



Causative Organisms of Hospital Acquired Infections Among The Pediatric Patients In Tertiary Level Hospitals of Dhaka City

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ABSTRACT

Hospital acquired infections (HAI) are important causes of morbidity and mortality. The purpose of this study was to see the type of HAI and causative organisms of these infections among the paediatric patients in tertiary level hospitals of Dhaka city. This cross sectional study was conducted in three tertiary level hospitals in Dhaka City over a period of two years. A total of 1055 patients were observed and the study population comprised of all the admitted paediatric patients irrespective of sex and basic diseases who were found present during data collection period as admitted patients in the paediatric wards of the hospitals under study. Among 1055 pediatric patients admitted in all the three hospitals under study a total of 115 (10.9%) were affected by hospital acquired infections. Higher prevalence (14.0%) of Hospital-Acquired Infections (HAI) was found in surgery ward and the lower prevalence (9.2%) of HAI was found in medicine ward. The most common type of HAI was surgical wound infection 26(22.6%). Out of 115 HAI patients highest number 44(38.3%) were affected by *staphylococcus aureus* followed by *E. coli* 23(20%).

Key words:

Hospital acquired infection, Nosocomial infection, paediatric patients, organisms of HAI.

Introduction:

A "hospital acquired infection (HAI)"-has been defined by WHO as: "an infection acquired in hospital by a patient who was admitted for a reason other than that infection," or as "an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission."¹ Such infections have also been called "nosocomial infections" and sometimes- "hospital associated infection."²

HAI remain a major problem in the health care centers across the world and leads to high mortality. These infections cause death, failure of surgeries, rejection of transplanted organs, failure of chemotherapies and increasing costs for patients and health centers, a longer stay in the hospital and mental and emotional stress.³⁻⁵

In the US nosocomial infections are estimated to occur in 5% of all acute care hospitalizations. The estimated incidence is more than 2 million cases per year, resulting in an added expenditure in excess of \$2 billion. The National Nosocomial Infections Surveillance (NNIS) System of the Centres for Disease Control and Prevention performed a survey from October 1986 to April 1998. They ranked hospital wards according to their association with central-line bloodstream infection. The highest rates of infection occurred in the burn ICU, neonatal ICU, and paediatric ICU.⁶ In a study conducted by WHO in 55 hospitals of 14 countries representing 4 WHO

regions (Europe, Eastern Mediterranean, South East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections, the highest frequencies were reported from hospitals in the Eastern Mediterranean Region (11.8%) followed by South East Asia where it was 10%, with a prevalence of 7.7 and 9.0% respectively in the European and Western Pacific Regions.^{1,7}In Europe, the incidence of HAI in the general children ward is 1% and in the neonatal intensive care units have been reported to be 23.6 %.⁴ The most common type of HAI in children are bloodstream infections, pneumonia (ventilator-associated VAP), urinary tract infections (UTI), skin and surgical site infections. Organisms such as gram-negative bacilli, coagulase-negative staphylococci, coagulase-positive *staphylococci*, *pseudomonas* spp, and *streptococcus* are the main causes of HAI.³

In our country, it is very difficult to present the detailed national level scenario regarding hospital acquired infection, because, till today no countrywide surveillance study has been conducted in this field. But the collective result of the studies undertaken at different times in several hospitals of Bangladesh. A study named "Prevalence study of hospital acquired infection" was performed in selected tertiary level hospitals and showed prevalence rate in different hospitals in the range of 6 to 18%.⁸ Another study by Zaman et al showed that the prevalence of HAI was 38% among postoperative patients.⁹ A study on post caesarean wound infection in Dhaka Medical College Hospital showed that 35.3% of caesarean patients developed hospital acquired infection.¹⁰ A study on 299 admitted patients of Dhaka Medical College Hospital 34(11.37%) were found affected by HAI. Surgical wound infection was the most prevalent (44.1%) among the various types of HAI followed by urinary tract infection (26.5%) and skin and soft tissue infection (14.7%).¹¹ Sharif SH found in his study that out of 456 respondents 54 (11.8%) of them developed hospital-acquired infection (HAI). Out of 54 (11.8%) events of infection, 64.8% surgical site infection (SSI), 22.2% urinary tract infection (UTI), 9.3% respiratory ' infection (RI) and 3.7% was skin and soft tissue infection (SSTI) were found.¹² The type of HAI and causative organisms varies from country to country, region to region, hospital to hospital even ward to ward.

