

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.606.380>

Prevalence of Bacterial Species Involved in Nosocomial Infections in Pediatrics Unit at Butare University Teaching Hospital (Chub)

Claude Bayingana^{1*}, Jean Bosco Gahutu¹, Augustin Sendegeya², Felix Habarugira², Caritas Mukumpunga², Francois Lyumugabe³ and Jules Ndoli²

¹University of Rwanda, College of Medicine and Health Sciences, Butare, Rwanda

²Butare University Teaching Hospital, Butare, Rwanda

³University of Rwanda, College of Sciences and Technology, Butare, Rwanda

*Corresponding author

ABSTRACT

Nosocomial infection (NI) is an infection acquired in hospital or other healthcare facilities by a patient in whom the infection was not present or incubating at the time of admission. Over 1.4 million people worldwide suffer from infectious complications acquired in hospital and the later are among the major causes of death and increased morbidity among hospitalized patients. Aiken *et al.*, (2011) found that NIs in sub-Saharan Africa is the major cause of death in children. The WHO Patient Safety program did a systematic review of health-care-associated infection in developing countries between 1995 and 2008 and found no reports about nosocomial bacteraemia in adults or children in Africa. The aim of this study was to provide knowledge on the prevalence of nosocomial infection in pediatric unit of Butare University Teaching Hospital (Rwanda). Nosocomial infections surveillance method and definition of infections described by CDC/NHSN (Horan *et al.*, 2008) were used. The present study showed that the prevalence of nosocomial infection was very high (12.1 %) and the main bacteria causing NIs in pediatric unit were *Klebsiella pneumonia*, followed by *E. coli* and *Staphylococcus aureus*. Nosocomial Low Respiratory Infections were the most prevalent. These data can be used as baseline for effective and sustainable infection control measures at Butare University Teaching

Keywords

Prevalence,
Bacteria,
Nosocomial
Infections

Article Info

Accepted:
15 May 2017
Available Online:
xx June 2017

Introduction

Nosocomial infection (NI) is an infection acquired in hospital or other healthcare facilities by a patient in whom the infection was not present or incubating at the time of admission. Nosocomial infections also called Hospital-acquired infections (HAI) are a major public health problem all over the world, but particularly in developing nations. Factors which promote nosocomial infections includes: the increasing variety of medical procedures and invasive techniques creating

potential routes of infection; decrease immunity among patient and the transmission of drug-resistant bacteria among crowded hospital populations, where poor infection control practices may facilitate transmission (WHO). A study done in Norway between 2002 and 2003 showed that nosocomial infection varied between 5.1 % and 5.4 % while in another study done in the University medical Center of Rabat in Morocco in 2012 the prevalence was 10.3 % (Eriksen *et al.*, 2005;

Razine *et al.*, 2012). A prevalence survey conducted in 55 hospitals of 14 countries representing 4 WHO regions found an average of 8.7 % of patients with NIs. Over 1.4 million people worldwide suffer from infectious complications acquired in hospital and the later are among the major causes of death and increased morbidity among hospitalized patient (WHO).

In Africa, where many hospitals are severely overcrowded, and frequently suffering from shortages of basics supplies such as clean linen and running water, no data exist on the prevalence of NIs (Aiken *et al.*, 2012). The WHO Patient Safety programme did a systematic review of health-care-associated infection in developing countries between 1995 and 2008 and found no reports about nosocomial bacteraemia in adults or children in Africa (Nejad *et al.*, 2011). Nosocomial infections are the most cause of illness and death in children (Aiken *et al.*, 2012). To our knowledge there is no data in Rwanda and particularly at the University Teaching of Butare (CHUB) on the Prevalence of bacterial species involved in nosocomial infections. The aim of this study was to provide knowledge on the prevalence of nosocomial infection in pediatric unit of CHUB where cases of nosocomial infections were suspected in the past two years, forming the prerequisites for effective and sustainable infection control measures.

