

# Assessment of Environmental Health Services in the White Nile State main hospitals, Sudan

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## المستخلص

تعتبر بيئة المستشفى الداخلية والخارجية مهمة لتأثيرها على صحة المرضى والزائرين والموظفين ومقدمي الخدمة الطبية والمجتمع ولها دور هام في مكافحة العدوى ويجب أن تعطى الاهتمام المناسب بالحفاظ عليها نظيفة وصحية. تمت الدراسة الوصفية بمستشفيات كوستي وربك والدويم وتعتبر المستشفيات الرئيسية بولاية النيل الأبيض بالسودان.

الهدف الرئيسي لهذه الدراسة هو تقييم الإصحاح البيئي بالمستشفيات الرئيسية بولاية النيل الأبيض بالسودان وذلك من خلال التقييم البيئي وفق المعايير البيئية المعتمدة من منظمة الصحة العالمية لمؤسسات الرعاية الصحية واستمارة ملاحظة للجوانب البيئية للمستشفيات بالاضافة لتوزيع الاستبيان للقوى العاملة لتقييم الإصحاح البيئي.

اوضحت نتائج تقييم الإصحاح البيئي ان المستشفيات تقع في مواقع يسهل الوصول إليها وليس هناك طرق معبدة داخل المستشفيات الثلاثة و لا توجد مواقف مخصصة للسيارات، التهويه والاضاءه ومصادر الضوضاء ، سيئه في مستشفى كوستي ( ٤٥.٥ ٪ ) ومتوسطه بمستشفيات ربك والدويم (٥٤.٥ ٪) و لا توجد مغاسل ولا مطابخ بالمستشفيات الثلاثة، مستوى النظافة جيد في غرف العمليات وبعض غرف المرضى في المستشفيات الثلاثة.

أهم توصيات الدراسة صيانة اسوار المستشفيات لتوفير الحماية الكاملة من الحيوانات التي تدخل المستشفيات و يجب أن تكون الإضاءة جيدة في جميع غرف العمليات وغرف المرضى في جميع الأقسام و مدخل و ممرات المستشفيات و الحفاظ على التهوية الجيده بالمستشفيات مع الاهتمام بنظافة المستشفيات لتوفير بيئه صحيه و نظيفه و انشاء مغاسل و مطابخ على ان تكون مصممه بمواصفات صحيه وبيئيه جيده بالمستشفيات الثلاثة.

## Abstract

Hospital environmental sanitation plays an important role in controlling infection inside the hospitals for patients, visitors, staff, and community. In order to prevent hospitals infection certain measures should be followed such as, maintaining a hygienic internal and external hospital environment. Descriptive study conducted in Kosti, Rabak, and Eduiem hospitals represent the main hospitals at White Nile State in Sudan.

The study aimed at the assessment of environmental sanitation. A descriptive study design to assess the environmental sanitation at the three selected hospitals. An assessment checklist, pre-designed and published by the WHO in 2008. Observation sheet, a pre-designed and precoded structural interviewing questionnaire were used to investigate the environmental health aspects at the three hospitals, assess the main site characteristics, outside and inside sources of environmental pollution were assessed in the three hospitals. The employees were interviewed regarding environmental services.

The study results showed that the three hospitals are located at an easily accessible site. There were no paved roads surrounding the three hospitals, there is no parking areas and no landscaping, there are no sources of pollution as ( public toilets, markets, refuse containers, sewage overflow, barns and stables, factories, railway station, bus stop, cemeteries, garbage dump sites, water treatment plant, wastewater treatment plants, mobile telephone stations, high voltage transmission, and industrial area) in two of the three hospitals (Rabak and Eduiem hospitals), markets, bus stops, and mobile telephone station are near Kosti hospital. Adequacy of ventilation, sufficiency of lighting, and noise general scores, poor in Kosti hospital (45.5%) and fair in Rabak and Eduiem hospitals (54.5%). Laundry services and kitchens were not applicable in the three hospitals. The level of cleanliness in wards and operation areas is good in the three hospitals. Mice, cockroaches, housefly, cats were present in the three hospitals and donkey in Kosti and Eduiem hospitals. Insecticides used as vector control in the three hospitals.

