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Comparison of Bacteriological Profiles from wound Swab Isolates among Hospital Acquired Infection and Community Acquired Infection in a Tertiary Care Hospital, Bangladesh

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Abstract

Background: Wound infection is one of the health problems that are caused and aggravated by the invasion of pathogenic organisms. **Objective:** The objective of study was to compare the bacteriological profiles including antimicrobial sensitivity pattern from wound swab isolates among hospital acquired infection and community acquired infection so that recommendations can be made for preventing resistance and empirical antibiotic treatment. **Methodology:** This retrospective study was conducted in the department of Microbiology at Monno Medical College, Manikganj, Bangladesh during the period from June 2020 to July 2021 for duration of one year. The patients attending at outpatient department were represented as community acquired infection and patient who admitted at least 48 hour were represented as hospital acquired infection. All the samples were inoculated on blood agar and Mac Conkey agar media for 24 to 48 hour at 35 to 37°C. Organisms were identified by standard microbiological procedures. Antimicrobial susceptibility test was done for all isolated bacteria by disc diffusion method. **Result:** A total number of 170 patients were recruited among them hospital acquired infection were predominant 96(56%) patients and community acquired infection was 87(49%) patients. About 126 (74.1%) yielded growth of different bacteria and culture positive cases were found 78 (61.9%) in HAI group. The predominant isolate is *Staphylococcus aureus* majority were found in the HAI than CAI which was 36(57.1%) and 27(42.9%) respectively. Followed by *Escherichia coli* majority were found in the HAI than CAI which was 17(68.0%) and 8(32.0%) respectively. Streptococcus pyogenes were found 11(61.1%) in the HAI, *Pseudomonas species* majority were found in the HAI than CAI which was 10(62.5%) and 6(37.5%) respectively and *Klebsiella species* all were found in the HAI 4 (100.0%). *Staphylococcus aureus* found highly sensitive to sulphamethoxazole (100%), imipenem (79.4%), gentamicin(76.2%). Escherichia coli found highly sensitive to sulphamethoxazole (100%), ceftazidim (100%), and gentamicin (100%). **Conclusion:** *Staphylococcus aureus* was the most frequently isolated pathogen from wound swab among both HAI & CAI. Antibiotic sensitivity pattern of various isolates will guide for appropriate selection of antibiotics to reduce the spread of resistant bacteria against wound infection.

Keywords: wound infection; HAI; CAI; Bacterial isolates; antimicrobial sensitivity
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Introduction

Wound is defined as an injury to any of the body tissue especially caused by physical means that interrupts continuity[1]. Wound can be accidental, pathological or post-operative. The exposed subcutaneous tissue provides a favorable substratum for a wide variety of

microorganisms to contaminate and colonize. The conditions become optional for microbial growth when the involved tissue is devitalized and the host immune response is compromised[2]. wounds are regularly encountered in surgical practice. They may arise postoperatively, following trauma or burns, or in association with certain medical conditions such as diabetes mellitus, haemoglobinopathy, lower extremities arterial disease, vasculitis, ulcerative skin diseases and malignancies, etc. The progression of a wound to an infected state is likely to involve a multitude of microbial and host factors[3]. Wound infection can be caused by variety of organisms like bacteria, virus, fungi and protozoa and may co-exist as poly microbial communities especially in wound margins and in chronic wounds. Infection of the wound is the invasion and proliferation by one or more species of microorganisms sometimes resulting in pus formation.

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[4]. Such infections have also been called nosocomial infections and sometimes- hospital associated infection. An infection would be classified as community-acquired if the patient had not recently been in a health care facility or been in contact with someone who had been recently in a health care facility. The pattern of infectious diseases may vary from country to country. Therefore, regional research regarding different aspects of community-acquired infection such as incidence, microbial etiology and focus of infection is essential for understanding the burden of infection locally in community, and for developing regional and national strategies for diagnosing and treating infectious diseases[5].

