVE

DISCUSSION

The standard measures and health facilities of the hospitalsconcerning food safety and hygiene:

The interpretation of the results of the general hospital capacityof Khartoum locality show large food services prepared for patients in the hospital kitchens by the food services staff.This service is of great importance since it is provided to one of the vulnerable groups to food borne diseases. The general standard measuresand health facilities concerning food safety and hygiene in the studied hospitals revealed well keeping of fivestatement(50%) out10 characteristics concerning basic measures of food safety and hygiene.Inthese hospitalsno adoption of food hygiene practice manual,no implementation of HACCPprogram,no microbial testing for food or food contact surfaces,no temperature monitoring of food and no educational or training onHAACP.Thoughabsence of these characters in hospitals represent disadvantages in processing of safety food,yet the inspection of raw food materials,developed foodstorage procedures ,personal hygiene procedures and developed cleaning anddisinfection procedures can be taken as prerequisites for successful implementation of HACCP system..

The hospital kitchen and other health facilities:

The buildings of the hospital Kitchen: Thebuilding of the hospital kitchen show well floor type and cleanliness meanwhile the wall show some defects and with visible dirt in8 (66.7%) and 7(5.3%) respectively. Though light and ventilation were good in allhospital kitchens, infestation was observed in (66.7%) hospital kitchen.The overall condition of the building detected these deviations that would be considered as risk factors that affect safety of food prepared for patients.

kitchen equipments utensils and basins: The study showed that all hospitals had equipments free from cracks, easily cleanable and were kept clean. Also all hospital kitchens had basins for the washing of utensils and preparation of food and all of them have fixed smooth and rough surface type of basins with tap water The study reported that cleanliness of the basins and the surrounding area is kept in 8(66.7%) of the hospital kitchens.. Utensils are cleaned and sanitized by using cold water with detergent in all hospital kitchens. The defects concerning equipments and utensils that were detected in the present study were that none of the hospitals use drying racks for the cleaned and sanitized equipments and none of the hospitals keep the utensils under conditions which prevent contamination. Such defects were considered as risk factors that affect safety of food prepared for patients in the hospitals.

Personal hygiene of thefood service staffwhile processing in the hospital kitchens: The interpretation of the results of the personal hygiene of the food service staff while food processing in the hospital kitchen revealed great deviations represented as not wearing appropriate clothing,dirty clothing and untrimmed dirty nails in 5(25%) ,2(16.7%) and 4 (33.3%)respectively.

In addition in all hospitals food handlers were wearing jewelry. Though managerial supervision of workers was conducted in all hospitals and a separate room for clothing were detected, yetstrict application of health conditions of personal hygiene of the food service staff in some hospitals were not held well.The role of personal hygiene of the food service staffwas considered as one of the most important part in safety of food.**Buccheri *et al*., 2007** stated that all food service staff in the hospital, should be aware that a careful personal hygiene is a key measure to prevent food contamination and spread of food borne diseases.**Refrigeration and storage:**

The overall conditions of the storage of food and the use of the refrigerators were well and approach to promotion of safety food since that the refrigerator were available in all hospital kitchens and that there was a separate storage room of well floor ceramics type which was specified for raw food materials The deviations were recorded for absence of fixed thermometer reading for the refrigerator in the hospital kitchens.**Waste management:**The waste management systems in all hospitals was working well, the exceptions were forimproper covering of the refuse receptacles inall hospitals and the obstacles of transportation of refuse before overfilling in7(58.3%) hospitals.These two defects represent environmental contaminants in the hospitals and were considered as high risk factors for food safety prepared in the hospitals.

Water source and toilets: The study showed that the source of water in all of the hospitals is privately installed from municipal supply; these findings indicated good source of water established in the studied hospitals. Since thatthe source contain chlorinated tap water.

A flush type toilets with water and separation between male and female toilet exists in all of the studied hospitals.The latrines werenot clean ,uncomfortable in 7(58.3%) and fly infestation was observed in 8 (66.7%) of the hospitals and no hand wash basinswere present near the toilets in any of the hospitals. Though that the presence of toilets were useful as they facilitate the workers to access best sanitary practices,yet their improper health status represent great hazard for safety and hygiene of food**. (Adam, 1999)** stated for large complexes, one separate unisex toilet with a maximum travel distance of 40m should be available. Similarly, a separate unisex accessible baby caring area should be provided if feasible.**Raw and packed food product quality**: The procured from certified sources and the inspection procedure adopted show well characters which indicated good quality of

raw and packed food product in all hospitals.This point is considered one of the important stages of safety food chain.

Socio-demographic characteristics of food services staff: Out of 132 of the food service staff 84(63.6%) were females meanwhile 48(36.4%) were males. This was combatable with most of the previous studies that showthe higher percentage of the food service staff were females **(Soares, etal2012; Baluka, etal 2015; Son, etal2015)**. The age group 3o-44years of the food services staff were 81(61.4%)which represents the greatest number meanwhile the age group of those less than30years and above 60 years were (21.2%) and(1.5%) respectively. These variations in percentage of numbers of the different age groups may be attributed to the income dissatisfaction. Fortythree (32.6%) of the food service staff were illiteracy compared with only 2(1.5 %) of high education. The presence of large numbers of illiterate of food service staff remain as one of the obstacles that faced development of food safety and hygiene programs.

Food services staff knowledge, attitudes and practices: The interpretation of the results of knowledge of the food service staff regarding food hygiene revealed great variation in knowledge of the different statements.Six(75.5%) out of 8 statements of knowledge formed in closed questions recorded incorrect answers with score percentage in the range of (62.1% - 84.1%).For the opened questions,the statements about the riskof contaminationrecorded correct knowledge with score percentage range of (65.2%-88.6%)meanwhile correct knowledge about *Clostridium botulinum*, *Staphylococcus aureus* and *HepatitisA Virus* as pathogens related to food borne diseases recorded percentage score of 25%,13.6%and32.6% respectively.The overall knowledge of the food service staff in the selected hospitals indicated weak knowledgeof food safety and hygiene. This

attributed mainly to the illiteracy of32.6% of the food service staff in addition to lack of educational and training courses of food safety and hygiene.