The study recommended that surrounding building should be maintained to provide full protection from animals entering the hospitals, sufficient, maintained, and cleaned toilets, good lighting both natural and artificial, ventilation and cleaning must be of a high standard in hospital units. Laundry and kitchens must be initiated in well-designed taken into account health and environmental requirements needs.

## **INTRODUCTION**

The duty of hospitals and healthcare centers is to take care of public health; directly through patient care or indirectly by ensuring a clean, healthy environment for their patients, as well as their employees and the community.<sup>(1)</sup> Improving the hospital environment usually relies on maintain very good sanitary conditions in the hospitals.<sup>(2)</sup>

There is strong evidence that design changes, that make the environment more comfortable, aesthetically pleasing and informative, relieve stress among patients and increase satisfaction with the quality of care provided.<sup>(3)</sup> Ventilation, good lighting and laundry services are other hospital environmental sanitation measures that play a great part in the suitability of a healthcare facilities, since they contribute not only to comfort and aesthetics, but also assist with infection control.<sup>(4, 5)</sup> Arthropod and vertebrate pest populations found in healthcare facilities can serve as vectors for the mechanical transmission of microorganisms.<sup>(6)</sup>

The present study aims at assessing some environmental sanitation practices at the main hospitals in White Nile State, Sudan, and to determine compliance of the

environmental health services at White Nile State main Hospitals with international guidelines.

## MATERIAL AND METHODS

Descriptive study design was used to assess the environmental sanitation at the three selected hospitals

A comprehensive survey was performed for the three selected hospitals in White Nile State, Sudan: Kosti hospital, Rabak hospital and Eduiem hospital. Field visits were conducted to provide information according to the assessment checklist, pre-designed and published by the WHO in 2008, <sup>(7)</sup>. The checklist concerning environmental health guidelines about: cleaning and laundry, food storage and preparation, control of vector borne diseases, and food hygiene promotion. Items were tested (Y) for (Yes), (N) for (No) and (NA) for not applicable. Yes was assigned the score of "1" while the (No) was assigned the score of "zero".

A score was given to every hospital regards every guideline using the following equation

$$\text{Score as \%} = \frac{\text{Number of (Yes) answers} \times 100}{\text{Total number of questions} - \text{Number of questions that got not applicable (NA) answers}} \dots(8)$$

Total number of questions - Number of questions that got not applicable (NA) answers

Environmental sanitation at the three hospitals under study was assessed through hospital observation sheets, which included the main site characteristics, outside and inside sources of environmental pollution.

The assessment of the services has been done through a predesigned and precoded structural interviewing questionnaire which was distributed among the selected hospital employees and it included the following items: Lighting, ventilation, noise, Laundry services. Cleanliness and infection control measures, control of insects and animals, and Hospital kitchen.

## RESULTS AND DISCUSSION

### 1- Outdoors environmental parameters around the selected hospitals:

**Table 1: Main site characteristics at the selected hospitals, in White Nile State, Sudan, 2013.**

Items observed in Hospitals	Hospitals					
	Kosti		Rabak		Eduiem	
	Yes	No	Yes	No	Yes	No
Accessibility	√		√		√	
Hospitals paved roads		√		√		√
Parking		√		√		√
Landscaping		√		√		√

Concerning the main site characteristics of the three hospitals (table 1), the current study results showed that, the three hospitals were easy accessible, no paved roads, absent of landscape design of grounds and spaces surrounding hospitals, and no special place of parking. This may be due to lack of funds and the experience of the hospital designers. Codinhoto R. et al in 2009<sup>(9)</sup> confirmed that, the design of healthcare environments is complex and challenging, there are many inter-related issues to be addressed including: the variety of users (patients, visitors, and staff); the frequent technological changes to support diagnosis and treatment; and the nature of the service, which is to care for people's health and wellbeing when they are most vulnerable. In contrast study done by Easa in Alexandria Medical Research Institute Hospital (MRIH) in Egypt in 2008<sup>(10)</sup>, revealed that roads surrounding MRIH are used as a parking area. Another study done by Anthopoulos K. Petros JN. in Greece in 2011<sup>(11)</sup> demonstrated that people prefer a well-designed landscape that includes a variety of plant materials surrounds the hospital, would make for a positive contribution to mood and well-being, and would offer the opportunity to spend part of free time there.

