



Prevalence and antibiotic resistance patterns of bacterial infections in dermatology inpatients: A cross-sectional study

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Abstract

Background: Nosocomial infections are among the most concerning issues affecting hospitalized patients. The present study investigated the frequency of bacterial infections and their antibiotic resistance patterns among patients hospitalized in the dermatology ward.

Methods: This cross-sectional study was conducted among patients admitted to the dermatology ward at Razi Hospital, Rasht, Iran, between 2018 and 2022. The demographic data and clinical characteristics of the 34 patients with bacterial infections were recorded and analyzed. Bacterial isolates were obtained from skin and soft tissue, urinary tract, or bloodstream infections, and the patients' clinical findings and outcomes were recorded.

Results: Thirty-four patients had positive bacterial culture results. The mean age of the patients was 53.56 ± 17.14 years, and 61.8% were female. The urinary tract was the most frequent site of infection. *Staphylococcus epidermidis* (*S. epidermidis*) and *Klebsiella* spp. were the most prevalent isolates. *Klebsiella* spp. and *Escherichia coli* (*E. coli*) were more common in patients aged <56 years and ≥ 56 years, respectively, and in those hospitalized for ≥ 13 days and <13 days, respectively. Antibiotic resistance was high among *S. epidermidis* and *Pseudomonas aeruginosa* (*P. aeruginosa*) isolates, both of which showed resistance to all antibiotics.

Conclusion: This study revealed significant patterns of bacterial infection and antibiotic resistance among patients in the dermatology ward. *E. coli* and *Klebsiella* spp. predominated in urinary tract infections, whereas skin and soft tissue infections exhibited a more diverse profile.

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Introduction

Hospital-acquired infections (HAIs) pose a significant challenge in dermatology wards, contributing to increased morbidity, prolonged hospital stays, and higher healthcare costs. Patients with dermatological conditions are particularly vulnerable to HAIs because of factors such as compromised skin barriers, immunosuppressive treatments, and extended periods of hospitalization (1-3). Common HAIs in dermatology wards include surgical site infections, cellulitis, and device-associated infections. Risk factors for HAIs in these patients include chronic skin conditions, extensive wounds or burns, the use of systemic corticosteroids or immunosuppressants, and invasive procedures (4,5).

Evidence has shown high rates of pneumonia and urinary tract, hematologic, and surgical infections. *Enterococcus faecium* (*E. faecium*), *Staphylococcus aureus* (*S. aureus*), *Klebsiella pneumoniae* (*K. pneumoniae*), *Acinetobacter baumannii* (*A. baumannii*), *Pseudomonas aeruginosa* (*P. aeruginosa*), and *Enterobacter* spp. pose a significant threat in the context of nosocomial infections (6). The burden of nosocomial infections in developing countries has been reported to be as high as 15.5% and to reach 34.1% among critically ill patients (7,8). The highest reported frequency of nosocomial infections has been associated with *Staphylococci* among gram-positive bacteria and *Escherichia coli* (*E. coli*) and *P. aeruginosa* among gram-negative bacteria (8).

The rising prevalence of antibiotic resistance complicates treatment and increases the risk of poor outcomes and the further spread of resistant strains within healthcare settings. Multidrug-resistant (MDR) bacteria may exhibit resistance to various types of antibiotics, and factors contributing to the emergence and spread of MDR organisms include inappropriate antibiotic use, inadequate infection prevention and control practices, and the overuse of antibiotics in both human and animal settings (9,10). Commonly reported MDR organisms cause severe infections and evade the effects of commonly used antibiotics

(11,12). The highest reported level of bacterial resistance in Iran was observed among *A. baumannii* strains, with 100% resistance to gentamicin, ampicillin, ceftriaxone, amikacin, and ceftriaxone. Carbapenems or polymyxins are the most effective antibiotics (13,14).