Previous studies conducted in Italy and Turkey (**Angelillo *et al*., 2001; Buccheri *et al*., 2007; Tokuç *et al*., 2008**) indicated better level of food safety awareness of the food service staff. This might possibly be due that most of the participants in the previous studies have attained better educational levels and some have had educational trainings on food safety.

Lack of knowledge about temperatures as a critical statement for safety of food A similar alarming lack of knowledge has been reported among food service staff in hospitals in Italy and in other countries (**Askarian *et al*., 2004; Angelillo *et al*., 2001**). Nevertheless, the importance of storing foods at correct temperatures has been widely documented. Knowledge about temperatures as a critical statement for safety of food is considered as a basic issue in the implementation of HACCP and in food safety legislations (**Decreto, 1997; Parliament and of the Council of the European on the hygiene of foodstuffs, 2004**).

The results show that high level of awareness about certain food pathogens and a very low awareness about other types. Scores of correct knowledge as pathogens related to foodwere obtained for *Vibrio cholera* or other *Vibrio spp*. (68.2%), *Salmonella* spp. (66.7%) and HepatitisA (32.6%). These results were found in compatible with previous studies made in Italy (**Buccheri *et al*., 2007**) and India (**Malhotra *et al*., 2008**)that indicated higher levels of knowledge fo *Vibrio cholera* or other *Vibrio spp*. were observed in the present study for *Vibrio cholera* andsimilar near results for the rest of the pathogens. On the other hand the results of the statement in the present study is in contrast to that of the previous studies done by (**Angelillo *et al*., 2001**), where food service staff in the Italian hospitals showed a slightly higher awareness for *Vibrio spp. Salmonella* spp. and a very

high level of awareness towards the rest of the pathogens.Thesedifferences of knowledge of the food service staff concerning pathogens associated with food in this study and the previous studies in Italy and India were probably due to the general awareness on foodborne diseases and educational levels, as most food service staff of the latter have attained high school and above educational levels.

The interpretation ofattitudes and practices of food services staff in the selected hospitals show thatwearing gloves and masks when touching and/or distributing food items were not implemented by all food services staff meanwhile wearing caps were practice by 43(32.6%) of them. On the other side the practices of not washing hands before or after touching unwrapped raw foodrevealed(43.9%) and (28.8%) respectively.Meanwhile the practices of not washing hands before or after touching cooked foods revealed percentage of (42.4%) and (24.2%) respectively. These improper practices of the food services staff play a great role in contamination of food with pathogens and were considered as risk factors for food borne diseases.Food handlers who do not use gloves and masks or with poor personal hygiene can inoculate the food item with infected excreta, pus, respiratory drippings' or other infectious discharges being a major source of contamination and ultimate sources of health risks (**Kaferstein, 2003**).Moreover, washing hands before and after touching unwrapped and raw food was not so generalized as expected in a personnel who should have been continuously trained about hand hygiene. All food service staff, especially in the hospital, should be aware that a careful personal hygiene is a key measure to prevent food contamination and spread of enteric diseases. This is of paramount importance when pathogens have a low minimum infective dose, such *E. coli* O157, and their introduction by contaminated food or infected food handlers may be followed by extensive human-to-human transmission (**Welinder *et al*., 2004, Kjellin *et al*., 2004**).

More or less analogous behaviors were represented in previous studies confirming the concept that cross-contamination is a poorly understood food safety issue (**Buccheri *et al*., 2007; Tokuç *et al*., 2008**). This is a very critical issue in hospitals as they deal with vulnerable people.

Some (29%) of the food services staff in the hospitals use appropriate clothing (head caps and dust coats) when working in the kitchen. All the hospitals stored raw materials, chemicals (such as detergents) and other equipments in the same rooms. The study also showed that the majority of staffs (97%) washing hands before handling food which could reduce the chance of food contamination. Other studies showed that the self-reported food hygiene behaviors yielded somewhat better results, though some disturbing findings arise from our results: indeed, improper practices, such as sharing of utensils for raw and cooked foods and thawing of frozen food at room temperature, appeared to be widespread among the respondents. Similar behaviors are described in several previous studies and confirm that cross-contamination is a poorly perceived food safety issue (**Angelillo *et al*., 2001**; **Altekruse *et al*., 1999; Shiferaw and Cieslak, 2000**).

Association between socio -demographic characters and KAP: Females had got better knowledge than males for allstatements of knowledge concerning food safety and hygiene.Significant differences were present where P ≤o.o5 for most of the statements.The age group16≤30years had got high percentage correct knowledge for most of the statements concerning food hygiene.The statement of the correct temperature of the refrigerator recorded low percentage knowledge within allaged groups. Significant differences were present where P ≤o.o5 for most of the statements of knowledge and type of work.Nurse who work infood services hadgot high percentage correct knowledge for most of the statements concerning food hygiene.It worth consider to state that the correct temperature of the

refrigerator recorded the lowest percentage correct knowledge within all workers type.

The significant differences (P ≤o.o5) for all statements of knowledge and level of education explained thatfood service staff with high education level had better knowledge concerning food safety and hygiene. Thiswas indicated by high percentage of correct knowledge within those of educational levels.The role of educated food handlers in ensuring food hygiene and safety in the hospital setting cannot be overemphasized. The study revealed that most of the food served to patients in the studied hospitals were done by workers who were illiterate or hadgeneral level of education. This representeda serious negative implications on food safety.Previous studies have documented the fact that food handlers with higher level of education had better knowledge and practices (**Buccheri *et al*., 2007, Isara and Isah, 2009; Angelillo *et al*., 2001; Angelillo *et al*., 2000**).

