Assessment of Mitigation Measures in Preventing Bacterial Infections in Selected Public Health Centres in Akure, Ondo State

F. O. Omoya[1*], A. O. Momoh[2] and K. O. Ajayi[1]

[1]*Department of Microbiology, Federal University of Technology, Akure, Nigeria.*
[2]*Department of Microbiology, Faculty of Basic and Applied Sciences, Elizade University,*
Ilara-Mokin, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author FOO designed and supervised the study and wrote the protocol. Author AOM managed the analyses of the study, performed the statistical analysis and wrote the first draft of the manuscript. Author KOA managed the literature searches and editing of the manuscript. All authors read and approved the final manuscript.

ABSTRACT

Introduction: Hospital acquired infection (or nosocomial) is an infection whose development is favored by hospital environment. They are usually acquired by either a patient during a hospital visit (or when hospitalized), hospital staff or patients' relatives that visit when the patient is on admission in the hospital. Nosocomial infections can cause severe pneumonia and infection of the urinary tract, wounds, blood stream and other parts of the body. Nosocomial infections are commonly encountered in Africa and in Nigeria in particular. Factors such as hospital hygiene / cleanliness, personal hygiene of patients, overcrowding hospital wards and illiteracy increases the risk of nosocomial infection.
Methods: The assessment of mitigation measures put in place to reduce bacteria present in surfaces of facilities (pillow, bed sheets, door handles, toilet seats and the floor) in wards of selected basic health centres (Arakale, Aule, Ayedun, Isolo, Oba-Ile and Orita-Obele) in Akure was evaluated using both questionnaire and on-sight assessment techniques.

_____

Corresponding author: E-mail: fomoya@yahoo.com;

Results: The results showed that there was a direct relationship between the hand washing or sanitizer used and the bacterial load present in the various surfaces examined.
Conclusion: Therefore, adequate ward hygiene in these health centres is necessary to reduce the risk of nosocomial infections for both patients and visitors.

1. INTRODUCTION

Hospital acquired infection or nosocomial infection is an infection whose development is favored by a hospital environment. They are usually acquired by patient, hospital staff or patients' relatives [1]. Nosocomial infection is responsible for 1.7 million hospital-associated infections in the United States and about 25,000 deaths in Europe annually from all types of microorganisms including bacteria [2]. Nosocomial infections can cause severe pneumonia and infection of the urinary tract, blood stream and other parts of the body.

Nosocomial infections are commonly encountered in Africa and in Nigeria in particular. According to Cheesebrough [3], factors such as hospital hygiene / cleanliness, personal hygiene of patients, overcrowding hospital wards and illiteracy can increase the spread of nosocomial infection. These infections are usually difficult to treat with antibiotics. Equally, antibiotics resistance is fast spreading to more Gram positive and Gram negative bacteria that can infect people within the hospital environment [4].

Nosocomial infections occur worldwide and affect both developed and resource-poor countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. They are a significant burden both for the patient and for public health. A prevalence survey conducted under the auspices of WHO in 55 hospitals of 14 countries representing 4 WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed that an average of 8.7% of hospital patients had nosocomial infections. At any time, over 1.4 million people worldwide suffer from infectious complications acquired in the hospital [5]. The highest frequencies of nosocomial infections were reported from hospitals in the Eastern Mediterranean and South-East Asia Regions (11.8 and 10.0% respectively), with a prevalence of 7.7 and 9.0% respectively in the European and Western Pacific Regions [6]. The most frequent nosocomial infections are infections of surgical wounds, urinary tract infections and lower respiratory tract infections. The WHO study, and others have also shown that the highest prevalence of nosocomial infections occurs in intensive care units and in acute surgical and orthopaedic wards. Infection rates are higher among patients with increased susceptibility because of old age, underlying disease, or chemotherapy.

Hospital-acquired infections add to functional disability and emotional stress of the patient and may, in some cases, lead to disabling conditions that reduce the quality of life.