Evidence suggests that patients with MDR nosocomial infections are primarily hospitalized in intensive care units (ICUs). These MDR strains exhibit resistance to a wide range of antibiotics, indicating the need for enhanced surveillance to guide appropriate antibiotic use and reduce the incidence of nosocomial infections (15,16). Given the varying frequencies of nosocomial infections across hospital wards and the diverse antibiotic resistance patterns of these isolates (17,18), the present study aimed to investigate the frequency of bacterial infections and their antibiotic resistance patterns among patients admitted to the dermatology ward of Razi Hospital in Rasht, Iran. By elucidating the prevalent pathogens and their resistance profiles, this research provides valuable insights for clinicians managing HAIs in dermatology patients.

Methods

This cross-sectional study was conducted among 34 patients in the dermatology ward of Razi Hospital, Rasht, Iran, between 2018 and 2022. The study was approved by the Ethics Committee of Guilan University of Medical Sciences [IR.GUMS.REC.1402.105]. Of the 2,890 patients hospitalized with bacterial infections at Razi Hospital in Rasht, Iran, 34 were admitted to the dermatology ward and included in the study. All patients provided written informed consent to participate in the study.

Demographic data and clinical characteristics were collected from the patients' records. Data on age, gender, underlying diseases (Diabetes, hypertension, and cardiovascular diseases), infection origin (Skin and soft tissue, urinary tract, or bloodstream), duration of hospitalization, patient outcomes, types of bacterial infection, and antibiotic resistance patterns were recorded. None of the patients had burn wounds or used immunosuppressive drugs, and patients with autoimmune diseases or

malignancies were excluded from the study. Standard biochemical and microbiological tests were used to identify the positive isolates, and the antibiotic susceptibility of all isolates was determined in accordance with the Clinical and Laboratory Standards Institute (CLSI) guideline 2023 using Mueller-Hinton agar (Merck, Germany) (19). A panel of antibiotics, including erythromycin (ERY), amikacin (AMK), penicillin (PEN), tetracycline (TET), gentamicin (GEN), doxycycline (DOX), ciprofloxacin (CIP), clindamycin (CLI), trimethoprim-sulfamethoxazole (SXT), imipenem (IPM), ceftazidime (CEF), cefepime (CFP), and nitrofurantoin (NIT), was used.

Statistical analysis

Variables were reported as numbers (Percentages) and means $\pm$ standard deviations (SD). All data were analyzed using IBM SPSS Statistics version 21.

Results

Of the 34 patients, 21 (61.8%) were female, and the mean age was 53.56 ± 17.14 years (19-86 years). Approximately 17 (50%) patients had underlying diseases, and 33 patients were discharged from the hospital. The overall frequency of bacterial infection in the dermatology department of Razi Hospital, Rasht, Iran, between 2018 and 2022 was 1.17%. In urinary tract infections, *E. coli* was the most prevalent pathogen (32.4%), followed by *Klebsiella* spp. (29.4%), *Staphylococcus epidermidis* (*S. epidermidis*) (14.7%), and *Enterobacter* spp. (11.8%). *Citrobacter* spp. (8.8%) and *P. aeruginosa* (2.9%) were also isolated from urinary tract infections. Wound infections showed a different profile, with *S. epidermidis*, *Enterobacter* spp., and *Klebsiella* spp. being equally prevalent (28.6% each), whereas *Citrobacter* spp. was found in 14.2% of cases. Bloodstream infections were primarily caused by *S. epidermidis* (42.8%), with *Enterobacter* spp. and *Klebsiella* spp. each accounting for 28.6% of cases (Table 1).

