



Food services and their relationship to food contamination in government hospitals, Khartoum state

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Abstract : Most hospitalized patients are dependent on hospital food for their nutritional requirements. Therefore, the food provided to them must be good and free of contaminants to help speed up their recovery. Large-sized food processing operations like in hospital need increased attention for hygienic practices and sanitary conditions. Also, the correct methods should be followed for that. Quality definition of food includes several complex factors like physical, compositional and microbial features, modifications induced by technological processes or storage [1]. This study was conducted in the year 2011 in 11 governmental teaching hospitals in the state of Khartoum, including: Khartoum Hospital, Khartoum Bahri, Ben Sinan, Jaafar bin Auf for children, Corn treatment, Ear, nose and throat, Dermatology, Omdurman hospital, dental hospital. which were the largest hospitals in the Sudanese capital, **The aim** of this study was to know the relationship between food contamination in government hospitals, Khartoum state and the food service system, the types of contaminations, giving advices to improve the service system. **The method used** is The primary data which was collected from the results of food samples (110 samples) that were collected from the kitchens and wards of the concerned hospitals, in addition to the results of swabs (100 samples) that were collected from the tools used in preparing and distributing foods and the hands of workers, and the secondary data that had been collected from a group of references and research that had been published on the same topic and other sources. **The result** obtained was that: 100 samples were taken and the result was 24 negative which no bacteria growth was observed, meaning that the percentage of positive samples was 76%. As for swabs samples from the hands of workers and work aids, they were 100 samples, the number of negative samples in which was 44 samples, meaning that the positive samples contained 56%, and the growth of *Pseudomonas*, *E Coli* and *staphylococcus SSP* on most of samples was much dominant.

Key words: Hospital Food Services, Food Contamination, Foodborne pathogens, Food hygiene and safety, Barriers for Dietary Intake

Introduction: Food is defined as any substance containing nutrients, such as carbohydrates, proteins and fats that can be ingested by living organisms and metabolized to provide energy and body tissue [2]

Hospital food services :- Hospital food consumption can affect patients' outcome leading to prolonged hospital stay or even increased mortality [3]. Catering services for patients in hospitals is a complex process compared to types of hospitality work in other places because of the presence of many factors associated with that, such as logistical burdens, receiving and distributing food, classifying foods according to the type of disease, and others, such as the time period between receiving and preparing food, then distributing it and eating it by the patient. Which sometimes leads to possible negative effects on the safety and quality of food. [4]. Food is considered one of the most important therapeutic means in many diseases such as diabetes, kidney failure, heart disease, lactose intolerance and gluten intolerance, diet represents the backbone for treating chronic diseases such as obesity, blood cholesterol, high blood pressure and others, so it is considered to give the right food to patients in the hospital, whether they are under Treatment or surgery is one of the most important things that help speed up their recovery and thus shorten their stay in the

hospital. Therefore, the service must be provided in a good way. A qualified cadre of nutritionists and their assistants must be available, and workers should be available technically and physically, and there must be aids to provide food in a healthy manner. Free from all pollutants, The problems of meals served inside hospitals sometimes are represented in poor quality standards for the foods provided, and failure to take into account the safety of foods during preparing or distributing meals to patients, where the general health of workers is an important factor in the safety of foods that must be served. {5} .**The goals of a hospital foodservice:** are to provide inpatients with nutritious meals that are beneficial for their recovery and health, and also to give them an example of healthy nutrition with menus tailored to patients' specific health conditions. When meals are carefully planned and customized to meet patients' specific needs, and when patients consume what they are served, these goals can be considered as achieved. Meal consumption by inpatients is related to nutritional status and satisfaction with the foodservice {6}

Common foodborne pathogens that are easily transmitted through food and can cause severe illness are *Salmonella*, *Clostridium botulinum*, Shiga toxin-producing *E. coli*(STEC), *Vibrio* spp., *Listeria monocytogenes*, *Campylobacter* spp., norovirus, *Shigella* spp., *Yersinia enterocolitica*, Hepatitis A virus, *Giardia*, and *Cryptosporidium*. Etc.. *Staphylococci* is gram positive cocci on stained smears and is arranged in clusters or pairs. The colonies are white or creamy and b hemolytic and clear when stored at night at 4°C. *Staphylococcus aureus* grows on Chapman Stone medium. There are over 30 types of *Staphylococcus* species but *Staphylococcus aureus* causes most of staph infections. {7}.

