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ORIGINAL ARTICLE

# Healthcare associated infections in a tertiary care cardiac hospital: A point prevalence survey

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**Author`s Contribution**

*[1] Conception, synthesis, planning of research and manuscript writing*
*[2] Interpretation and discussion*
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A B S T R A C T

**Objective:** Hospitalized patients can pick infections from healthcare facilities which may lead to extended hospital stay, increased morbidity and mortality of hospitalized patients and economic burden on health care. Active surveillance of HAIs that is continuous and prospective in nature has been accepted as a gold standard approach in preventing and controlling healthcare associated infections. To estimate the prevalence HAIs and their types in a tertiary care cardiac center and to identify associated risk factors.

**Methodology:** Nine prospective point prevalence surveys were conducted on three separate days in three consecutive weeks for three months. A data collectors team comprising of two research officers and an infection control nurse, visited the enrolled patients and patient's history, demographics, physical examination, laboratory findings and other details were reviewed from patient files and recorded on study questionnaire.

**Results:** A total of 559 patients were enrolled in the study. The prevalence of HAIs was 6.4%, which means 36 HAIs were identified in 559 patients. Univariate analysis showed a significant association between HAI and being in ICU/CCU ward (OR 3.4, 95% CI 1.5-7.4) longer duration of hospital stay (OR 3.0, 95% CI 1.5-6.0, P=0.001), exposure to urinary catheter, use of antimicrobials (OR 2.8, 95% CI 1.3-6.1, P=0.006), and diabetes (OR 2.5, 95% CI 1.2-5.2, P=0.008).

**Conclusion:** Healthcare associated infection is a major public health problem and rate of HAIs in the selected centers was found to be 6.4%. Present survey provided baseline evidence for further surveillance and multifaceted infection.

**Keywords:** *Hospital acquired infection, healthcare associated infections, surgical site infection, catheter associated urinary tract infection, point prevalence survey.*

## Introduction

Healthcare associated infections (HAIs) also known as nosocomial infections are defined by World Health Organization (WHO) as "An infection acquired in hospital by a patient who was admitted for a reason other than that infection; 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; this includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility".[1] Center for Disease Control and Prevention (CDC) classifies HAIs in four main types: central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), ventilator-associated pneumonia (VAP) and surgical site infection (SSI).[2] Hospitalized patients can pick infections from healthcare facilities which may lead to extended hospital stay, increased morbidity and mortality of hospitalized patients and economic burden on health care.[3] Therefore, HAIs are one of the major, yet preventable, threats to patient's safety and wellbeing. There are some factors

which may predispose a patient to HAIs for example decreased immunity of the patient, complex medical procedures, invasive techniques providing potential routes for infection, poor hygiene and over-crowding leading to transmission of drug-resistant microorganisms.[4]

A prevalence survey conducted worldwide, by World Health Organization (WHO) reports that on average 8.7% of all hospitalized patients suffer from nosocomial infections and these rates are higher for Eastern Mediterranean and South-East Asia Regions (11.8% and 10.0% respectively) as compared to European and Western Pacific Regions (7.7% and 9.0% respectively). Moreover, around 1.4 million people in the world suffer from HAIs at any point in time.[5] The most commonly reported HAIs include surgical site infections, urinary tract infections and respiratory tract infections. Highest prevalence of such infections has reported to occur in critical care units, intensive care units and surgical wards. The patients with old age, complex underlying illness and/or on chemotherapy are more likely to develop HAIs.[6,7]

Despite of putting earnest efforts in preventing occurrence of HAIs, they continue to occur at a prevailing rate.[8] Majority of the HAIs can be prevented by applying appropriate preventive measures.[7] Active surveillance of HAIs that is continuous and prospective in nature has been accepted as a gold standard approach in preventing and controlling HAIs. But continuous prospective surveillance of HAIs is a lengthy process and requires quite a lot of resources. Therefore, point prevalence surveys are recommended for resource limited countries to determine the magnitude of HAIs in their local settings. Point prevalence surveys are relatively cheaper and do not require extensive resources.[9, 10]

Hence, the aim of this point prevalence study was to estimate the burden of various HAIs and associated risk factors in our tertiary care hospital. This study helped us to discover target areas for quality improvement and formulating a preventive strategy for HAIs.

## Methodology

This study was designed to conduct the prospective point prevalence survey on three separate days in three consecutive weeks of each month for three times at 3 months intervals.

Therefore, nine point-prevalence surveys were conducted in the months of May 2016, September 2016 and January 2017. Surveys were conducted at Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD), which is a 400 bedded hospital consisting of 2 critical care units (CCUs), 2 intensive care units both for adult and pediatric patients, a high dependency unit for cardiac surgical patients and 12 post-catheterization/general medical wards. AFIC/NIHD is a tertiary care hospital located in Rawalpindi and it acts as a referral hospital for a large population of upper Punjab, federal capital Islamabad, Khyber Pakhtunkhwa province, Azad Kashmir and referred cardiac cases from all the Armed Forces hospitals of the country.