Prolonged hospital stay, long-term disability, increased antimicrobial resistance, additional financial burden, and even avoidable deaths are the evidence that indicate HAI[6]. The types of HAI and microbials vary 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[7]. Surgical site infections (SSI) are the third most frequently reported nosocomial infections accounting for 14.0% to 16.0% of all the infections in hospitalized patients. Among surgical patients SSI are the most common nosocomial infections. These remain a complication of surgical procedures resulting in increased morbidity, mortality and cost. The risk of developing a surgical site infection depends upon the balance between factors determining the number of bacteria contaminating the site and the factors determining the resistance of the site against infection[8]. The increasing frequency of antimicrobial resistance among pathogens causing nosocomial and community acquired infections is making numerous classes of antimicrobial agents less effective resulting in emergence of antimicrobial resistance[9]. Continued use of systemic and topical antimicrobial agents has provided the selective pressure that has led to the emergence of antibiotic resistant strains which in turn, has driven the continued search for new agents. Unfortunately, the increased costs of searching for effective antimicrobial agents and increasing and differentiating antimicrobial resistance are confusing for clinicians for selecting the most appropriate treatment options. However, early initiation of effective treatment is the key determinant for better outcomes. Therefore, investigating the pathogen profiles and monitoring their antimicrobial susceptibility are valuable for successful management of these patients related to preventive, control and therapeutic actions[10]. The objective of study was to compare the bacteriological profiles including antimicrobial sensitivity pattern from wound swab isolates among hospital acquired infection and community acquired infection so that recommendations can be made for preventing resistance and empirical antibiotic treatment.

Methodology

Study Settings and Population: This retrospective cross-sectional study was conducted in the Department of Microbiology at the Monno Medical College, Manikganj from June 2020 to July 2021 for a period of one year. Wound swabs were collected from patients attending at outpatient and inpatient department of Monno Medical College and Hospital. The patients attending at outpatient department were represented as community acquired infection and patient who admitted at least 48 hour were represented as hospital acquired infection. Wound infection was suspected if a wound was not healing well, getting bigger, exudating pus or fluid. Very ill patients and those undergoing antibiotic therapy two weeks prior to the study were

excluded.

Sample Collection Procedure: Open wound swabs were aseptically obtained after the wound immediate surface exudates and contaminants were cleansed off with moistened sterile gauze and sterile normal saline solution. Dressed wounds were cleansed with sterile normal saline after removing the dressing. The specimen was collected on sterile cotton swab by rotating with sufficient pressure. Double wound swabs were taken from each wound at a point in time to reduce the chance of contamination. The samples were transported to the laboratory after collection with minimum delay.

Isolation and Identification of Bacteria: All the samples were streaked on blood agar and Mac Conkey agar media by sterile inoculation loop and incubated 24 to 48 hour at 35 to 37°C. Organisms were identified by standard microbiological procedures including colony characters, haemolysis on blood agar, changes in physical appearance in differential media and enzyme activities of the organisms. Gram staining and biochemical reactions tests were performed on colonies from primary cultures for identification of the isolates. Gram-negative rods were identified by performing a series of biochemical tests namely: Kliger Iron Agar (KIA), Indole, Simon's citrate agar, urea and motility. Gram-positive cocci were identified based on their gram reaction, catalase and coagulase test results. Susceptibility to antimicrobial agents of all isolates was done by Kirby Bauer modified disc diffusion technique using Mueller Hinton agar plates and zones of inhibition were interpreted according to CLSI guidelines (2015)11. Antibiotic discs such as Cefotaxime (30µg), Ceftriaxone (30µg), Amoxicillin (20µg), Ciprofloxacin (5µg), Cefuroxime (30µg), Amikacin (30µg), Azythromycin (15µg), Gentamicin (10µg), Doxycycline(30µg), NalidixicAcid (30µg), Tetracycline (30µg), Cefixime (30µg), Imipenum (10µg), Nitroflurantoin (300µg), vancomycin (30µg⁄disc), linezolid (30µg⁄disc), Sulphamethozazole with Trimethoprim (25 µg).

Statistical Analysis: Statistical analyses was performed with SPSS software, versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data that were normally distributed were summarized in terms of the mean, standard deviation, median, minimum, maximum and number of observations. Categorical or discrete data were summarized in terms of frequency counts and percentages. When values are missing, the denominator was stated. Chi-square test was used for comparison of categorical variables and Student t test was applied for continuous variables. Every effort was made to obtain missing data. A two-sided P value of less than 0.05 was considered to indicate statistical significance.