Education and training of food service staff on food safety and hygiene: All the hospitals had not adopted anytraining or education courses on food safety and hygieneor HACCP for food services staff. This could probably be due to the fact that hospital administrations did not place a high premium on the importance of training of food service staff in promoting and ensuring safe and sound food served to patients in hospitals.

Training of food handlers is a very important tool in assuring food safety in hospitals and other health institutions. A study done by**El Derea *et al*., 2008**in Alexander-Egypt, demonstrated an improvement in the overall food safety practices and their associated parameters in two hospitals that prepared food for patients after a training program for food handlers.

Previous studies suggest that knowledge alone is an insufficient tool to promote food safety and hygienic behaviors since some studies have shown that there were no differences between the staff who attended an educational course and those who

did not (**Angelillo *et al*., 2001; Tokuç *et al*., 2008**). In other words, designing food hygiene training as an isolated domain with the sole purpose of providing information and producing certificated personnel is unlikely result in significant changes in food hygiene practices. There is, therefore a need for alternative educational strategies, such as those based on motivational health education and promotion models (**Angelillo *et al*., 2001; Tokuç *et al*., 2008**).

Microbiological testing of food contact surfaces: From a total of 300 swabs taken from different food contact surfaces, 254(84.7%) revealedbacterial contamination.Food contact surfaceswere found positive for *Staph epidermitis, Coliform andpseudomonas* .Thisis attributed mainly to inadequate cleaning and disinfection procedures used in the hospital kitchens.

The hospital kitchen conditions in this study have shown that utensils were stored under conditions which did not prevent contamination and that working clothes of the food handlers were not clean. Theseconditions have contributed for microbial contamination of food. According to the quality of ready to eat foods (**PHLS, 2000**) and NSW Food Authority microbiological quality guide for ready-to-eat foods (**NSW, 2009**) such contaminated surfaces andthe direct contact with the prepared food would be a major reason for microbial contamination of food.

Microbiological testing of the ready to eat food: The study showed that 19 (52.8%) out of (36) of ready to eat- food samples were positive for microbial growth. This indicated high percentage contamination of ready to eat food to patients in the hospitals The possible sources of contamination for this food were the different contaminated contact surfaces.(**Dugassa, 2007**) stated that the contaminated environment in the hospital kitchens includes contaminated food containers, unclean utensils and equipments, hands andcloth of the food handlers or pests.

About 13 (68.4%) out of 19 of those detected with bacterial contamination revealed APC. The APC involved 5 samples of vegetables and 4 samples of each of amylaceoues and legumes in the range of3×10^2forthe both. This APC were found to be within the limits of the SMS for acceptable ready to eat food but indicate some hygiene problems. Themicrobiological testing for detection of the presence of certain pathogens in ready to eat food revealed 6(31.6%) samples with *Staphylococcus aureusCoagulase positive*.The types of food encountered with this pathogen included 3samples of legumes, 2samples of vegetables and one sample ofamylaceous.The presence of *Staphylococcus aureusCoagulase positive* in such ready-to-eat food of this study is potentially hazardous.Theirpresence may be due to improper personal hygienic practices and that handlers do not use gloves or masks during food preparation and distribution of wrapped and unwrapped food.From the study the practices of not washing hands before or after touching unwrapped raw food revealed (43.9%) and (28.8%) respectively. Meanwhile the practices of not washing hands before or after touching cooked foods revealed (42.4%) and (24.2%) respectively Comparing this finding with other previous studies done in France (**Poupet-Réglier *et al.*, 2005**) and Turkey (**Ayçiçek *et al.*, 2004**) similarity were found.Actions were needed for correction in such a way that hospitals should have their food handling controls investigated, ensure well hygiene practices and determine the sources of the problem.

CONCLUSION

On the basis of the findings of the study, it was concluded that:

-all studied hospitals have no standard food safety systems in place this lack of food safety systems lead to poor food safety standards.

-The hospital kitchen buildings and other supplementary health facilities revealed great deviations from the standard measures of food safety and hygiene and need to be reviewed.

- Food handlers and their supervisors in the hospitals studied have insufficient knowledge regarding hygiene and safety of food. Frequent improper attitudes and practices were involved in food contamination.

-The microbial quality of the majority of the food types were satisfactory as most results fell within the acceptable range but the presence of *Coagulase* positive *staphylococcus aureus* indicated post-cooking contamination and a potential risk to food borne diseases

- Food safety education and training programs for food services staff would increase food safety knowledge and adoption of safe food handling behaviors.

-Results from this study underlined the importance and need of a full implementation of the HACCP system for proper hygiene and proper handling of food items in the hospitals.

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RECOMMENDATIONS

In light of the findings of the study the following recommendationscan be made**:**

- Hospitals: Strict immediate actions to correct the deviations from the standard measures in the different sections of food safety and hygiene in the hospitals such as rehabilitation of the buildings of the hospital kitchens, adequate cleaning and disinfection procedures, developed proper personal hygiene procedure,
- MOH: To adopt, develop and strengthen the main food safety measures that were not detected in the studied hospitals such as, temperature monitoring, microbial testing of contact surfaces and ready to eat food.
- Hospitals: To take the standard measures of food safety and hygiene that were well present and properly applied in the hospitals, as pre-requisites for successful implementation of HACCP. .
- Hospitals: To maintain good personal hygiene, proper attitudes and practices of the food service staff in the hospital at all times of processing and distribution of ready to eat food, educational and training programs need to be established.
- MOH: To underline food safety and hygiene laws, legal requirements, standard measurements and guidelines. Moreover to strengthen enforcement mechanisms that supervise, follow up, inspect, audit and monitor food safety and hygiene settings in the hospitals..
- Hospital: To check continuously proper sanitation of equipments, utensils, shelves boards, knives, basins and the area surround the hospital kitchen so as to minimize microbial contamination. Further exploration and testing the safety of the food is needed.