All the patients admitted for more than 48 hours on the days of survey were enrolled in the study, patients admitted or retained in the emergency department were excluded. The study questionnaire was specifically designed for the survey, comprising of patient's demographics, ward name, date of admission, clinical history, comorbidities, diagnosis, medical procedures / interventions received, laboratory findings, prescribed antimicrobial drugs along with doses, use of any urinary catheter, central or peripheral intravascular line, endotracheal tube or mechanical ventilator support and presence of any HAIs. CDC/NHSN surveillance definition for HAIs and criteria for specific type of infection was used to identify infected patients.[11] Patients identified with blood stream infection, ventilator associated pneumonia, surgical site infection or any other HAI were investigated in further detail for presence of fever, raised TLC, blood / pus cultures etc. Patient's history, demographics, physical examination, laboratory findings and other details were reviewed from patient files and recorded on study questionnaire. A data team of collector comprising of two research officers and an infection control nurse, visited all the enrolled patients at least once a day and more visits were made in order to complete any missing data or information.

All the data were entered in computer software IBM SPSS (version 23.0). For descriptive statistics of continuous variables, means and standard deviations were calculated, while frequencies and percentages were calculated for categorical data. For calculating prevalence of HAIs, all types of HAIs were included for all infected patients with one or multiple infections divided by total

number of admitted patients. Associations among comparable groups were calculated by using student's t test and chi square test for continuous and categorical variables respectively. Association of various risk factors with occurrence of HAIs was calculated and reported as odds ratios (OR) with 95% confidence intervals. Multiple logistic regression model was used for variables with p-value less than or equal to 0.05 in univariate analysis. A p-value of less than or equal to 0.05 was considered to show statistically significant differences. The study was approved by Institutional Ethical and Review Board (IERB) of AFIC/NIHD prior to data collection.

## Results

A total of 559 patients were enrolled in the study. There were 374 (66.9%) males and 185 (33.09%) females in the study sample group. The ages of patients ranged from 1 to 90 years (median = 53 years) with a mean of 55.25±19.46 years among males and 45.57±25.24 years among females. 271 (48.5%) patients were from Intensive care unit and/or critical care unit, while 288 (51.5%) were admitted in post-catheterization and/or general cardiology wards.

The prevalence of HAIs was 6.4%. Out of 36 patients, the most frequently reported HAIs included surgical site infections (55.55%), catheter-associated urinary tract infections (22.22%) central line-associated bloodstream infections (16.66%), and ventilator-associated pneumonia (5.55%). Microbial cultures were performed for all patients with HAIs, out of which 19.4% (7/36) culture growths were obtained. Isolated microorganisms included Staphylococcus aureus [42.8% (3/7)], Acinetobacter [28.5% (2/7)], Pseudomonas aeruginosa [14.2% (1/7)] and Escherichia coli [14.2% (1/7)].

Majority of the HAIs occurred in patients admitted to intensive care units and/or critical care units as compared to post-catheterization and medical wards (75.0%) vs (25.0%) p value 0.009]. A total of 296 (52.9%)] patients were receiving antibiotics on the days on survey, out of which 96 (32.4%) patients were on antibiotics for curative purpose while remaining 200 (67.6%) received antibiotics for pre-operative or post-operative prophylactic reason. The most frequently used class of antimicrobial drugs was Ceftriaxone [144 (48.6%)] a broad-spectrum third generation cephalosporin, followed by levofloxacin [84 (28.4%)] belonging to fluoroquinolone antimicrobial drug class; while other antibiotics included broad and narrow spectrum β-lactam antibiotics/ beta-lactamase inhibitors i.e. Amoxicillin/clavulanic acid and Piperacillin/tazobactam [46 (15.5%) and 22 (7.4%) respectively].

**Table 1: Comparison of demographics and clinical characteristics of patients with or without hospital acquired infection**

| Characteristics | Hospital acquired infection | | p-value |
|---|---|---|---|
| | Yes (n=36) | No (n=523) | |
| **Age** | 52.2±25.3 | 50.1±21.4 | 0.78[a] |
| **Gender**<br>Males<br>Females | <br>26 (72.2%)<br>10 (27.8%) | <br>348 (66.5%)<br>175 (33.5%) | 0.48[b] |
| **Type of ward**<br>ICU/CCU<br>Post-cath ward | <br>27 (75.0%)<br>9 (25.0%) | <br>244 (46.7%)<br>279 (53.3%) | 0.001*[b] |
| **Co-morbidities**<br>Hypertension<br>Diabetes | <br>12 (33.3%)<br>13 (36.1%) | <br>199 (38.0%)<br>95 (18.2%) | <br>0.57[b]<br>0.008*[b] |
| **Duration of stay**<br>>1 week<br><1 week | <br>22 (61.1%)<br>14 (38.9%) | <br>178 (34.0%)<br>345 (66.0%) | 0.001*[b] |
| **Antimicrobial use**<br>Yes<br>No | <br>27 (75.0%)<br>9 (25.0%) | <br>269 (51.4%)<br>254 (48.6%) | 0.006*[b] |
| **Exposure to urinary catheter**<br>Yes<br>No | <br>5 (13.9%)<br>31 (86.1) | <br>21 (4.0%)<br>502 (96.0%) | 0.007*[b] |
| **Exposure to IV-line**<br>Yes<br>No | <br>6 (16.7%)<br>30 (83.3%) | <br>157 (30.0%)<br>366 (70.0%) | 0.08*[b] |

