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A -4year Study on Antimicrobial Susceptibility Trends of Nosocomial Infections in a Mashhad Referral Hospital, Mashhad, Iran

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ABSTRACT

Introduction: In the present study, we evaluated the 4-year antimicrobial resistance trends of several nosocomial pathogens during 2018-2021 in a reffereal Mashhad hospital, Mashhad, Iran.
Methods: In this study, we reviewed the data of 70,234 clinical isolates were registred Infection Control Data of Ghaem Hospital, Mashhad, Iran. The antimicrobial susceptibility testing was performed using Kirby-Bauer disk diffusion method according to clinical and laboratory standard institute (CLSI) instructions to evaluate trends of antimicrobial resistance over the times.
Results: There were identified (A. baumannii: n = 19,374; K. pneumonia n = 17,206; E. coli n = 23,777; S. epidermidis: n = 9,877). We did not find any significant difference in changes of antimicrobial trends over the time except in minor cases . However, The pattern of antimicrobial drug resistance was gradually differed except E. coli.
Conclusion: our results suggested the overall antimicrobial resistance trends was remins the same level during 2018-2021. It seems that in accessibility and stop prescribing of antibiotics can lead to decreasing antibiotic resistance rate.

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Introduction

Nosocomial infections are one of the most important concerns of health centers, which their numbers have unfortunately been increased in recent years, imposing high costs on the patients and medical centers (1,2). More than 4.1 million cases of nosocomial infections occur annually, in which urinary tract infections being the most common and pneumonia the most fatal nosocomial infections (3).

The prevalence of nosocomial infections in Iran has been reported between 1.9-25% (3,4). Staphylococcus aureus, S. epidermidis, Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli, Enterococcus faecalis, and Acinetobacter baumannii are considered among the most important infectious agents associated with nosocomial infections (5-7).

According to the latest reports, the situation in Iran regarding the control of nosocomial infections is very worrying (3). Antibiotic resistance is one of the most important problems related to nosocomial infections, which is quite important in the nosocomial infection control program (8).

Antibiotic resistance is one of the most import-

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ant challenges causing treatment failure and patient mortality, as WHO designated 2011 as the Year of Antibiotic Resistance (9,10).

Pathogenic bacteria become resistant to different classes of antibiotics through various mechanisms such as resistance gene acquisition, efflux pump, changes in outer membrane proteins, mutations in the active site of enzymes, and competitive inhibition (11,12).

Screening and rapid detection of antibiotic resistance can lead to adequate treatment, reduce treatment costs, and decrease patient mortality; Thus, it is very important in the nosocomial infection control program (13-15). However, the emergence and spread of multi-drug resistant strains can affect the treatment outcomes and ultimate results (16).

Based on the available evidence, the antimicrobial resistance pattern is unique in each geographical area, especially in the developing countries where due to over-the-counter services without prescription, the frequency of antibiotic resistance in these communities is more severe (17,18). However, limited reliable data have been reported on changes in the trend of antimicrobial resistance in Iran. Moreover, the population sample size in these studies was low. This study aimed to evaluate a 4-year trend of antimicrobial resistance pattern of four common hospital pathogens such as S. epidermidis, E. coli, K. pneumonia, and A. baumannii, using the antimicrobial susceptibility testing data from one of the referral hospitals in the city of Mashhad, Iran.

Methods

We retrospectively evaluated the 2018-2021 Infection Control Data of Ghaem Hospital, Mashhad, Iran. This hospital is one of the most important referral hospitals in Khorasan Razavi province that a large number of patients with a different spectrum of socioeconomic levels from all over Khorasan Razavi province refer to. The data on the type of microorganisms and drug-susceptibility testing were obtained from the hospital's microbiology laboratory.

Isolation and identification of microorganisms

Clinical blood, urine, respiratory, abscess, wound, and sterile fluid samples were cultured under routine microbiological media under 37 ° C and 5% CO2. After the bacterial colonies appear on solid media, the identification of bacteria was performed using Gram staining and a conventional biochemical test.

Antimicrobial susceptibility testing

Antibiotic susceptibility testing was performed based on Kirby-Bauer disk diffusion method. The antibiotic discs used for this purpose included: Cefotaxime, Ceftazidime, Cefepime, Azithromycin, Erythromycin, Clindamycin, Cefoxitin, Levofloxacin, Gentamicin, Trimethoprim/ Sulfamethoxazole, Ciprofloxacin, Amopenem, Meropenem, Amikacin, and Imipenem. Interpretation of inhibitory zone (susceptible, intermediate, and resistant) was performed using clinical and laboratory standard institute (CLSI) instructions.

