Survey of nosocomial gastrointestinal protozoa infections among hospitalized patients of a tertiary and a secondary hospital in Awka, Anambra state, Nigeria

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Abstract

The hospital environment often become contaminated by infectious agents either through patients or hospital sources. This cross-sectional hospital-based study was conducted to survey the epidemiology of nosocomial gastrointestinal protozoa infections among hospitalized patients in a tertiary and a secondary hospital, Awka, Anambra state. Stool samples were collected from 210 admitted patients and analyzed using direct wet mount and formol ether concentration technique. Demographic and risk factor information were gathered using a structured questionnaire. Data was analyzed using Pearson chi-square test and Probability values $\leq$ 0.05 were considered significant. From the 210 patients examined, 31(14.8%) contracted nosocomial gastrointestinal protozoa infections. Nosocomial gastrointestinal protozoa infection was recorded in all two hospitals with the tertiary hospital (COOUTH) having the highest infection prevalence of 15.7% at an occurrence rate of 80.6%. Female gender, 10-19years of age, patients with longer admission duration had more prevalent rates of 16.2%, 28.6% and 89.5% respectively. Also, patients admitted in the paediatric ward, those with only primary education and those who don't always wash their hands before introducing any substance into the mouth had higher prevalence of 20.0%, 25.0% and 20.7% respectively. Nosocomial gastrointestinal protozoa infection was strongly associated with duration of hospital stay and hand washing habits $P<0.05$. Among the five protozoa parasites seen, *Entamoeba histolytica* was the most prevalent 18(58.1%). There is an urgent need for improved patients and health workers personal hygiene, hospital sanitation, and the use of safer medical practices to stop the spread of nosocomial infection.

Key words: Nosocomial, Gastrointestinal Protozoa, Hospitalized patients, Prevalence, Anambra, Nigeria.

Running Title: Survey of nosocomial GIT protozoa infection among hospitalized……

Introduction

Nosocomial infection is an infection that occur in a patient admitted to a healthcare setting for more than 48 hours but without any evidence that the infection was present or incubating at the time of admission (Wang *et al*., 2019). Nosocomial infection also referred to as hospital acquired or health care associated infection is a major patient safety issue as well as public health concern affecting hundreds of millions of people globally (Ige *et al*., 2011, Wang *et al*., 2019). In a hospital, nosocomial infection due to gastrointestinal protozoa parasites is a leading cause of increased morbidity, mortality and financial burden due to increased cost of hospital treatment (Meric *et al*., 2005; Oznur *et al*., 2011; Umscheid *et al*., 2011; Rosenthal *et al*., 2014; Cassini *et al*., 2016). It is estimated that seven out of 100 patients in countries with high standard healthcare facilities are diagnosed with nosocomial infection while 10 out of 100 patients have been reported in poor countries with low health care standards (Wuranek *et al*., 2021). Gastrointestinal protozoan infections are ranked 2nd after malaria as the leading cause of morbidity and mortality (Berhe *et al*., 2020). Protozoa parasites are one of the pathogenic agents parasitizing the human gastrointestinal tract and are mainly in the middle and low-income countries in the tropical and subtropical regions of the world (Hassan *et al*., 2018; Belkessa *et al*., 2021). Numerous factors such as poor healthcare services and facilities, lack of access to portable water, poor sanitation, overcrowding, low level of education, poverty and prevailing weather conditions influences the endemicity of gastrointestinal protozoa infections (Atu *et al*., 2014; Strunz *et al*., 2014; Oluwole *et al*., 2015; Rop *et al*., 2016). Infection due to gastrointestinal protozoa parasites have been implicated in over 450 million illness with an average prevalence rate of 50% in industrialized countries and almost 95% in underdeveloped countries (Ntulume *et al*., 2017). Research conducted previously have shown that age of patient, gender, longer hospital stay, incubation, type of hospital, urinary catheter, surgery since admission, mechanical ventilation and intravascular catheter are some of the determinants or risk factors that influence the occurrence and distribution of hospital acquired infections (Nejad *et al*., 2011; Yallew *et al*., 2017). Epidemiological data indicates that gastrointestinal parasitic infections affect all gender irrespective of age, although incidences often times differ in different parts of the world (Eshetu *et al*., 2019; Yeshitila *et al*., 2020). The transmission of gastrointestinal protozoa parasites occurs through contact with infected human or animal faeces, contaminated water, food, soil, person to person, low altitude (Abate *et al*., 2013) as well as through poor hygiene habits such as eating with dirty hands, poor sanitation, direct transfer of ova or cyst to mouth (Dogara *et al*., 2017) poor sewage disposal, illiteracy (Essendi *et al*., 2021) improper waste disposal (Yeshitila *et al*., 2020) and dirty nails (Eshetu *et al*., 2019). These protozoan infections cause diarrheal illness (Shinkafi and Muhammad, 2017), intestinal obstruction, anaemia, retarded growth, vitamin A deficiency, malnutrition and impaired mental health (Wale and Gedefaw, 2022). Medical experts have documented intestinal parasitic infections as being responsible for abdominal cramps, nausea (Tombang *et al*., 2019), increased protein-energy malnutrition, malnutritional anaemia (Mohammed *et al*., 2015), loss of iron due to blood loss, decreased appetite and food intake, vomiting, competition for nutrients, amnesia, physical activity, dehydration, diarrhea and fever (Tyoalumun *et al*., 2016). In addition to inducing acute symptoms,