Almost forty percent of all hospital-acquired infections are urinary tract infection, 80% of them are associated with the use of indwelling catheter. Surgical wound infections are covering 5-15% of HAI depending on the type of operation and patient's physical status.¹³⁻¹⁵ About 10% of all HAI are respiratory tract infection. 3% of patients on ventilators usually develop pneumonia. In one study pneumonia was found to be responsible for 60% of all death due to HAI. Septicaemia covers approximately 5% of HAI, among them more than 50% is fatal and the infection usually enters through the skin entry site of the intravascular device.¹⁶⁻²⁰ Bacteria are the most common nosocomial pathogens and are responsible for occurring more than 80% of HAI. Viruses are

accountable for 12% of all HAI. Many fungi and some parasites are opportunistic organisms and cause HAI during extended antibiotic treatment and severe immunosuppression.²¹⁻²³

The impact of hospital acquired infections is considerable, the patient may need longer hospital treatment, readmission, or even further surgery, increasing time off work and extra use of hospital and community resources. As these infections cause the patient to spend longer in hospital, resources such as consumable items, the time of health care professionals and the capacity of capital equipment and infrastructure are used to provide the appropriate care. A patient with a hospital infection might occupy a bed at least for three days longer than normal during which time nursing and medical staff might administer drugs and care for the patient.²⁴ A common problem in the treatment of HAI in pediatric wards in hospitals is increasing frequency of antibiotic-resistant organisms. Surveillance activities are the first step in developing infection control programs and may help in decreasing the incidence of infections and reducing costs.⁴ However there is a significant knowledge gap regarding the HAI due to the lack of enough data from the previous studies in our country.

The purpose of this study was to see the type of HAI and causative agents of these infections among the paediatric patients in tertiary level hospitals of Dhaka city.

Methods & materials:

The cross sectional study was conducted in three purposively selected tertiary level hospitals in Dhaka City. The selected hospitals were Dhaka Medical College Hospital (DMCH), Dhaka Shishu Hospital (DSH) and Bangladesh Medical College Hospital (BMCH).

The study was conducted over a period of two years starting from a convenient time after approval of the protocol.

The study population comprised of all the admitted paediatric patients irrespective of sex and basic diseases who were found present during data collection period as admitted patients in the paediatric wards of the hospitals under study.

A total of 1055 patients were observed for finding out HAI patients. Sample size in three study hospitals was as follows: DMCH: 165 + BMCH: 125 + DSH: 765 = **1055**

Inclusion and exclusion criteria for sample selection are:

- i) Only those patients who had passed 48 hours or more after admission was considered as sample.
- ii) Basic diseases for which the patients had been admitted was not taken into consideration in selecting sample.
- iii) Patients who presented with features of infection at the time of admission were included as non-HAI sample.
- iv) Patients developing infection within 48 hours after admission were also included as non-HAI sample.
- v) Ambulant patients who had not been admitted were not included in sample.

During the days of data collection period all the admitted patients who had been selected as sample irrespective of sex and diseases involved was carefully screened for finding out the HAI patients.

Screening was done by reviewing the patient's daily diagnostic and treatment records, by physical examination and by arranging laboratory tests by researcher himself when and where necessary.

Screening for HAI sample was done on the basis of positive findings: (Which are specific for the different types of HAI)-

Positive findings for surgical site infection -

1. Any purulent discharge from the surgical site.
2. Any Abscess beneath or around the surgical site.
3. Spreading cellulites at the surgical site.