Food contamination: One of the most important things to maintain a healthy and clean environment is the good design of sanitation, which helps to produce food away from pollutants, especially in hospitals. {8}. There are several factors that lead to the lack of quality of food services, including first providing unhealthy food by introducing unhealthy ingredients and leaving food for long periods without consuming or preserving, lack of attention to healthy methods in preparing and distributing meals, which can be largely linked to increased food waste due to the refusal of some patients to eat those foods. {9} .There are different Rules for Safe Food Preparation, which may be summed up as follows: Choose foods processed for safety, cook food thoroughly, eat cooked foods immediately, Store cooked foods carefully, reheat cooked foods thoroughly, avoid contact between raw foods and cooked foods, Wash hands repeatedly, keep all kitchen surfaces meticulously clean, protect foods from insects, rodents and other animals, Use pure water {10}.

Food borne bacteria: can multiply rapidly if food is not maintained at an appropriate temperature (below 5 C/41 F) for refrigeration and above 57 C for hot holding), and if there are delays between food preparation and distribution. Foods intended to be eaten cold or at room temperature should be consumed, preferably, within 30 min of removal from chilled storage. {11}.

Hazard Analysis Critical Control Point (HACCP) is a systematic approach for the identification, evaluation, and control of potential hazards at every stage of food operation. This system emphasizes the role of continuous problem solving and prevention rather than solely relying on spot-checks of manufacturing processes and random samples of finished food products. {12}. Thus, the HACCP approach is to control problems before they happen which involves major principles that like Analyzing hazards that must be prevented, eliminated or reduced to acceptable levels, Identifying critical control points (CCPs) at which control is essential to prevent or eliminate a hazard or reduce it to acceptable levels, Establishing preventive measures with critical limits for

each control point {13} ..Although food safety has dramatically improved in the last decades but outbreaks of nosocomial gastroenteritis continue to occur worldwide{14}.

Food handlers: Food contamination depends a lot on the health status of food handlers and their hygiene behaviors and practices. These food handlers are often hired without a proper health check since they have often not had training before starting work., The hands of foodservice workers can be vectors for the spread of foodborne illnesses due to poor personal hygiene or cross-contamination. For example, an employee may contaminate their hands in the restroom, or bacteria may be transferred from raw meat to lettuce from a food worker's hands. {15}

Food hygiene and safety: The term food safety is increasingly being used in place of food hygiene and encompasses a whole range of issues that must be addressed for ensuring the safety of prepared food. Food hygiene probably put too much emphasis on cleanliness but food safety requires much more than a clean premises . The high incidence of food borne illnesses has led to an increase in global concern about food safety .{16}.

Several food-borne disease outbreaks have been reported to be associated with poor personal hygiene of people handling foodstuffs. Food borne diseases are increasing in both developed and developing countries. Diarrheal diseases mostly caused by food borne microbial pathogens, are leading causes of illness and deaths in the developing countries, killing an estimated 1.9 million people annually at the global level .{17} .

Barriers to Improve Dietary Intake: Barriers to adequate food intakes by hospital inpatients are multifactorial and complex, and require multilevel interventions, including a change in the awareness and attitude toward food among healthcare staff and hospitalized patients, {18} . The main issue with regard to the management of food services is the fragmented nature and the difficulty of communication between the kitchen and the wards, where food service managers sometimes have to rely on untrained workers from inside the kitchen to deliver food to patients, which sometimes leads to difficulty in communication between service recipients and the kitchen management, including the dietitian, to clarify some notes . Also, financial constraints were a prominent part of the concerns of food service managers, especially in the event that they were reduced from what negatively affects the quality of services. While nurses may view the nutritional care of patients as an important aspect of their job, increased time pressures and competing tasks may mean that they are not able to prioritize feeding above other duties, such as the distribution of medicines at. Most research in this area has reported common themes of time restraints and staff shortages. A further study investigated the most common barriers in food intake of long-stay, The key barriers identified were lack of choice due to special diet, boredom arising from the length of stay, a lack of feeding assistance, limited variety, and inadequate flexibility of food service. {19}.