**Table 2: Outdoor sources of pollution at the selected hospitals, in White Nile State, Sudan, 2013.**

Items observed in Hospitals	Hospitals					
	Kosti		Rabak		Eduiem	
	Yes	No	Yes	No	Yes	No
Public toilets		√		√		√
Markets	√			√		√
Refuse containers		√		√		√
Sewage overflow		√		√		√
Barns and stables		√		√		√
Factories		√		√		√
Railway station		√		√		√
Bus station	√			√		√
Cemeteries		√		√		√
Garbage dump sites		√		√		√
Wastewater treatment plants		√		√		√
Mobile telephones tower	√			√		√
High voltage transmission lines		√		√		√
Industrial area		√		√		√

Regarding the outdoor sources of pollution it is clear that licensed market, bus station and mobile telephone tower near Kosti hospital (table 2), while all items absent in the other two hospitals. The findings in Kosti hospital were in consistent with the study done by Easa in MRIH in Alexandria in 2008<sup>(10)</sup> reported absence of

mobile telephone tower and markets and the findings of Eduiem and Rabak hospitals were similar to the study in Egypt in MRIH study.<sup>(10)</sup>

## 2- Indoor hospital environmental parameters:

**Table 3:**

**Opinion of employees regarding lighting, ventilation and noise in patient rooms at the selected hospitals, in White Nile State, Sudan, 2013.**

Lighting, ventilation and noise	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
Patient rooms have adequate light	√			√			√		
Hospital equipped with stable electric current	√			√			√		
Alternative current device ready for use in the event of general power failures	√			√			√		
Hospital entrances and hallways good lighting		√			√			√	
Ventilation priority to immuno-compromised patients rooms	√			√			√		
Air conditioners and fans regularly cleaned		√			√			√	
Hospital rooms fitted with easy to clean furniture not hinder ventilation and lighting		√			√			√	
Hospital equipped with sources to ease the noise and loud sounds			√			√			√
Hospital maintain calm inside and outside patient rooms		√			√			√	
Hospital not use any loud speakers caused inconvenience	√			√			√		
Hospital not close to transportation lines or highways causing inconvenience to patients	√			√			√		
Guidelines for cars that entering the hospital not to use the horn		√			√			√	
Hospital scores as %	54.5%			54.5%			54.5%		

Y=Yes N=No NA=Not Applicable

The total scores of the three hospitals regarding lighting, ventilation and noise were 54.5% equally (table 3). Regarding lighting the present study results revealed that, most of the three hospitals patient rooms in the three hospitals have adequate light and the hospitals equipped with stable electric current supply from the towns national electricity network and the three hospitals have alternative current device ready for use in the event of general power failure, but the hospitals entrance and hallways did not have enough light.

Several studies have shown the significance of full-spectrum light in a hospital more than elsewhere, whether the light was natural sunlight or from an electrical source. <sup>(12,13)</sup>Hoskings, et al. <sup>(14)</sup> and Walder B, et al. <sup>(15)</sup> reported that, hospital lighting is not just a matter of ensuring that all staff working in the various hospital components enjoy optimum seeing conditions, but also important for the associations of light to mood and the need for individuals to be able to control lighting levels for different activities. Foster R. <sup>(16)</sup> stated that, any hospital lighting has to meet the visual needs of staff, patients and visitors. Furthermore, many areas are in use 24 hours a day, seven days per week. Hosking, et al. <sup>(14)</sup> and Iwata et al. <sup>(17)</sup> revealed that, the effects of daylight on emotional well-being seem to be well enough documented to make it worthwhile installing full-spectrum daylight in a number of patient areas. Most hospital designs utilize daylight with the use of large windows, natural, and artificial light.