Materials and Methods

Ethical clearance was obtained from the IRB of the College of Medicine and Health Sciences of the University of Rwanda. All inpatients of pediatric unit of CHUB from the 1st of June to the 30th of November 2015 were enrolled in this study to investigate clinical illness both on admission and during hospital stay. A written consent was obtained from their parents or guardians. Nosocomial infections surveillance method and definition

of infections described by CDC/NHSN (Horan *et al.*, 2008; Emori *et al.*, 1991) were used. Demographic data, date and site of infection were collected for each patient. Nosocomial Infection was defined as new infection which occurs after 48 hours of admission. Pathogens associated with each nosocomial infection site were reported. Coagulase-negative *Staphylococci*, *Bacillus* spp, *Micrococcus* spp, and viridans group *Streptococci* bacteria were regarded as contaminants. For statistical analysis, software packages “SPSS”, and “EpiInfo” were used.

Results and Discussion

From June to November 2015, four hundred seventy six children were admitted in pediatric department of Butare University Teaching Hospital (BUTH). Among these, 12.10 % had nosocomial infections during their stay in the hospital. The prevalence of NI per month from June to July was: 13.4, 20, 6.17, 8.41, 11.11 and 15.78 respectively (Table 1). Among all cases of nosocomial infections, 46, 55 % were Low Respiratory Infections (LRI), 36.2 % were Blood Stream Infections (BSI) and 17.24 % were Urinary Tract Infections (UTI). The prevalence of LRI due to Nosocomial Infections was high in July with 71.42 %, followed by November 58.33 % and June with 54.54 % (Table 2). For BSI due to NIs, October had the highest prevalence with 57.14 %, followed by November with 41.66 %, August with 40 %, June with 36.36 %, September with 33.33 % and July with 21.42 %. About UTI due to NIs, August had the highest prevalence with 60 %, followed by October with 42.85 %, September with 22.22 %, June with 9.09 and July with 7.14 % (Table 2).

Among all the recorded cases of nosocomial infections, 51.66 % were caused by *Klebsiella pneumoniae*, 20 % *Escherichia coli*, 18.33 %

Staphylococcus aureus, 3.33 % for *Acinetobacter* and *Enterobacter* each and 1.66 % for *Streptococcus pneumoniae* and other Gram positive cocci each. Among all cases of NIs caused by *Klebsiella pneumoniae*, 80.64 % were for LRI, 12.90 % BSI and 6.41 % UTI. For NIs caused by *Escherichia coli*, 50 % were BSI and 50 % UTI. About NIs caused by *Staphylococcus aureus*, 81.81 % were BSI, LRI (9.09 %) and UTI (9.09 %) (Table 3).

Among all LRI caused by NIs, 92.59 were caused by *Klebsiella pneumoniae*, *Enterobacter* (3.703 %) and *Staphylococcus aureus* (3.703). For BSI caused by NIs, 39.13 % were due to *Staphylococcus aureus*, *Escherichia coli* (26.086 %), *Klebsiella pneumoniae* (17.391 %), *Acinetobacter* (8.695 %), *Streptococcus pneumoniae* (4.347 %) and Gram + Cocci (4.347 %). For UTI, 60 % of NIs was caused by *Escherichia coli*, *Klebsiella pneumoniae* (20 %), *Staphylococcus aureus* (10 %) and *Enterobacter* (10 %) (Table 4).

The objective of this study was to provide knowledge on the prevalence of nosocomial infection in pediatric unit of CHUB. The study was conducted from the 1st of June to the 30th of November 2015. The average prevalence of nosocomial infections was 12.10 %. This figure is very high comparing with studies done elsewhere. A multicenter study done in Europe in 2000 found that the average incidence of nosocomial infection was 2.5 % (Raymond and Aujard, 2000).

Another study done in an Iranian referral hospital found an overall incidence of NIs of 3.34 % 9 months.

Which had a high incidence of NIs were June-July (13.4 and 20 %) and October-November (11.11 and 15.78 %).

