

## An Epidemiological Study of Nosocomial Infections in Tabriz Children's Hospital Based on National Nosocomial Infection Surveillance System (NNIS)

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**Abstract:** Nosocomial infections are major public health problems particularly in developing countries. These are one of the most important causes of mortality and morbidity in hospitals. Therefore, the purpose of this study was to estimate the epidemiology of NIs in a university-affiliated pediatric hospital in Northwest of Iran. The epidemiology of nosocomial infections were evaluated in Tabriz children hospital during a 12 month period from May 2008 to May 2009 using national nosocomial infections surveillance system definitions. One hundred and three patients (56.3% males and 43.7% females) were diagnosed with nosocomial infections. The incidence of nosocomial infection was 1.33 per 100 hospital discharges and 0.34 days per 100 hospital days. Frequencies of nosocomial infections by type were as follows bacteremia (68.9%), urinary tract infection (13.6%), lower respiratory tract infection (9.7%), and wound infection (7.8%). Neonates ward was the highest portion of nosocomial infections followed by NICU and hematology wards. The most common pathogenic organisms were Coagulase-negative *Staphylococcus* (35%), *Klebsiella* (20.4%), *Serratia* (9.7%), *E. coli* (6.8%), and *Pseudomonas* (5.8%). The mean hospital stay was 25.54±17.64 days. The difference in the mean stay days for patients with nosocomial infection and non-infected patients (3.9±1.5 days) was statistically significant ( $P<0.0001$ ). More than one-fourth of these patients expired. Our study emphasizes the need for implementing further health associated infections surveillance systems with proper methods to prevent and manage infections in hospitalized patients.

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### 1. Introduction

Nosocomial infection (NI) is a major complication of hospital care in both adults and children. Health care associated infections are important causes of mortality, substantial morbidity, prolonged hospital stay, and increased costs (Fanos and Cataldi, 2002). Accelerated improvements in diagnostic and therapeutic procedures have helped significant progress in medical era but plentiful using of invasive methods cause many health care problems every day. In the United States between 5% and 10% of hospitalized patients in acute care units suffer NI. The frequency of NI in children seems to be lower and is negatively correlated with age ranging from 7-9 % for infants younger than 1 year of age to 1.5 % to 4 % for hospitalized 10 year old children (Fanos and Cataldi, 2002).

NI monitoring is very difficult especially with limited resources, but it is vital if infection control measures are to be appropriately implemented and assessed. Nowadays substantial progress has been made in measuring the burden of nosocomial infections in pediatric patients, particularly in certain populations such as critical care units and after certain procedures (Khan and Celik, 2001). As a

result, preventive measures have been subjected to new and additional study. In Iran, as in most developing countries, the true burden of NIs is not known (Askarian and Gooran, 2003). Therefore, the purpose of this study was to estimate the epidemiology of NIs in a university-affiliated pediatric hospital in Northwest of Iran.

### 2. Material and Methods

In a prospective and analytic-descriptive study, epidemiological characteristics of NIs were evaluated in Tabriz Children's Hospital, a university-affiliated hospital, during a 12 month period between May 2008 and May 2009 using national nosocomial infections surveillance (NNIS) system definitions. NIs were reviewed and data were collected from patients hospitalized in various wards of the hospital including pediatric intensive care unit (PICU), neonatal intensive care unit (NICU), neonate unit, and surgery, infectious diseases, hematology and internal medicine wards.

The CDC-NNIS system defines an NI as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent or its toxin, and not present or incubating at the time of admission to the hospital (Garner et al., 1988;

Horan et al., 2008). Patients who were not infected or were not in incubation period at the admission time and had positive culture of other criterion after third day of admission were defined as cases of NI in our study. Infection control nurse reviewed reports of fever, changes in surgical wounds, prescription of new antibiotics or any change in antibiotic regimen and probable case of NI based on physician's clinical suspicions daily and all positive cultures weekly. The nurse presented all suspicious cases to infection control physician (a subspecialist of pediatric infectious diseases) and after confirming the diagnoses, NIs were registered. The data included the name, age, sex, ward, location of the infection, organism and its susceptibility pattern to current antibiotics, and infection onset dates. Admission and discharge times and the patient's final condition at the discharge time were collected as well. Four types of NIs were selected including bacteremia, lower respiratory tract infections (LRTIs), urinary tract infections (UTIs), and post-surgical wound infections.

Data were presented as mean  $\pm$  standard deviation (SD), or percentage. Statistical analysis was performed with SPSS for windows version 13.0 using independent-samples t-test. A  $P < 0.05$  was considered statistically significant.

### 3. Results

In this study 103 patients (58 boys and 45 girls) were reviewed as NIs cases. Overall we recorded 71 (68.9%) cases of bacteremia, 14 (13.6%) cases of UTIs, 10 (9.7%) cases of LRTIs, and 8 (7.8%) cases of wound infections. The mean age of the patients with NIs was  $21.60 \pm 39.32$  months. The mean hospital stay was  $25.54 \pm 17.64$  days. The difference in the mean hospital stay days of the patients with NI and non-infected patients ( $3.9 \pm 1.5$  days) was statistically significant ( $P < 0.0001$ ).