Concerning ventilation the current results demonstrated that, the three hospitals consider priority of ventilation to the immune-compromised patient rooms, most patient rooms have appropriate spaces between beds (at least 1 meter). The air conditioners are absent in patient rooms except private ward, fans not regularly cleaned, and hospitals patient rooms furniture not easy to clean. Mills F. in 2005 <sup>(18)</sup> reported that, the problem with natural ventilation is that air movement is unknown and unpredictable, being subject to wind pressures on the building, opening and closing of doors and any other events or features likely to affect airflows. There were large areas of hospitals that are not under effective pressure control and it would be difficult to anticipate the movement of harmful organisms from one area to another. In the case of mechanical ventilation, there is the opportunity of cleaning the air by filtration, so that harmful microorganisms are removed. On the other hand Malkin J. <sup>(19)</sup> stated that, in mechanical ventilation particular attention is needed to prevent the sick building syndrome, which is caused by sealed buildings and the total dependence on mechanical systems for heating and ventilation. Weinstein JW, et al <sup>(20)</sup>, confirmed, ventilation particularly important in specific areas such as laboratories and operating theatres, where there is specific need to suppress, minimize, or control hazardous gases, dusts, fumes, etc.

Regarding the hospital noise, the current results showed that, the three hospitals were not equipped with sources to reduce the noise and loud sounds. Although, the hospitals are not using any loud speakers caused inconvenience, it could not maintain calm inside and outside patient rooms. Two of the three hospitals namely Kosti and Eduiem were located close to transportation lines causing inconvenience to the patients. No guidelines are available to prohibit car drivers who entering the hospitals to use the horn. A review by Choiniere D. in 2010 <sup>(21)</sup> indicated that there is a positive correlation between hospital noise and physiological responses experienced by patients, the most significant being an increased risk of hypertension and ischemic heart disease.” Another review by Morrison et al. in 2003 <sup>(22)</sup> concluded that noise is potentially a significant contributor to higher heart rates, tachycardia, stress, and annoyance in nurses.

**Table 4:**

**Assessment of Cleaning, laundry, hygiene and infection control according to the WHO checklist at the selected hospitals in White Nile State, Sudan, 2013.**

Cleaning, laundry hygiene and infection control	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
Are washed surfaces made of non-porous and resistant material?	√			√			√		
Are surfaces and fittings cleaned routinely? Are they visibly clean?	√			√			√		

**Continued table (4)**

Are the cleaning requirements of different zones of the HCS defined?			√			√			√
Are different zones of the HCS cleaned according to their specific requirements?			√			√			√
Are the cleaning requirements for blood and body fluids well defined?	√			√			√		
Are there sufficient laundry facilities at the HCS?			√			√			√
Is soiled linen placed immediately in bags and then correctly washed and dried?			√			√			√
Are there sufficient bags and storage facilities for clean and soiled linen?			√			√			√
Is clean and soiled linen transported and stored separately?			√			√			√
Do mattresses have waterproof covers?	√			√			√		
Are mattresses and pillows cleaned between patients and whenever soiled?	√			√			√		
If mats are used, are they destroyed and replaced between patients?		√			√			√	
Is appropriate equipment available for cleaning, disinfection and sterilization of medical equipment?	√			√			√		
Is medical equipment appropriately cleaned and then disinfected or sterilized between uses?	√			√			√		
Is there a plan for hygiene promotion and staff management?		√			√			√	
Are staff aware of this plan?			√			√			√
Are staff informed about changes and updated about plans or strategies?			√			√			√
Do staffs follow new procedures?			√			√			√
Are staffs adequately trained in infection control procedures?			√			√			√

Do staffs follow infection control procedures correctly and consistently?			√			√			√
Is there sufficient communication support available for hygiene information?		√			√			√	
Do staffs provide appropriate hygiene information to careers and patients?		√			√			√	
Are health-care setting facilities designed so as to be easy to use and maintain hygienically?		√			√			√	
Are health-care setting facilities maintained so as to be easy to use hygienically?		√			√			√	
Hospital scores as %	53.8%			53.8%			53.8%		

Y=Yes N=No NA=Not Applicable

**Table 5:**

**Opinion of employees regarding cleaning, laundry, hygiene and infection control at the selected hospitals, in White Nile State, Sudan, 2013.**

Cleaning, laundry hygiene and infection control	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
Most importance and priority to operating rooms cleaning	√			√			√		
HCW collection workers clothes washing and ironing at the hospital to prevent infection		√			√			√	
Hospital walls and corridors regularly washed		√			√			√	
Following personal protective equipment available at the hospital									
Gloves	√			√			√		
Masks		√			√			√	
Nose masks		√			√			√	
Lab coats	√			√			√		
Special infection control department at the hospital		√			√			√	
Infection control guidelines in all sections of the hospital		√			√			√	
Beds sheets cleaned between the patient and the other regularly	√			√			√		
Equipment cleaned between the patient and the other regularly	√			√			√		
Enough hands washing basins at the hospital		√				√		√	