gastrointestinal protozoa parasites are associated with long term post infectious sequelae, including functional gastrointestinal disorders, arthritis, failure to thrive, cognitive impairment, chronic fatigue syndrome and ocular pathology. The observed disparity in clinical manifestations of gastrointestinal protozoa parasite infections is attributed to age of the patient, strength of the immune system, number of cysts ingested and virulence of the parasite strain (Belkessa *et al*., 2021). Epidemiological survey of gastrointestinal protozoa infection has been reported in some parts of Southeast and Nigeria in general. Unfortunately, very little medical literature exists on the state of nosocomial gastrointestinal protozoa infections in Awka, Anambra State. Hence this study was carried out to survey the prevalence of nosocomial gastrointestinal protozoa infection and associated risk factors among hospitalized patients of a tertiary and a secondary hospital in Awka South Local Government Area of Anambra State, Nigeria.

Materials and methods

Study Area: The study was carried out on patients attending Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH) and Regina Caeli Specialist Hospital (RCSH) both in Awka, Anambra State. Awka, the capital of Anambra State is located on latitude 8.2069ºN and longitude 7.0678ºE and has a population of 361,657 as of the 2006 Nigeria Census (Okafor *et al*., 2020). The city is located 199km by road, directly North of Port Harcourt in the center of the densely populated Igbo heartland in South East Nigeria. The West-East Federal high way links it to other important towns such as Ekwulobia, Agulu, Enugu-Ukwu, Abagana and Nnewi.

Study Design: The research is a cross-sectional hospital-based study which was carried out to elucidate the prevalence of nosocomial gastrointestinal protozoa infection in Awka. The study was conducted between June and November 2021.

Ethical Approval: Ethical approval was obtained from the Health Research Ethics committee of Chukwuemeka Odumegwu Ojukwu University Teaching Hospital and was assigned number (COOUTH/CMAC/ETH.C/Vol.1/FN:04/0099). Permission was also obtained from the HOD's of the various units/wards in the hospitals from which stool samples were collected.

Informed Consent: Informed consent was sought from the patients after a clear explanation of the research was given to them. Consent was also obtained from care givers or relatives of patients who were incapable of consenting. Information generated from patients in the research was kept confidential and used only for the purpose of this research. Patient's identities were not disclosed and treated with utmost confidentiality.

Study Population: The research was carried out in Chukwuemeka Odumegwu Ojukwu University Teaching Hospital which is a 270-bed capacity and Regina Caeli Specialist Hospital with bed space of 59 in Awka. Patients admitted in the two (2) hospitals within the study period were eligible. However, only patients presenting with no gastrointestinal protozoa parasites in their stool samples as at the time of their admission in the hospital were recruited for the study.