- Without microbial analyses and time/temperature checks of the food, it is impossible to determine if the food safety curriculum and delivery of the program made the food served by food handlers to patients.
- Hospitals: To provide and support the food service staff with the special requirements of the work, such as gloves, masks, caps, clothes, aprons …..etc) .
- MOH: To endeavor adoption of Hazard Analysis Critical Control Points (HACCP) Such approach will definitely ensure the quality and safety of food served to patients in the hospitals.

  Similar studies are to be done on other public and private hospitals of other states of SUDAN in order to obtain more data on GHP, GKP and microbiological quality of food prepared to patients. Further studies assessing the practice of food hygiene and safety using qualitative methods such as direct observation are advocated

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Appendix 1
Culture Media

1.Nutrient agar

(Hi Media Laboratories limited, india)

2.Blood agar

(Hi Media Laboratories limited, india),

3.Chocolate preparation

(Hi Media Laboratories limited, india)

4.MacConkey broth:

(Hi Media Laboratories limited, india)

5. MacConkey agar

(Hi Media Laboratories limited, india),

6.Plate count agar

(Hi Media Laboratories limited, india)

7.Lauryl tryptose broth

(Hi Media Laboratories limited, india)

8.Brilliant green

(Hi Media Laboratories limited, India

9.EMB

(Hi Media Laboratories limited, india)

10.Baird parker agar

(Hi Media Laboratories limited, India) petri dish.

11.Rappaport vassiliadis enrichment salmonella broth

(Hi Media Laboratories limited, india)

12.XlD

(Hi Media Laboratories limited, india)

13.Glucose-phosphate medium (MR-VP test medium):

Prepared according to Barrow and Fletham (1993)

14.Citrate medium:

Prepared as recommended by Cowan(1974).

15.Tsi agar :

According to manufacturing instructions (Hi Media Laboratories limited, india)

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Appendix (2)

Chech list

The Hospital KitchensStandards and Control Measuers- Existed and Implmented

A-The kitchen buildings conditions:

1. Type of floor: Concrete/ cement ____ other (specify) _____

2. Floor cleanliness. Yes _____No_____

3. Floor status: Good conditionYes _____No_____

4. The wall free from visible dust, dirt or spider web: Yes_____No_____

5. The wall free from holes and cracks: Yes ____No_____

6. The kitchen space served for other additional purpose: Yes_____No_____

7. The kitchen provided with adequate lighting systems: Yes ____No_____

8. The kitchen provided with adequate ventilation systems:Yes____ No____

9. There is infestation in the kitchen: Yes ____No__

B-Kitchen equipments, utensils, basins and cleanliness.

10. The equipments kept clean and free from dirt: Yes ____No_____

11. The equipments are free from cracks: Yes ____No_____

12. The equipments are easily cleanable: Yes ____No_____

13. There is basin for washing utensils and food : Yes ____No_____

14. Basin:Fixed smooth surface with water tapYes ____No____

15. Cleanness of the basin and itssurrounding area: Yes _____No_____

16. Methods of cleaning of equipments and utensils:Hot and cold water with detergent __ cold water with detergent ___ hot and cold water __ Only cold water _____ Only soap and cold water _____17. Presence of drying racks for sanitized and cleaned utensils. Yes ____No_

18.Well keeping of Utensils and equipments :Yes_No_

C-Personal hygiene of the food handlersat time of visits:

19. All food handlers wear appropriate clothes: Yes ____No_____

20. Food handlers' clothing are clean: Yes ____No_____

21. Food handlers' nails are short trimmed and clean: Yes ____No_____

22. Food handlers have discharges:Yes____No_____

23. Visible skin rashes, boils, cuts and wounds: Yes ____No_____

24. Visible cuts and wound (If present):Plastered with water impermeable bandage _____left Opened ___ Other (specify)___

25. Food handlers wear jewelry: Yes ____No_____

26. Food handlers properly keep food in conditions that prevent access to insect and environment: Yes ____No_____

D-Storage and refrigeration of raw and packed food products:

27. A refrigerator is available: Yes ____No_____

28.Perishable and non perishable food are stored together: Yes ___No___

29. The refrigerator is over filled: Yes ____No_____

30 Refrigeratorstorage of cooked foods and raw foods:

a. Separate refrigerators for raw and cooked foods. _____

b. Same refrigerator (cooked food in different comportment). _____

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

d. Other (specify) _____

31.The refrigerator have a fixed thermometer reading: Yes ____No_____

32. The presence of a separate storage room: Yes ____No_____

33. Concrete/ cement floor of storage room:Yes ____No

34. The storage room is free from moisture and dust: Yes ____No_____

35. Stored chemicals come in contact with equipments foods:Yes __ No__

E-Water supply and Sanitary facilities:

36. Source of the water: Installed from municipal supply:Yes ____No_____

37. Type of toilet: flush type Yes ____No_____ other (specify) _____

38. Toilet at time of visit giving service:Yes ____No_____other (specify)

39. Separation for male and female toilets: ____Yes ____No_____

40. The latrine is clean;Yes ____No_____

41. Fly infestation is present: ____Yes ____No_____

42. Hand wash basins provided after toilet use ____Yes _____ No_____

F-Wastes management:Solid and Liquid wastes

43. Appropriate refuse receptacles present in the kitchen: Yes ____No_____

44.The receptacles are properly covered and tight Yes ____No_____

45.The receptacles are overfilled : Yes ____No_____

46.The refuse transported to final disposal before over filing:Yes__No__

47. Final disposal of the refuse is supplied to municipal service:Yes__No__ Other (specify)___

48. Drainage system for collection and handling of liquid waste present: Yes ____No____

49.Closed type of drainage system :Yes__No__ Other (specify)___

50.Liquid wastes disposed toseptic tank:Yes__No__ Other (specify)

51.Stagnation of liquid wastes present: Yes ____No____

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Appendix3

CHEC LIST

Raw and Packed Food Product Inspection and Quality

CRITERIA	statements	YES	NO
Source	procured from authorized/ certified sources		
Quality	RM/ Products are free from any physical impurities.		
	RM is free from any off odour		
	RM is Free from any fungal (frothy) growth		
	Packaging and pack seals are intact		
Quality of packaged Food products	Pack is without holes		
	Pack air/vacuum intact		
	Pack is without leakage, dents, puffing and rusting signs		
	RM/products are used under best before expiry date		

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Appendix (4) Questionnaire

Hospital Medical Directors:

Please read the questionnaire and respond in the manner clearly indicated for each statement. Your responses will only be used for research purpose and therefore be kept confidential.