Among patients younger than 56 years, *Klebsiella* spp. was the most prevalent pathogen (35.4%), followed by *E. coli* (23.5%). However, among patients aged 56 years or older, *E. coli* was the most common pathogen (41.2%), followed by *Klebsiella* spp. (23.5%). Gender differences were also observed: *Enterobacter* spp. was most prevalent among males (30.8%), followed by *S. epidermidis* (23.1%), whereas *Klebsiella* spp. was most common among females (38.1%), followed by *E. coli* (4.9%). Patients with underlying diseases had a higher prevalence of *Klebsiella* spp. (47.1%) and *E. coli* (23.5%), whereas those without underlying diseases had a higher prevalence of *E. coli* (41.2%) and *Enterobacter* spp. (23.4%). The distribution of pathogens also varied according to the duration of hospitalization. For hospital stays of less than 13 days, *E. coli* was the most prevalent pathogen (50.0%), whereas *Klebsiella* spp. was the most common pathogen among patients hospitalized for 13 days or longer (44.3%). Regarding patient outcomes, most patients were discharged, and *E. coli* and *Klebsiella* spp. were the most prevalent pathogens among discharged patients (30.3% each). Only one death was reported and was associated with an *E. coli* infection (Table 1).

Among *S. epidermidis* isolates, the highest resistance was observed to ERY (100%), and the highest susceptibility was observed to GEN (60%). *E. coli* showed the highest resistance to SXT (54.5%) and the highest susceptibility to AMK (92.7%). *Enterobacter* spp. showed the highest resistance to CFP (75%) and was fully susceptible to AMK, GEN, SXT, CIP, and NIT. *P. aeruginosa* was 100% resistant to all tested antibiotics, with no susceptibility observed. *Citrobacter* spp. showed the highest resistance to SXT and NIT (Both 100%) and the highest susceptibility to IPM (100%). *Klebsiella* spp. also showed the highest resistance to SXT (90%) and the highest susceptibility to AMK (60%) (Table 2).

Table 1. Demographic and clinical data of patients according to the frequency of isolated bacteria

Variables		Isolated bacteria n (%)					
		<i>Staphylococcus epidermidis</i>	<i>Escherichia coli</i>	<i>Enterobacter</i> spp.	<i>Pseudomonas aeruginosa</i>	<i>Citrobacter</i> spp.	<i>Klebsiella</i> spp.
Age (Year)	< 56	3 (17.6)	4 (23.5)	3 (17.6)	0 (0.0)	1 (5.9)	4 (35.4)
	≥ 56	2 (11.7)	7 (41.2)	1 (5.9)	1 (5.9)	2 (11.8)	4 (23.5)
Gender	Male	3 (23.1)	2 (15.4)	4 (30.8)	1 (7.7)	1 (7.7)	2 (15.3)
	Female	2 (9.5)	9 (4.9)	0 (0.0)	0 (0.0)	2 (9.5)	8 (38.1)
Underlying disease	Yes	3 (17.6)	4 (23.5)	0 (0.0)	0 (0.0)	2 (11.8)	8 (47.1)
	No	2 (11.8)	7 (41.2)	4 (23.4)	1 (5.9)	1 (5.9)	2 (11.8)
Origin of the infection	Urine	0 (0.0)	11 (55.0)	0 (0.0)	1 (5.0)	2 (10.0)	6 (40.0)
	Wound	2 (28.6)	0 (0.0)	2 (28.6)	0 (0.0)	1 (14.2)	2 (28.6)
	Blood	3 (42.8)	0 (0.0)	2 (28.6)	0 (0.0)	0 (0.0)	2 (28.6)
Duration of hospitalization (Day)	< 13	3 (18.8)	8 (50.0)	3 (18.8)	0 (0.0)	0 (0.0)	2 (12.4)
	≥ 13	2 (11.1)	3 (16.7)	1 (5.6)	1 (5.6)	3 (16.7)	8 (44.3)
Outcome	Discarded	5 (15.2)	10 (30.3)	4 (12.1)	1 (3.0)	3 (9.1)	10 (30.3)
	Death	0 (0.0)	1 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 2. Antibiotic resistance pattern of isolated bacteria