Sample Collection: Admitted patients were given well labeled, grease free, plastic specimen bottles in which to collect their faecal samples. The samples were immediately carried to the Zoology

laboratory of Nnamdi Azikiwe University, Awka for parasitological analysis. Patients were also given Nosocomial Infection Surveillance Form (structured questionnaires) to obtain other relevant demographic information.

Sample Size: A sample size of 210 hospitalized patients was used for this study. Out of this, 159 patients were from Chukwuemeka Odumegwu Ojukwu University Teaching Hospital and 51 from Regina Caeli Specialist Hospital. This sample size was scientifically determined by taking a representative fraction of the total number of hospital bed capacities from the study hospitals using the formula: n =

$$\frac{\frac{[Z^2 \, x \, P(1-P)]}{e^2}}{1 + \frac{(Z^2 \, x \, P \, (1-P)}{e^2 \; x \; N}}$$

N- is the population size (Hospital Bed Capacity)
n- is the sample size
z- is the standard of normal distribution at 95% (1.96)
- ise margin of error at 5% (0.05)
P- is the standard of deviation (0.5)
(Duedu *et al*., 2015)

Sampling Technique: Random sampling technique was used to recruit patients into the study. Patients who were admitted into the hospital wards were immediately approached for consent to include them in the study. Only those willing were involved in the study.

Parasitological Analysis: Direct wet mount and formol ether concentration technique were the methods used for the laboratory analysis of the stool samples. The procedures were performed as described in pages 193-198 of *District Laboratory Practice in Tropical Countries*, Part 1 by Cheesbrough, (2009).

Result Analysis: Data obtained from this study was subjected to statistical analysis using SPSS Version 22. Prevalence rates were calculated and expressed as percentages (%), this was done for all the categories or variables. Chi square test (χ^2) was used to test for difference in prevalence rates among the variables and $P \leq 0.05$ were considered significant.

Results

Nosocomial gastrointestinal protozoa infection occurred in the two hospitals sampled (Table 1). Five gastrointestinal protozoa parasites were observed in this study. These were *Entamoeba histolytica, Trichomonas hominis*, *Giardia lamblia, Cryptosporidium spp* and *Entamoeba coli*. Table 1 shows these parasites and their prevalence among the 210 patients examined.

Table 1: Occurrence of nosocomial gastrointestinal protozoa infections in the hospitals

Infection	COOUTH	RCSH	TOTAL
E. *histolytica*	13(41.9)	5(16.1)	18(58.1)
T. *hominis*	5(16.1)	1(3.2)	6(19.4)
G. *lamblia*	3(9.7)	0(0.0)	3(9.7)
C. *parvum*	1(3.2)	0(0.0)	1(3.2)

E. *coli*	3(9.7)	0(0.0)	3(9.7)
Total	25(80.6)	6(19.4)	31(100%)

Out of a total of 400 hospitalized patients examined at baseline upon admission in the hospital ,210 patients had no protozoa infection and were included in the study. From this sample size, 31(14.8%) were found infected for nosocomial gastrointestinal protozoa infections (Table 2). Of the two hospitals studied, the tertiary hospital (COOUTH) recorded the highest prevalence of 15.7% while the missionary hospital (RCSH) recorded a lower prevalence of 11.8% (Table 2). Table 3 indicates that the most infected age group was the 10-19 years (28.6%). The least infected was 40-49 years (9.1%). There was no significant difference in the age-related prevalence (P>0.05) (Table 2). Out of the 105 males examined, 14(13.3%) were infected while 17 (16.2%) of the 105 females were infected (Table 2). No significant association existed between sex and prevalence of nosocomial GIT protozoa infections.

Table 2: Effects of associated risk factors on the Distribution of nosocomial gastrointestinal protozoa infections in patients attending two hospitals in Awka

Risk factors	Number examined	Number infected (%)	**(χ^2)**	P-value
Hospital				
COOUTH	**159**	**25(15.7)**	**0.481**	**0.488**
RCSH	**51**	**6(11.8)**		
Age group (**years**)				
0-9	**48**	**7(14.6)**	**4.651**	**0.589**
10-19	**21**	**6(28.6)**		
20-29	**23**	**3(13.0)**		
30-39	**33**	**5(15.2)**		
40-49	**22**	**2(9.1)**		
50-59	**23**	**4(17.4)**		
>60	**40**	**4(10.0)**		
Sex				
Male	**105**	**14(13.3)**	**0.341**	**0.559**
Female	**105**	**17(16.2)**		

The result also reveals the highest prevalence of 89.5% in patients who were hospitalized for >30days while no infection (0.0%) was recorded in patients admitted for only 0-5days. There was

a significant association between duration of hospital stay and prevalence of nosocomial GIT infection P=0.000 (Table 3).