Thank you

1-Capacity of the hospital:

1. Number of beds in the hospital _____

2. Number of food service staff in the hospital according to type of work

cooks_____ nurses _____ dietitians_____

Domestic staff _____ (washing utensils-preparing ingredients-

3. Number of meals served daily to patients. _____

2-Guidelines of measures and standards being developed in the hospital:

1.Food hygiene practices manual adopted: Exist_____ Not exist_____

2.Hazard analysis Critical Control Points: Exist_____ Not exist_____

3.Inspection of raw and packed food product : Exist_____ Not exist_____

4. Microbial testing of surfaces and food: Exist_____ Not exist_____

5. Temperature monitoring of food : Exist_____ Not exist_____

6. Food storage procedures :Exist_____ Not exist_____

7. Personal hygiene of food service staff: Exist_____ Not exist_____

8.Cleaning and sanitation of surfaces : Exist_____ Not exist_____

9 . Educational courses and trainings on HACCP: Exist_____ Not exist

10-Managerial work supervision: Exist_____ Not exist

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Appendix5

Questionnaire Food service staff

This questionnaire is prepared to determine knowledge, attitudes and practices about food hygiene and safety. You are kindly requested to respond for each statement. Your responses will only be used for research purpose and therefore be kept confidential.

Hospital: _____

NAME: _____

A. Sociodemographic characteristics: 1.Sex: Male _____ Female_____

2**. Age**::16_29, _____ 30_44, _____ 44_60, _____ 60 and above____

3. **Type of work:** Nurse____ Cook____ Dietitian____ Other domestic_____

4. **Level of education**: Illiteracy ____ General education____ High education_____

B. Knowledge, Attitudes and Practices:

5. The correct temperature for a refrigerator:

<1^{o}C _____ 1-4^{o}C _____5-8^{o}C _____9-12^{o}C _____13-16^{o}C_____

6. Fresh fruits and vegetables is to be washed with : regular soap _____hot water _____ anti bacterial soap _____cool running water: _____

7. The procedures for cleaning kitchen counters include:

spray with a strong sanitizing solution _____wash with a detergent ___wipe with asanitizing solution _____brush off any dirt or food piece_____

8.You prepare food for other people when you have a sore on the back of your hand:

Yes, if it isn't infected ____Yes, if you put a bandage on it _____Yes, if you wear a glove

_____Yes, if you bandage the sore and wear a glove _____ No, you should not prepare until

the sore heals_____

9. You wash your hands after touching objects and before preparing food: Yea _____No _____

10. Foodleftover is to be heated: until they are boiling _____ just until they are hot _____at roomtemperature ___reheating is notnecessary ___

11. Chilling or freezing eliminates harmful germs in food: ___Yes _____No

12.The following individuals are excluded from preparing food:

_____a person with diarrhea _____a person with fever _____a person with HIV_____a person with bandage burns on his /her hands that are covered with gloves_____a person with itching_____a person who smokes_____a person with sore throat _____a person with vomiting

13.Pathogens related to food-borne diseasesincludes:*Hepatitis A virus*Yes _____ No _____I Don't know

. *Clostridium spp*Yes _____ No _____I Don't know

. *Salmonella spp*Yes _____ No _____I Don't know

. *Vibrio cholera /Vibrio spp*Yes _____ No _____I Don't know

. *Staphylococcus aureus*Yes _____ No _____I Don't know

14.The correct application of cleaning procedures of equipment decrease the risk of transmission of pathogens to patients _____Yes _____No _____I don't know

15Washing hands before handling food reduce the risk of contamination;

Yes_____ No_____ I don't know_____

16. The use of caps, masks, protective gloves and adequate clothing reduce the risk of food contamination: Yes _____No _____I don't know_____

16.Raw foods have to be kept separate from cooked foods: Yes _____No _____I don’t know_____

17.It is important to know that temperature of the refrigerator reduce the risk of food contamination:Yes _____No _____I don’t know_____

18 . Food service staff with cuts and abrasions on hands should not touch unwrapped foods:.yes _____No _____I don’t know _____,

19.You use gloves when you touch or distribute food to patients:Yes __No

20 You use a mask when you touch or distribute food to patients:Yes__No

21.You wear a cap when you touch or distribute food to patients Yes _No_

29.You wash your hands before touching unwrapped raw foods Yes _No __ 30. You wash your hands after touching unwrapped raw foods Yes__No __

31. You wash your hands before touching unwrapped cooked foods: Yes ___No __

2. You wash your hands after touching unwrapped cooked foods Yes___No ___

جامعة شندى

جامعة شندى

كلية الدراسات العليا والبحث العلمي

الملحق2: قائمة تحقق- المعايير الصحية لحالة مبانى المطبخ و تدابير الرقابة الموجودة والمنفذة

حسب ملاحظات الباحث في وقت الزيارة:

المطبخ:

1. نوع الأرضيات:

خرسانية اسمنتية ☐ ترابية☐ من الطوب ☐ بلاط ☐ أخرى حدد .....