Positive findings for urinary tract infection (UTI) -

1. Positive urine culture (at least 10^5 bacteria/ml.) with or without clinical symptoms but presence of pyuria (≥ 5 -10 WBC/HPF) is present. OR
2. Positive urine culture with symptoms but no pyuria,

Positive finding for respiratory tract infection -

(Respiratory symptoms with at least two of the following signs)-

1. Presence of cough
2. Purulent sputum (>25 WBC with 10-25 squamous epithelial cells/LPF)
3. New infiltrate on chest radiograph consistent with infection.

Positive findings for vascular catheter infections -

1. Inflammation around the insertion site or along the vascular pathway.
2. Lymphangitis
3. Purulent discharge at the insertion site of catheter

Positive findings for blood Stream infection (Septicaemia) -

1. Isolation of any pathogen from one or more blood cultures with clinical symptoms of fever.
2. Hypotension
3. Chills
4. Decreased urine output, and
5. Lethargy

Positive findings for all other types of infections -

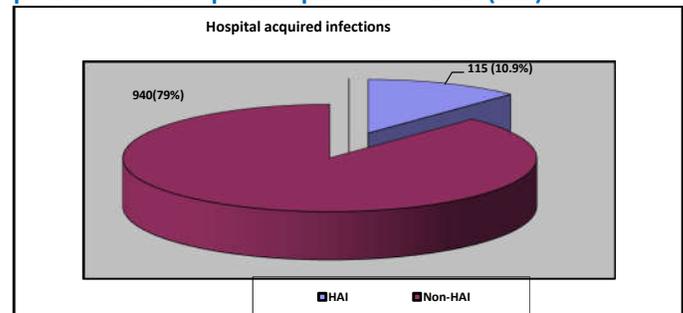
1. On the basis of recognized diagnostic criteria specific for the particular infection.

After screening finished the sampled patients were taken as sample to be interviewed and observed till discharge or death.

Results:

As per the following graph (Figure-1) it is evident that among 1055 pediatric patients admitted in all the three hospitals under study a total of 115 were affected by hospital acquired infections and 940 were not being affected. So the calculated overall prevalence HAI was 10.9%.

Figure-1: Distribution of the pediatric patients by overall prevalence of Hospital Acquired Infections (HAI):



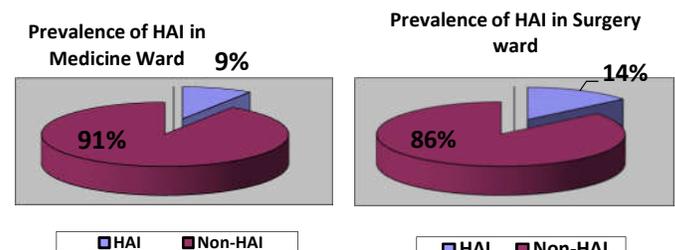
The following table (Table-1) reveals that highest prevalence (11.5%) of Hospital-Acquired Infections (HAI) was found in Dhaka Medical College Hospital (DMCH) and the lowest prevalence (9.6%) of HAI was found in Bangladesh Medical College Hospital (BMCH). In Dhaka Shishu Hospital (DSH) the prevalence of HAI was 10.9%.

Table-1: Prevalence of HAI in different hospitals under study:

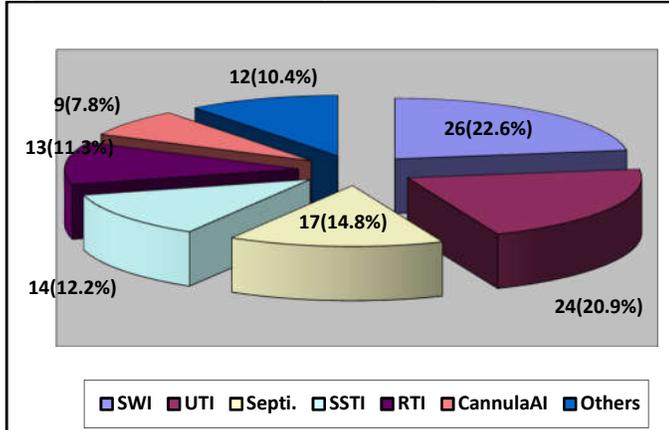
Study Hospitals	Total number of patients observed	Total number of HAI patients	Prevalence of HAI (%)
DMCH	165	19	11.5
BMCH	125	12	9.6
DSH	765	84	11.0
Total	1055	115	10.9