Statistical analysis

The time series analyses was applied for evaluation of antimicrobial resistance pattern over the times. All statistical analyses was performed using Microsoft Excell software. the results considered as significant, if p-value was ≤0.05.

Results and Discussion

Changes in the pattern of antibiotic resistance of the most common nosocomial pathogens were investigated in the period 2018-2021 to monitor the drug resistance of these bacteria. During 4 years, 70,234 isolates were identified (A. baumannii: n = 19,374; K. pneumonia n=17,206; E. coli n =23,777; S. epidermidis: n=9,877). The bacteria were isolated from the clinical specimens such as sputum, urine, wounds, biopsy, blood, and sterile fluids.

The overall antibiotic resistance rate of S. epidermidis to different classes of antibiotics included Azithromycin: 84.63%, Erythromycin: 81.25%, Clindamycin: 68.19%, Cefoxitin: 62.20%, Levofloxacin: 45.18%, and Gentamicin: 26.35%. The total resistance to E.coli strain was as follows: Trimethoprim/Sulfamethoxazole: 45.31%, Cefotaxime: 48.62%, Ceftazidime: 59.16%, Ciprofloxacin: 62.0%, Cefepime: 62.73%, Gentamicin: 50.23%, Ceftazidime/Clavulanic acid: 15.60%, Meropenem: 36.39%, Amikacin: 44.74%, and Imipenem: 49.87%. In addition, the overall antibiotic resistance for K. pneumonia included: Cefotaxime: 81.11%, Ceftazidime: 77.46%, and Cefepime: 74.55%. Also, the resistance in relation to A. baumannii was reported as Ceftriaxone: 95.78%, Ceftazidime: 89.54%, Meropenem: 87.03%, Ciprofloxacin: 84.88%, Imipenem: 81.61%, Gentamicin: 80.08% and Amikacin: 76.80%.

The pattern of antibiotic resistance varied over 4 years. Regarding the antibiotic resistance pattern of S. epidermidis, the trend of antibiotic resistance was uniform over four years, and except for levofloxacin, which had a significant increase (p-value: 0.002), the rates of antibiotic resistance for other antibiotics showed no significant difference (Fig 1). Over the last four years, Azithromycin resistance has changed from 85.8% to 83.8%, 81.7% to 81.4%, Clindamycin from 68.4% to 69.6%, Cefoxitin from 57.9% to 58.4%, Levofloxacin from 47.4% to 55.8%, and Gentamicin from 32 % has changed to 25.8%.

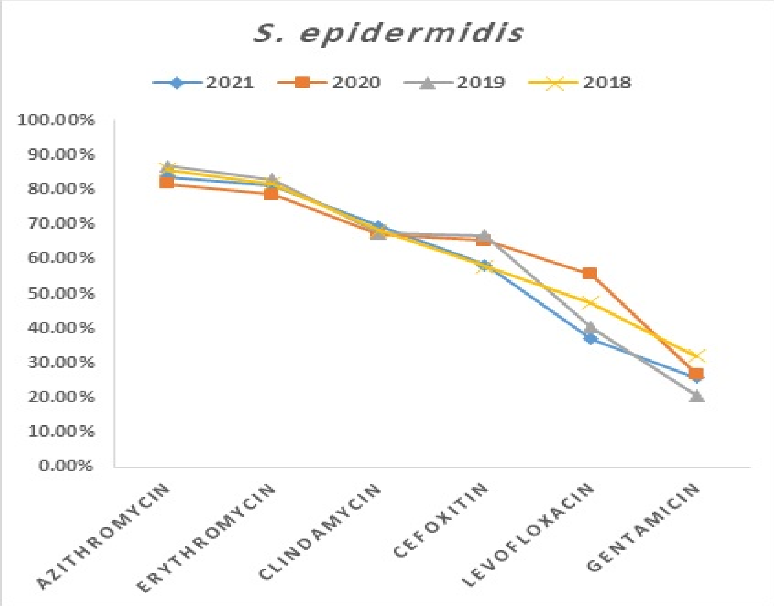

Figure 1: Resistance trends of S. epidermidis clinical isolates against several antibiotics during a 4-years period

The pattern of antibiotic resistance for E. coli was highly variable and non-uniform (Fig 2). Resistance to TMP-SXT and Cefotaxime was significantly increased while the overall resistance to aminoglycosides and monobactams was significantly reduced. During this period, the resistance to TMP-SXT changed from 12% to 73%, Cefotaxime from 22.11% to 70.74%, Ceftazidime from 85.5% to 67.1%, Ciprofloxacin from 60.2% to 57.3%, Cefepime from 66.7% to 51.8%, Gentamicin 72.5% to 35.8%, Ceftazidime from 6.13% to 29.2%, Meropenem from 51.6% to 13.2%, Amikacin from 78.9% to 10.83%, and Imipenem from 70.2% to 5.8%.s.