Nosocomial infections are also one of the leading causes of death [7]. The economic costs are considerable [8]. The increased length of stay for infected patients is the greatest contributor to cost. One study showed that the overall increase in the duration of hospitalization for patients with surgical wound infections was 8.2 days, ranging from 3 days for gynaecology to 9.9 for general surgery and 19.8 for orthopaedic surgery. Prolonged stay not only increases direct costs to patients or payers but also indirect costs due to lost work. The increased use of drugs, the need for isolation, and the use of additional laboratory and other diagnostic studies also contribute to costs. Hospital-acquired infections add to the imbalance between resource allocation for primary and secondary health care by diverting scarce funds to the management of potentially preventable conditions. The advancing age of patients admitted to healthcare settings, the greater prevalence of chronic diseases among admitted patients, and the increased use of diagnostic and therapeutic procedures which affect the host defense will provide continuing pressure on nosocomial infections in the future. Organisms causing nosocomial infections can be transmitted to the community through discharged patients, staff, and visitors [9]. If organisms are multi-resistant, they may cause significant disease in the community.

In Akure, Ondo State, several communities which are densely populated have primary health centres to cater for the immediate health need of

the people. According to Ondo State Health/ Hospital Management report [10], Government has taken some steps to improve on the hygiene status of these primary health centres to minimize nosocomial infections. However, there is no constant evaluation of the hygienic status of these primary health centres.

In our previous study, antibiotic sensitivity assay on pathogenic microorganisms isolated from selected areas in some primary health centres in Akure metropolis, Nigeria was reported in which six different primary health centres were visited. A total of 720 swab samples were collected from bed sheet, door handles, floor, pillow and toilet; it was noted that the highest bacterial counts ranged from 53.33±1.86 to 1.67±0.33 cfu/ml from toilet in maternity and pillows in pediatric wards respectively. The bacterial isolated include; *Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, Bacillus subtilis, Pseudomonas aeruginosa, Klebsiella pneumoniae*, while the fungi were*Candida albicans* and *Candida dubliensis.*The bacterial isolates were mostly resistant to tetracycline and streptomycin, *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the most resistant bacteria isolates many antibiotics used. However, ofloxacin exerted the highest inhibitory effect against all the bacteria [4].

There is currently no study or records of the relationship between contaminated facilities as reported by Omoya and Afolabi [4] in these primary health centres, the spread of infections and the safety of the public that visit these health centres. Such records will in turn help prevent the spread of nosocomial infections from formites to patients, staff and visitors or the general public from the health centres. Hence, there is a need to evaluate the mitigation measures put in place both by the government and the health centres to reduce nosocomial infections within and outside these health facilities for safety of the populace, patient and staff of the health centres.

2. MATERIALS AND METHODS

2.1 Description of Study Area

The study area is Akure South Local Government Area. Akure South Local Government Area was carved out of Ondo Municipal Government of Akure central in 1996 after the creation of Ekiti State. It covers a land area of 15, 500 square kilometers. It has a population density of 3, 300 persons per square kilometer. The Akure South Local Government Area shares boundaries with Akure North Local Government Area and Akure East Local Government Area respectively.

Akure South Local Government Area has a total population of 360, 268; comprising of 173, 153 males and 187, 115 females according to the 2006 national population with 2010 estimated population of 459,164 using a growth rate of 3.2% from 2006 census. It is an urban area and therefore, no major farming activities take place. Yoruba and other tribes dominate the area. The residents are engaged in various economic activities such as trading, transportation business, civil service and education.

The symbol of tradition is evident in Akure South Local Government Area. The official resident of the Oba Adesida is situated in the area. There are twelve primary Health care centres in the area, fifty-nine registered private health facilities, two public secondary health care facilities and no tertiary health facilities in the area. There are four mission (private) hospitals that provide secondary health care for the people. The surrounding Local Government areas have public secondary health centres.

2.2 Study Design

This study was a descriptive cross sectional survey.

2.3 Study Population and Study Subjects

All consenting primary health centers' facilities in Akure metropolis of Akure South Local Government area were included in the survey regardless of size and location.