Table 3: Nosocomial gastrointestinal protozoa infection with respect to duration of hospital admission

Duration of stay(days)	Number examined	Number infected (%)
0-5	**48**	**0(0.0)**
6-10	**82**	**3(3.7)**
11-15	**37**	**2(5.4)**
16-20	**17**	**4(23.5)**
21-25	**3**	**2(66.7)**
26-30	**4**	**3(75.0)**
>30	**19**	**17(89.5)**
Total	**210**	**31(14.8)**
Pearson chi-square(χ^2):122.205	**Df:6**	**P-value:0.000**

Patients admitted in the paediatric ward revealed the highest prevalence of (20.0%) followed by (15.0%) from the male ward. The least prevalence of 10.4% was observed in the surgical ward (Table 4).

Table 4: Distribution of nosocomial gastrointestinal protozoa infection according to ward/unit admitted

Ward/Unit	Number examined	Number infected (%)
Male	**20**	**3(15.0)**
Female	**17**	**2(11.8)**
Paediatric	**65**	**13(20.0)**
Medical	**60**	**8(13.3)**
Surgical	**48**	**5(10.4)**
Total	**210**	**31(14.8)**
Pearson chi-square(χ^2):2.357	**Df:4**	**p-value:0.670**

Based on their level of education, patients in the primary education category were the most infected (25.0%). The least prevalence of 9.3% was recorded among patients with tertiary education (Table 5). There was no association between the level of education and prevalence of nosocomial GIT protozoa infection (P>0.05).

Table 5: prevalence of nosocomial gastrointestinal protozoa infection according to patients' level of education

Level of education	Number examined	Number infected (%)
None	**45**	**5(11.1)**
Primary	**40**	**10(25.0)**
Secondary	**50**	**9(18.0)**
Tertiary	**75**	**7(9.3)**
Total	**210**	**31(14.8)**
Pearson chi-square(χ^2):5.982	**Df:3**	**P-value:0.112**

According to how often patients wash their hands before introducing any substance into the mouth, infection was highest in those that only wash their hands sometimes (20.7%) while those that always wash their hands revealed a lower prevalence of 3.2% (Table 6). Patients hand washing habit before introducing any substance into the mouth significantly influenced the prevalence of nosocomial GIT protozoa infection P=0.01.

Table 6: Nosocomial intestinal protozoa infection according to how often patients wash hands before introducing any substance into the mouth

How often do you wash your hands before introducing any substance into your mouth	Number examined	Number infected (%)
Always	**62**	**2(3.2)**
Sometimes	**116**	**24(20.7)**
Not at all	**32**	**5(15.6)**
Total	**210**	**31(14.8)**
Pearson chi-square(χ^2):9.816	**Df:2**	**P-value:0.007**

Discussion

The findings of this research reveal the occurrence of nosocomial gastrointestinal protozoa infections in the two hospitals and an overall prevalence of 14.8% in the 210 patients examined from the two hospitals. This study has also revealed higher nosocomial infection prevalence of 15.7% in the tertiary hospital (COOUTH). Among the risk factors analyzed, only duration of hospital admission and hand washing habit before introducing any substance in the mouth were found to be statistically associated with nosocomial intestinal protozoa infection. This overall prevalence of 14.8% is comparable to the 19.3% reported in southwest Nigeria by Hassan *et al*., (2018). However, the result is higher than earlier

