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MONETARY COST OF NOSOCOMIAL INFECTIONS IN PAEDIATRIC WARDS OF A UNIVERSITY TEACHING HOSPITAL IN NORTH- WEST NIGERIA: A RETROSPECTIVE STUDY

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Abstract

Study on the monetary cost of bacterial nosocomial infections in the paediatric wards of a University Teaching Hospital in the North West of Nigeria was carried out. The study was done retrospectively by analysing all the reported cases of patients with bacterial infections admitted into the paediatric wards of the hospital as contained in their case files, over a period of one year (January 2010-December 2010,). The following information was retrieved; age, sex, clinical diagnosis on admission, duration of hospital stay, bacterial infection diagnosed, laboratory data and the antibiotics used with their costs. The cases of bacterial nosocomial infections were established when patients have infections not present or incubating at the time of admission to the hospital or a positive bacterial culture from a focus of infection had on repeat culture from the same focus a different bacterial agent. The data collected were statistically analyzed using SPSS version 17.0. Comparisons were made between mean duration of hospital stay, costs of antibiotics and laboratory investigations of patients with various clinical forms of bacterial nosocomial infections, and duration of hospital stay of patients, costs of antibiotics and laboratory investigations of patients with similar clinical forms of non-nosocomial (community-acquired) bacterial infections. The results showed that a total of 109 out of 1002 patients acquired hospital infections this represent 10.88%. The total cost of managing these hospital acquired infections was estimated at N2, 009, 610.00. The mean cost of antibiotics for managing the Nosocomial infections was greater than that for non-nosocomial infections and this difference between the two groups was statistically significant ($p < 0.001$). The mean cost of laboratory investigations for patients with nosocomial infection was higher than that of patients with non-nosocomial infections. However, the difference was not statistically significant ($p > 0.05$). The mean cost of accommodation for patients with nosocomial infections was also higher.

Key Words: Cost of nosocomial, infections, antibiotics in nosocomial, Length of hospital.

Introduction

Nosocomial infection is defined as an infection occurring in a patient during the process of care in a hospital or other health-care facility that is not manifested or incubating at the time of admission. This includes infection acquired in the hospital and any other settings where patients receive health care, and may appear even after discharge (Nejad *et al.*, 2011). As a general timeline, infections occurring more than 48 hours after admission are usually considered nosocomial. Hospital acquired infections (HAI) also include health care associated infections (HCAI) and occupational infections among health facility staff (Nejad *et al.*, 2011). Nosocomial infections represent an important public health problem in both developing and developed

countries. Data from some developed nations indicated that between 20,000 and 50,000 deaths occur annually in the USA and UK respectively due to HAI (Plowman *et al.*, 1997). Nosocomial infections increase the mortality and morbidity of patients imposing additional economic and social costs. Such infections increase length of hospital stay and add considerably to the original cost of hospital intervention. These infections, when caused by multi-drug resistant pathogens, take a heavy toll on patients and their families by causing illness, prolonged hospital stay, potential disability, excess costs in laboratory cultures of pathogens, extra antimicrobial treatment and sometimes can lead to death (Nejad *et al.*, 2011). The antibiotic cost varies markedly according to site and type of infection. Pneumonia