Ethical Clearance: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the IRB of Monno Medical College. Participants in the study were informed about the procedure and purpose of the study and confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and analyzed using the coding system.

Results

A total number of 170 patients were recruited after fulfilling the inclusion and exclusion criteria. Among them hospital acquired infection were predominant which was 96(56%) patients and community acquired infection was 87(49%) patients (Figure I).

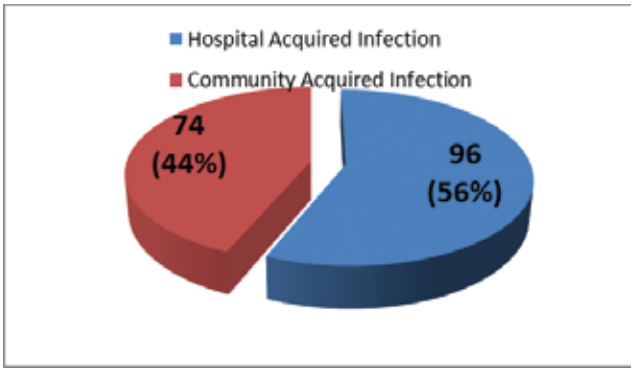

Figure I: Pie chart showing Distribution of Participants (n=170)

Among 170 cases, 126 (74.1%) yielded growth of different bacteria. Among them culture positive cases were found 78 (61.9%) in HAI group and 48 (38.1%) in CAI group. On statistical analysis the association between culture findings in HAI & CAI group differ significantly (P value=0.016) (Table 1).

Among 170 respondents male participants were predominant than female which was 90 (53%) and 80(47%). About 96 respondents from HAI group female participants were predominant than male which was 54(67.5%) and 42(46.7%) respectively. About 74 respondents from CAI male participants were predominant than female which was 48(53.3%) and 26(32.5%) respectively. The association between

gender and HAI & CAI group differ statistically significantly (P =0.006) (Table 2).

Table 1: Culture positivity among HAI & CAI group (n=170)

Culture Result	Source of infections		Total
	HAI	CAI	
Positive	78(61.9%)	48(38.1%)	126(100.0%)
Negative	18(40.9%)	26(59.1%)	44(100.0%)
Total	**96(56.5%)**	**74(43.5%)**	**170(100.0%)**

Chi- Square (X^2) test was performed to see the association. P≤0.05 was determined as level of significance; p value=0.016

Out of 63 isolates of Staphylococcus aureus majority were found in the HAI than CAI which was 36(57.1%) and 27(42.9%) respectively. The difference between the isolation rate in HAI and CAI was not statistically significant (p=0.271).

Table 2: Distribution of Gender among HAI and CAI Group (n=170)

Gender	Source of infections		Total
	HAI	CAI	
Female	54(67.5%)	26(32.5%)	80(100.0%)
Male	42(46.7%)	48(53.3%)	90(100.0%)
Total	**96(56.5%)**	**74(43.5%)**	**170(100.0%)**

Chi- Square (X^2) test was performed to see the association. P≤0.05 was determined as level of significance; p value=0.006

Out of 18 isolates of Streptococcus pyogenes majority were found in the HAI than CAI which was 11(61.1%) and 7(38.9%) respectively. The difference between the isolation rate in HAI and CAI was not statistically significant (p=0.940). Out of 25 isolates of Escherichia coli majority were found in the HAI than CAI which was 17(68.0%) and 8(32.0%) respectively. The

Table 3: Distribution of Isolated Bacteria from HAI and CAI group (n=170)

Name of Bacteria	Source of infections		Total	P value
	HAI	CAI		
Staphylococcus aureus	36(57.1%)	27(42.9%)	63(100.0%)	0.271
Streptococcus pyogenes	11(61.1%)	7(38.9%)	18(100.0%)	0.940
Escherichia coli	17(68.0%)	8(32.0%)	25(100.0%)	0.483
Pseudomonas species	10(62.5%)	6(37.5%)	16(100.0%)	0.958
Klebsiella species	4(100.0%)	0(0.0%)	4(100.0%)	0.110

Chi- Square (X^2) test was performed to see the association. P≤0.05 was determined as level of significance.