Aims: This study was conducted at a group of government teaching hospitals in the state of Khartoum, and the aim of this was to know the relationship between the causes of food contamination such as pathogenic bacteria and the system of providing food services in those hospitals and to consider the factors that enhance the stability of the food service system in hospitals .

Justification: It was noticed that there are many patients in hospitals who refuse to eat the food provided to them inside the hospital, especially the food provided from the hospital kitchen, believing that it is unhealthy food in terms of quality and safety.

Methods and material : This is a descriptive study conducted in 11 government hospitals in Khartoum, the capital of Sudan .

Study area : Khartoum is the capital of Sudan ,it has a high population density in Sudan and located in the heart of Sudan at the confluence of the White Nile and the Blue Nile {20}.

Sampling :A total of 200 samples were collected. 100 samples were ready to eat food samples such as Bean, lentil, milk, boiled, eggs, Meat. fish, chicks, beefsteak, juice, cheese, Meat, soup, Vegetables, Soup, noodles, tahini, jam, Green, salad, Kwash milk , potatoes, pasta. and 100 swab samples were taken from workers hands and utensils. Sterile gloves were used to collect samples, placed them directly in sterile plastic containers, and kept them in an ice box to protect them from contamination. 200 samples were collected to be cultivated in specialized laboratories to be cultured on bacteriological culture media to identify some types of bacteria ten grams of the above food sample under aseptic conditions immediately after arrival at the laboratory and put in sterile diluent (0.1% peptone solution) to make serial dilution { 21} . The samples were seeded on different bacteriological culture media and incubated at 37°C for 24 hours. Bacteria were grouped on the basis of their Gram and/or Ziehl–Nelsen staining, The biochemical tests described in Bergey's Manual of Systematic Bacteriology(22) . were used for the identification of bacteria. The laboratories where the sampling examination was conducted are Khartoum Central Laboratory and Soba Central Laboratory . After the first cultivation in the appropriate media, the bacteria were isolated to determine their type, as more advanced bacteria were not isolated .

The results: The following tables show the results of the analysis in the laboratory for a number of food samples that were taken from inside the kitchen and wards, and swabs that were taken from the hands of workers in the preparation and distribution of foods and some utensils that are used in the preparation and distribution of foods .

Table {1} the total of ready-to-eat foods collected from inside the kitchen and others collected from wards.

Sample source	Types Cooked food	Total of samples	No of positives samples	Percentage
Kitchen	Water , Bean, lentil, milk boiled ,eggs ,Meat .fish ,chicks beefsteak , juice , Meat ,soup Vegetables ,noodles ,tahini , jam , Green salad ,Kwash milk , potatoes , pasta , chicken	50	34	68%
Wards	Bean, lentil, milk ,boiled eggs Meat .fish ,chicks ,beefsteak juice cheese , Meat ,soup ,Vegetables, Soup noodles ,tahini , jam , chicken Green , salad ,Kwash milk , potatoes , pasta	50	42	84%

The above table (1): shows that 68% of Food samples taken directly of the hospital kitchen was positive while 84% From the food samples that were distributed on the plates and ready to be served to patients It was positive, and this result confirms that there is a weakness in Poor

hygiene practices while distributing food Especially inside the ward where food may remain For a long time, which leads to the multiplication of bacteria

Table {2} Total food samples that were taken from the kitchens of the concerned hospitals and the types of bacteria that were isolated from them.