Isolated bacteria		Antibiotics %												
		ERY	AMK	PEN	TET	GEN	DOX	CLI	SXT	IPM	CEF	CFP	CIP	NIT
<i>Staphylococcus epidermidis</i>	Resistant	100	60.0	80.0	60.0	40.0	60.0	80.0	80.0	-	-	-	-	
	Intermediate	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	-	-	-	-	
	Susceptible	0.0	40.0	20.0	20.0	60.0	40.0	20.0	20.0	-	-	-	-	
<i>Escherichia coli</i>	Resistant	-	27.3	-	-	40.0	-	-	54.5	18.2	36.4	-	40.0	9.1
	Intermediate	-	0.0	-	-	0.0	-	-	0.0	27.3	9.1	-	0.0	9.1
	Susceptible	-	92.7	-	-	60.0	-	-	45.5	54.5	54.5	-	60.0	81.8
<i>Enterobacter spp.</i>	Resistant	-	0.0	-	-	0.0	-	-	0.0	0.0	-	75.0	0.0	0.0
	Intermediate	-	0.0	-	-	0.0	-	-	0.0	25.0	-	0.0	0.0	0.0
	Susceptible	-	100	-	-	100	-	-	100	75.0	-	25.0	100	100
<i>Pseudomonas aeruginosa</i>	Resistant	-	100	-	-	100	-	-	-	100	-	100	100	-
	Intermediate	-	0.0	-	-	0.0	-	-	-	0.0	-	0.0	0.0	-
	Susceptible	-	0.0	-	-	0.0	-	-	-	0.0	-	0.0	0.0	-
<i>Citrobacter spp.</i>	Resistant	-	33.3	-	-	66.7	-	-	100	0.0	66.7	-	66.7	100
	Intermediate	-	0.0	-	-	0.0	-	-	0.0	0.0	0.0	-	33.3	0.0
	Susceptible	-	66.7	-	-	33.3	-	-	0.0	100	33.3	-	0.0	0.0
<i>Klebsiella spp.</i>	Resistant	-	40.0	-	-	50.0	-	-	90.0	70.0	60.0	-	70.0	50.0
	Intermediate	-	0.0	-	-	0.0	-	-	0.0	0.0	10.0	-	10.0	0.0
	Susceptible	-	60.0	-	-	50.0	-	-	10.0	30.0	30.0	-	20.0	50.0

Erythromycin (ERY), Amikacin (AMK), Penicillin (PEN), Tetracycline (TET), Gentamicin (GEN), Doxycycline (DOX), Ciprofloxacin (CIP), Clindamycin (CLI), Trimethoprim-Sulfamethoxazole (SXT), Imipenem (IPM), Ceftazidime (CEF), Cefepime (CFP), and Nitrofurantoin (NIT)

Discussion

Gram-negative bacteria cause most nosocomial infections and have developed resistance to most antibiotics. This study showed that *E. coli* and *Klebsiella* spp. were the most frequently isolated bacteria in the hospital's dermatology ward and that urinary tract infections were the most common infections caused by these organisms. Most infections occurred among female patients, and the mean duration of hospitalization was 13 days; only one patient died. A prolonged duration of hospitalization has been reported to result in infections with ESBL-producing microorganisms (20), and longer hospitalization is considered a determinant of the burden of nosocomial infections (21). Females typically exhibit more robust immune responses to antigens than males, resulting in sex-based variations in autoimmune and infectious diseases. In some conditions, such as urinary tract infections, females generally exhibit greater susceptibility to bacterial infections than males (22,23).

The study by Azimi et al. showed that, of 610 bacterial isolates, 53.2%, 22.9%, 21.6%, and 35.2% were *P. aeruginosa*, *A. baumannii*, *S. aureus*, and other bacteria, respectively. The mortality rate was 12%, and all patients had at least one positive result for *P. aeruginosa* or *A. baumannii* (24). The increased use of and resistance to broad-spectrum antimicrobial agents establishes a link between the consumption of and resistance to these antibiotics. The ten-year observation period demonstrated the development of pan-resistance in *K. pneumoniae*, potentially attributable to carbapenemase production. In contrast, ESBL production emerged as the prevalent resistance mechanism in *E. coli*, underscoring the need for ongoing surveillance and antibiotic stewardship initiatives to mitigate selection pressure and prevent further spread (25). A study by Iqbal et al. involving pediatric patients with urinary tract infections reported that *E. coli* and *K. pneumonia* were the predominant extensively drug-resistant uropathogenic bacteria. These bacteria were resistant to the most commonly used classes of β -lactams, pyridopyrimidines, quinolones, and fluoroquinolone antibiotics (26).

