

# Hospital Acquired Infections in Pediatrics Unit at Butare University Teaching Hospital (CHUB)

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## Abstract

### Background

Hospital acquired infection (HAI) also called nosocomial infection is an infection acquired in hospital or other healthcare facilities. HAIs are a major public health problem all over the world, but particularly in developing nations and they are among the major causes of death and increased morbidity among hospitalized patients. It was found that HAI in sub-Saharan Africa is the major cause of illness and death in children.

### Aim

The aim of this study was to provide knowledge on the prevalence of hospital acquired infection in pediatric unit of the University Teaching Hospital of Butare (Rwanda).

### Methods

Hospital acquired infections surveillance method and definition of infections described by CDC/NHSN were used.

### Results and conclusion

This study showed that the prevalence of HAI was very high (12.1 %) and the main bacteria causing NIs in pediatric unit were *Klebsiella pneumoniae*, followed by *E. coli* and *Staphylococcus aureus*. Low Respiratory HAIs were the most prevalent.

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**Key words:** Prevalence, Hospital Acquired infection, Pediatrics

## Introduction

Hospital acquired infection (HAI) also called 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. HAIs are a major public health problem all over the world, but particularly in developing nations. Factors which promote HAIs 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.[1]

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 %.[2,3] A prevalence survey conducted in 55 hospitals of 14 countries representing 4 WHO regions found an average of 8.7 % of patients with HAIs. 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.[1] 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 HAIs.[4]

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.[5] Nosocomial infections are the most cause of illness and death in children.[4] To our knowledge there is no data in Rwanda and particularly at the University Teaching hospital of Butare (CHUB) on the Prevalence of bacterial species involved in hospital acquired infections. The aim of this study was to provide knowledge on the prevalence of hospital acquired infection in pediatric unit of CHUB where cases of nosocomial infections were suspected in the past years, forming prerequisites for effective and sustainable infection control measures.

## Methods

All inpatients of pediatric unit of CHUB from the 1<sup>st</sup> of June to the 30<sup>th</sup> of November 2015 were enrolled in this

study to investigate clinical illness both on admission and during hospital stay. CHUB is a University teaching Hospital situated in the Southern Province of Rwanda. Ethical clearance was obtained from the IRB of the College of Medicine and Health Sciences of the University of Rwanda. A written consent was obtained from the parents or guardians of the children. Hospital acquired infections surveillance method and definition of infections described by CDC/NHSN were used.[6,7]

On a daily basis, all patients admitted to the unit were evaluated for HAI. Hospital acquired Infection was defined as new infection which occurs after 48 hours of admission, taking into consideration if it was acquired in the unit and with no evidence of the infection being in incubation at admission. This study was based on the following main types of HAIs: Urinary Tract Infections (UTI), Lower Respiratory Tract Infections (LRI) and Blood Stream Infections (BSI). Primary bloodstream infection was considered as laboratory confirmed infections with a positive blood culture not related to infection at another site (Excluding phlebitis) and clinical sepsis. Clinical Sepsis was reported when a physician has instituted treatment for sepsis and no apparent infection at another site, and a negative blood culture or no blood culture was taken. When the BSI was associated

with a central intravascular line, LRI with mechanical ventilation, UTI with catheterization, it was recorded.[7]

Infection site definition were in agreement with CDC definitions. Demographic data, date and site of infection were collected for each patient. Pathogens associated with each hospital acquired infection site was reported. Coagulase-negative staphylococci, *Bacillus* spp, *Micrococcus* spp, and viridans group streptococci bacteria were regarded as contaminants. For statistical analysis, software packages “SPSS 16.0” was used. Frequencies were calculated using descriptive statistics

## Results

### Prevalence of Nosocomial Infection in the six months of the study

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 hospital acquired infections during their stay in the Hospital. The prevalence of HAI per month from June to July were: 13.4%, 20%, 6.17%, 8.41%, 11.11% and 15.78% respectively (See Table 1).

**Table 1. Prevalence of Nosocomial Infection in the six months of the study**

	June	July	August	September	October	November	June-November
<b>Number of admitted patients for more than 48 hours</b>	82	70	81	107	63	76	476
<b>% of NI</b>	13.4	20	6.17	8.41	11.11	15.78	12.10

### Nosocomial infection by infection types

Among all cases of HAIs, 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 were high in July with 71.42%, followed by November 58.33% and June with 54.54% (See Table 2). For BSI due to HAIs, 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% (See Table 2).

