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Original Article

Pattern of Healthcare-Associated Infections in a Tertiary Care Setting

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ABSTRACT

Objective: To establish the frequency of emerging pathogens and their susceptibility profiles amongst various healthcare-associated infections.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Microbiology, Combined Military Hospital, Lahore Pakistan, from Jan to Dec 2020.

Methodology: One hundred and ninety-six samples with a history of hospital-acquired infections were received and processed following standard microbiological techniques. Antibiotic susceptibility testing was done by the Kirby-Bauer Disk Diffusion technique for the commonly used antibiotics. For colistin susceptibility, the Clinical and Laboratory Standards Institute recommends broth microdilution, colistin broth disk elution, or colistin agar testing MIC methods, however, colistin susceptibility was performed by the E-strip method.

Results: One hundred and ninety-six clinical samples with bacterial isolates causing healthcare-associated infections were processed. Specimens were from patients with surgical site infections (59,30.1%), Catheter-associated bloodstream infection (52, 26.5%); Ventilator-associated pneumonia (48, 24.5%) and Urinary tract infection (37,18.9%). Klebsiella pneumoniae (64, 32.7%), E.coli (51, 26%) and Acinetobacter baumanii (45,23%) were the leading bacterial pathogens. A total of 72(36.7%) isolates showed multidrug resistance whereas extensively drug-resistant isolates were calculated to be 124(63.3%).

Conclusion: High level of bacterial resistance amongst common health-care-associated infections is an eye-opener and impacts applying strict infection control measures along with antimicrobial stewardship. It will also help clinicians modify empiric treatment regimes in affected patients.

Keywords: Antimicrobial Resistance, Bacterial Isolates, Health-Care-Associated Infections.

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INTRODUCTION

Healthcare-associated infection (HAI) is an infection emerging in a patient during the hospital stay, which the patient was not harboring at the time of admission and occurs after >48 hours of hospital stay [1,2]. In developing countries like Pakistan, 10 out of every 100 admitted patients have to bear the burden of HAI[3]. Ventilator-associated pneumonia, catheter-related bloodstream infections, surgical-site infections, and urinary tract infections are the distinct categories of HAI according to CDC [4]. Some of the most important etiological factors of HAI are Methicillin-resistant Staphylococcus aureus (MRSA), multidrug-resistant Gram-negative bacilli (MDR GNB), vancomycin-resistant Enterococci (VRE), Legionella pneumophila, and Clostridium difficile.[5]. Antimicrobial resistance (AMR) is a major clinical concern these days as WHO marks it amongst the top 13 global public health threats[6]. AMR occurs through the acquisition of resistance genes or mutations among microorganisms leading to ineffective standard treatments. The absence of antibiotic stewardship, injudicious use of antimicrobials, poor control of over-the-counter sales, over-enthusiastic empiric coverage, and delayed diagnosis along with de-escalation of therapy are major factors contributing to increasing resistance[7]. This study aimed to get an overview of HAI patterns in our hospital in terms of common bacterial agents, their susceptibility patterns, and the diseases in light of which antibiograms created might help the clinicians start appropriate empiric treatment therapy to the patients.

METHODOLOGY

The cross-sectional study was conducted at the Department of Microbiology, Combined Military Hospital, Lahore Pakistan, from January to December 2020, after obtaining approval of the Ethical

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Committee (ERC no. 258/2020). The sampling technique was non-probability convenience sampling.

Inclusion criteria: The samples were taken from patients documented to have developed infections after 48 hours of admission to our hospital. The study included all the clinical specimens including blood, bronchoalveolar lavage (BAL), endotracheal secretions, urine, pus, peritoneal fluid, CSF, etc.

Exclusion criteria: Contaminated and duplicated samples and the ones received from patients infected at the time of admission with a history of hospitalization in a setup other than CMH Lahore were not included.