August and September had a low rate of NIs with 6.17 and 8.41 % respectively. The decrease of NIs in August and September may be due to the absence of medical school students who are in holiday and this may be supported by the increase of NIs in October and November where medical students are back from holiday. Suchitra *et al.*, (2007) reported that 27 % of health care students had insufficient knowledge about infection control (Pourakbari *et al.*, 2012).

This study showed that 46.55 % of NIs were LRI, 36.2 % were BSI and 17.24 % were UTI. Some previous studies found that LRI was the most common site of infection (Pourakbari *et al.*, 2012; Abramczyk *et al.*, 2003) while others found BSI as the most frequent NI (Urrea *et al.*, 2003; Richards *et al.*, 1999, Grohskopf *et al.*, 2002). The high prevalence of LRI and BSI nosocomial infections at CHUB pediatrics patients could be explained by the high frequency of use of Nasogastric tube (NGT) and Peripheral venous Catheter (PVC). NGT and PVC are considered independent risk factors for NIs (Belvisi *et al.*, 2012; Dasgupta *et al.*, 2015; Geffers *et al.*, 2010).

Table.1 Prevalence of nosocomial infection in the six months of the study

	June	July	August	September	October	November	June- November
No of admissions for more than 48 hours	82	70	81	107	63	76	476
% of NI	13.4	20	6.17	8.41	11.11	15.78	12.10

Table.2 Percentage of NI by infection types

Percentage of NI by infection types							
	June	July	August	September	October	November	Total
LRI	54.54	71.42	0	44.44	0	58.33	46.55
BSI	36.36	21.42	40	33.33	57.14	41.66	36.2
UTI	9.09	7.14	60	22.22	42.85	0	17.24

Table.3 Type of infection associated with species involved in NIs

Pathogens	Percentage of type of Infection Associated with Species involved in NIs		
	LRI	BSI	UTI
<i>Klebsiella pneumoniae</i> (n = 31)	80.64	12.90	6.41
<i>Escherichia coli</i> (n = 12)	0	50	50
<i>Staphylococcus aureus</i> (n = 11)	9.09	81.81	9.09
<i>Enterobacter</i> (n = 2)	50	0	50
<i>Acinetobacter</i> (n = 2)	0	100	0
<i>Streptococcus pneumoniae</i> (n = 1)	0	100	0
Gram + Cocci (n = 1)	0	100	0

Table.4 Percentage of bacteria isolates associated with infection types

Pathogens	Percentage of isolates by infection type		
	LRI	BSI	UTI
<i>Klebsiella pneumoniae</i>	92.592	17.391	20
<i>Escherichia coli</i>	0	26.086	60
<i>Enterobacter</i>	3.703	0	10
<i>Staphylococcus aureus</i>	3.703	39.13	10
<i>Acinetobacter</i>	0	8.695	0
<i>Streptococcus pneumoniae</i>	0	4.347	0
Gram + Cocci	0	4.347	0

More than the half (51.66 %) of all cases of NIs in pediatric patients were caused by *Klebsiella pneumoniae*, followed by *Escherichia coli* (20 %) and *Staphylococcus aureus* (18.33 %). A previous study reported that *Klebsiella pneumoniae*, accounts for a significant proportion of hospital-acquired urinary tract infections, pneumonia, septicemias, and soft tissue infections. It was ranked among the most important cause of nosocomial infections because of their incidence of 5 to 7% of all hospital-acquired infections (Podschun and Ullmann, 1998). Among all cases of NIs due to *Klebsiella pneumoniae*, 80.64 % were for LRI, 12.90 % for BSI and 6.41 % for UTI (Table 3)

also among all LRI caused by NIs, 92.59 were *Klebsiella pneumoniae* (Table 4). Anton and David (2010) found that Hospital-acquired pneumonia is the most common life-threatening hospital-acquired infection, and the majority of cases were associated with mechanical ventilation. They also reported that Gram-negative were the predominate organisms in hospital-acquired pneumonia (Anton and David, 2010).

