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Original Article

The antibiotics resistance and the prescriptions' pattern for urinary tract infections at Buraidah Central Hospital

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ABSTRACT

This retrospective cross-sectional study evaluated antibiotic prescribing patterns and bacterial resistance for urinary tract infections (UTIs) at Buraidah Central Hospital (BCH), Saudi Arabia. Data from 401 UTI patients (January 2021–March 2022) were analyzed. Females constituted 52.6% of cases, and patients aged 60–75 years were most affected (35.2%). Escherichia coli (32.9%) and Klebsiella pneumoniae (24.4%) were the predominant pathogens. Antimicrobial susceptibility testing (n=317) revealed high sensitivity to tigecycline (72.9%), amikacin (72.6%), and meropenem (72.2%), but significant resistance to ampicillin (52.4%), ciprofloxacin (46.1%), and trimethoprim/sulfamethoxazole (TMP-SMX; 43.2%). Empirical antibiotics (n=158 prescriptions) were predominantly ceftriaxone 1g (24.1%) and ciprofloxacin 500mg (11.4%). For definitive treatment (n=264 prescriptions), ciprofloxacin 500mg (15.2%), meropenem 1g (9.5%), and amoxicillin-clavulanic acid 625mg (8.7%) were most prescribed. Most patients (61%) received one antibiotic, while 19% received none due to comorbidities. The study underscores high resistance to commonly used antibiotics (ampicillin, ciprofloxacin) and confirms the efficacy of carbapenems and aminoglycosides. Routine urine culture and sensitivity testing before initiating antimicrobial therapy are critical. Local resistance patterns should guide empirical treatment to optimize efficacy, reduce resistance, and lower healthcare costs. Adherence to follow-up visits post-diagnosis is essential for appropriate antibiotic adjustment.

Keywords: UTIs, Antibiotics, Prescribing patterns, Antimicrobial resistance, Saudi Arabia

Introduction

Urinary tract infections (UTIs) are among the most common infections worldwide, affecting millions each year. They represent a significant global health challenge due to their high prevalence and the growing issue of antimicrobial resistance. The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) have highlighted UTIs as a major driver of antibiotic use (and misuse) in healthcare settings. In the Kingdom of Saudi Arabia (KSA), UTIs account for roughly 10% of all reported infections and are the second most common cause of emergency department visits [1]. Women are disproportionately affected – an estimated 60% of women will experience at least one UTI in their lifetime, making UTIs far more frequent in females than males [2-4].

A concerning trend in recent years is the increasing antibiotic resistance among UTI pathogens. Sula *et al.* [1] note that UTIs in KSA are associated with rising resistance rates, with Escherichia coli and Klebsiella spp. The most common uropathogens are showing significant resistance to first-line drugs like co-trimoxazole (trimethoprim-sulfamethoxazole) and ciprofloxacin. On the other hand, some antibiotics, such as amikacin, have remained highly effective against UTI bacteria in the region. However, only a few studies have been published on UTIs in Saudi Arabia, so local data are crucial for guiding treatment. This report summarizes findings from Buraidah Central Hospital (BCH) between January 1, 2021, and March 31,

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2022, focusing on UTI cases. We present an overview of patient demographics, departmental distribution of cases, the spectrum of bacterial isolates, antibiotic sensitivity and resistance patterns, and prescribing practices (both empirical and definitive). The findings are discussed in the context of regional and global studies, with an emphasis on the implications of antibiotic resistance and recommendations to improve UTI management and reduce resistance.

Materials and Methods

In this cross-sectional, retrospective study, data were collected from patient files and lab results on the electronic system (VIDA) in BCH, Saudi Arabia, from January 1, 2021, to March 31, 2022. Patients who were diagnosed with UTI and had a positive lab result from both outpatient and inpatient departments were included. The data collection form is designed with three sections. Section one includes demographic data of the participants. Section two includes the urine analysis and sensitivity test results. Section three includes the antibiotics prescribed for the UTI, either empirically or as part of the treatment. This study followed the regulations, and the Qassim Region Research Ethics Committee approved it, numbered (607-42-2655), dated April 17, 2021. The confidentiality of patients' data was ensured in accordance with the regulations of the Qassim Region Research Ethics Committee.