The present study demonstrated that *E. coli* was highly susceptible to amikacin and nystatin and resistant to trimethoprim-sulfamethoxazole. We observed that *Klebsiella* spp. was resistant to trimethoprim-sulfamethoxazole, imipenem, and ciprofloxacin but susceptible to amikacin. Mirzarazi et al. reported that *E. coli* isolates were highly resistant to trimethoprim-sulfamethoxazole and that *Klebsiella* spp. showed resistance to trimethoprim-sulfamethoxazole, ciprofloxacin, and nalidixic acid (27). Another study by Jalali et al. showed that the predominant pathogen was *E. coli*, which was present in 68.3% of urine samples, followed by *K. pneumonia*, which was detected in 31.7% of samples. Regarding antibiotic resistance, they reported that *E. coli* isolates exhibited significant resistance to ceftriaxone and ampicillin. According to their results, *K. pneumonia* isolates exhibited elevated resistance to piperacillin, levofloxacin, ampicillin, cefotaxime, and trimethoprim-sulfamethoxazole, respectively (28). Resistance to antimicrobial drugs in *K. pneumoniae* is mediated by genes such as plasmid-mediated carbapenemases or by enzymes capable of hydrolyzing all beta-lactam compounds (29).

Kariuki et al. demonstrated that ciprofloxacin non-susceptibility was prevalent among hospitalized children with *E. coli* and *Klebsiella* spp. infections (30). Sharma et al. reported that *K. pneumoniae* increased from 7.5% in 2018 to 21.4% in 2022. Concurrently, the prevalence of extensively drug-resistant *K. pneumoniae* among mechanically ventilated ICU patients increased notably from 62.5% in 2018 to 71% in 2022. Escalating antibiotic resistance in *K. pneumoniae* poses a significant threat in Asia, necessitating vigilant monitoring and control measures (29). Given the increasing resistance to existing medications, addressing this challenge requires concerted efforts to develop a new generation of antimicrobials. Regular monitoring and reporting of antibiotic resistance by healthcare institutions are crucial for managing this evolving concern.

Our results demonstrated that *S. epidermidis* was susceptible to gentamicin (60%) and resistant to erythromycin (100%), penicillin (80%), clindamycin (80%), and trimethoprim-sulfamethoxazole (80%). Moreover, *P. aeruginosa* was resistant to all antibiotics used (Amikacin, gentamicin, trimethoprim-sulfamethoxazole, imipenem, cefepime, and ciprofloxacin). The study by Khashai et al. showed that *A. baumannii*, *P. aeruginosa*, and *E. coli* were among the most commonly isolated bacteria and that the highest level of resistance to ampicillin was

observed among *P. aeruginosa* isolates. In contrast, *P. aeruginosa* was susceptible to imipenem, and *E. coli* was susceptible to amikacin (31).

We observed that *Enterobacter* spp. was susceptible to most of the antibiotics used (Amikacin, gentamicin, trimethoprim-sulfamethoxazole, imipenem, ciprofloxacin, and nystatin); cefepime was the only antibiotic to which it showed resistance. *Citrobacter* spp. was resistant to trimethoprim-sulfamethoxazole and nystatin. Yekani et al. reported that fosfomycin, carbapenems, and amikacin were highly effective against Enterobacteriaceae. Conversely, quinolones, trimethoprim, and sulfamethoxazole are unsuitable for empirical therapy because of elevated resistance levels. Amikacin is particularly effective among aminoglycosides and may demonstrate enhanced efficacy in complex cases when used in combination with fosfomycin and carbapenems (32). Clinical *Citrobacter* spp. strains are often resistant to multiple classes of antibiotics. Infections caused by MDR *Citrobacter* strains have been associated with a higher rate of in-hospital mortality than infections caused by susceptible strains (33).