The following figures (Figure-2& 3) shows that higher prevalence (14.0%) of Hospital-Acquired Infections (HAI) was found in surgery ward and the lower prevalence (9.2%) of HAI was found in medicine ward.

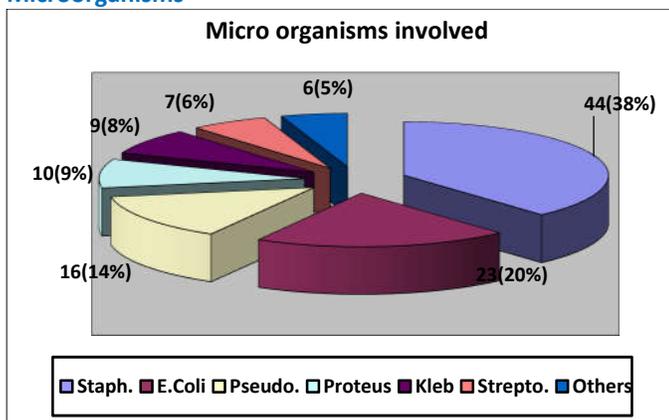
Figure-2 and 3: Prevalence of HAI in Medicine and Surgery wards



It is evident from the following graph (Figure-4) that out of 115 HAI patients highest number {26(22.6%)} was affected by Surgical Wound Infection (SWI) and the lowest number {9(7.8%)} was affected by Cannula Associated Infection. Second highest number {24(20.9%)} of patients was affected by Urinary Tract Infection (UTI). Septicemia or Bacteremia was represented by 17(14.8%) HAI patients. Skin & Soft Tissue Infection (SSTI) and Respiratory Tract Infections (RTI) were represented by 14(12.2%) and 13(11.3%) patients respectively. Only 12(10.4%) patients were found to be affected by others type of infections.

Figure-4: Distribution of HAI patients by Sites of Infections

It is shown by the following graph (Figure-5) that out of 115 HAI patients highest number {44(38.3%)} were affected by *Staphylococcus aureus* and the lowest number {7(6.1%)} was affected by *Srteptococcus pneumoniae*. Second highest number {23(20%)} of patients were affected by *E. coli*. *Pseudomonas* and *klebsiella* were responsible for infecting 16(13.9%), 10(8.7%) and 9(7.8%) patients respectively. Only 6(5.2%) patients were being infected by other types of microorganisms.

Figure-5: Distribution of HAI patients by Isolated Microorganisms**Discussion:**

It was found from this study that the overall prevalence of Hospital Acquired Infection (HAI) among 1055 pediatric patients admitted in all the three hospitals under study was (figure- 1) 10.9%. Prevalence of HAI was 18.9% in Gulandaz's study among all age groups of patients in tertiary level hospitals.²⁵ After five years, Khan M.H. found that the prevalence was 15.5% in his study on similar group of patients in a selected tertiary level hospital.¹¹ Sharif found in his study that 54 (13.8%) respondents developed hospital-acquired infection out of 456 admitted patients.¹² Comparing the findings of the present study with the above mentioned previous studies, it can be concluded that the prevalence of HAI in the tertiary level hospitals of our country is declining to some extent. The findings of the present study were almost similar with a seven day period prevalence survey in Switzerland that included all patients in acute, sub-acute and chronic care settings. Overall prevalence of NI of that study was 11.3% in the 1928 patients studied, and ranged from 0%

in ophthalmology to 23% in critical care units.²⁶ In a multi country study at paediatric oncology hospitals in Europe on 5,031 patients, 12% of the patients were found to develop nosocomial infections.²⁷ WHO reported that out of every 100 hospitalized patients at any given time, 7 in developed and 10 in developing countries will acquire at least one health care-associated infection.²⁸ It is obvious from the above references that, in global perspective the prevalence of HAI is declining with time. In our country though it is declining from the previous rate but it is still higher especially in the pediatric patients than that of developed countries at present.