The more resistant organism was chosen in the case of multiple specimens from the same patient with similar infections. American Society for Microbiology (ASM) recommended criteria were followed for sample collection and culture media were chosen considering the specific requirements of every clinical specimen[8]. Identification of significant pathogens associated with HAI was done with standard recommended techniques which involved identifying from the colony appearance on culture media, differentiating between gram-positive and gram-negative on staining, and doing general biochemical tests like oxidase, catalase, and coagulase. API 10S, API 20E, and also API 20NE (BioMerieux, France) aided in confirming the identification of isolates up to the genus and species level. The antibiotic susceptibility was determined by the Kirby-Bauer Disk Diffusion technique by applying the drugs on Muller Hinton agar (Oxoid), according to procedures recommended by the Clinical and Laboratory Standards Institute (CLSI) 20209. However, colistin susceptibility was performed by the E-strip method. According to already standardized definitions, an isolate is labeled MDR if it is at least resistant to one agent in no less than three antimicrobial classes under consideration, an isolate is extensively drug-resistant (XDR) if it is resistant to at least one agent in all antimicrobial classes, but still susceptible to one or two available classes and an isolate is PDR if it is resistant to all agents in all antimicrobial classes[10].

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) version 28.0. Qualitative variables were described as frequencies and percentages.

RESULTS

Out of 196 samples analyzed, 128(65.3%) were males and 68(34.7%) were females. Elderly patients in the age group of >60 years had the highest percentages of HAIs. A large number of specimens were of pus or pus swabs (65, 33.2%) followed by urine (44, 22.4%), blood (36, 18.4%), CSF (29, 14.8%), endotracheal secretions (14, 7.1%) and body fluids (8, 4.1%). Klebsiella pneumoniae was the most common pathogen amongst all HAIs, making up 32.7% of reported pathogens. E.coli (51, 26%), and Acinetobacter baumanii (45, 23%) were the second and third most commonly reported pathogens, respectively as shown in Figure. Frequencies of various diseases associated with these organisms were as follows; Surgical site infection (SSI) (59, 30.1%), Catheter associated bloodstream infection (CABSI) (52, 26.5%), Ventilator associated pneumonia (VAP) (48, 24.5%) and Urinary tract infections (UTI) (37, 18.9 %). Table-I shows association between hospital-acquired diseases and their respective etiological agents. CABSI and SSIs appear to have the highest percentages of Klebsiella pneumonia as etiological agents. However, E.coli and Acinetobacter were major pathogens of UTI and VAP respectively. A total of 72(36.7%) isolates expressed multidrug resistance whereas a threatening number of 124(63.3%) pathogens exhibited extensive drug resistance. In the present research Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas had higher percentages of extensive drug resistance. E.coli and MRSA were comparatively less resistant with more isolates being MDR than XDR however, 100 % of Enterococcus isolates were MDR as shown in Table-II.

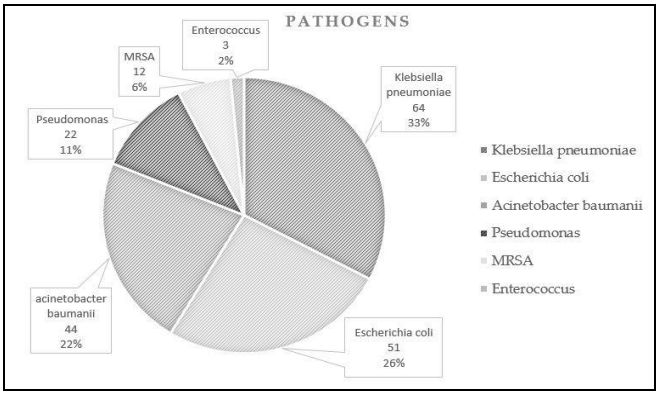

Figure: Distribution of Pathogens amongst Various Health-Care-Associated Infections (n=196)

Table-I: Frequency of Healthcare-Associated Infections and Etiological Factors (n=196)

Healthcare-Associated Infections	E.Coli n (%)	Klebsiella Pneumoniae	Acinetobacter Baumannii n (%)	MRSA n (%)	Pseudomonas n(%)	Enterococcus n (%)
Ventilator Associated Pneumonia	8(16.7)	16(33.3)	18(37.5)	0(0)	4(8.3)	2(4.2)
Candida Bloodstream Infection	12(23.1)	24(46.2)	12(23.1)	0(0)	4(7.7)	0(0)
Surgical Site Infection	7(11.9)	14(23.7)	13(22)	12(20.3)	13(22)	0(0)
Urinary Tract Infection	24(64.9)	10(27)	1(2.7)	0(0)	1(2.7)	1(2.7)
Total (%)	51(26)	64(32.7)	44(22.4)	12(6.1)	22(11.2)	3(1.5)

Table-II: Antimicrobial Resistance Pattern (n=196)