and blood stream infections are associated with the highest daily antibiotic costs. Surgical site infections have also high daily antibiotic cost (Coello *et al.*, 1993). Clearly, antimicrobial treatment of patients with multiple nosocomial infections might be even more expensive. Expensive antibiotics, such as piperacillin-tazobactam, carbapenems, cefepime, ciprofloxacin, teicoplanin are prescribed more commonly than the cheaper ones, because the infections for which they were prescribed are caused by the antibiotic resistant organisms, such as gram-negative nosocomial pathogens and ventilator-associated pneumonia agents (Yalcin *et al.*, 2002). In 2002, an estimated 1.7 million healthcare-associated infections occurred in the United States, resulting in 99,000 deaths accompanied with a report estimating overall annual direct medical costs of healthcare-associated infections of \$28 to 45 billion (CDC, 2009). In addition to the costs incurred by the health sector there are private costs incurred by the patient and those who provide informal care for them. These costs could be financial, such as additional medications, travel costs, cost of laboratory tests, and other hospital charges. Recent reports related to HAI in Europe suggest a prevalence rate ranging from 4.6%-9.3%. About 5 million cases of HAI occur in acute care hospitals annually resulting in 135,000 deaths/year. This amounts to 25% extra days of hospital stay and an economic burden of 13-24 billion Euros (Pittet *et al.*, 2008). In 2002, HAI rate in the United States of America was 4.5% which translated to 9.3 infections per 1000 patient days and 1.7 million affected patients. This yielded an annual economic burden of \$6.5 billion in 2004. Incidence of HAI in developed countries range from 9-37% in Europe and USA with crude estimates of mortality rates of 12-15%. In ICU settings, the use of invasive devices is one of the most important risk factors for acquiring HAI. Catheter related bloodstream infections caused by MRSA may cause US\$ 38,000 per episode. Sixty percent of the infections were pneumonias, 20% were abdominal and 15% were urinary tract infections (Nejad *et al.*, 2011). Reliable estimates of the prevalence of HAI in developing countries are hampered by paucity of data adequately describing endemic infections at national and regional levels. A retrospective survey of records from the infection control unit of the University

College Hospital, Ibadan, Nigeria, was carried out in the year 2005-2009. The prevalence of HAI over the 5-year period was 2.6%. Surgical and medical wards had the most infections (48.3%) and (20.5%) respectively. Urinary tract infection (UTI, 30.7%) and surgical site infection (43.9%) were the most prevalent HAI. UTIs were significantly higher in surgical and medical wards; surgical site infections in obstetrics and gynaecology wards; and soft tissue infections and bacteraemia in paediatric wards ($P < 0.05$). Gram-negative infections occurred about four times as often as gram-positive infections with *Klebsiella sp.* and *staphylococcus aureus* being the predominant isolates (34.3%) and (20.1%) respectively (Ige *et al.*, 2011). To the best of our knowledge there had been no previously published studies on either the cost or prevalence of nosocomial infections in the tertiary healthcare institution in the North-West where the study was carried out.

Materials and methods

The Study Area

The study was conducted at the Department of Paediatrics, of a University Teaching hospital in the North-West of Nigeria. The Department consists of the Paediatric Medical Ward (PMW), Emergency Paediatric Unit (EPU), the Paediatric Clinic and the Special Care Baby Unit (SCBU).

Ethical Issue.

Ethical clearance was obtained from the ethical committee of the hospital

Study Design

The study was done retrospectively. All the case files of patients with bacterial infections admitted into the paediatric wards of the hospital, over a period of one year (January to December 2010,) were retrieved and analysed, with the aim of identifying bacterial nosocomial infections, and the financial burden of these infections. The following information: hospital number, age, sex, tribe, socioeconomic status of parents (occupation of mother and father), date of admission, date of discharge, outcome (recovered fully, improved, died or discharge against medical advice, DAMA), duration of stay in hospital, initial

diagnosis warranting admission, bacterial infective process clinically diagnosed: bacterial pneumonias (lobar pneumonia, bronchopneumonia), empyema thoracis, meningitis, septicaemia, septic arthritis, osteoarthritis, upper respiratory tract infections (tonsillopharyngitis, otitis media, sinusitis) urinary tract infections, pyoderma, soft tissue infections (abscess, pyomyositis), purulent conjunctivitis, umbilical sepsis and bacterial gastroenteritis.

The method of Ige *et al* (2011) was used to clinically distinguish between hospital acquired infections and community acquired infections in patients admitted in hospital. Patients with infections not present and without the evidence of incubation at the time of admission to the hospital meet the criteria for nosocomial infections. Available data on bacteriological findings on such patients were recorded. Another criterion employed for identification of nosocomial infections in this study was, patients with a positive bacterial culture from a focus of infection, had on repeat culture from the same focus a different bacterial agent, then the second bacterial pathogen was assumed to be nosocomially acquired.