2. الأرضية نظيفة في وقت الزيارة

نعم ☐ لا ☐

3.حالة الأرضية:

جيدة ☐ متوسطة ☐ حالة سيئة ☐

4 الجدار خالي من الغبار المرئي والأوساخ أوبيت العنكبوت

نعم ☐ لا ☐

5الجدار خالية من الثقو ب والشقوق

نعم ☐ لا ☐

6مساحة المطبخ تسمح لأغراض إضافية أخرى

نعم ☐ لا ☐

7المطبخ مزود بأنظمة الإضاءة الكافية؟

نعم ☐ لا ☐

8المطبخ مزود بتهوية كافية؟

نعم ☐ لا ☐

9.وجود حشرات فى المطبخ لاحظتها في وقت زيارتك

نعم ☐ لا ☐

المعدات والادوات واحواض الغسيل فى المطبخ

10المعدات تحفظ نظيفة وخالية من الأوساخ والقاذورات

نعم ☐ لا ☐

11. المعدات خالية من الشقوق

نعم ☐ لا ☐

12. المعدات سهلة للتنظيف

نعم ☐ لا ☐

13. وجود حوض لغسل الأواني المستخدمة في إعداد الطعام

نعم ☐ لا ☐

14نوع الحوض (إذا كان موجودا):

مثبت أملس السطح مع صنبور الماء دش مع وعا☐ جردل مثبت على سطح خرسانى مع صنبور ☐ الماء ☐ أخرى ☐.....

16. نظافة الحوض والمنطقة المحيطة بها :

يحافظ عليها ☐ لا يحافظ علي☐

17. طرق تنظيف وتعقيم الأواني:

الماء الساخن او البارد والمنظفات المستخدمة للتنظيف☐ الماء البارد مع المنظفات ☐ المستخدمة

الماء الساخن فقط ☐ الماء البارد ف☐ الصابون المحلي والماء ب☐دة

المعدات والأواني تعقم بتغطيسها فى محلول سيدكس☐

18. هل هناك تجفيف لرفوف الأواني بتطهيرها وتنظيفها؟

نعم ☐ لا ☐

19. الأواني والمعدات المخزنة في الحاويات أو على الرفوف موجودة فى ظروف تحول دون تلوث

نعم ☐ لا ☐

<u>متداولي الأغذية اثناء العمل فى المطبخ</u>

20. جميع متداولي الأغذية يرتدون الملابس المناسبة

نعم ☐ لا ☐

21. ملابس متداولي الأغذية "نظيفة

نعم ☐ لا ☐

21. أظافر متداولي الأغذية "قصيرة ونظيفة

نعم ☐ لا ☐

22. تسيل الافرازات من الأنف والعين والسعال كذلك من متداولي الأغذية:

نعم ☐ لا ☐

23. ظهور الطفح الجلدي، والقطع او الجروح على الايدى :

نعم ☐ لا ☐

24. حالة معاملة القطع أو الجرح، (اذا وجد) هى:

عليه لاصق او ضمادة غير نفاذة للما☐ ترك مفتوحا☐ اخرى حدد☐

25. متداولي الاغذية يرتدون انوع من المجوهرات علي الايدى:

نعم ☐ لا ☐

26. وجود مدراء مشرفون على متداولي الاغذية العاملين اثناءعملهم العادي:

نعم ☐ لا ☐

27. الطعام المطبوخ يتم التعامل معه بطريقة تمنع وصول إلى الحشرات وتلوث البيئة:

نعم ☐ لا ☐

<u>إدارة المخلفات</u>

<u>النفايات الصلبة</u>

28. أوعية القمامة المناسبة موجودة في المطبخ

نعم ☐ لا ☐

29. الاوعية مغطاة بشكل صحيح ومحكمة الاغلاق

نعم ☐ لا ☐

30. أوعية القمامة مملوء وقت الزيارة

نعم ☐ لا ☐

31. القمامة يتم نقلها إلى مكان التخلص النهائي قبل أن تتكدس

نعم ☐ لا ☐

31. التخلص النهائي من القمامة هو:

☐ **يتم بواسطة** خدمات البلدية ☐ مواقع مخصصة للحرق (حرق مفتو☐ ☐ يتم التخلص منها في الشارع أو في الانهار ☐ اخرى حدد

<u>النفايات السائلة</u>

32. هناك نظام للصرف الصحي لجمع ومعالجة النفايات السائلة

نعم ☐ لا ☐

33. نوع نظام الصرف الصحي

نوع مغلق يمكن من جمع كل النفايات السائلة المتولدة خندق مفتو☐ يمكن أن يجمع جزء من النفايات المتولدة ☐ أخرى حدد ☐ .....

34. يتم التخلص من المخلفات السائلة في نهاية المطاف من خلال:

الاغراق في منطقة معينة خزان للصر فالصحي ☐ الاغراق في مرحاض ☐ التصريف في النهر ☐

35. وجود ركود للنفايات السائلة بسبب الانسداد أو الاهمال:

نعم ☐ لا ☐

<u>التخزين والتبريد</u>

36. هل الثلاجة متاحة لتخزين الأطعمة القابلة للتلف؟

نعم ☐ لا ☐

37. هل الأطعمة سريعة التلف والمواد الغذائية الغير القابلة للتلف تخزن معا؟

نعم ☐ لا ☐

38. هل الثلاجة مليئة للدرجة التى تحد من دوران الهواء؟

نعم ☐ لا ☐

39. تخزين الأطعمة المطبوخة والأطعمة النيئة:

ثلاجات منفصلة للأ طعمة النيئة والمطبوخة ☐ نفس الثلاجة (الطعام المطبوخ في غرف مختلفة) . ☐

الثلاجة نفسها (الاطعمة النيئة والمطبوخة جنب الى جنب) ☐ أخرىحدد ..... ☐

40. هل الثلاجة لديها ميزان حرارة ثابت للقراءة؟

نعم ☐ لا ☐

41. إذا كان موجودا، ماهو قراءة درجة الحرارة في وقت من الزيارة؟

42. إذا كانت الإجابة بنعم، كم كانت قراءة درجة الحرارة فى وقت الزيارة: .(.....)