For NIs caused by *Escherichia coli*, 50 % were BSI and 50 % UTI and for *Staphylococcus aureus*, 81.81 % were BSI, LRI (9.09 %) and UTI (9.09 %) (Table 3). A previous study

showed that the most five predominant bacterial species in NIs are *Escherichia coli* (13.7%), *Staphylococcus aureus* (11.2%), *Enterococci* (10.7%), *Pseudomonas aeruginosa* (10.1%), and coagulase-negative *Staphylococci* (9.7%) (William and William, 1992).

Another study in USA showed that *E. coli* was the most common etiologic Gram-negative organism of hospital-acquired urinary tract infections, followed in descending order of frequency by *P. aeruginosa*, *Klebsiella* species, *Enterobacter* species, and *A. baumannii* (Hidron *et al.*, 2008). *Klebsiella* species, *Escherichia coli*, *Enterobacter* species, and *P. aeruginosa* were reported as the most common Gram negative organism in Nosocomial Blood stream infections (Anton and David, 2010).

A study done in USA found that Gram-positive organisms caused 65% of nosocomial BSIs and the most-common organisms causing nosocomial BSIs were coagulase-negative *Staphylococci* (CoNS) (31% of isolates), *Staphylococcus aureus* (20%), *Enterococci* (9%), and *Candida* species (9%) (Hidron *et al.*, 2008). in this study coagulase-negative *Staphylococci* were considered as contaminants.

The present study showed that the prevalence of nosocomial infection was very high (12.1 %) and the main bacteria causing NIs in pediatric unit were *Klebsiella pneumoniae*, followed by *E. coli* and *Staphylococcus aureus*. Nosocomial Low Respiratory Infections were the most prevalent. These data can be used as baseline for effective and sustainable infection control measures at Butare University Teaching Hospital.

Acknowledgement

This study was funded by the University of Rwanda. The authors would like to thank also the staff of the department of pediatric of the University teaching hospital of Butare for their co-operation and assistance.

References

- Abramczyk, M., Carvalho, W., Carvalho, E., Medeiros, E. 2003. Nosocomial Infection in a Pediatric Intensive Care Unit in a Developing Country. *Braz J Infect Dis.* 7 (6): 375-380.
- Aiken, L.H, Sermeus, W., Van den Heede, K, Sloane, D.M., McKee, M., Bruyneel, L., Rafferty, A.M., Griffiths, P, Moreno-Casbas, M.T, Tishelman, C., Scott, A., Brzostek, T., Kinnunen, J, Schwendimann, R., Heinen, M, Zikos, D., Sjetne, I.S., Smith, H.L., and Kutney-Lee, A. 2012. Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and the United States. *BMJ.* 2012; 344: e1717. Published online 2012 Mar 20. doi: 10.1136/bmj.e1717.
- Anton, Y. P. and David, C. H. 2010. Hospital-Acquired Infections Due to Gram-Negative Bacteria. *N Engl J Med*, 362:1804-1813
- Belvisi, V., Citton, R., Di Vincenzo, E., Del Borgo, C., Melucci, A., Cosentino, C. and Mastroianni, C.M. 2012. Nosocomial infections in an intensive care unit: predisposing role of enteral feeding tube in critically ill patients. *Prevention and Research* 1(2): 53-57.
- Dasgupta, S., Das, S., Chawan, N.S., Hazra, A. 2015. Nosocomial infections in the intensive care unit: Incidence, risk factors, outcome and associated pathogens in a public tertiary teaching hospital of Eastern India. *Indian Journal of Critical Care Medicine*: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 19(1):14-20.
- Emori, T.G., Culver, D.H., Horan, T.C., *et al.*, 1991. National Nosocomial Infections Surveillance System. Description of surveillance methods. *Am J Infect Control.* 19:19–35.
- Eriksen, H.M., Iversen, B.G. and Aavitsland, P. 2005. Prevalence of nosocomial infections in hospitals in Norway, 2002 and 2003. *J Hosp Infect.* 60: 40-45.
- Geffers, C., Gastmeier, A., Schwab, F., Groneberg, K., Rüden, H., Gastmeier, P.