We recorded that neonate unit was the most common ward of the hospital regarding the NI (32%) followed by NICU (22.3%), hematology unit (16.5%), and PICU (12.6%). Mechanical ventilation was used in 42.3% of patients with bacteremia, 42.9% with UTI, 90% with LRTIs, and 12.5% with wound infection. Furthermore, urinary catheter was used in 23.9%, 85.7%, 30% and 12.5% of these patients, respectively. In addition, total parenteral nutrition was administered for 29.6% of patients with bacteremia, 42.9% with UTI, 70% with LRTIs, and 37.5% with wound infections. Laparotomy (23.2%), umbilical catheter (11.6%), central venous lines (7.2%), and venous cutdown (7.2%) were the most common invasive procedures performed in these patients. The most common pathogenic organisms were coagulase-negative *Staphylococci* (35%), *Klebsiella* (20.4%), *Serratia* (9.7%), *E. coli* (6.8%),

*Pseudomonas* (5.8%), and *Candida* (1.9%). The frequency of antimicrobial resistant isolated organisms was high. Half of isolated *S. aureus* was methicillin resistant. *Klebsiella* was resistant to third generation cephalosporins (87%), aminoglycosides (80%), and imipenem (52%). All isolated *Pseudomonas* were resistant to third generation cephalosporins and imipenem. More than one-fourth of the patients expired with the diagnosis of NI (Figure 1).

Considering total number of hospitalized patients (7730 cases) and total number of hospitalized day (30147 days), the incidence of NIs was 1.33 (infection per 100 hospital discharges), 0.34 (infection per 100 hospital days).

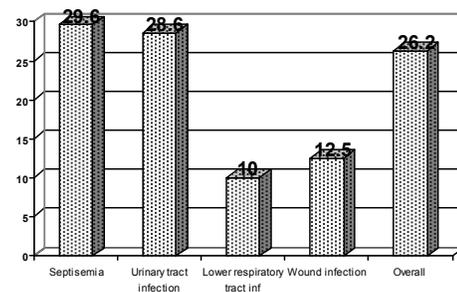


Figure 1. Mortality rates among the studied patients

### 4. Discussion

The overall incidence of 1.33 of NIs in this study is consistent with the results of Canadian and European studies. Ford-Jones et al (1989) reported average incidence of 0.17% to 14% according to age and pediatric specialty. Salamati et al (2006) computed the incidence of NIs in NICU, neonates and neonatal surgery units as 2.9%, 0.3%, and 1.7%, respectively. Technological advances in surfactant replacement therapy have improved the survival rate of premature infants with very low birth weights and thereby increasing the risk of NIs. Welliver and McLaughlin (1984) reported the attack rate of the entire hospital population surveyed was 4.1 NIs per 100 discharged patients. Raymond and Aujard (2000) reported overall incidence of 2.5% ranging from 1% in general pediatric units to 23.6 in PICU. The NIs incidence of 1.33 in our study is lower than the report of 7.7% for 1623 Australian children (Burgner et al., 1996). Burgner et al (1996) revealed that in contrast to other studies, younger children were not at increased risk of NI, admission into neonate unit rather than age per se was associated with increased risk. The frequency of NI in adult units is higher 5% of 8.4% in Germany and 10.4% in France.

We recorded that bacteremia was the most common type of NI (69.8%), which was consistent with that of the reports of Urrea et al. (2003) (51.7%),

de Gentile et al. (2001) (46.1%), and Ben Jaballah et al. (2006) (68.2%). However, it was higher than the reports of Raymond and Aujard (2000) (36%), Mühlemann et al. (2004) (37%), and Tantracheewathorn et al. (2007) (28.6%). Nonetheless, in these studies bacteremia was known as the most common type of infection.

The rate of 13.61 for UTI in our study was consistent with the report of Raymond and Aujard (2000) as 11%. The UTI frequency (13.61) was low similar to that of the previous study and was lower than for adults (30-40%) probably due to less frequent use of urinary catheters in children. The lower rate of LRTIs in our study (9.7%) is comparable with the results of de Gentile et al (2001) but is lower than the results of other studies. The bacterial species responsible for NI differ in adult and pediatric studies. Coagulase-negative Staphylococci infect children more often than adults, and were the pathogens isolated most frequently in our hospital (35%) especially in neonate and hematology units. Richards et al (1999) reported that Coagulase-negative Staphylococci (36%) were the most common blood stream isolated in NIs, while in the study by Welliver and McLaughlin (1984) *S. aureus* was the most commonly isolated pathogen. This study also revealed that documented viral infections were more common than infections caused by gram negative bacilli. In our hospital, *S. aureus* was isolated in 8.2% of the patients. Similar to the study by Raymond and Aujard (2000), the antimicrobial resistance frequency of Klebsiella and other gram-negative bacilli was high. *Candida* was a pathogen of increasing importance. Infections due to antibiotic resistant bacteria were associated with increased length of stay in PICU after onset of infection and increased mortality. Similar to the previous reports, the difference between hospital days in patients with NI and non-infected patients was statistically significant. In our study, incidence of NI was underestimated because viral infections were not included due to limitations in medical equipments and also due to the absence of post-discharge surveillance. Increasing frequency of antimicrobial resistant isolated emphasizes the necessity for bacteriological monitoring of hospitalized children.

In conclusion, repeated prevalence surveys might enable simple and cost effective assessment of NIs, facilitating appropriate infection control interventions.

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