**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

### Type of Infection Associated with Species involved in NIs

Among all recorded cases of hospital acquired infections, 51.66% were caused by *Klebsiella pneumonia*, 20% *Escherichia coli*, 18.33% *Staphylococcus aureus*, 3.33% for *Acinetobacter* and *Enterobacter* each and 1.66% for *Streptococcus pneumonia* and other Gram positive cocci

each. Among all cases of HAIs caused by *Klebsiella pneumonia*, 80.64% were for LRI, 12.90% BSI and 6.41% UTI. For HAIs caused by *Escherichia coli*, 50 % were BSI and 50 % UTI. About HAIs caused by *Staphylococcus aureus*, 81.81% were BSI, LRI (9.09%) and UTI (9.09%) (See Table 3).

**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 pneumonia</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 pneumonia</i> (n = 1)	0	100	0
Gram + Cocci (n = 1)	0	100	0

### Percentage of bacteria isolates associated with infection types

In all LRI caused by HAIs, 92.59 were caused by *Klebsiella pneumonia*, *Enterobacter* (3.70%) and *Staphylococcus aureus* (3.70%). For BSI caused by HAIs, 39.13% were due to *Staphylococcus aureus*, *Escherichia coli* (26.08%), *Klebsiella pneumonia* (17.39%), *Acinetobacter* (8.69%), *Streptococcus pneumonia* (4.34%) and Gram + Cocci (4.34%). For UTI, 60% of HAIs were caused by *Escherichia coli*, *Klebsiella pneumonia* (20%), *Staphylococcus aureus* (10%) and enterobacter (10%) (See Table 4).

**Table 4. Percentage of bacteria isolates associated with infection types**

Pathogens	Percentage of isolates by infection type		
	LRI	BSI	UTI
<i>Klebsiella pneumonia</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 pneumonia</i>	0	4.347	0
Gram + Cocci	0	4.347	0

## Discussion

The objective of this study was to provide knowledge on the prevalence of hospital acquired infection in pediatric unit of CHUB. The study was conducted from the 1<sup>st</sup> of June to the 30<sup>th</sup> of November 2015. The 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 hospital acquired infection was 2.50%.[8]

Another study done in an Iranian referral hospital found an overall incidence of HAIs of 3.34%.[9]

Months which had a high incidence of HAIs were June-July (13.4% and 20%) and October-November (11.11% and 15.78 %). August and September had a low rate of HAIs with 6.17% and 8.41% respectively. The decrease of HAIs in August and September may be due to the absence of medical school students who are in holiday at that period and this may be supported by the increase of HAIs in October and November where medical students are back from holiday. Suchitra JB. Et al., (2007) reported that 27% of health care students had insufficient knowledge about infection control.[10]

This study showed that 46.55% of HAIs were LRI, 36.2% were BSI and 17.24% were UTI. Some previous studies found that LRI was the most common site of infection (9, 11%) while others found BSI as the most frequent HAI.[11–14]

The high prevalence of LRI and BSI hospital acquired 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 HAIs.[15–17]

More than the half (51.66 %) of all cases of HAIs in pediatric patients were caused by *Klebsiella pneumonia*, 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 hospital acquired infections because of their incidence of 5% to 7% of all HAIs.[18]

Among all cases of HAIs due to *Klebsiella pneumonia*, 80.64% were for LRI, 12.90% for BSI and 6.41% for UTI. Among all LRI caused by NIs, 92.59 were *Klebsiella pneumonia*. Anton Y. P. and David C. H. (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 predominant organisms in hospital-acquired pneumonia.[19]

For HAIs 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%) (See Table 3). A previous study showed that the most five predominant bacterial species in HAIs are *Escherichia coli* (13.7%), *Staphylococcus aureus* (11.2%), Enterococci (10.7%), *Pseudomonas aeruginosa* (10.1%), and coagulase-negative staphylococci (9.7%).[20]

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*, klebsiella species, *Escherichia coli*, enterobacter species, and *P. aeruginosa* were reported as the most common Gram negative organism in Nosocomial BSIs.[19]

A study done in USA found that Gram-positive organisms caused 65% of hospital acquired 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%).[21]

In this study coagulase-negative staphylococci were considered as contaminants.

## Conclusion and recommendations

The present study showed that the prevalence of hospital acquired infection was very high (12.1%) and the main bacteria causing HAIs 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 a baseline for effective and sustainable infection control measures at Butare University Teaching Hospital.

### Authors' contribution

The PI has participated in every part of this study. Authors from Butare University teaching hospital (CHUB) have participated in sample collection and analysis of results. The author from the college of science and technology has participated in analysis of results and paper writing.

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