Table 4: Antibiotic Sensitive Pattern of the isolated bacteria

Name of ntibiotics	Name of bacteria				
	***Staphylococcus aureus* (n=63)**	***Streptococcus pyogenes***	***Escherichia coli***	**Pseudomonas**	**Klebsiella**
Vancomycin	17(27%)	4(16%)	4(16%)	0(0.0%)	0(0%)
Sulphamethoxazole	13(100.0%)	3(100%)	3(100%)	0(0.0%)	4(100%)
Imipenum	50(79.4%)	22(88.0%)	22(88.0%)	12(75%)	3(75%)
Amikacin	13(21%)	3(12.5%)	3(12.5%)	10(62.5%)	1(25%)
Azithromycin	35(55.6%)	17(68.0%)	17(68.0%)	14(87.5%)	4(100%)
Ciprofloxacin	39(61.9%)	13(52%)	13(52%)	11(68.8%)	2(50%)
Levofloxacin	13(20.6%)	7(28%)	7(28%)	3(18.8%)	1(25%)
Linezolid	0(0.0%)	14(56%)	14(56%)	1(6.3%)	0
Tetracycline	13(20.6%)	5(20%)	5(20%)	1(6.3%)	1(25%)
Doxycycline	24(38.1%)	9(36%)	9(36%)	2(12.5%)	1(25%)
Cefotaxime	0	23(92%)	23(92%)	2(12.5%)	1(25%)
Ceftazidim	8(12.7%)	25(100%)	25(100%)	3(18.8%)	2(50%)
Gentamicin	48(76.2%)	25(100%)	25(100%)	12(75%)	2(50%)
Ceftriaxone	0(0.0%)	14(56%)	14(56%)	1(6.3%)	0(0.0%)
Nitroflurantoin	0(0.0%)	12(48%)	12(48%)	1(6.3%)	0(0.0%)
Cefixime	0(0.0%)	10(40%)	10(40%)	0	0(0.0%)
Total	**63**	**18**	**25**	**16**	**04**

difference between the isolation rate in HAI and CAI was not statistically significant (p=0.483). Out of 16 isolates of Pseudomonas species majority were found in the HAI than CAI which was 10(62.5%) and 6(37.5%) respectively. The difference between the isolation rate in HAI and CAI was not statistically significant (p=0.958). Out of 4 isolates of Klebsiella species all were found in the HAI 4 (100.0%). The difference between the isolation rate in HAI and CAI was not statistically significant (p=0.110) (Table 3).

All the bacterial isolates were tested for antimicrobial susceptibility. Staphylococcus aureus was detected highly sensitive to Sulphamethoxazole (100%), imipenem (79.4%), Gentamicin (76.2%) and low sensitivity found in Ceftazidim (12.7%), Tetracycline (20.6%), Levofloxacin (20.6%). In case of Streptococcus pyogenes highly sensitive to sulphamethoxazole (100%), imipenem (88.9%) and low sensitive to tetracycline (5.6%), cefixim (11.1%), nitroflurantoin (11.1%), vancomycin (11.1%). Escherichia coli found highly sensitive to sulphamethoxazole (100%), ceftazidim (100%), gentamicin (100%) and low sensitivity found in amikacin ((12.5%)), vancomycin (16%). In case of Pseudomonas highly sensitive to azithromycin (87.5%), gentamicin (75%) and low sensitivity found in linezolid (6.3%), tetracycline (6.3%), ceftriaxone (6.3%), nitroflurantoin (6.3%). In case of Klebsiella highly sensitive to sulphamethoxazole (100%), azithromycin (100%) (Table 4).

Discussion

Wound infection is one of the most common and serious complications among the hospital acquired infections.[11-13] Purulent wound infections are exemplified by severe local inflammation, habitually with pus formation caused by severe pyogenic bacteria. Wound infection can increase the length of hospital stay and accounts for the mortality rate up to 70.0% to 80.0% cases.[12-13] A total number of 170 patients were recruited after fulfilling the inclusion and exclusion criteria. Among them hospital acquired infection were predominant which was 96(56%) patients and community acquired infection was 87(49.0%) patients. In-patients face additional exposure to hospital acquired infections due to longer stays. In the present study among 170 cases, 126(74.1%) yielded growth of different bacteria. This culture positivity rate is in accordance with the study by Raza et al (78.3%),[14] Tarana et al[15] (65.25%). However, lower rate was also reported by Shrestha et al[16] (50.0%).