2.4 Sample Size Determination

A total of six primary health centres in Akure metropolis were evaluated/visited:

1. Primary health centre, Aule;
2. Primary health centre, Ayedun;
3. Primary health centre, Isolo;
4. Primary health centre, Arakale;
5. Primary health centre, Oba-ile and
6. Primary health centre, Orita-Obele.

They were analyzed using questionnaire and physical surveillance of the hospitals to ascertain their hygienic status. A total of one hundred and

twenty (120) questionnaires (twenty in each health centre) were administered to staff of the health centres as check list to assess their facilities.

2.5 Data Collection

This was done using two (2) different instruments. The first survey instrument was physical surveillance of the health centre environment to evaluate the hygienic status of the basic primary health centre. The second instrument was a structured questionnaire administered to staff of the basic primary health centres to assess their health facilities available to the health centres and the public to maintain a hygienic status.

2.6 Ethical Consideration

Consent: Approval for the study was obtained from the Ondo State Hospital Management Board. Respondents were told of their right to decline the questionnaire without any consequences but appealed to not to decline it.

Confidentiality: Data collected was used only for research purpose and kept confidential on a password protected computer. Names and addresses were not included in the data collection questionnaires and thus data collected cannot be linked with any person.

Beneficence: Data obtained in this study can be useful in policy making and to identify appropriate areas requiring attention to improve health care service delivery in Ondo State.

2.7 Limitation of the Study

The following were limitations to this study:

Information on monthly average internally generated revenue of the basic primary health centre was not used, cleaners and health attendants did not disclosed their monthly take home during this study and information on the time at which monitoring and evaluation team visit the basic primary health centres to evaluate their hygienic status was included. All these could play a vital role in the hygienic status of primary health centres.

3. RESULTS

The availability of the facilities assessed is shown in Table 1. The result of the availability of the facilities in the basic primary health centres selected in Akure metropolis showed that they all have toilets in their wards; they all equally have beddings (bed sheets and pillow cases) materials in their wards, the wards were well tiled and the doors have good handles. However, only Aule, Ayedun and Oba-Ile basic primary health centres have bore-holes for water supply. Of these three basic primary health centres, only Aule and Oba-Ile basic primary health centres have tap water system while only Oba-Ile basic primary health centre had washing hand basins situated in strategic locations. All the basic primary health centres selected for this study have well water.

The condition of the facilities assessed in the basic primary health centres showed that Isolo basic primary health centre had bad toilets and bed sheets. The bore hole in Ayedun was bad, only the tap water system in Oba-Ile health centre was in good working condition. Their floor was very neat while their well was fine and well situated as seen in Table 2.

Other assessment of the equipment for hygienic purpose in the basic primary health centres showed that there was no hand washing basins in the toilets of five health centres except that of Aule whose own was in bad condition and not in use. Isolo health centre lack hand towel for hand cleaning. All the basic primary health centres however had hand sterilizer for staff after work. They all have good foot-mats at their entrance to reduce the carriage of dirty materials by shoes into the wards.

The assessment of the environmental hygiene level of the basic health centres using questionnaire for the staff of the centres showed that of the twenty questionnaire distributed in each centre, a total of 65% of the staff in each of the basic health centre were females and 35% were males. They all had secondary and tertiary education and have been working in the basic health centres for more than five (5) years. They all agreed that the wards were cleaned once daily using antiseptic mopping. They all use hand sanitizers without hand washing sink and the available disposable hand towels were for the staff only. The questionnaire also showed that the Arakale and Isolo basic health centres records more than 50 patients visiting the centres for one treatment or the other and admits less than twenty patients daily, while the other 4 basic health centres had less than 30 patients daily and admits less than 10 patients daily. Table 3 shows the scores for the questionnaire given to

the staff of the basic health centres and the total score for each health centre respectively. A copy of the questionnaire is also attached to the Appendix I.

