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Original Article

Epidemiological Profile of Hospital-acquired Infection in a Tertiary Care Hospital of Eastern India

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Abstract

Introduction: "Hospital-acquired infection (HAI)" can be defined as an infection acquired in hospital by a patient who was admitted for a reason other than that infection.

Purpose: This study was done to observe the incidence of HAI (with bacteriological profile and their antibiotic susceptibility pattern) in the Orthopaedics Ward of Bankura Sammilani Medical College.

Materials and Methods: A total of 2062 patients admitted for more than 48 h were studied for 1 year for the detection of the development of any of the HAI during hospitalization. On suspicion of the development of an HAI, representative samples for the diagnosis of a site-specific HAI were collected, processed, and interpreted. A total of 158 patients admitted for more than 48 h showing clinical features of any one of the HAIs were selected for sampling.

Results: From the 158 samples collected during the study period, samples from 92 patients were positive in bacteriological culture.

Conclusion: The study attempts to understand the epidemiological profile of HAI in this tertiary care hospital in a non-urban region of eastern India to take necessary infection control measures.

Key words: Bacterial infections, Epidemiological profile, Hospital-acquired infections, Infection control, Methicillin-resistant *Staphylococcus aureus*

INTRODUCTION

Hospital-acquired infection (HAI) or healthcare-associated infection or nosocomial infection refers to 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]

These infections occur worldwide and affect both developed and developing countries pose a constant threat to patients and their families by causing illness, prolonged hospital stay, potential disability, excess costs, and sometimes death.[2,3]

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In 2008, Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN) published a document providing the terms and definition of infections acquired in the hospital. Urinary tract infections (UTIs) are the most common type of HAI reported to the NHSN.[4]

Infections can be of exogenous (which are acquired from the hosts' environment) or endogenous (when commensal flora from the hosts' own skin or mucous membrane originate transferred to another site and infect the same patient). The most common HAIs are UTI, surgical site infection (SSI), respiratory tract infection, and bloodstream infections.[5]

HAIs are a major global safety concern for both patients and health-care professionals.[6] In addition to increased morbidity and mortality, these HAIs contribute significantly to the financial burden borne by patients, their families, and the health-care system. The increasing occurrence of HAI with antibiotic-resistant bacteria makes the situation more complicated.

This study has been conducted at Bankura Sammilani Medical College serving the people of Bankura and adjacent districts of West Bengal. There is lack of proper

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epidemiological and microbiological data regarding HAI cases for this region. This study was conducted to study the occurrence of HAI (with bacteriological profile and susceptibility pattern) caused by pathogenic bacteria, which would be helpful for infection control measures.

MATERIALS AND METHODS

This study was conducted in the Department of Orthopaedics and Department of Microbiology of Bankura Sammilani Medical College, from February 1, 2015, to January 31, 2016, after receiving approval from the ethical committee of Bankura Sammilani Medical College. A total of 2062 patients were admitted for more than 48 h in the male and female orthopedics ward during this period. These 2062 patients were followed up clinically for the detection of the development of any of the HAI during hospitalization until they were discharged. On suspicion of the development of an HAI, representative samples for the diagnosis of a site-specific HAI were collected, processed, and interpreted as per standard guidelines.[7]

A total of 158 patients, admitted for more than 48 h, who showed one or more symptoms and signs of any one of the HAIs – as per CDC guidelines[4] were selected for sampling. A pro forma designed for the study was used for data collection. A written informed consent was taken from each patient before collecting the samples.

A simplified diagnostic criterion for HAI by Mukherjee *et al.*[8] was used for categorizing the cases, which was as follows:

Hospital-acquired infections	Clinical features	Laboratory features
Urinary tract infection	Fever Lower abdominal pain Change in urinary characteristics	Leukocytosis Positive urine culture (10^5 CFU/mL of urine)
Pneumonia/LRTI	Fever Pleuritic chest pain Decreased intensity of breath sounds Presence or increase in rales	Leukocytosis Sputum for Gram stain Positive sputum culture Positive chest X-ray
Bloodstream infection	Unexplained fever with chills and rigor Pain, tenderness, or purulent discharge at the site of insertion of I.V. access or CVP catheter	Leukocytosis Positive blood culture
Surgical site infection/ skin and soft tissue infections	Pain, swelling, tenderness or inflammation, and warmth of skin Purulent drainage from skin Fever	Smear for gram stain Positive swab culture Leukocytosis