Soap available always at hand washing basins		√			√			√	
Enough towels at hand-washing basins		√			√			√	
Hospital bathrooms cleaned regularly and effectively		√			√			√	
Are blood and fluids that lead to infection cleaned immediately?	√			√			√		
Blood and fluids that lead to infection cleaned immediately with the appropriate detergents	√			√			√		
Laundry workers training on ways to collect, transport and washing bed sheets			√			√			√
Special colors for used sheets			√			√			√
Separation between clean sheets and used during transport			√			√			√
Separation between the sheets used normally and that contaminated with body fluids			√			√			√
Special care when transporting sheets contaminated with infection			√			√			√
Complete drying laundered sheets			√			√			√
Sheets ironing properly			√			√			√

**Continued table (5)**

Enough space between the laundry and the hospital departments			√			√			√
Regularly cleaning and disinfection storage rooms			√			√			√
Laundry rooms kept cleaned all times			√			√			√
Hospital scores as %	41.2%			41.2%			42.2%		

Y=Yes N=No NA=Not Applicable

Scores for cleaning, laundry, hygiene and infection control were 53.8 % regarding WHO standards assessment (table 4) and 41.2% regarding employee's assessments (table 5). The findings of the present study concern that cleaning demonstrated that, the three hospitals washed surfaces by non-porous and resistant material. The surfaces are visibly clean, and mattresses were found to have water-proof covers. They were disinfected following each admission of new patient and whenever soiled and the medical equipment disinfected and sterilized effectively among patients.

Cleaning priority was given to operating rooms, personal protective measures available at the three hospitals are gloves and labcoats. Equipment cleaned between each patient and the next regularly.

The present study results regarding cleaning were in agreement with the WHO statement that "Surfaces in healthcare environment should be kept clean".<sup>(7)</sup> A study done in Boston , USA by Goodman ER, et al. in 2008<sup>(23)</sup>, have documented that healthcare workers may contaminate their hands or gloves by touching contaminated environmental surfaces, and that hands and gloves become contaminated with numbers of organisms are likely to be transmitted to other patients. Another study carried out in 10 hospitals in Alexandria in Egypt by Hussein RA, in 2009<sup>(8)</sup> reported that all the surveyed hospitals practice the suitable methods for cleaning surfaces, blood spills, and equipment. A study was carried out in UK by Griffith CJ, et al in 2000<sup>(24)</sup>, assessing the cleanliness of up to 113 environmental surfaces in an operating theatre and a hospital wards. Seventy-six percent of these sites were unacceptable after cleaning. The sites most likely to fail in the ward were in the toilets and kitchens, areas which are frequently implicated in the spread of infectious intestinal disease among operating theatre sites, 61% would be considered unacceptable. The study concluded that the routine cleaning programs used did not include biocide and that cleaning using a hypochlorite based sanitizer would be more efficient. Ayliffe GA, et al.<sup>(25)</sup> states, an objective in the control of hospital infection is to "expose patients to an environment at least as free from microbial hazard as that which they would find outside the hospital". Laundry, hygiene and infection control items in the previous tables were not applicable.

**Table 6: Assessment of control of vector-borne disease according to the WHO checklist at the selected hospitals in White Nile State, Sudan, 2013.**

Control of vector-borne disease	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
Are HCS environments protected from vector borne disease?		√			√			√	
Are vector-breeding sites avoided or controlled?		√			√			√	
Are HCS buildings designed and built to exclude disease vectors?		√			√			√	
Are inbuilt protective measures effectively used and maintained?		√			√			√	
Is insecticide sprayed in and around the HCS?	√			√			√		

Are barriers or repellents used to reduce exposure to vectors?	√			√			√		
Are HCSs equipped with bed nets and window screens?	√			√			√		
Are all patients, and particularly patients with vector-borne diseases, treated or protected to prevent further transmission?	√			√			√		
Are there facilities to safely contain the waste produced?		√			√			√	
Are infectious substances removed or covered or disposed of immediately and completely?		√			√			√	
Hospital scores as %	40.0%			40.0%			40.0%		