The three hospitals under study were different by ownership and size (bed strength). Dhaka Medical College Hospital (DMCH) is a government owned hospital and larger than the other two hospitals under study. Dhaka Shishu Hospital (DSH) is a non-profit based private hospital and Bangladesh Medical College Hospital (BMCH) is a profit based private hospital; these two hospitals are smaller than DMCH. Among the three hospitals under study, highest prevalence (11.5%) of HAI was found in DMCH and the lowest (9.6%) was in BMCH, In DSH the prevalence of HAI was 11% (Table-1). The findings of the present study was supported by a nosocomial survey on 28643 admitted patients in Australia that found significant association of infection rates with size and ownership of hospitals. The nosocomial infection prevalence rate increased from 4.2% in hospitals with 50-99 beds to 7.6% in hospitals with 500 or more beds. After adjusting for hospital size, public hospitals had significantly-higher prevalence (10.6%) of nosocomial infection than did private hospitals (6.3%).²⁹ In a point prevalence survey in Europe it was also found that the prevalence of HAIs varied according to the hospital type and varied considerably within each hospital type. Primary hospitals recorded the lowest HAI Prevalence of 4.8%, in secondary hospitals HAI prevalence was 5.0%, in tertiary hospitals 7.2% and in specialized hospitals 6.0%.³⁰ Oli AN in a study on relative prevalence of hospital-acquired infections in Nigeria found HAIs having more prevalence in government hospitals compared to other hospitals.³¹

The present study was conducted on pediatric patients of both the medicine and surgery specialty. The prevalence of HAI was found higher (14.0%) among the surgical patients than the patients of medicine specialty who had not undergone any surgery among whom the prevalence was only 9.2% (Figure-2 & 3). The pediatric infectious disease journal of European society during their 4-year period study on 78,120 patients found occur 4,684 nosocomial infections. Prevalence of nosocomial infections varied from 0.17% to 14.0% on different wards or services. The highest rates (>5.6) were found in the surgery units.³² As per a study published in American journal of infection control it was found that the patients with surgery had a statistically significantly higher prevalence (11.4%) of HAI than the group without surgery ($P < .001$).³³ As the chance of exposure of the body tissue and fluids to the external environments for the surgery patients is much higher than the non-surgical patients, so it is usual and logical that they would have the higher chance to be infected

by hospital acquired infections. But the proportion could be minimized by strictly following WHO guidelines for safe surgery and by taking appropriate precautions in different stages of surgery.