درجة مئوية

43. هل هناك غرفة تخزين منفصلة؟

نعم ☐ لا ☐

44. اذا كانت الاجابة بنعم ماهو نوع الارضية؟

الخرسانية / الأسمنت جبص ☐ من الطوب ☐ خشبية ☐ ترابية ☐ أخرى ☐

45. هل غرفة تخزين خالية من الرطوبة والغبار؟

نعم ☐ ☐

46. المواد الكيميائية المخزنة هل تكون في اتصال مع المعدات و / أو الأطعمة؟

نعم ☐ لا ☐

<u>مرافق الصرف الصحي وإمدادات المياه:</u>

47. **مصدرالمياه:** توصيل خاص من إمدادات مياه البلدية ☐ من التوزيع العام (الشبكة) ☐

تشترى من ماسورة الخط الخاص ☐ أخرى حدد..... ☐

48. هل هناك أينا قلة لتخزين الماء لسد فترة النقص؟

نعم ☐ لا ☐

49. نوع المرحاض : مرحاض مائى ☐ مرحاض حفرة ☐ أخرى ☐ لايوجد ☐ مرحاض

50. عملها في وقت الزيارة: فى الخدمة ☐ مغلقة وليست فى الخدمة ☐ خارج الخدمة ☐ أخرى ☐

51. فصل المراحيض للذكور والإناث؟

نعم ☐ لا ☐

52. هل المراحيض نظيفة ومريحة للاستخدام في وقت الزيارة؟

نعم ☐ لا ☐

53. هل هنالك أسراب للذباب في وقت الزيارة؟

نعم ☐ لا ☐

54.وجود حوض غسيل الايدى موجود للاستخدام بعد الحمام قرب المرحاض؟

نعم ☐ لا ☐

55. وجود غرفة منفصلة للملابس، والراحة ووضع الملابس للعمال

نعم ☐

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ملحق: 3
قائمة تحقق فحص وجودة الاغذية الخام والمعباة

البيان	الفحص والاختبار	نعم	لا	
المصدر	الشراء من مصادر معتمدة أو معترف بها			
الجودة	المنتجات الخام خالية من أي شوائب مادية (مثل الأتربة والغبار)			
	المنتجات الخام خالية من أى رائحة			
	المنتجات الخام خالية من أي نمو للفطريات (رقيق)			
	التعبئة والتغليف وحزمة الأختام سليمة			
	العبوات الغذائية من غير ثقوب			
	العبوات الغذائية سليمة منالهواء / فراغ			
	العبوات من دون تسرب، خدوش، وانتفاخ وعلامات الصدأ			
	المنتجات الخام تحت وضع "أفضل قبل " انتهاء /" أو" الاستخدام "بتاريخها"			

جامعة شندى

كلية الدراسات العليا والبحث العلمى

الملحق4

استبيان لمدراء المستشفيات الطبيين او رؤوساء اقسام التغذية

يرجى قراءة الأسئلة والرد بوض وحل كل منها. شكرا لأخذ وقتك لاستكمال الاستبيان. ل نتستخدم ردودكم إلا لغرض البحث وبالتالي ستبقى سرية.

1. عدد الأسرة في المستشفى .....( )

2. عدد موظفين الخدمات الغذائية في المستشفى لكل مما يلي

الطباخين.....(.....فرد)

الممرضين/الممرضات.....(.....فرد)

أخصائين التغذية.....(.....فرد)

بقية الموظفين (العاديين).....(.....فرد)

3. العدد المقدر من الوجبات التي تقدم يوميا للمرضى (..... وجبة)

4. تتبنى المستشفى دليل اعتماد الممارسات الصحية للغذاء نعم ☐ لا ☐

المبادئ التوجيهية التالية يتم اتباعها في المستشفى (تحقق من كل ما ينطبق).

5. اجراءات تخزين الغذاء ☐

6. اجراءات الصحة الشخصية للعاملين فى الأغذية ☐

7 .النظافة والتطهير للأسطح والمعدات ☐

8. مراقبة درجة حرارة الطعام ☐

9. الممارسات الصحية الغذائية التالية تتم في المستشفى (املأ كل الخانات التي تطبق)

10. تحليل المخاطر من الممارسات الغذائية:

نعم ☐ لا ☐

11. التفتيش على المواد الخام:

نعم ☐ لا ☐

12. الاختبار الميكروبي للاسطح والأغذية

نعم ☐ لا ☐

13. الدورات التعليمية أو التدريبية في تحليل مخاطر نقاط التحكم الحرجة وصحة الغذاء للعاملين فى الأغذية. نعم ☐ لا ☐

14. الاشراف الادارى على طاقم العاملين:

نعم ☐ لا ☐

جامعة شندى

كلية الدراسات العليا والبحث العلمى

تم إعداد هذا الاستبيان لتحديد المعرفة والسلوك والممارسات الصحية المتعلقة بصحة وسلامة الاغذية لدى العاملين فى تقديم الخدمات الغذائية فى مستشفيات محلية الخرطوم. نرجو منكم التكرم بالاجابة بدقة على الاسئلة. المعلومات التي تقدمها فى بالغ الأهمية لنجاح الدراسة. ردودكم لنتستخدم إلا لغرض البحث وبالتالي ستبقى سرية.

الملحق 5 الاستبيان

اسم المستشفى.....**اسم العامل**.....

أ. الخصائص الاجتماعية والديمغرافية للعاملين فى تقديم الخدمات الغذائية للمرضى:

اسم العامل.....