For each patient, all the antibiotics used in the management of the bacterial infections were recorded. The route of administration of the antibiotics, the daily doses and the duration of treatment were also recorded. In determining the cost of management of bacterial infections, only the following cost implications were considered for each patient: total cost of all the antibiotics used, and cost of relevant laboratory and radiological investigations. Other costs of management, such as I.V. fluids, cost of delivery of drugs, feeding, transportation, blood transfusion, use of drugs other than antibiotics, oxygen therapy, surgical procedures, nutritional rehabilitation (in cases of protein energy malnutrition) were not included in the calculation because such treatments are not specific to infections and the usage of these vary greatly from patient to patient. For calculating the cost of relevant laboratory and radiological investigations for each patient, the hospital price list of 2010 and those of major private were used for the calculation of the cost of antibiotics used on each patient. Where there is a

difference between the prices, the average price of the three pharmacy shops was used.

A total of 2454 patients were admitted and discharged in the paediatric wards and SCBU with various diagnoses during the period under review. Of these, 1005 (41%) cases were due to various types of bacterial infections and 3 were excluded from further analysis, because of incomplete data (no records on treatment or investigations. during the period under review therefore (January 2010 to December 2010) 1002 patients who satisfied the inclusion criteria were analyzed. There were 655 (65.4%) males and 347 (34.6%) females. Out of the 1002 cases of bacterial infections, 109 (10.9%) were considered to have nosocomial infections. The remaining 893 (89.1%) were cases of community acquired bacterial infections. (Fig 1)

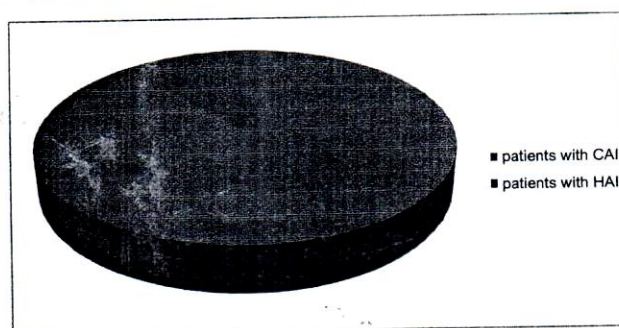


Fig. 1 Prevalence of bacterial nosocomial infections among cases admitted and discharged due to bacterial infections in paediatric wards. CAI = Community acquired infections; HAI = Hospital acquired infections (nosocomial infections)

Among the 109 cases of hospital acquired infections, 72 (66.1%) were males and 37 (33.9%) were females. Out of the 109 patients with nosocomial infections, 32 (29.4%) were septicaemia, 22 (20.1%) pneumonia, 11 (9.2%) septic arthritis, 19 (17.4%) urinary tract infections (UTI), 11 (9.2%) bacterial gastroenteritis, and 14 (12.8%) multiple infections (more than one nosocomial infection) Fig 2.

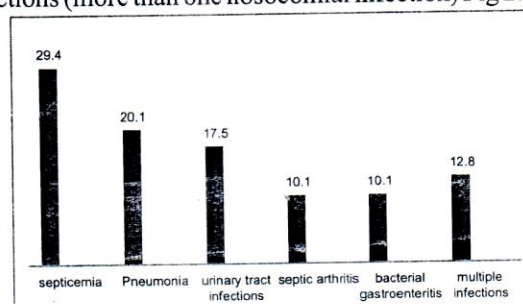


Fig 2: Sites of nosocomial infections in 109 patients admitted in paediatric wards between January and December 2010

The duration of hospital stay in 32 cases of nosocomial bacterial septicaemia ranged from 2 days to 13 days (mean = 5.8 days SD = $\pm$ 3.1 days), while the duration of stay in those with septicaemia (215 cases) originating from non-nosocomial source ranged from 1 days to 10 days; (mean = 4 days SD = $\pm$ 4.6). Patients with nosocomial septicaemia stayed much longer in hospital than those with septicaemia due to non-nosocomial septicaemia. The difference in the length of stay in hospital between the two groups is highly statistically significant ($t = 3.208$; $df = \infty$; $p < 0.001$). The means of duration of hospital stay in those with nosocomial bacterial infections and those with non-nosocomially acquired bacterial infections are depicted in Figure 3. The duration of hospital stay in those with nosocomial bacterial pneumonia and those with nosocomial UTI was longer than in those with the non-nosocomial pneumonia and non-nosocomial UTI respectively (Fig.3).