As per the findings of the present study (Figure-4) it was found that highest number (22.6%) of the pediatric patients was affected by Surgical Wound Infection (SWI) and the lowest number (7.8%) was affected by Cannula Associated Infection. Second highest number (21%) of patients was affected by Urinary Tract Infection (UTI). Septicemia or Bacteremia was represented by 15% HAI patients. Skin & Soft Tissue Infection (SSTI) and Respiratory Tract Infections (RTI) were represented by 12% and 11% patients respectively. Sharif MSH found in his study that only four types of HAI were found among the respondents such as; 64.8% Surgical Site Infection (SSI) followed by 22.0% Urinary tract infection (UTI), 9.3% Respiratory infection (RI) and 3.7% Skin and Soft tissue Infection (SSTI).¹²As per an US study on 110709 patients with 6290 nosocomial infections bloodstream infections (28%), pneumonia (21%), and urinary tract infections (15%) were most frequent and were almost always associated with use of an invasive device.³⁴Sydnor ERM found in his study that the respiratory tract was the most common site of infection, followed by bloodstream, surgical wound, and urinary tract infection.³⁵In a study of US oncology society it was found that Bloodstream infections- 28%, Ventilator-associated pneumonia-21%, Urinary tract infection (UTI)-15%, Lower respiratory infection-12%, Gastrointestinal, skin, soft tissue- and cardiovascular infections- 10%, Surgical-site infections- 7% and ENT infections-7%.³⁶In a study on 4684 paediatric patients it was found that the proportional frequencies of the sites of infections were: 35% gastrointestinal; 21% bacteremia; 16% respiratory (10% upper, 6% lower); 7% postoperative wound; 6% urinary tract; 5% skin (32% of these skin infections were related to intravascular lines); 5% eye; 3% cerebrospinal fluid; and 2% other.³² As per WHO facts sheet regarding global survey on hospital acquired infections, urinary tract infection is the most frequent health care-associated infection in high-income countries, surgical site infection is the leading infection in settings with limited resources, affecting up to one-third of operated patients; this is up to nine times higher than in developed countries.³⁷The variation of proportions of the sites of infections in different studies might be due to differences of study population, sample size and research design. Geographical differences and time gap among the studies had also played some roles in revealing the different proportions of the sites of infections in different studies.

It was found in the present study (Figure-5) that out of 115 HAI patients highest number (38.3%) were affected by *Staphylococcus aureus* and the lowest number (6.1%) was affected by *Streptococcus pneumoniae*. Second highest number (20%) of patients was affected by *E. coli*, *Pseudomonas* and *klebsiella* were responsible for infecting 13.9%, 8.7% and 7.8% patients respectively. Only 5.2% patients were being infected by other types of microorganisms. Sharif MSH also found in his study that

Staphylococcus aureus was responsible for occurring infections in 29.6% cases which was followed by *E. coli* and *P. aeruginosa* by 27.8%.¹²Khan HA, of National Healthcare Safety Network along with Centers for Disease Control for surveillance has classified nosocomial infection the micro organisms involved in hospital-acquired infections include *Streptococcus spp.*, *Acinetobacter spp.*, enterococci, *Pseudomonas aeruginosa*, coagulase-negative staphylococci, *Staphylococcus aureus*, *Bacillus cereus*, *Legionella* and Enterobacteriaceae family members, namely, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Escherichia coli*, *Serratia marcescens*.³⁸In a study in Ethiopia a total of 42 bacterial pathogens were identified of which *S. aureus* was the leading isolates accounting 26.2% followed by *E. coli* and Coagulase negative *Staphylococcus* species each 21.4%. Nearly 100% of Gram positive and 95.5% of Gram negative bacterial isolates showed resistance against two or more antimicrobial drugs.³⁹A study in Erie County Medical Center, New York, it was found that Overall, *Staphylococcus aureus* and Enterococci were the most commonly identified colonizing organisms. *Escherichia coli* and *Pseudomonas aeruginosa* were the most commonly identified colonizing gram-negative bacilli.⁴⁰Razine R in a study in Morocco found that *Staphylococcus* was the organism most commonly isolated (18.7%) among the patients affected by hospital acquired infections.⁴¹Most of the previous studies were conducted to explore the details about micro biological aspects in relation with HAI, where as the prime view of the present study was to find out the extents, determinants and impacts of HAI. Even though the findings of the previous studies are almost in the same line of the present study though there are some variations in proportion of role of the microorganisms in occurring HAI. These variations may happen due to the variation of time, study places and study subjects.

Conclusion:

In our country though HAI is declining from the previous rate but it is still higher especially in the pediatric patients than that of developed countries at present. It was found from this study that Prevalence of HAI was found higher in surgery ward than that of medicine wards. Surgical Wound Infection was found to occupy the top of the list among all types of HAI. *S. aureus* was found the most common organism responsible for HAI.

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