1 .**النوع**: ذكر ☐ أنثى ☐

2. **العمر:**..... سنة

3. **نوع العمل:**:ممرض/ ممرضة ☐ طباخ ☐ اخصائة تغذية ☐ أخر حدد.....☐

4.**المستوى التعليمى**: ابتدائى ☐ ثانوى عالى ☐ دبلوم ☐ بكالوريوس☐ماجستير ☐ بدون ☐

ب.المعرفة-السلوك والممارسة:

5. يقلل التطبيق الصحيح لإجراءات تنظيف المعدات من خطر انتقال العدوى إلى المرضى

نعم ☐ لا ☐ لا أعرف ☐

6. غسل اليدين قبل تناول الطعام يقلل من خطر التلوث

نعم ☐ لا ☐ لا أعرف ☐

7. استخدام قبعات وأقنعة وقفازاتواقية والملابس المناسبة تقلل من مخاطر تلوث الأغذية

نعم ☐ لا ☐ لا أعرف ☐

8. درجة الحرارة الصحيحة للثلاجة هى.

أقل من 4 درجة مئوية ☐ 1-4 درجة مئوية ☐ 5-8 درجة مئوية ☐ 9-12 درجة مئوية☐

13-16 درجة مئوية ☐

9.الأطعمة النيئة يجب أن تبقى منفصلة عن الأطعمة المطبوخة

نعم ☐ لا ☐ لا أعرف ☐

10.من المهم أن تعرف درجة حرارة الثلاجة لتقلل من مخاطر تلوث الأغذية؟

نعم ☐ لا ☐ لا أعرف ☐

11. ينبغي للعاملين فى الاغذية الذين لديه الجروح وقطع في أيديهم أن لا يلمسوا الأطعمة غير المغلفة:

نعم ☐ لا ☐ لا أعرف ☐

12. إن أفضل طريقة للحماية من التسمم الغذائي من انواع الفواكه والخضروات الطازجة هو غسلهاب:

الصابون بصورة منتظمة☐ الماء الساخن ☐ الصابون المضاد للبكتريا ☐ الماء البارد المتدفق ☐

13. مسببات الأمراض التالية متعلقة بالأمراض التي تنتقل عن طريق الطعام

14.فيروس التهاب الكبد الوبائي:

نعم ☐ لا ☐ لا أعرف ☐

15. كلوستريديوم بوتولينوم:

نعم ☐ لا ☐ لا أعرف ☐

16. السالمونيلا:

نعم ☐ لا ☐ لا أعرف ☐

17. بكتريا الكوليرا (الضمات) أو غيرها من أنواع البكتريا الأخرى:

نعم ☐ لا ☐ لا أعرف ☐

18. المكورات العنقودية الذهبية:

نعم ☐ لا ☐ لا أعرف ☐

19. تغسل، تشطف وتطهر رفوف المطبخ عند:

بعد كل استخدام ☐ عندما تبدأ العمل بنوع أخر من الأطعمة ☐ بمعدل 4 ساعات لوكانت الرفوف ثابتة فى كل استخدام ☐ كل ما ذكر ☐

20. الإجراءات المستخدمة فى تنظيف رفوف المطبخ والأكثر احتمال المنع التسمم الغذائي هى:

ترش بمحلول بمعقم قوى☐ تغسل بالمطهرات ☐ يمسح بقطعة من محلول معقم ☐ استخدام فرشاة لازالة أى أوسا خ أوبقايا طعام ☐

21. عند ظهور قرحة على ظهر يدك، تقوم بإعداد الطعام للآخرين:

نعم، اذا كانت غير معدية ☐ نعم ، اذا وضعت عليه ضمادة ☐ نعم، لو ارتديت قفازات ☐ نعم ، لوضمدت القرحة ولبست قفاز ☐ لا، يجب أن لاتجهز حتى تشفى القرحة ☐

22. لمنع التسمم الغذائي، الافراد الذين لا ينبغي لهم إعداد الطعام هم:

(تحقق من كل الافراد الذين ينطبق عليهم ذلك)

الشخص المصاب بالإسهال ☐ الشخص المصاب بالحمى ☐ الشخص المصاب بفيروس نقص المناعة البشرية ☐ شخص بحروق وضمادة حروق على يديها لمغطاة بالقفازات ☐

الشخص المصاب بالحكة ☐ الشخص الذي يدخن ☐ الشخص الذى يتقيأ (يستفرغ) ☐

الشخص المصاب بالتهاب في الحلق ☐

23. عند إعداد الطعام، تغسل يديك بعد لمس هذه الأشياء:

وجهك ☐ الأوانى المعدة لاعداد الطعام ☐ الملابس ☐ الفواكه الطازجة ☐ البثور(القروح) ☐

الشعر ☐

24. لمنع التسمم الغذائي، يجب أن تكون بقايا الأطعمة ساخنة نعم ☐ لا ☐

25. التبريد الشديد والتجميد يزيل الجراثيم الضارة في الغذاء نعم ☐ لا ☐

ج. تدابير قياسية للسيطرة على الأمراض المنقولة بالأغذية:

26. عند لمس أو توزيع المواد الغذائية للمرضى تستخدم القفازات

نعم ☐ لا ☐

27. عند لمس أو توزيع المواد الغذائية للمرضى تستخدم قناعا

نعم ☐ لا ☐

28. عند لمس أو توزيع المواد الغذائية للمرضى ترتدى قبعة

نعم ☐ لا ☐

29. قبل لمس الأطعمة النيئة الغير مغلفة تغسل يديك

نعم ☐ لا ☐

30. بعد لمس الأطعمة النيئة الغير مغلفة تغسل يديك

نعم ☐ لا ☐

31. قبل لمس الأطعمة المطبوخة الغير مغلفة تغسل يديك نعم ☐ لا ☐

32.بعد لمس الأطعمة المطبوخة الغير المغلفة تغسل يديك نعم ☐ لا ☐

Plate (1): Legumes based sauce (Ready-to-eat food) prepared in hospital kitchen.

Plate (2): Improper practices of waste collection andbad status floor in the hospitalkitchen.

Plate (3): Cracked floor and wall inaddition to dirty fixed installed wash basin for utensils in the hospital kitchen

Plate (4): A refrigerator used for raw and ready-to-eat food (improper practice)

Plate (5): Food stuffs stored in a separate room

Plate (6): Food service staff not wearing gloves while touching ready – to –eat food22