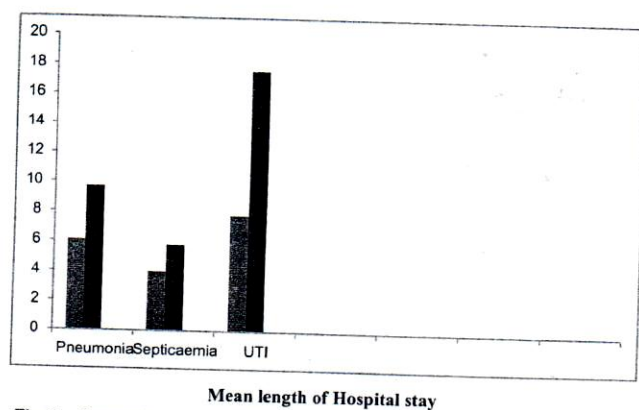


Fig 3: Comparisons of mean duration of hospital stay in patients with community-acquired bacterial infections and those with nosocomial infections

Key: Blue bars = patients with non-nosocomial infections; Red bars = patients with nosocomial infections

However these differences in the duration of hospital stay between the patients with nosocomial infections and those with non-nosocomial infections with regards to pneumonia and UTI were not statistically significant ($p > 0.5$ for pneumonia; $p > 0.1$ for UTI). The mean cost of management (cost of antibiotics, investigations and accommodation) of 215 patients with non-nosocomial septicaemia was N2839 (range: 600-10, 850); while the mean cost of management of 32 patients with nosocomial bacterial septicaemia was N11, 618 (range: 4,830-20,400). The cost of managing nosocomial septicaemia was higher than managing non-nosocomial septicaemia (see Fig.4).

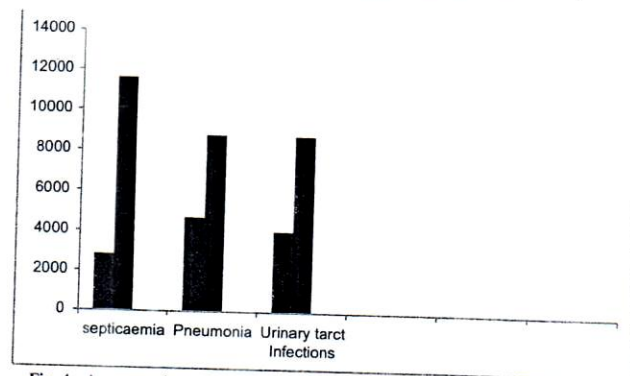


Fig 4: A comparison between the mean costs of patients with nosocomial infection and those with non-nosocomial infections

Key: Red= Patients with nosocomial Infections; Blue= patients with non-nosocomial Infections

However, the difference in the mean cost of management between the two groups of patients was not statistically significant ($p > 0.05$; $df = \infty$; $t = 683.427$). With regards to pneumonia, the cost of managing nosocomial bacterial pneumonia was also higher than that of managing non-nosocomial bacterial pneumonia (Fig.4). However, the difference in the cost of management between the two groups was also not statistically significant ($p > 0.05$; $df = \infty$; $t = 7.157$). Concerning UTI, the cost of managing the nosocomial type is higher than that of non-nosocomial form, and the difference was statistically significant ($p < 0.02$; $df = \infty$; $t = 2.568$ Fig.4).

Table 1: Cost Implications of Nosocomial infections according to sites

Site of infections	Cost of hospitalization in naira			
	Accommodation subsidy	Antibiotics	Laboratory	Total
Septicaemia (n=32)	55,500	321,090	61,400	437,990
Pneumonia (n=22)	58,200	150,840	30,550	239,590
Septic arthritis (n=11)	85,200	417,020	172,150	674,370
UTI (n=19)	58,200	62,400	63,400	184,000
Bacterial gastroenteritis (n=11)	81,000	64,900	19,800	165,700
Multiple infections (n=14)	96,600	158,160	53,200	307,960
Total	434,700	1,174,410	400,500	2,009,610

*Note that there are no charges for hospital accommodation for children. The figures shown under cost of accommodation are the amounts lost by Government as subsidy for free accommodation for children

The break-down of costs of managing nosocomial infections according to site of infection is depicted in Table I. The total

cost of managing all forms of bacterial nosocomial infections- covering cost of antibiotics, investigations and accommodation in the 109 patients, during the review period, was N 2,009,610.00.