2010. Use of central venous catheter and peripheral venous catheter as risk factors for nosocomial bloodstream infection in very-low-birth-weight infants. *Infect Control Hosp Epidemiol.* 31(4):395-401
- Grohskopf, L., Sinkowitz-Cochran, R., Garrett, D., Sohn, A., Levine, G., Siegel, J., Stover, B. and Jarvis, W. 2002. The Pediatric Prevention Network: A national point-prevalence survey of pediatric intensive care unit-acquired infections in the United States. *J Pediatr.* 140: 432-438.
- Hidron, A.I, Edwards, J.R., Patel, J., *et al.*, 2008. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007. *Infect Control Hosp Epidemiol.* 29:996–1011.
- Horan, T.C., Andrus, M., and Dudeck, M.A. 2008. Surveillance definition of Health Care-associated infection and criteria for specific types of infections in the acute care setting. *Am J Infect Control*, 36:309-320.
- Nejad, S.B., Allegranzi, B., Syed, S.B., Ellis, B., and Pittet, D. 2011. Health-care-associated infection in Africa: a systematic review. *Bull World Health Organ.* 89(10): 757–765.
- Podschun, R., and Ullmann, U. 1998. *Klebsiella* spp. as Nosocomial Pathogens: Epidemiology, Taxonomy, Typing Methods, and Pathogenicity Factors. *Clin Microbiol Rev.* 11(4): 589–603.
- Pourakbari, B., Rezaizadeh, G., Mahmoudi, S., Mamishi, S. 2012. Epidemiology of nosocomial infections in pediatric patients in an Iranian referral hospital. *J Prev Med Hyg.* 53(4):204-6.
- Prevention of hospital-acquired infections. A practical guide. 2nd edition. WHO/CDS/CSR/EPH/2002.12.
- Raymond, J., Aujard, Y. 2000. Nosocomial infections in pediatric patients: a European, multicenter prospective study. European Study Group. *Infect Control Hosp Epidemiol.* 21(4):260-3.
- Razine, R., Azzouzi, A., Barkat, A., Khoudri, I., Hassouni F., Chefchaoui, A.C. and Abouqal, R. 2012. Prevalence of hospital-acquired infections in the university medical center of Rabat, Morocco. *International Archives of Medicine.* 5:26.
- Richards, M.J., Edwards, J.R., Culver, D.H., Gaynes, R. 1999. Nosocomial infections in pediatric intensive care units in the United States. *Pediatrics.*, 103: e39-10.1542/peds.103.4.e39.
- Suchitra, J.B., Lakshmi, Devi, N. 2007. Impact of education on knowledge, attitudes and practices among various categories of health care workers on nosocomial infections. *Indian J Med Microbiol.* 25:181–187.
- Urrea, M., Pons, M., Serra, M., Latorre, C., Palomeque, A. 2003.: Prospective incidence study of nosocomial infections in a pediatric intensive care unit. *Pediatr Infect Dis J.* 22: 490-493.
- William, R. J. and William, J. M. 1992. Predominant pathogens in hospital infections. *J. Antimicrob. Chemother.* 29 (suppl A): 19-24.

How to cite this article:

Claude Bayingana, Jean Bosco Gahutu, Augustin Sendegeya, Felix Habarugira, Caritas Mukumpunga, Francois Lyumugabe and Jules Ndoli. 2017. The Prevalence of Bacterial Species Involved in Nosocomial Infections in Pediatrics Unit at Butare University Teaching Hospital (Chub). *Int.J.Curr.Microbiol.App.Sci.* 6(6): xx-xx.
doi: <https://doi.org/10.20546/ijcmas.2017.606.380>