reports by Wang *et al*., 2019 (7.57%) and Ige *et al*., (2011) whose review revealed lower prevalence's of 2.4% in 2005 to 3.1% in 2008 in a Nigerian tertiary health facility, western Nigeria. On the other hand, this prevalence is lower compared to studies conducted by Dogara *et al*., (2017), Ntulume *et al*., (2017) and Wale and Gedefaw, (2022) that reported higher prevalence of 22.0% in Kano state, Northern Nigeria, 36.5% in western Uganda and 65% in Ethiopia respectively. The occurrence of nosocomial gastrointestinal protozoa infections in the sampled hospitals further confirms reports by various researchers that documented nosocomial gastrointestinal protozoa infections among hospitalized patients around the world. The higher prevalence of 15.7% seen in the tertiary hospital (COOUTH) can be as a result of its referral status that see the hospital handle larger number of patients, very complicated medical ailments and procedures and a longer duration of hospital admission by numerous patients due to long term medical complications that can only be handled by a more technologically advanced health facility. Of the five protozoa parasites isolated from the stool analysis, *Entamoeba histolytica* was the predominant parasite 58.1% followed by *Trichomonas hominis* 19.4% and *Cryptosporidium spp* 3.2% as the least seen parasite. This finding agrees with the work of Mohammed *et al*., (2015) and Tyoalumun *et al*., (2016) who also reported *Entamoeba histolytica* as the predominant parasite 36.0% followed by *Giardia lamblia* 18.4% and 51.0%, 29.0% respectively. This result however disagrees with the work of Belkessa *et al*., (2021) that reported *Blastocystis* 15.8% in Algeria as the most seen protozoa parasite while Atu *et al*., (2014) reported *Giardia lamblia* 19.7% as the predominant protozoa parasite with *Entamoeba histolytica* as the least seen protozoa parasite in "Zone C" area of Benue state, north central Nigeria. This parasite variation can be as a result of the different environmental and weather conditions as well as hygiene and awareness levels of the patients and inhabitants of Awka. In the age distribution of nosocomial gastrointestinal protozoa infections, the highest prevalence of 28.6% occurred in the 10-19years age group while the least 9.1% was seen in the 40-49years age group. The difference between age groups in the research was however not statistically significant (P=0.589). The result contradicts the work of Dogara *et al*., (2017) in northern Nigeria, who reported higher prevalence 29.2% among the 40-49years age group and Wuranek *et al*., (2021) that reported highest prevalence 38.89% within the age group of 50-69years and least 12.50% in the 0-30years' bracket. However, the result is similar to the work of Shinkafi and Muhammad, (2017) that reported higher prevalence of 60% among the younger age group of 6-8 and 9-10 years respectively. This age prevalence could be as a result of the more playful nature of children and their ignorance of the protozoa infectious agents as well as poor hand washing practices. On the gender distribution of nosocomial gastrointestinal protozoa infections, female patients were found to be more infected 16.2% compared to 13.3% prevalence by men. This outcome agrees with the findings of Essendi *et al*., (2021) that reported 13.30% in females to 7.84% in males. The result however, differs from studies conducted by Yallew *et al*., (2017) that documented higher prevalence of 58.7% in males to females 41.2%. The reason for this gender prevalence disparity is unclear considering the fact that equal number of samples were analyzed for both male and female patients. However, females are likely to pick up infections because of the nature of their genitalia, hair styling and menstrual period. In another discovery, duration of hospital admission was found to be highly significant (P=0.000). Patients who were admitted for >30 days