Although this study highlighted the prevalence of bacterial infections in dermatology wards, it had several limitations. One limitation was the cross-sectional design. In addition, the association between patients' conditions, according to the type of underlying disease, and infection was not evaluated and should be considered in future studies.

Conclusion

This study reveals significant patterns of bacterial infection and antibiotic resistance among patients in the dermatology ward. The findings indicate that *E. coli* and *Klebsiella* spp. predominantly caused urinary tract infections, whereas skin and soft tissue infections exhibited a more diverse profile. Concerning levels of antibiotic resistance were observed, particularly in *S. epidermidis*, *Klebsiella* spp., and *P. aeruginosa*. These results underscore the need for tailored infection prevention strategies and regular surveillance of local pathogen profiles and resistance rates.

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Ethical Statement

All subjects provided informed consent to participate in the study. All methods were conducted in accordance with the relevant guidelines and regulations, including the Declaration of Helsinki. The study was approved by the Ethics Committee of Guilan University of Medical Sciences [IR.GUMS.REC.1402.105].

Conflicts of Interest

The authors declare that they have no competing interests.

Author Contributions

H.S.E. and H.E. contributed to the conception and design of the study. Material preparation, data collection, and analysis were performed by T.Y., H.S.E., and Z.F. The first draft of the manuscript was written by H.S.E., T.Y., Z.F., and M.P., while H.F. conducted the literature review and edited the final version of the manuscript. All authors approved the final version of the manuscript.

Data Availability Statement

The datasets used and/or analyzed in the current study are reported in this study.

Use of Artificial Intelligence

The authors declare whether AI or AI-assisted technologies were used during the preparation of this manuscript. If used, AI tools were employed solely to enhance language quality, grammar, readability, and

organizational structure. The authors have carefully reviewed and edited all AI-generated content and take full responsibility for the accuracy, integrity, and originality of the final manuscript. No AI tool was used to generate, analyze, or interpret scientific data or images, or to draw scientific conclusions. The use of AI-assisted technologies complies with current publication ethics recommendations and journal policies.