Y=Yes N=No NA=Not Applicable HCS= Health Care Setting

**Table 7:**

**Opinion of employees regarding the control of insects and the animals at the selected hospitals, in White Nile State, Sudan, 2013.**

Control of insects and the animals	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
<b>Types of insects and animals inside the hospital</b>									
Absence of mice		√			√			√	
Absence of cockroaches		√			√			√	
Absence of housefly		√			√			√	
Absence of cats		√			√			√	
Absence of dogs	√			√			√		
Absence of goats		√		√				√	
Absence of donkeys		√		√				√	

**Continued table (7)**

<b>Controls of the elimination of insects and animals in the hospital</b>									
Natural ways		√			√			√	
Fumigation		√			√			√	
Spraying	√			√			√		

Hospital doors and windows contain glass and repellants		√			√			√	
Hospital walls provides full protection from animals entering		√		√				√	
Hospital scores as %	16.7%		41.7%		16.7%				

Y=Yes N=No NA=Not Applicable

Regarding control of vector-borne disease, scores were 40% equally to WHO standards assessment (table 6) and 16.7% for employees assessments for Kosti and Eduiem hospitals, while Rabak hospital was 41.7% (table 7). Insecticide spray were used in, and around the hospitals and repellents used to reduce exposure to vectors in the three hospitals. Mice, cockroaches, cats, and housefly were present in the three hospitals, goats and donkeys were present in Kosti and Eduiem hospitals. This may be due to unmaintained surrounding walls and the poor HCW management particularly HCW storage areas. The WHO states that "Patients, staff and carers should be protected from vectors", consequently, windows in all HCS should be equipped with screens. <sup>(7)</sup>

Similar study has been done by Saad LM, et al. in Damanhur hospital in Egypt in 1994 <sup>(26)</sup>, demonstrated that, the construction of hospital building and their internal design are often the main reasons for the ease with which cockroaches; infestation is established and for the difficulties encountered in their control. The hollow support of benching and trolleys provide ideal shelters with little access for cleaning or treatment. Trolleys provide an excellent method for disseminating cockroaches throughout the hospital. Kurth JM. <sup>(27)</sup>, reported, the presence of cockroaches in hospital environment can play a principle role in the spread of infection. Cockroaches spread from a focus of infestation which is usually storage area, a receiving, or preparatory area serving the kitchen. Cockroaches are known to carry various microorganisms as bacteria, parasites, viruses, and fungi. <sup>(26)</sup>

Regarding houseflies, a previous study has been done by Saad LM, et al.in Damanhur hospital in Egypt in 1994 <sup>(26)</sup>, reported that houseflies have been considered important agents in the dissemination of numerous infectious diseases. They act as vectors for potentially pathogenic bacteria in hospital environment. Houseflies have been reported to be involved in the spread of many bacterial infections, such as enteric fever, cholera, shigelloses, and salmonellosis.

**Table 8:**

**Assessment of sanitation practice of the kitchens according to the WHO checklist regarding food storage and preparation at the selected hospitals**

**in White Nile State, Sudan, 2013.**

Kitchen, food storage and preparation	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA
Are there hand washing points in the food preparation area and at the toilets that food handlers use?			√			√			√
Do food handlers wash their hands when necessary?			√			√			√
Are food storage and preparation areas designed and built so as to be easy to keep clean?			√			√			√
Are food preparation areas kept clean and protected from rodents and insects?			√			√			√
Are there facilities and equipment provided for preventing contact between cooked and raw foodstuffs?			√			√			√
Is contact between raw foodstuffs and cooked food prevented?			√			√			√
Are cooking facilities adequate for heating food sufficiently?			√			√			√
Is food cooked thoroughly?			√			√			√
Is food kept at safe temperatures?			√			√			√
If dry foods are stored at the HCS, is the store appropriate?			√			√			√
Are dry food stores kept clean and protected from rodents and insects?			√			√			√
Do facilities exist to allow the safe preparation, storage and handling of powdered infant formula?			√			√			√
Is powdered infant formula prepared with hot water that is not cooler than 70°C, stored and handled according to the WHO and FAO (2007) guidelines?			√			√			√
Hospital scores as %	0.0%			0.0%			0.0%		