recorded the highest protozoa infection rate of 89.5% while no infection was found in patients who were admitted for only 0-5days. This indicate that, the more days spent in a hospital, the greater the risk of being infected. This result corresponds to earlier studies conducted by Meric *et al*., (2005) who also reported higher prevalence of 82.7% in patients that stayed for >7days. This result is higher than the findings of Oznur *et al*., (2011) that reported higher prevalence in patients that spent 33.92 ± 27.02days on admission (P =0.00) and Wang *et al*., (2019) who also documented highest prevalence of 52.7% among patients that were admitted for ≥60days P=0.000. However, this result contradicts studies carried by Wuranek *et al*., (2021) whose result showed that the number of infected patients decreases with duration of hospitalization [0-30days (20.89%); >180days (18.05%)]. In terms of ward admitted into, paediatric ward recorded the highest nosocomial gastrointestinal protozoa infection 20.0% with surgical ward having the least infection rate of 10.4% although the result was statistically insignificant. This result however, is in contrast to the work of Meric *et al*., (2005) and Yallew *et al*., (2017) who both published higher prevalence of 82.6% and 48.6% in the surgical wards. This ward prevalence variation may be as a result of the length of stay, complex medical procedure and use of medical devices for insertion that differs within the paediatric and surgical wards. On the other hand, patients level of education although statistically insignificant revealed higher prevalence of 25.0% among patients in the primary education category compared to the lower prevalence of 9.3% observed in the tertiary level of education. This result is consistent with the work of Yeshitila *et al*., (2020) who reported 28.4% prevalence in patients from grade 1-3. However, the result of the present study is lower than 58.1% documented by Eshetu *et al*., (2019) among patients from school level 1-6years and the 37.4% published in Kenya by Rop *et al*., (2016) among unschooled children. The high level of infection observed with the lower school category which basically consist of children can be due to their very active and playful nature which always bring them in close contact with objects, soil, dirt etc. Also, the distribution of nosocomial gastrointestinal protozoa infection was found to be highly significant P=0.007 with respect to how often patients wash their hands before introducing any substance into the mouth. Patients who only wash their hands sometimes before introducing any substance into the mouth revealed the highest prevalence of 20.7% and the least infection rate of 3.2% in patients who always wash their hands before introducing any substance into the mouth. The result of this research is comparable to the studies conducted in northern Ethiopia by Yeshitila *et al*., (2020) 30.4% (P=0.001). Several studies conducted worldwide by different scholars have also established that hand washing is the most effective way of reducing infection. For instance, Berhe *et al*., (2020) reported that individuals who had not wash their hands before meal are 3.3 times more at risk of acquiring protozoa infections than those who always wash their hands before a meal. This observed prevalence is most certainly through oral route which involve hand to mouth transmission of infectious agents through contact with contaminated materials, objects or substances. The full burden of hospital acquired intestinal protozoa infection could not be captured as this study was limited to in-hospital assessment leaving out patients who may potentially develop nosocomial infection after discharge. Notwithstanding, this study still provides a reasonable amount of information concerning nosocomial intestinal protozoa infection that can help inform interventions as well as serve as

baseline data for future studies and comparisons.

Health promotion implications of the findings

The hospital environment is a war front to conquer both prevailing and underlying diseases. Even though parasitic infections, communicable diseases and antimicrobial resistance is on the rise, health care seekers should not contact diseases from the health facilities other than the disease they are seeking cure for. The burden associated with the affordability of health care services is already weighing heavily on the Nigerian masses given the current economic constraints. More burdens should not be added to hospitalized patients through hospital acquired infections.

Thus, there is a pertinent need for consistent sensitization of medical personnel, patients and caregivers to reduce HAI in our hospitals. However, sensitization without proper monitoring and supportive supervision to ensure compliance may not yield the expected outcome. Training and retraining of hospital attendants on the importance of consistent hygiene in the hospital environment with administrative support in the provision of relevant equipment and reagents cannot be overly emphasized. Personal and environmental hygiene should be promoted in the hospital environment by the implementation of environmental laws and regulations. Above all, hospitals should set up nosocomial infection control unit to champion the course of reducing nosocomial infection to zero level.

Conclusion

The findings of this study showed that nosocomial gastrointestinal protozoa infection occurred in the study hospitals with an overall prevalence of 14.8%. Entamoeba histolytica was the most predominant protozoa parasite detected among hospitalized patients. Duration of hospitalization and handwashing habit before introducing any substance into the mouth were statistically associated with the distribution of nosocomial gastrointestinal protozoa infections. The study hospitals and all health care facilities in general are hereby encouraged to set up nosocomial infection control units" in their hospitals, ensure constant training and retraining of medical personnel on infection control practices as well as routine education of hospitalized patients, relatives and visitors on the importance of maintaining good personal hygiene. More so, studies should be carried out to assess the awareness and knowledge of hospital acquired infections among the public to inform interventions in that regards.

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Conflict of interest

The authors declare that they have no conflict of interest

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