CFU: Colony-forming units

The samples collected from the department of orthopedics were labeled and transferred immediately to the laboratory of the department of microbiology for bacteriological examination. Urine, pus/wound swab, sputum, and blood were collected for suspected hospital-acquired UTI, SSI, hospital-acquired pneumonia, and bloodstream infections, respectively. Clean-voided midstream urine sample was collected in sterile, screw cap container with patient's identification number mentioned on it, by the clean-catch technique. In catheterized patients, samples were collected by aspiration in a sterile, screw cap container, after disinfection of catheter collection port. Pus/wound swabs were collected from patients who had developed post-operative wound infection with purulent discharge and clinically diagnosed as post-operative sepsis. Purulent materials were collected on sterile commercial cotton swabs aseptically and gently, before redressing and administration of antibiotic therapy. For superficial wounds, two swabs were taken, one for the preparation of a smear for microscopy and the other for the seeding of cultures. For deep wounds, the material was aspirated from the wall with a sterile syringe. Sputum was collected before any antibiotic therapy in a sterile, wide mouth plastic container with tightly fitted screw cap with laboratory number mentioned on it was given to the patient. Patient was instructed how to open and close the container and also on the proper collection of the sputum. Blood sample for culture was drawn before the use of systemic antibiotics, from two different venipuncture sites from the right and left arms. A blood volume of 10 mL was injected into each of two BacT/ALERT 3D blood culture bottles. All blood samples were inoculated into aerobic BacT/ALERT 3D bottles and sent to microbiology laboratory.

The samples were inoculated without delay. The culture media used were MacConkey agar (HiMedia, Mumbai), blood agar, and chocolate agar (for sputum samples). Identification of bacterial isolates grown was done by conventional biochemical tests for identification.[9]

For those patients who had a positive culture report, repeat culture was made every week till discharge for evidence of any new infection. Those patients who had same isolate with the same antibiotic susceptibility pattern were reported to have a single episode of infection. Antimicrobial susceptibility testing of the bacterial isolates was done on Mueller-Hinton agar (HiMedia Laboratories Pvt. Ltd., Mumbai, India) by disk diffusion technique using Kirby–Bauer's method[10] as per Clinical Laboratory Standards Institute guidelines.[11]

All the collected data from the study w compiled, analyzed, and finally interpreted statistically using the SPSS Statistics 19.0 (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.).

RESULTS

The total number of patients who were admitted for more than 48 h during the study period of 1 year was 2062, which comprised 1104 male patients and 958 female patients [Figure 1].

Of the 2062 patients, a total of 158 patients were suspected to develop any of the HAI. Rest of the 1904 patients did not have any clinical sign of HAI [Figure 2].

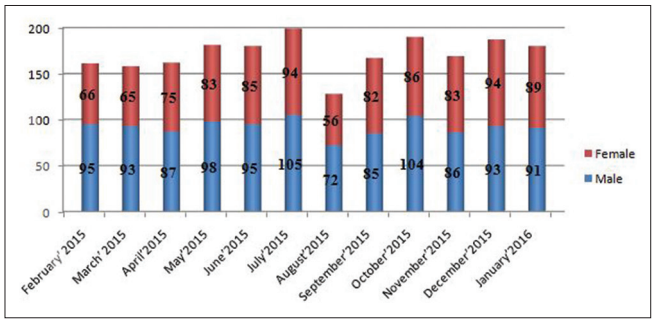

Figure 1: Distribution of the number of patients admitted for more than 48 h during the study period of 1 year along with gender-wise distribution

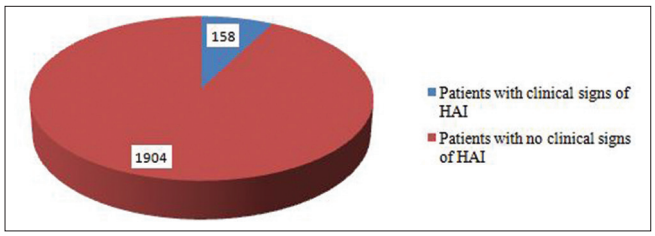

Figure 2: Distribution of patients based on the development of clinical signs of hospital-acquired infection