The mean cost of antibiotics used for treatment of patients with non-nosocomial infections was N 3,900 (range: N200-N31,400) while the mean cost of antibiotics used in the management of those with nosocomial infections was N12090 (range: N2930-42820). The mean cost of antibiotics for managing nosocomial infections was greater than that for non-nosocomial infections (fig 5).

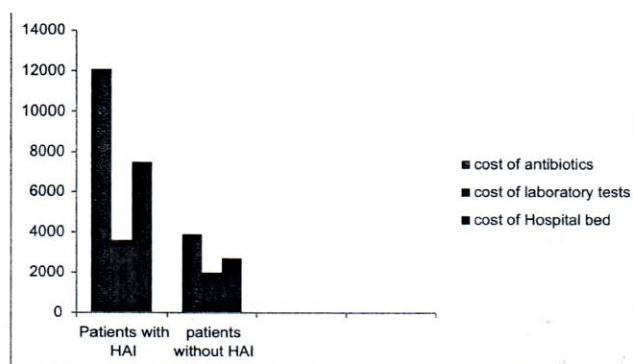


Fig 5: Comparison between the mean cost of antibiotics, laboratory investigations and hospital accommodation per patient for patients with HAI and patients with Non-nosocomial infections

The difference between the two groups was statistically significant ($t = 3.4495$; $df = \infty$; $p < 0.001$; fig 5). With regards to laboratory investigations, the mean cost for patients with nosocomial infections was N3200 (range: N400-N15650) while for patients with non-nosocomial infections, the mean cost was N2000 (range: N200-N5950). The mean cost of laboratory investigations for patients with nosocomial infection was higher than that of patients with non-nosocomial infections (fig 5). However, the difference was not statistically significant ($t = 0.67128$ $df = \infty$; $p > 0.05$;). The mean cost of hospital accommodation for patients with nosocomial infections was N3600 (range: N900-N7500); while that of patients with non-nosocomial infections was N2700 (range: N300-N6000). The mean cost of accommodation for patients with nosocomial infections was higher (fig 5). However, the difference between the two groups was not statistically significant ($t = 0.36879$; $df = \infty$; $p > 0.05$;).

Discussion

In this study, a total of 1,002 patients with bacterial infections were analyzed. Of this number, 109 (10.9%) had nosocomial infections. This agreed with the study of Plowman *et al.*, (1997) which showed that approximately one in ten hospitalised patients will acquire an infection after admission to the hospital. The result also agreed with the WHO prevalence rate of nosocomial infections (WHO

2005) which is between 5-10% but disagrees with the study by Pittet *et al.*, (2008) which reported that the prevalence in developed countries exceeds 25%. According to this study, there is preponderance of males over females in cases with bacterial nosocomial infections (male: female ratio = 2:1). Out of the 109 patients with nosocomial infections, 72(66.1%) were males while 37(33.9%) were females. The distribution of nosocomial infections according to site in this study indicated that out of the 109 patients with nosocomial infections, 32 (29.4%) had septicaemia, 22 (20.2%) had pneumonia and 19 (17.5%) urinary tract infections. These results are comparable to the study by Michael *et al.*, (1998) which shows that septicaemia, pneumonia and Urinary tract infections were the most common types of nosocomial infections in paediatric Intensive Care Unit (ICU). Also, in the study carried out by Ige *et al.*, (2011) septicaemia was also the most common type of nosocomial infection in the paediatric ward.

Comparisons between the mean length of hospital stay of patients with various clinical forms of bacterial nosocomial infections, and duration of hospital stay of patients with similar non-nosocomial (community-acquired) bacterial infections showed that patients with nosocomial infections stayed longer in the hospital. This finding is supported by Plowman *et al.*, (1999). The mean duration of stay for patients with nosocomial septicaemia was 5.8 days, patients with pneumonia stayed in the hospital for an average of 9.7 days and those with nosocomial urinary tract infections, stayed in the hospital for an average of 20.3 days. This is in contrary to the result of Mermel *et al.*, (2001), where it was reported that, patients with nosocomial septicaemia, pneumonia, and UTI stayed in the hospital for an average of 7, 4-13, and 1-3 days days, in the hospital. Comparisons between costs of management of patients with non-nosocomial bacterial infections and those with nosocomial infections were made. The mean costs of management (cost of antibiotics, investigations and accommodation) of patients with bacterial nosocomial infections were remarkably higher than in patients with non-nosocomial infections this finding is supported by Coello ., (1993). This study showed that the total cost of management of hospital acquired infections in the paediatric ward from January 2010- December 2010 stood at N2, 009,610.00. this cost was incurred by patients as a result of bacterial nosocomial infections during the review period. Of the N2, 009,610, a total of N434, 700 was spent by the government as subsidy for hospital accommodation in the paediatrics wards. Patients spent a total of N1, 174,610 (58.4%) on antibiotics, this agrees with the findings of Yalcin *et al.*, (2002) which showed that the major cost of nosocomial infections is attributable to the cost of antibiotics. Ker *et al.*, (1992) also found the cost of antibiotics in treatment of nosocomial infections to be markedly high.