*Significant p-values
[a] Independent t-test
[b] Pearson's Chi-square test

A total of 259 (46.3%) patients were suffering from chronic illness, out of which 108 (19.3%) patients were diabetic, 211 (37.7%) were hypertensive. Out of these 259 suffering patients with chronic illness, 46 (8.2%) were both hypertensive and diabetic. No significant association has been found between presence of chronic illnesses (both hypertension and diabetes) and developing HAIs, but while considering only diabetes, it was found that diabetic

patients tend to develop HAI significantly more as compared to non-diabetic patients [13/95 (12.0%) vs 23/428 (5.1%) p value 0.008].

Univariate analysis showed a significant association between HAI and being in ICU/CCU ward (OR 3.4, 95% CI 1.5-7.4, p 0.001) longer duration of hospital stay (OR 3.0 95% CI 1.5-6.0, p 0.001), exposure to urinary catheter, use of antimicrobials (OR 2.8, 95% CI 1.3-6.1, p 0.006), and diabetes (OR 2.5, 95% CI 1.2-5.2, p 0.008). Multiple logistic regression found only one significant association i.e. between developing HAIs and long hospital stay (OR 2.1, 95% CI 1.1-6.5, p 0.01).

## Discussion

The prevalence of HAIs reported in this study (6.4%) is comparable to the published results from other HAI surveys conducted worldwide, where HAI prevalence lie between 4 to 7%.[12-14] Some studies have also reported quite a higher prevalence of HAIs occurring among ICU patients, which ranges from 15 to 29%.[15] Similarly, high prevalence of HAIs has been reported in most of the studies conducted in low and middle income countries where prevalence ranges up to 15%.[16, 17] High variability in HAI rates might be caused by high occupancy rate, seasonal variations, epidemics, and variability in duration and conditions under which prevalence surveys are conducted.[17, 18]

A significantly higher number of HAIs were encountered in ICUs/CCUs (21/271, 10%), because more invasive procedures and surgeries were being done on ICU/CCU patients, the patients are usually seriously ill, have compromised immunity, and are being administered with multiple therapeutic agents. The most common type of HAI in our study is reported to be the surgical site infections i.e. (20/36), followed by catheter-associated urinary tract infections (8/36). Surgical site infections are most prevalent in our study because our hospital acts as a main referral hospital in the region where most complicated and serious surgical cases are referred and catered for and appears to match the rates reported in other studies conducted at cardiac hospitals.[12] In a study conducted by Andrioli et al, the most frequently encountered HAIs were surgical site infections (24/60), followed by urinary tract infections (14/60), bloodstream infections (11/60) and pneumonia (11/60).[12] Other studies reports urinary tract infection to be the most commonly encountered HAI and significant association between developing urinary tract infection and indwelled urinary catheter has also been established by various authors.[11, 13, 19, 20] Ventilator-associated pneumonia and intravascular line-associated blood stream infections were least commonly reported HAIs in literature, results of whom are in line with findings of our study.[11-13, 20]

Microbiological cultures were performed for all cases of HAIs, out of which 7 positive cultures were obtained, where isolated microorganisms included Staphylococcus aureus (3/7), Acinetobacter (2/7), Pseudomonas aeruginosa (1/7) and Escherichia coli (1/7). The number of positive cultures is quite low, because empirical broad spectrum antibiotic therapy is usually started immediately which results in negative culture growths. A study conducted by Stichi et al, the most commonly isolated micro-organism was methicillin-resistant Staphylococcus aureus, followed by Enterobacteriaceae.[21] Results of a study conducted by Xie et al, reports Pseudomonas aeruginosa to be the most commonly isolated organism, followed by followed by Escherichia coli.[13] Other studies conducted by Afle et al and Phu et al, reports gram negative Acinetobacter baumannii to be the most common isolates in HAIs.[22,23]

The most significant predictors of developing HAIs were found to be long hospital stay and indwelling catheter/intravascular line/ventilator. Literature also reports similar sort of predictor variables to be significantly associated with developing HAIs.[9, 15, 20, 23] A study conducted by Kolpa et al reports long hospital stay and intubation to be the most significant predictors of HAIs, while another study conducted by Jroundi et al reports critical illness, immune status, surgery and catheterization to be the most significant predictors.[20, 24]

In the end it is to be summarized that HAIs do occur, and there is dire need to continuously conduct active surveillance and point prevalence surveys, in order to understand current trends of HAIs occurring at health care facilities and to prevent them by adopting various infection control programs and other multifaceted interventions.

## Conclusion

Healthcare associated infection is a major public health problem and rate of HAIs in our centre is reported to be 6.4%. Present survey provided baseline evidence for further surveillance and multifaceted infection.

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