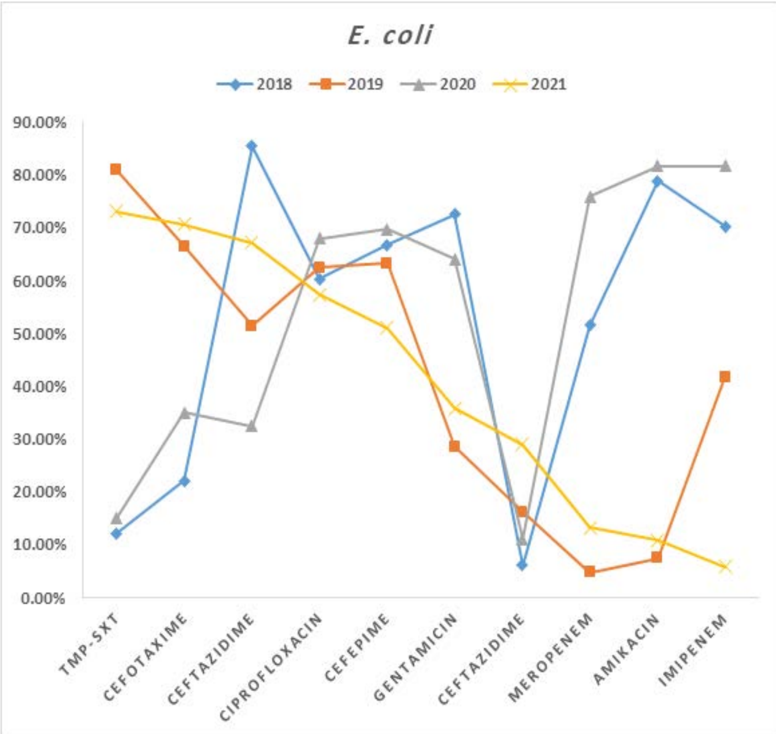

Figure 2: Resistance trends of E. coli clinical isolates against several antibiotics during a 4-years period

No significant change was observed concerning K. pneumonia, such that based on our measurements, Cefotaxime changed from 84.5% to 79.4%, Ceftazidime from 73.6% to 77.8%, and Cefepime from 71.9% to 71.6% (Fig 3).

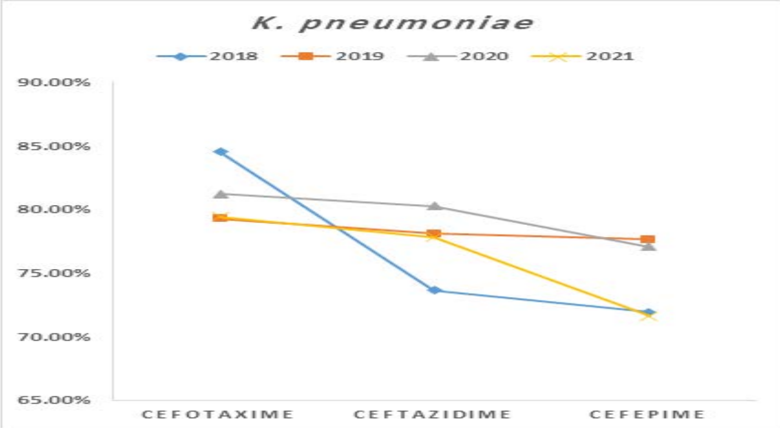

Figure 3: Resistance trends of K. pneumoniae clinical isolates against several antibiotics during a 4-years period

The pattern of A. baumannii antibiotic resistance was also uniformly reduced but the changes were not significant. Regarding changes in antibiotic resistance between A. baumannii isolates, the resistance to Ceftriaxone changed from 95.5% to 95.6%, Ceftazidime from 94% to 86.5%, Meropenem from 92.2% to 86%, Ciprofloxacin from 90.9% to 84.4%, Imipenem 84.5% to 81.8%, Gentamicin from 84.3% to 79.8%, and Amikacin from 83.2% to 77.1% (Fig 4).