Table 1: Distribution of the study patients according to the presence or absence of infection (*n*=158)

Total samples collected	Culture positive number (%)	Culture negative number (%)
158	92 (58.23)	66 (41.77)

Table 2: Frequency distribution of patients included in the study according to the age group (*n*=158)

Age group (in years)	Total (%)
11–20	22 (13.92)
21–30	24 (15.19)
31–40	28 (17.72)
41–50	33 (20.89)
51–60	26 (16.46)
61–70	25 (15.82)
Total	158 (100.00)

Figures in parenthesis indicate percentage

A total of 158 samples of blood, urine, sputum, and pus/wound swabs were collected from those patients for microbiological assessment.

Of the 2062 patients, a total of 158 patients were suspected of developing symptoms and signs of any of the HAI. A total of 158 samples of blood, urine, sputum, pus, and wound swabs were collected from the 158 patients for microbiological assessment during the study period. Therefore, the overall infection percentage was 7.66% over the study period of 1 year. From the 158 samples collected during the study period, samples from 92 patients revealed positive culture reports. The rest 66 cases showing clinical signs of suspected HAI were not detected as having healthcare-associated bacterial infection by laboratory methods [Table 1].

The mean age of the 158 patients (with clinical signs of HAI) included in the study was 41.37 ± 16.27 years, with age groups ranging from 12 years to 70 years. Majority of the patients (20.89%) were of 41–50 years age group followed by 31–40 years age group (17.72%) and 51–60 years age group (16.46%). Percentage of patients in the age group of 61–70 years and 21–30 years were 15.82%–15.19%, respectively. Patients in the age group of 11–20 years were least (13.92%) [Table 2].

Gender profile of the 158 patients (with clinical signs of HAI) included in the study was that 69.62% (110/158) were male and 30.38% (48/158) were female [Table 3].

From the 158 samples collected during the study period, samples from 92 patients were positive in bacteriological culture; they were considered as infected from HAI. The rest 66 cases with clinical signs of HAI were not detected of having hospital-acquired bacterial infection by laboratory methods, and these patients were considered as not infected from HAI caused by bacteria.

During the study period of 1 year, among the detected infections, SSI was most common (83.70%), followed by UTI (8.70%), bloodstream infection (5.43%), and pneumonia (2.17%) [Table 4].

The number of detected infection out of total collected samples was 58.22 (92/158) during the whole study period. During the study period of 1 year, the number of detected infection out of total samples for UTI, SSI, pneumonia, and bloodstream infection was 25.00% (8/32), 74.04% (77/104), 15.38% (2/13), and 55.56% (5/9), respectively.

A total of 92 bacterial isolates were identified during the study period of 1 year. *Staphylococcus aureus* was the

most frequently detected bacteria (28.26%) followed by *Escherichia coli* (19.57) and *Pseudomonas aeruginosa* (17.39%). Among *S. aureus* isolates, 17.39% (16/92) were methicillin-resistant *S. aureus* (MRSA) and 10.87% (10/92) were methicillin-sensitive *S. aureus* [Figure 3].

DISCUSSION

HAIs are a problem of high concern in hospitals. Surveillance data regarding HAI are limited in India, especially from hospitals in non-urban settings. This study provides baseline data regarding HAI which will give direction to the infection control team to carry out their activities. The risk of HAI is 2–20 times higher in developing countries than the developed nations. The actual rates vary from 5% to 10% of all patients admitted in developed countries, whereas it may be as high as 25% in developing countries.[12] This study shows an infection rate of 7.33% in the orthopedic wards of our hospital.

A study by Coello *et al.*[13] showed that the overall increase in the duration of hospitalization for patients with SSI was 8.2 days, ranging from 3 days for gynecology to 9.9 for general surgery and 19.8 for orthopedic surgery. One significant aspect of this study lies in the fact that patients in orthopedics ward stay longer than the patients admitted in other wards of the same hospital; thus, they are more exposed to the hospital-acquired drug-resistant pathogens and development of HAIs.