No	Types of sample	Total no of samples	+ve samples	Types of isolated bacteria
1.	Grilled meat	2	2	the type is not detected
2.	fish	1	1	the type is not detected
3.	Green salad	8	8	<i>E.coli</i> + <i>Sstaphylococcus</i>
4.	Beans (fool)	5	5	
5.	cheese	5	5	<i>Sstaphylococcus</i> + <i>E.coli</i>
6.	Juice	7	7	<i>E.coli</i>
7.	Fried potato	1	1	the type is not detected
8.	Jam	2	2	the type is not detected
9.	Milk	3	3	<i>E.coli</i>
10.	Kwash milk	2	2	the type is not detected
11.	soup	1	1	the type is not detected
12.	boiled egg	2	2	the type is not detected
13.	Minced meat	1	1	the type is not detected
14.	macaroni	1	1	the type is not detected
15.	Tahniah	2	2	<i>E.coli</i>
16.	lentil	3	3	<i>E.coli</i> <i>Sstaphylococcus</i>
17.	Tap water	2	2	the type is not detected
18.	Chicken meat	1	1	the type is not detected
19.	Cooking vegetables	1	1	the type is not detected
Total		50	34	

The above table shows the number of positive samples 34 that were taken from the ready-to-eat meals before being distributed inside the ward. The ratio of positive to negative samples was 68%. It also shows some types of bacteria that were isolated from the samples, while some samples had growth were positive, but not specified The final type of microbes

Table {3} Total food samples that were taken from the ward of the concerned hospitals and the types of bacteria that were isolated from them.

NO	type of food	Total No of samples	+ve bacteria	Isolated types of
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1.	Meat	5	4	<i>Bacillus SPP-E.coli- seudomonas seudomonas-Fluorescence</i>
2.	macaroni	2	1	
3.	Green salad	8	8	<i>Staph Bacillus, Sphecicus Auricularis , Staphylococcus , Captious , Bacillus , E.coli</i>
4.	beans	5	5	<i>Staph. hominis , Staph Epidermises , Staph Aureus , Memophilus , Avium , Pseudo nonas , Pseudo mallei, Bacillus , nace</i>
5.	cheese	4	4	<i>Yeast</i>
6.	Tab Water	3	3	<i>Bacillus –Mace ran, staphylococcus, Caprie</i>
7.	Juice	6	5	<i>Pastilles SPP seudomonas -Pseudo mallei , Cepacian , Staphylococcus , Hemolytic , Caseo lytic us</i>
8.	Fried potato	1	1	<i>Staph Lantus , Staph - Gallinari</i>
9.	Jam	2	2	<i>Staphylococcus, Hemolytic</i>
10.	Milk	2	2	<i>Pseudomonas -Pseudo nallei ,</i>
11.	soup	5	3	<i>Bacillus SP P, Pseudo nonas Cepacian</i>
12.	Lentil	3	3	<i>Bacillus SP P, seudomonas , Malt philia , Staph Hyicus</i>
13.	Steak meat	1	1	<i>Staph -SPP</i>
14.	boiled egg	2	-	<i>No growth</i>
15.	Fish meat	1		<i>Pseudomonas -Pseudo nallei</i>
Total		50	42	

The above table shows the number of positive samples 42 that were taken from the ready-to-eat meals after distribution inside the ward. The ratio of positive to negative samples was 84%. It also shows some types of bacteria that were isolated from the samples, while some samples had growth (positive, but not specified). The final type of microbes **table {4}**: The total swab samples that were collected from the hands of workers in preparing and

distributing foods for patients, and others that were collected from utensils used in preparing and distributing foods in those government hospitals.

Sample sources	The total number of samples taken from different sources in hospital kitchens	+ve bacteria	Types of isolated	%
The surfaces	12	11	Citrobacter Enterobacter , Cloacae, Staphylococcus -Aureus, E.coli , Micrococcus Cedeca Device ,	91 %
Workers' hands samples	51	25	Citrobacter Enterobacter , Cloacae, Staphylococcus -Aureus, E.coli , Micrococcus Cedeca Device , Enterobacter , Elocute , Micrococcus , Staph SPP, Klebsiella , Pneumonia , Citrobacter	54 %
Samples from the utensils used for preparing and distributing food	37	20	Klebsiella -SPP, Pneumonia Cloacae, Staphylococcus -Aureus, E.coli , Micrococcus Cedeca Device , Enterobacter , Cloacae , Micrococcus , Staph SPP, E.coli , Fungal , Streptococcus , Faecalis ,	54 %
Total	100	56		

The above table shows the number of swab samples that were taken from different sources of work aids in preparing and distributing food, in addition to swabs that were taken from workers hands who preparing and distributing food in the concerned hospitals, the result of which was that 56 samples were positive (56%).