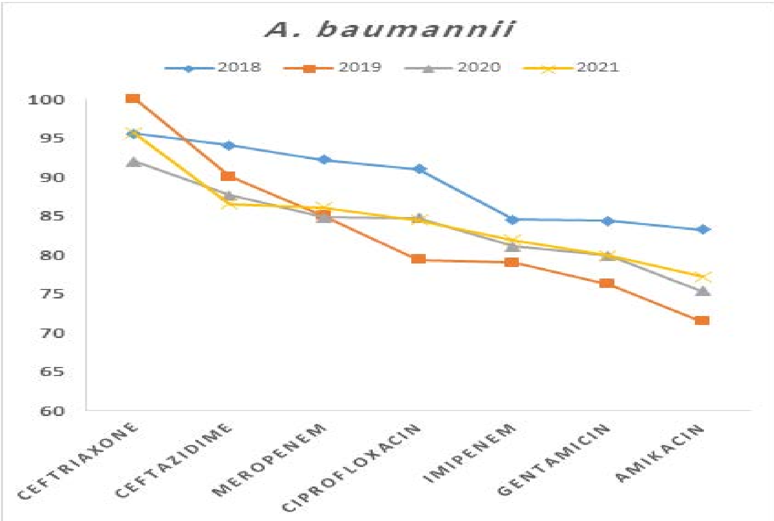

Figure 4: Resistance trends of A. baumanii clinical isolates against several antibiotics during a 4-years period

In this study, the trend of antibiotic resistance of 4 pathogenic bacteria during the last 4 years was evaluated. We showed that in most cases the pattern of antibiotic resistance did not significantly change l, and except for E. coli, the pattern of antibiotic resistance in other pathogens of S. epidermidis, K. pneumonia, and A. baumannii was almost similar during the last four years.

Recent studies have shown that the pattern of antibiotic resistance is different in each geographical area, and determining the antibiotic resistance profile is an effective step in setting up health programs for patient management, adequate treatment, mortality reduction, and local antibiotic resistance programs [19-20]. In the present study, we determined the four-year trend of antibiotic resistance in one of the reference hospitals in the northeast of Iran, using data from 70,234 clinical isolates, and no similar study had been previously conducted in this geographical area.

Abbasian et al. (2019) showed in a recent study that the rate of antibiotic utilization in Iran has increased significantly between 2000 and 2016, which indicates the need to determine national antibiotic stewardship to combat the antibiotic resistance in Iran (8).

S. epidermidis is one of the pathogens associated with catheter and skin infections (21). According to a study in Italy, more than half of the Staphylococci isolated from clinical specimens belong to S. epidermidis. Moreover, in this study, it was found that the pattern of S. epidermidis antibiotic resistance is highly variable (22).

In a similar study in the USA, the Coagulase-Negative Staphylococci antibiotic resistance trend was evaluated from 1999 to 2012. In this study, it was determined that resistance to ciprofloxacin, clindamycin, and levofloxacin increased significantly over a period of thirteen years (23). The pattern of S. epidermidis antibiotic resistance did not change significantly in our study.

E. coli is one of the most common members of enteric bacteria, isolated from a wide range of infections (24). This bacterium has a high capacity for recombination and reception of genes and plasmids associated with antibiotic resistance (25). Based on similar studies, the pattern of E. coli antibiotic resistance was highly variable in different geographical regions, which was consistent with the findings of our study (26,27).

K. pneumonia is another important member of enteric bacteria that causes a wide range of infections, including bloodstream, lung, urinary tract, catheter-related infections as well as gastrointestinal infections (28). Recent reports have shown that in recent years we have seen a significant increase in infection with multi-drug resistant K. pneumonia strains (26,27).

Many recent studies have shown that the global prevalence of resistance to beta-lactams, carbapenems, tigecycline, and colistin is increasing (30,31). In our study, the antibiotic resistance of K. pneumonia strains to cephalosporins was reported to be between 80-70%.

Moradi et al (2015) evaluated the pattern of antibiotic resistance of Acinetobacter baumannii in Iran in a meta-analysis study and showed that the level of antibiotic resistance in Acinetobacter baumannii has been increased in recent years (32).

However, the results of our study showed that the overall antibiotic resistance of A. baumannii was decreasing in recent years, although this decrease was not significant.

Conclusion

In the present study, the 4-year trend of antibiotic resistance of clinical strains of S. epidermidis, E. coli, K. pneumonia, and A. baumannii at one of the main northeast hospitals of Iran was evaluated and we showed that the pattern of antibiotic resistance in it is different geographically. The results also suggested that the pattern of antibiotic resistance has remained the same over the last four

Conflict of interest

All authors declare that they have no conflicts of interest.

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