Etiology	Resistance MDR XDR n (%)	
Escherichia Coli	36(70.6)	15(29.4)
Klebsiella pneumoniae	15(23.4)	49(76.6)
Acinetobacter baumannii	2(4.5)	42(95.5)
MRSA	10(83.3)	2(16.7)
Pseudomonas	6(27.3)	16(72.7)
Enterococcus	3(100)	0(0)
Total	72(36.7)	124(63.3)

DISCUSSION

Analysis of our study samples indicated that the healthcare-associated infections were two times more in males than females. Two different studies conducted in Nepal and Italy also had higher percentages of male patients than females[11,12]. However, there seems to be no specific association of gender with acquiring infections. On the other hand, higher percentages of diseases in extremes of ages are probably because of the immunocompromised state and comorbidities associated with old age. Our data marked gram-negative bacteria as the most common cause of health-care-associated infections. Amongst various pathogens, Klebsiella pneumoniae was found responsible for 32.7% (64) of the total infections, followed by E.coli 51(26%), and Acinetobacter baumannii 45(23%). This was similar to research conducted by Bianco *et al*.[12] in Italy and Ali *et al*. in Ethiopia[13]. These organisms are notorious for causing fatal outbreaks which often need aggressive infection control measures[14]. The findings of our study are therefore alarming and need to be addressed. The findings of our study showed that the most common HAI was SSI 59(30.1%). CABSI 52(26.5%), VAP 48(24.5%) and UTI 37(18.9%) followed SSI in descending order. This was in accordance with another study conducted in Punjab, Pakistan with SSI (40%) on top. Similar to our study CABSI was next to SSI making 21.5% of the total and was followed by lower respiratory tract infections (14.6%)[15]. The high rate of SSI is probably associated with various patient-related, surgery-related, and hospital-related factors[16]. Contrary to the above-mentioned studies, in another study done amongst pediatric patients of Pakistan, bloodstream infections were ranked on top of HAIs with a 32.8% infection rate[17].

The association between the disease and causative organism varies with the circulating organisms in a particular setup and the time of year at which the data was collected. Geographical differences may also be a reason for variations in results. In a summary of data from 2015-2017 reported to the National healthcare safety network, Staphylococcus aureus was ranked on top as a pathogen of VAP, CABSI, and SSI with 28.8%, 15.5%, and 17.5% respectively[18]. Contrary to this, our study showed Klebsiella as the commonest pathogen of CABSI and SSI (46.2% and 23.7%) whereas Acinetobacter had the highest percentages in VAP (37.5%). E.coli was reported as the major pathogen of UTI in the study quoted above with 34.3%. This was in accordance with our study as well but with a higher percentage of 64.9%. The overall prevalence of XDR organisms exceeded MDR organisms by a huge margin (63.3% vs 36.7%). This alarming rate was also observed in a study conducted in Ethiopia with 52% XDR organisms and 38% as MDR[19]. The observed MDR and XDR rates at the hospital highlight the perturbing trend of AMR which is associated with prolonged hospital stays and the circulating pathogens in the hospital acquiring more resistance with time. This has serious implications on modern medicine with limited treatment options for the patients infected with these pathogens. XDR was more pronounced in Klebsiella, Acinetobacter, and Pseudomonas. This pattern has also been observed in various studies across the globe [18-19]. The implacable steadiness of resistance in gram-negative bacilli is of grave concern. Although

resistance to colistin was not observed in our study, the 'pan drug resistant' term is now being used in medical literature, leading to complex scenarios.

This study was the first portrayal of different patterns of healthcare-associated infections acquired by the patients in our tertiary care setup. It expresses the significance of infection prevention and control and the dire need for taking up effective measures to halt the rising resistance in the pathogens. It will also help clinicians modify empiric treatment regimes in affected patients.

LIMITATIONS OF THE STUDY

Phenotypic or genotypic characterization of resistant organisms would have been more significant as the outcome of infections with more resistant pathogens could have been effectively correlated with the follow-up of the patients over a longer duration of time.

CONCLUSION

In summary, the majority of pathogens isolated from the samples expressed a high rate of resistance to the antibiotics commonly prescribed by the physicians for the treatment of prevailing bacterial infections in the hospital. The resistance patterns highlighted in the study not only helped in highlighting the need for prudent use of antibiotics, continuous surveillance and strict infection control measures but also emphasized the need of formulating an empiric treatment of the patients.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AT, IAM: Conception, study design, drafting the manuscript, approval of the final version to be published.

QF, FH: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AK, AA: Data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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