Table 1. The availability of facilities assessed in this research

Centre	Toilets	Bed sheets / pillows	Tiled floor	Door handles	Bore hole	Taps	Washing hand basin	Well water
Arakale	+	+	+	+	-	-	-	+
Aule	+	+	+	+	+	+	-	+
Ayedun	+	+	+	+	+	-	-	+
Isolo	+	+	+	+	-	-	-	+
Oba-Ile	+	+	+	+	+	+	+	+
Orita-Obele	+	+	+	+	-	+	-	+

Keys: + = Present; - = Absent

Table 2. Conditions of the facilities assessed in basic health centres

Centre	Toilets	Bed sheets	Floor	Door handles	Bore hole	Taps	Washing hand basin	Well water
Arakale	G	A	N	G	-	-	-	G
Aule	G	N	N	G	G	B	-	G
Ayedun	G	N	N	G	B	-	-	G
Isolo	B	B	A	G	-	-	-	G
Oba-Ile	G	N	N	G	G	G	G	G
Orita-Obele	G	N	A	G	-	B	-	G

Keys: A= Averagely neat/ok; B= Bad; G= Good; N= Neat; - = Not present

Table 3. Scores / rating of the questionnaire distributed to staff of basic health centres

S/N	Point considered	Arakale	Aule	Ayedun	Isolo	Oba-Ile	Orita-O
1	Staff strength	4	3	3	4	3	3
2	Cleaning method employed	2	3	3	1	4	3
3	Cleaning of wards daily	2	3	3	2	3	3
4	Washing of beddings	3	4	4	3	4	3
5	Modern washing of beddings	2	2	2	2	2	2
6	Water supply	3	3	3	3	4	3
7	Waste disposal	3	3	3	3	3	3
8	Hand washing sink	2	3	2	2	3	2
9	Disposable hand towels	1	2	1	1	2	2
10	Washing of toilets	2	2	2	2	2	2
11	Cleaning agent used	3	3	3	3	3	3
12	No. of visitors to centre	4	3	3	4	3	3
13	No. of patients admitted	4	3	2	4	2	3
14	Overall hygiene strength	2	3	3	2	3	3
15	**Total score/70**	**34**	**37**	**35**	**34**	**39**	**36**

Keys: Very adequate/very high= 5; Adequate/high= 4; Average= 3; Inadequate/few/low/poor= 2; Very poor/low/few= 1

Table 4. Environmental and waste management assessment of basic health centres

Centre	Clearing of bushes	Insect control	Mosquito nets in wards	Available incinerator	Destruction of wastes	Use of germicide in gutters
Arakale	No bush	No	No	No	Empty in waste van	No
Aule	No bush	No	Ye	Yes	Yes	Yes
Ayedun	No bush	No	No	No	Empty in waste van	Yes
Isolo	No bush	No	No	No	Empty in waste van	No
Oba-Ile	Uses mower	Spray insecticide	Yes	Yes	Yes	Yes
Orita-Obele	Manually	No	No	Yes	Empty in waste van	No

Table 4 shows the waste management mechanism and the environmental cleaning method put in place by each of the health centre to curtail the spread of communicable diseases via wastes. Most of the centres do not have bushes around them. However, Oba-Ile and Orita-Obele that have bushes, controled it with the use of a mower and manually respectively. Only Oba-Ile health centre spray insecticide occasionally to control insects especially on their flowers. They also treat their gutter with germicide to control communicable diseases as well as burn their generated waste in an incinerator every week.

4. DISCUSSION

The results obtained from this work have shown that many of the facilities in our basic health centres need attention to reduce nosocomial infections. According to Plowman [11], the major reason for high bacterial load of pillows and beddings in the hospitals is basically due to the fact that patients under critical conditions may not be able to bath for days and most hospitals in developing countries may not have enough of these beddings for daily change [4]. Hence proper cleaning methods such as surface sterilization of all the facilities in these basic health centres should be adopted for reducing the microbial loads.