References

- Abban MK, Ayerakwa EA, Mosi L, Isawumi A. The burden of hospital acquired infections and antimicrobial resistance. *Heliyon*. 2023;9(10):e20561. Available from: <https://www.sciencedirect.com/science/article/pii/S2405844023077691> [View at Publisher] [DOI] [PMID] [Google Scholar]
- Faraji N, Malekzadegan Y, Khashei R, Haghighi MA, Alam AN, Fathi J, et al. The prevalence and characterization of the epidemic ST239-MRSA clone. *Rev Res Med Microbiol*. 2024;35(1):1-7. [View at Publisher] [DOI] [Google Scholar]
- Hosseini M, Hasannejad-Bibalan M, Yaghoubi T, Mobayen M, Khoshdoz P, Khoshdoz S, et al. Prevalence and Antibiotic Resistance Pattern of Gram-Positive Isolates from Burn Patients in Velayat Burn Center in Rasht, North of Iran. *Med Lab J*. 2021;15(6):52-7. [View at Publisher] [DOI] [Google Scholar]
- Alamer A, Alharbi F, Aldhilan A, Almushayti Z, Alghofaily K, Elbehiry A, et al. Healthcare-Associated Infections (HAIs): Challenges and Measures Taken by the Radiology Department to Control Infection Transmission. *Vaccines*. 2022;10(12):2060. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Blot S, Ruppé E, Harbarth S, Asehnoune K, Poulakou G, Luyt C-E, et al. Healthcare-associated infections in adult intensive care unit patients: Changes in epidemiology, diagnosis, prevention and contributions of new technologies. *Intensive Crit care Nurs*. 2022;70:103227. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Denissen J, Reyneke B, Waso-Reyneke M, Havenga B, Barnard T, Khan S, et al. Prevalence of ESKAPE pathogens in the environment: Antibiotic resistance status, community-acquired infection and risk to human health. *Int J Hyg Environ Health*. 2022;244:114006. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Furtado de Assis S, Feijó Villas Boas Vieira D, Raphael Escobar Gímenes de Sousa F, de Oliveira Pinheiro CE, Rezende do Prado P. Adverse events in critically ill patients: a cross-sectional study. *Rev Esc Enferm USP*. 2022;56:e20210481. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Ghashghaee A, Behzadifar M, Azari S, Farhadi Z, Luigi Bragazzi N, Behzadifar M, et al. Prevalence of nosocomial infections in Iran: A systematic review and meta-analysis. *Med J Islam Repub Iran*. 2018;32:48. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Endale H, Mathewos M, Abdeta D. Potential Causes of Spread of Antimicrobial Resistance and Preventive Measures in One Health Perspective-A Review. *Infect Drug Resist*. 2023;16:7515-45. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Velazquez-Meza ME, Galarde-López M, Carrillo-Quiróz B, Alpuche-Aranda CM. Antimicrobial resistance: One Health approach. *Vet world*. 2022;15(3):743-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Wilson H, Török ME. Extended-spectrum β -lactamase-producing and carbapenemase-producing Enterobacteriaceae. *Microb Genom*. 2018;4(7):e000197. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Bharadwaj A, Rastogi A, Pandey S, Gupta S, Sohal JS. Multidrug-Resistant Bacteria: Their Mechanism of Action and Prophylaxis. *Biomed Res Int*. 2022;2022:5419874. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Razavi Nikoo H, Ardebili A, Mardaneh J. Systematic Review of Antimicrobial Resistance of Clinical *Acinetobacter baumannii* Isolates in Iran: An Update. *Microb Drug Resist*. 2017;23(6):744-56. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Pourhajibagher M, Hashemi FB, Pourakbari B, Aziemzadeh M, Bahador A. Antimicrobial Resistance of *Acinetobacter baumannii* to Imipenem in Iran: A Systematic Review and Meta-Analysis. *Open Microbiol J*. 2016;10:32-42. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Wang M, Wei H, Zhao Y, Shang L, Di L, Lyu C, et al. Analysis of multidrug-resistant bacteria in 3223 patients with hospital-acquired infections (HAI) from a tertiary general hospital in China. *Bosn J Basic Med Sci*. 2019;19(1):86-93. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Schinas G, Polyzou E, Spernovasilis N, Gogos C, Dimopoulos G, Akinosoglou K. Preventing Multidrug-Resistant Bacterial Transmission in the Intensive Care Unit with a Comprehensive Approach: A Policymaking Manual. *Antibiotics*. 2023;12(8):1255 [View at Publisher] [DOI] [PMID] [Google Scholar]
- Carlsen S, Krall SP, Xu KT, Tomanec A, Farias D, Richman P. Sensitivity of urinary pathogens for patients discharged from the emergency department compared with the hospital antibiogram. *BMC Emerg Med*. 2019;19(1):50. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Sakkas H, Bozidis P, Ilia A, Mpekoulis G, Papadopoulou C. Antimicrobial Resistance in Bacterial Pathogens and Detection of Carbapenemases in *Klebsiella pneumoniae* Isolates from Hospital Wastewater. *Antibiotics (Basel)*. 2019;8(3):85. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Rai S, Dash D, Agarwal N. Introducing the new face of CLSI M100 in 2023: An explanatory review. *Indian J Med Microbiol*. 2023;46:100432. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Dayan N, Dabbah H, Weissman I, Aga I, Even L, Glikman D. Urinary tract infections caused by community-acquired extended-spectrum β -lactamase-producing and nonproducing bacteria: a comparative study. *J Pediatr*. 2013;163(5):1417-21. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Wolkewitz M, Schumacher M, Rücker G, Harbarth S, Beyersmann J. Estimands to quantify prolonged hospital stay associated with nosocomial infections. *BMC Med Res Methodol*. 2019;19(1):111. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Dias SP, Brouwer MC, van de Beek D. Sex and Gender Differences in Bacterial Infections. *Infect Immun*. 2022;90(10):e0028322. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Al-Badr A, Al-Shaikh G. Recurrent Urinary Tract Infections Management in Women: A review. *Sultan Qaboos Univ Med J*. 2013;13(3):359-67. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Azimi L, Motevallian A, Ebrahimzadeh Namvar A, Asghari B, Lari AR. Nosocomial infections in burned patients in motahari hospital, tehran, iran. *Dermatol Res Pract*. 2011;2011:436952. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Datta S, Wattal C, Goel N, Oberoi JK, Raveendran R, Prasad KJ. A ten year analysis of multi-drug resistant blood stream infections caused by *Escherichia coli* & *Klebsiella pneumoniae* in a tertiary care hospital. *Indian J Med Res*. 2012;135(6):907-12. [View at Publisher] [PMID] [Google Scholar]
- Iqbal Z, Mumtaz MZ, Malik A. Extensive drug-resistance in strains of *Escherichia coli* and *Klebsiella pneumoniae* isolated from paediatric urinary tract infections. *J Taibah Univ Med Sci*. 2021;16(4):565-74. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Mirzarazi M, Rezatofighi SE, Pourmahdi M, Mohajeri MR. Antibiotic resistance of isolated gram negative bacteria from urinary tract infections (UTIs) in Isfahan. *Jundishapur J Microbiol*. 2013;6(8):e6883. [View at Publisher] [DOI] [Google Scholar]
- Jalil MB, Al Atbee MYN. The prevalence of multiple drug resistance *Escherichia coli* and *Klebsiella pneumoniae* isolated from patients with urinary tract infections. *J Clin Lab Anal*. 2022;36(9):e24619. [View at Publisher] [DOI] [PMID] [Google Scholar]
- Sharma A, Thakur A, Thakur N, Kumar V, Chauhan A, Bhardwaj N. Changing Trend in the Antibiotic Resistance Pattern of *Klebsiella Pneumonia* Isolated From Endotracheal Aspirate Samples of ICU Patients of a Tertiary Care Hospital in North India. *Cureus*. 2023;15(3):e36317. [View at Publisher] [DOI] [Google Scholar]