Y=Yes N=No NA=Not Applicable HCS= Health Care Setting

**Table 9:**

**Opinion of employees sanitation practice of the kitchens regarding food storage and preparation at the selected hospitals in White Nile State, Sudan, 2013.**

Kitchen, food storage and preparation	Hospitals								
	Kosti			Rabak			Eduiem		
	Y	N	NA	Y	N	NA	Y	N	NA

Proper food cover available in the hospital kitchen			√			√			√
Hospital kitchen worker complying with the health requirements			√			√			√

**Continued table (9)**

Hospital kitchen workers dressed their own wearing in the kitchen			√			√			√
Nutrients that enter the kitchen is validated			√			√			√
Fuel used in cooking takes into account environmental requirements			√			√			√
Hospital kitchen well ventilated			√			√			√
Hospital kitchen, good lighting			√			√			√
Cleaning processes in the hospital kitchen taken into account health and environmental requirements are needed			√			√			√
Windows in hospital kitchen protected			√			√			√
Hospital kitchen ground insured from entering any kind of rodents			√			√			√
Hospital kitchen doors are designed to be self - closing			√			√			√
Materials for cleaning available in the hospital kitchen			√			√			√
Garbage collection baskets available in the hospital kitchen			√			√			√
Washing basins for hands washing and utensils available in the hospital kitchen			√			√			√
Walls and roof of the hospital kitchen locked and not allow the insects to co - exist			√			√			√
Hospital scores as %			0.0%			0.0%			0.0%

Y=Yes N=No NA=Not Applicable HCS= Health Care Setting

**Table 9** revealed that items recorded in the WHO check-list and employees opinion sheet were not applicable in the three hospitals, scores were 0.0%. The kitchens and food storage and preparation were not applicable in the three hospitals, patients and visitors brought their food either from home or cooked inside the hospitals. This is not complying with the WHO standards which states that "Food for patients, staff, and carers should be stored and prepared so as to minimize the risk of disease transmission".<sup>(7)</sup>

A study in England by Barbara ML, et al.in 2009<sup>(28)</sup>, reported that, National Health Service (NHS) spent about 500 million pounds annually in providing about 300 million meals for patients. In many hospitals meals are prepared and cooked in the hospital kitchen and distributed directly to the wards. Many hospitals have

canteens serving visitors, but inpatients, outpatients and staff can often purchase food. Food from these outlets must be safe for patients and staff. Other studies reported that, food hygiene in the hospital can acquire peculiar features include: many patients could be more vulnerable than healthy subjects to microbiological and nutritional risks, large numbers of persons can be exposed to infections with 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. <sup>(29, 30)</sup>

Study has been done in England and Wales by Meakins SM, et al. in 2003 <sup>(31)</sup>, concluded that, the mortality risk has been proved to be significantly higher than the community outbreaks.

Prevention of foodborne infection in healthcare settings is essential. Most of the foodborne outbreaks in healthcare settings could have been prevented if good hygienic practice and Hazard Analysis and Critical Control Point (HACCP) principles had been followed. Food safety policy in a hospital should involve persons such as a consultant in communicable disease control, control of infection officer and environmental health officer as well as the catering management. The policy should include commitment to good hygienic practice, an HACCP system, and procedures to ensure that suppliers of food and water have satisfactory food safety policies. <sup>(32)</sup> Study done in Mumbai in India by Bobhate PS, et al. in 2011 <sup>(33)</sup> confirmed an association between educational status and personal hygiene and diseases spreading through food still remain a common problem resulting in appreciable morbidity and occasional mortality. Although numerous control strategies are in place, person-to-person disease transmission has not ceased.

## **Recommendations**

- ❖ Surrounding building should be maintained to provide full protection from animals entering the hospitals.
- ❖ Cleaned toilets should be available and easy accessed for patients, visitors, and staffs
- ❖ Hospital lighting should be adequate in patient rooms, operating rooms, hospital entrance and in all hospital departments.
- ❖ Immuno-compromised patient rooms should have priority in ventilation and maintenance.
- ❖ High standard cleaning in hospital units and cleaning equipment during and after use must be followed.
- ❖ Laundry with appropriate facilities as hand-washing and special colour-coded bags, should be installed in the three hospitals.
- ❖ Kitchens should be well designed according environmental requirements needs with good ventilation and sufficient light.

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