The absence of flowing tap water and bore holes could hinder high level of hygiene standard as seen in the results of these assessments, from these basic health centres. The basic primary health centres without tap water or bore hole are likely to have high bacterial load isolated from them and promote the spread of nosocomial infections because well water used could have been contaminated. Therefore, the level of hygiene maintenance in these health centres is directly related to the availability of water.

The condition of the facilities assessed in the basic primary health centres showed that Isolo basic primary health centre had bad toilets and bed sheets. The bore hole in Ayedun was bad, only the tap water system in Oba-Ile health centre was in good working condition. According to Omeleke [12], the lack of maintenance of the available facilities in our health centres have contributed to the increased nosocomial infections often acquired from these health centres. Equally, the fact that the low income earners in the society are the major patronage of these health centres make their hygiene level low as they often involve in overcrowding and use of dirty water for cooking and cleaning [1].

Many factors contribute to the frequency of nosocomial infections: hospitalized patients are often immune-compromised, they undergo invasive examinations and treatments, and patient care practices and the hospital environment may facilitate the transmission of microorganisms among patients. Cowman *et al*. [13] stated that most of the health centres in Africa have only doors without nets to prevent mosquito and this often lead to re-infection of patients in wards with malaria. The selective pressure of intense antibiotic use promotes antibiotic resistance [14], and while progress in the prevention of nosocomial infections has been made, changes in medical practice continually present new opportunities for development of infection. The information obtained from the questionnaire given to the staff of these basic

health centres have shown the relationship between the questionnaire and the physical surveillance assessment done.

According to Prescott et al. [1], the number of patients visiting a hospital is a pointer to the number of visitors that will visit such hospital. Mansouri et al. [15], stated that this point is well abused in developing countries were a patient has multiple visitors coming daily when they are on hospital admission. Due to this reason, Tikhomirov [16], concluded that the floor, door handle as well as the chairs which these visitors have direct contact with cannot be devoid of bacteria, especially pathogenic ones.

The absence of flowing tap water and bore holes could hinder high level of hygiene standard as seen in the results of bacterial isolations from these basic health centres. The basic primary health centres without tap water or bore hole had high bacterial load isolated from their wards, beddings and toilets respectively. Therefore, the level of hygiene maintenance in these health centres is directly related to the availability of water for laundry purpose in such centre.

The regular treatments of the drainage system of hospitals with germicides as well as use of mosquito nets in wards have been noted to help reduce nosocomial infection from series of studies [14,15,17]. This habit was only seen to be practiced by one health centre (Obal-Ile) out of the six health centres studied. This probably was made possible by the contributory effort of the elites in the estate in which the health centre was situated.

5. CONCLUSION

Thus, there is need for adequate water supply to these health centres and constant ward hygiene in these health centres to reduce the risk of nosocomial infections for both the patients who are already admitted for different infection and for the visitors who previously may be free of certain infection before coming to the health centres. Equally, though the mitigation measures seen in these health centres are good, they should be improved upon.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL CONSIDERATION

Approval for the study was obtained from the Ondo State Hospital Management Board.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Prescott LM, Harley JP, Klein DA. General microbiology. 8th Edition, McGraw Hill, New York, USA. 2011;1098.
2. Pollack M, Andrew JT. Rising threats of infections unfazed by antibiotics. New York Times. 2010;42.
3. Cheesebrough M. Distric laboratory practice in tropical countries. 2nd Edition, Cambridge University Press, United Kingdom. 2010;480.
4. Omoya FO, Afolabi Temitope. Antibiotic sensitivity assay on pathogenic microorganisms isolated from selected areas in some primary health centres in Akure Metropolis, Nigeria. International Journal of Public Health and Epidemiology. 2016;5(8):292-300.
5. Danchaivijitr S, Tangtrakool T, Chokloikaew S. The second Thai national prevalence study on nosocomial infections 1992. J Med Assoc Thai. 2005;78(Suppl 2):S67–S72.
6. Vasque J, Rossello J, Arribas JL. Prevalence of nosocomial infections in Spain: EPINE study1990–1997. EPINE Working Group. J Hosp Infect. 2000; 43(Suppl):S105–S111.
7. Gastmeier P. Prevalence of nosocomial infections in representative German hospitals. J Hosp Infect. 2008;38:37–49.
8. Emmerson AM. The second national prevalence survey of infection in hospitals overview of the results. J Hosp Infect. 2006;32:175–190.
9. Ducel G. Les nouveaux risques infectieux. Futuribles. 2005;203:5–32.
10. Ondo State Hospital Management Board Report. Hospital Development in Ondo State; the Journey So Far. 2010;19-36.
11. Plowman R. The socio-economic burden of hospital-acquired infection. London, Public Health Laboratory Service and the London School of Hygiene and Tropical Medicine; 2009.