Among 170 respondents' male participants were predominant than female which was 90 (53%) and 80(47%). Another study in Bangladesh was showed that the incidence of wound infection was higher in males (60.52%) than in females (39.47%).15 About 96 respondents from HAI group female participants were predominant than male which was 54(67.5%) and 42(46.7%) respectively. A study conducted in India on Post-operative wound infection supporting the fact that gender difference is not significant[17]. About 74 respondents from CAI male participants were predominant than female which was 53.3% cases and 32.5% cases respectively. This might be explained by the fact that traditionally, in this country mainly males are involved in occupations such as farming, construction works, transportation and industry works where the likely exposure to trauma is common[18].

The predominant isolated bacteria were *Staphylococcus aureus* which were found in the HAI than CAI which was 36(57.1%) and 27(42.9%) respectively. Several studies had reported that *Staphylococcus aureus* was the common isolate of purulent wound infections worldwide with the prevalence rate ranging from 4.6% to 54.4% cases[15,19]. Out of 25 isolates of *Escherichia coli* majority were found in the HAI than CAI which was 17(68.0%) and 8(32.0%) respectively followed by Pseudomonas species, *Klebsiella species* which was similar to the study done by Albumani et al[20].

In this study *Staphylococcus aureus* found highly sensitive to sulphamethoxazole (100.0%), imipenem (79.4%), gentamicin (76.2%) and low sensitivity found in ceftazidime (12.7%), tetracycline (20.6%) and levofloxacin (20.6%). This finding is in agreement with the study of Mama et al[18], Bibi et al[21] and Gautam et al[22] who reported that clinical *Staphylococci species* are 100.0% sensitive to sulphamethoxazole trimethoprim and gentamicin (83%). The same organism was remarkably resistance to Ceftazidime (27.9%)[15], tetracycline (52.0%)[18]. This finding was comparable with the previous studies done in different parts of the world. In this study Escherichia coli are 100% sensitive to sulphamethoxazole, ceftazidim, gentamicin low sensitivity found in amikacin (12.5%), vancomycin (16%) which was similar to the study done by Tarana et[15], Mama et al18 and Mahmood et al23. So, antibiotic sensitivity pattern for Escherichia coli suggests its importance for hospital acquired infection. In case of Pseudomonas highly sensitive to Azithromycin (87.5%), gentamicin (75.0%) and low

sensitivity found in linezolid (6.3%), tetracycline (6.3%), ceftriaxone (6.3%), nitroflurantoin (6.3%). *Pseudomonas species* showed lowest sensitivity to almost all of the drugs[15], however the study done by Albumani et al[20] had shown variable susceptibility pattern for *Pseudomonas aeruginosa*. In fact, the irrational and inappropriate use of antibiotics is responsible for the development of resistance of *Pseudomonas species* to antibiotic monotherapy. The incidence of *Pseudomonas aeruginosa* in wound infection among admitted patient is becoming more serious in developing countries because of lack of general hygienic conditions, production of low quality antiseptics and medicinal solutions for treatment[24]. In this study *Klebsiella species* are 100.0% sensitive to Sulphamethoxazole, Azithromycin which was similar to the study done by Anderl et al[25].

Conclusion

This present study reveals that wound infection is more common in hospital acquired infection compare to community acquired infection. The predominant isolate is *Staphylococcus aureus* followed by *Escherichia coli, Streptococcus pyogenes, Pseudomonas species* and *Klebsiella species*. These isolates show highly sensitive to sulphamethoxazole, imipenem, gentamicin, and azithromycin. Therefore periodic review of the bacteriological profile and antibiotic susceptibility pattern should be done at regular intervals to evolve and reduce the infection rate. To decide the empirical therapy for reducing mortality and morbidity in wound infections the information of the most likely causative organisms and prevailing drug susceptibility pattern of this study may be helpful.

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Conflict Of Interest
The authors have no conflicts of interest to disclose.

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Authors' contributions
Jahan T, Yusuf MA conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Yusuf MA, Sultana S, Mollika FA, Rahman MM contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Shahid SB involved in the manuscript review and editing. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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