Table {5} Types of sources from which kitchen swabs were taken for laboratory examination.

Pots for cooking distribution

Milk dispensing utensils

Fruit cutting plates

Dishes for distributing fresh meat

Spoons

utensils for distributing juice

Utensils for distributing soup

Steel plates for food distribution

Porcelain dishes for distributing food

salad cutting table

Table for distributing juice

Table for distributing porcelain dishes

Refrigerators

A barrel to keep water in the kitchen

Swabs from the hands of workers

The table above shows the different types of sources from which kitchen swabs were taken for laboratory examination.

Discussion: the result was sorting of a number of bacteria types and there were a number of samples in which there was growth, but the final classification of bacteria was not done. There is a similarity in the types of bacteria taken from different sides, such as wards, workers' hands, kitchen surfaces and utensils, which explains the extreme weakness in the follow-up of the healthy environment. Some types of bacteria that have been isolated do not cause pathological problems, while others exist and have been isolated from a number of sources, such as *Escherichia coli* and *Staphylococcus aureus* which present in a lot of the samples, which may cause health problems

the dominant bacteria present were Staphylococci in addition to *Escherichia coli* which is an indicator of poor hygiene in food services since *Escherichia coli* normally lives in the intestines of humans and animals {23}.

This result is in line with other study conducted in 2018 entitled Prevalence of intestinal parasites among food handlers. They came to the public health laboratories in Khartoum state, Sudan, which resulted in their examination that the infection rate was 23.7% and intestinal parasites were more prevalent among males (73; 25.1%) than food handlers (10; 16.9%). Three protozoa, two nematodes, two tapeworms and one fluke were detected among the infected population: their frequency was as follows: *Entamoeba histolytica* (7.4%), *Entamoeba coli* (6.86%), *Giardia lamblia* (6%), *Schistosoma Manzoni* (1.40%), *Nicator americanus* (1.43%), *Hymnologies nana* (0.68%), *Strongyloidiasis stercoralis* (0.68%), *Taenia*, the general prevalence rate of protozoan infection among food handlers in Khartoum State, Sudan was 20.26% while helminth infections were 5.97% {24}.

Ethical consideration: In accordance with university standards, the author collected a written consent from the Ethics Committee of the university and delivered it to all parties through which the data was collected, and it was collected after approval.

Conclusion: Hospital catering services began in Sudan in the early fifties of the last century, and kitchens were designed with ideal characteristics to meet the catering needs of that time. But unfortunately, no updates have been provided to meet current needs. In addition, most kitchens do not have warm water, some freezers do not operate in the required ways and often all food is cooked daily {25}. The results indicate that the hospital catering system may have a direct effect in food hygiene at the intended hospital. The number of positives culture samples of ready to eat food, which were taken directly from the kitchen is less than from the rest of the sample taken from the wards. These show the increased chances of contamination when food is left a long time in the

wards as well as poor food handling. There were similarities of isolated bacteria(Eg Escherichia) from the different sample sources indicating the possibility of cross of contamination.

Recommendations:

- Medical examination of food handlers should be taken seriously
- Kitchens must be made in conformity with health standards in terms of construction and equipment and commensurate with the size of the work. Warm water must be entered for use when needed.
- Kitchens and food preparation rooms must be in good condition with proper ventilation and the surfaces should be easy to clean.
- A course for workers to learn about the HACCP system and make them aware of the food hygiene process and how to avoid risks.
- Continuous medical examinations for food workers.
- Food should be served to the patient in a timely manner to reduce the time remaining in the ward.
- Follow the rules in importing foodstuffs
- Foodservice workers must pay close attention to personal hygiene.
- the flu or other communicable illness, should inform their supervisor and not handle food.

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