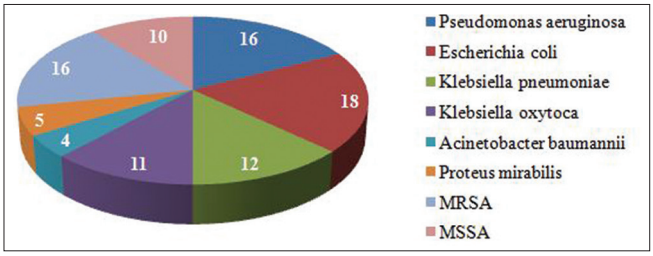

Figure 3: Distribution of bacteria isolated from the samples (*n* = 158)

Table 3: Frequency distribution of patients included in the study according to sex (*n*=158)

Sex	Total
Male	110 (69.62)
Female	48 (30.38)
Total	158 (100.00)

Figures in parenthesis indicate percentage

Therefore, bacteriological profile of the HAI in this study reflects the prevalence of drug-resistant pathogens. It was seen that of *S. aureus* isolated in this study almost 40% were MRSA. This is at par with national figures in a study done by INSAR group in 2013.[14]

The mean age for patients developing culture confirmed HAI (infected) was 45.08 ± 15.74 years, with age groups ranging from 16 to 70 years. Most of the patients (53.17%) included in this study who had clinical signs of HAI were more than 40 years of age, which was similar to the finding of a study done by Mythri and Kashinath.[15]

During the study period of 1 year, among the detected infections, SSI was most common (83.70%), followed by UTI (8.70%), bloodstream infection (5.43%), and pneumonia (2.17%). In the previous studies by Green and Wenzel[16] and Haley,[17] SSIs are the most common HAIs. Therefore, this finding of the study was corroborative of other related studies.

Of the total 92 bacteria isolated from the samples collected from patients included in the study, Gram-negative bacteria isolated were 71.74% (66/92). Hence, the Gram-negative bacteria were the predominant organisms causing HAIs in this study. This finding was similar to other studies conducted in India. Some of the studies from India by Orrett[18] and Rajkumari *et al.*[19] also showed similar predominance of Gram-negative bacilli.

The most common bacteria causing UTI in the patients in the study was *E. coli* causing 19.57% (18/92) of total number of bacterial isolates. *P. aeruginosa* was the second common organism accounting for 17.39% (16/92) followed by *Klebsiella pneumoniae* which was 13.04% (12/92). This finding was consistent with the recent US data[20] indicating *E. coli* as the most common etiologic Gram-negative organism, followed in descending order of frequency by *P. aeruginosa*, *Klebsiella* Species, *Enterobacter* Species, and *Acinetobacter baumannii*.

Infections caused by Gram-negative bacteria have some epidemiological concern. These organisms are highly

Table 4: Distribution of HAIS during the study period

Type of HAI	Type of collected samples	Total number of collected samples	Number of detected infections (% of total samples)
UTI	Urine	32	8 (25.00)
SSI	Pus/wound swab	104	77 (74.04)
Pneumonia/LRTI	Sputum	13	2 (15.38)
BSI	Blood	9	5 (55.56)
Total		158	92 (58.22)

SSI: Surgical site infection, UTI: Urinary tract infection, BSI: Bloodstream infection, HAI: Hospital-acquired infection, LRTI: Lower respiratory tract infection

efficient at upregulating or acquiring genes which code for the mechanisms of antibiotic resistance, especially in the presence of antibiotic selection pressure, which is a real concern in regular medical practice. Proper surveillance of HAI following standard methodology is required for the identification of the pathogen.

The advantage of this study was, we could identify potential bacterial pathogens, which are predominant in causing HAIs in this hospital. This should provide valuable inputs for formulating antibiotic stewardship guidelines for this hospital.

There were some limitations of this study. Due to limited resources, it was done in only orthopedics ward as a representative sample, but inclusion of few more areas of the hospital would have been more representative, thereby resulting in more effective infection control interventions.

CONCLUSION

HAIs are a significant cause of morbidity and mortality of patients admitted in hospitals. These infections, often caused by drug-resistant pathogens, pose serious threat to the health-care system. Emergence of newer resistance patterns in both Gram-negative and Gram-positive bacteria further complicates the scenario. Proper surveillance of HAI following standard methodology is essential to implement any infection control program. Interventional programs to reduce the occurrence of HAIs should be planned based on the local epidemiological data.

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