12. Omeleke II. Administration of health and welfare services in Nigeria: Policies and Issues. 2010;51-55.

13. Cowman AF, Berry D, Baum J. The cellular and molecular basis for malaria parasite invasion of the human red blood cell. Journal of cell Biology. 2012;198(6):961-971.

14. Monali PM, Rachita SR, Padhy N. Prevalence of multidrug resistant uropathogenic bacteria in pediatric patients of a tertiary care hospital in eastern India. Journal of Infection and Public Health. 2016;308-314.

15. Mansouri M, Afshar D, Hemati-Harsini M, Amir H. Prevalence and microbial resistance of uropathogenic bacteria isolated from neonatal and pediatric patients in Western of Iran. British Microbiology Research Journal. 2015; 10(6):1-8.

16. Tikhomirov E. WHO Programme for the control of hospital infections. Chemiotherapia. 2007;3:148–151.

17. Mayon-White RT. An international survey of the prevalence of hospital-acquired infection. J Hosp Infect. 2008;11 (Supplement A):43–48.

APPENDIX I

QUESTIONNAIRE

Basic Health Centres in Akure metropolis

Environmental Hygiene of Basic Health Centres and Influx of Patients and Visitors Assessment

Questionnaire

Please, tick box or underline where applicable

Sex / Gender: M ☐ F ☐

Age: Less than 20 years ☐ 20-30 years ☐ 30-Above ☐

Educational Status of Respondent: Primary / Secondary / Tertiary

Religion: Christianity / Islam / Others

Number of Years in the Health Centre: Less than 1year/ Less than 5years / More than 5 years.

Are the wards cleaned daily? Yes / No

The mode of cleaning employed: Antiseptic mopping / Just mopping / Sweeping

How often are the wards cleaned daily: Once / Twice /Three times daily

How often are the beddings (Pillows and bed sheets) washed: Daily/Twice a week/Once a week/After the discharge of an admitted Patient.

Mode of washing: By hand / By washing machine

Number of toilet in wards: One / Two / Three / More than three

Source of water supply: Well / Over head tanks / Borehole / Pipe borne water

Method of waste disposal in the wards: Use of waste basket / Dust bin / Covered trash can

Provision of hand sanitizers in wards: Yes / No

Provision of hand washing sink in wards: Yes / No

Provision of disposable hand towels in wards: Yes / No

How often are the toilets washed: Always / Twice daily / Daily / After use / Weekly

Do you clean the door handle? Yes / No

If yes, how often: Daily /Every other day/Weekly

The cleaning agent(s) employed: Liquid soap only /Liquid soap and Izal /Liquid soap and detol / Powdered soap and other disinfectants.

The estimated number of patients that visit your centre: Less than 10 daily / Less than 20 daily / Less than 30 daily / Less than 40 daily / Less than 50 daily / More than 50 daily /More than 100 daily.

Estimated number of patients admitted: Less than 10 daily / Less than 20 daily / Less than 30 daily / Less than 40 daily / Less than 50 daily / More than 50 daily /More than 100 daily.

Estimated number of visitors to the wards: Less than 10 daily / Less than 20 daily / Less than 30 daily / Less than 40 daily / Less than 50 daily / More than 50 daily /More than 100 daily.