Patients with nosocomial septicaemia spent a total of N437,990, those with pneumonia spent a total of N239,590, those with septic arthritis spent a total of N674,370 and those with UTI spent N184,000 this study is comparable to but different to that of Jarvis et al. (2002). Jarvis et al reported that the estimated costs of nosocomial infections were \$558 to 593 for each urinary tract infection, \$2734 for each surgical site infection, \$3061 to 40000 for each bloodstream infection, and \$4947 for pneumonia (Jarvis et al., 1991). Although these costs of HAI may be different in different countries and may change with time, the magnitude remains the same (Plowman, et al., 1999). The costs of nosocomial infections are huge and include cost of antibiotics, laboratory and radiological investigations and hospital accommodation. Hospital acquired infections are resistant to most conventional antibiotics and their treatment is very difficult. This adds to the increase in cost of antibiotics and increase duration of hospital stay in patients with nosocomial infections. Prospective study to Further characterize in details the specific species of bacteria isolates from the hospital environment, healthcare workers and patients with nosocomial infections is desirable. The study was limited to only the paediatric wards, and did not cover other departments in the hospital. Retrospective study is usually not free from the flaws such as; poor recording or lack of details on some relevant aspects. This work is not an exception to this flaw.

Reference

- Coello, R., Glenister, H., Fereres, J., Bartlett, C., Leigh, D., Sedgwick, J. and Cooke, E. (1993) the cost of infection in surgical patients: A case control study, *Journal of Hospital Infection*, 25, 239
- Ige OK, Adesanmi AA, Asuzu MC. (2011). Hospital-acquired infections in a Nigerian tertiary health facility: An audit of surveillance reports. *Nigerian Medical Journal*; 52:239-43
- Jarvis WR: (1996). Selected aspects of socioeconomic impact of nosocomial infections: morbidity, mortality, cost, and prevention. *Infect Control Hosp Epidemiol*, 17:552-557.
- Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE (2001). Guidelines for the management of intravascular catheter-related infections. *Clinical Infectious Disease* ; 32:1249-1272.
- Michael J. Richards, Jonathan R. Edward, David .H. C, Robert D Gaynes (2011). Nosocomial infections in paediatric ICU in United States, The national nosocomial infection surveillance system. Vol 2.

Nejad Sepideh Bagheri a, Benedetta Allegranzi a, Shamsuzzoha B Syed b, Benjamin Ellis & Didier Pittet (2011). Health-care-associated infection in Africa: a systematic review

Pittet D. (2008). Infection Control as a major World Health Organization priority for developing countries. *Journal of Hospital Infection*; 68:285

Pittet D, Allegranzi B, Storr J, Bagheri Nejad S, Dziekan G, Leotsakos A, et al. (2008). Infection control as a major World Health Organization priority for developing countries. *J Hosp Infect.*; 68:285-92.

Plowman, R.P., Graves, N. and Roberts, J.A. (1997) *Hospital Acquired Infection*, Office of Health economics, London

Plowman, R.P., Graves, N., Griffin, M., Roberts, J.A., Swan, A.V., Cookson, B.C. and Taylor, L. (1999). *The Socioeconomic Burden of Hospital Acquired Infection*, Public Health Laboratory Service, London.

Yalcin AN, Turgut H, Cetin CB, Tefci F (2002): Cost of antimicrobial therapy in nosocomial infections In Turkish. *Turkish Journal of Hospital Infection*, 6:41-45.