30. Kariuki K, Diakhate MM, Musembi S, Tornberg-Belanger SN, Rwigi D, Mutuma T, et al. Plasmid-mediated quinolone resistance genes detected in Ciprofloxacin non-susceptible *Escherichia coli* and *Klebsiella* isolated from children under five years at hospital discharge, Kenya. *BMC Microbiol.* 2023;23(1):129. [[View at Publisher](#)] [[DOI](#)] [[PMID](#)] [[Google Scholar](#)]
31. Khashei R, Navabi Z, Mohebi S, Samadi N. Antibiotic Resistance Among *Escherichia coli*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii* Isolates Obtained From Shiraz Nemazi Hospital ICU Wards. *Iran J Med Microbiol.* 2018;12(4):294-300. [[View at Publisher](#)] [[DOI](#)] [[Google Scholar](#)]
32. Yekani M, Baghi HB, Sefidan FY, Azargun R, Memar MY, Ghotaslou R. The rates of quinolone, trimethoprim/sulfamethoxazole and aminoglycoside resistance among Enterobacteriaceae isolated from urinary tract infections in Azerbaijan, Iran. *GMS Hyg Infect Control.* 2018;13:Doc07. [[View at Publisher](#)] [[DOI](#)] [[PMID](#)] [[Google Scholar](#)]
33. Leski TA, Taitt CR, Bangura U, Stockelman MG, Ansumana R, Cooper WH 3rd, et al. High prevalence of multidrug resistant Enterobacteriaceae isolated from outpatient urine samples but not the hospital environment in Bo, Sierra Leone. *BMC Infect Dis.* 2016;16:167. [[View at Publisher](#)] [[DOI](#)] [[PMID](#)] [[Google Scholar](#)]

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