Results and Discussion

Table 1 provides an overview of the patient demographics in the study period. A total of 401 patients were included (from Jan 2021 through Mar 2022). Patients aged 60-75 years were more likely to have UTI, with 64 males (16%) and 77 females (19.2%) affected. On the other hand, younger patients (less than 18) comprised a small percentage of UTI-infected patients (2.2%). The skew toward female cases is consistent with epidemiology studies indicating women are far more likely to develop UTIs than men [5-8].

Table 1. Characteristics data of patients (n=401)

Age Group	Male	Female
Younger than 18	3 (0.7%)	6 (1.5%)
18 – 30	24 (6%)	17 (4.2%)
31 – 45	16 (4%)	34 (8.5%)
46 – 59	19 (4.7%)	28 (7%)
60-75	64 (16%)	77 (19.2%)
Older than 75	64 (16%)	49 (12.2%)
Total	190 (47.4%)	211 (52.6%)

Figure 1 illustrates the distribution of UTI laboratory requests between inpatient and outpatient departments at BCH. In this study, most of the lab requests were sent from the inpatient departments. Inpatient requests were 280 (70%), while the patients from the outpatient departments were 121 in number (30%). Overall, the distribution of **Figure 1** underlines that while UTIs are predominantly a community/outpatient issue, the hospital still sees a considerable burden of UTIs severe enough to warrant inpatient care. This has implications for hospital resources and infection control, as inpatients may receive broader-spectrum antibiotics and have a higher risk for resistant infections.

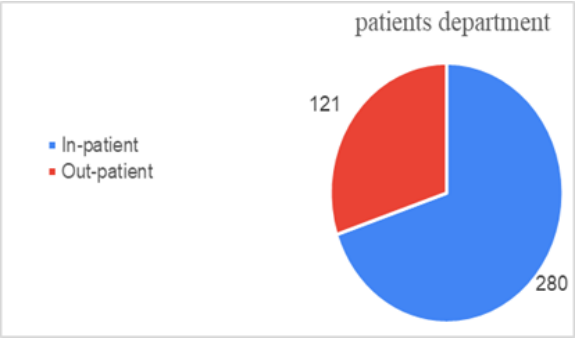

Figure 1. The department in which the urine analysis had been requested for each patient (n=401)

Table 2 Organisms that caused the UTI; a variety of bacterial pathogens were isolated from the urine cultures of UTI patients, but the majority were Gram-negative organisms. Escherichia coli was by far the most common uropathogen, accounting for roughly half of all isolates (approximately 50-60%). This finding is in line with the known epidemiology that E. coli is the leading cause of UTIs, responsible for about 50-70% (or even more in uncomplicated cases) of infections [9-12]. The second most frequent isolate was Klebsiella spp, comprising approximately 15–20% of the cases. The table also analyzed the distribution of isolates by patient gender, revealing a statistically significant association between the type of bacteria and gender ($p = 0.019$). Specifically, E. coli was disproportionately more frequent in female patients' UTIs, whereas male patients had a higher relative proportion of non E. coli infections. Unusual pathogens were also reported, such as Vibrio albensis [13, 14], Raoultella ornithinolytica [15, 16], and Geotrichum species [17, 18].

Table 2. Bacterial Isolates (n=401)

Organism	Gender		Total
	Male	Female	
Ac baum/heam *	3 (0.7%)	2 (0.5%)	5 (1.2%)
B. cepacia cplx **	1 (0.2%)	0 (0%)	1 (0.2%)
C neo/gatti cplx ***	0 (0%)	1 (0.2%)	1 (0.2%)
Candida albicans	6 (1.5%)	10 (2.5%)	16 (4.0%)
Candida catenulate	0 (0%)	1 (0.2%)	1 (0.2%)
Candida famata	6 (1.5%)	4 (1.0%)	10 (2.5%)
Candida guilliermond	7 (1.7%)	2 (0.5%)	9 (2.2%)

Candida kefyr	0 (0%)	1 (0.2%)	1 (0.2%)
Candida parapsilosis group	2 (0.5%)	1 (0.2%)	3 (0.7%)
Candida tropicalis	20 (5.0%)	7 (1.7%)	27 (6.7%)
Citrobacter braakii	1 (0.2%)	1 (0.2%)	2 (0.5%)
Citrobacter farmer	1 (0.2%)	1 (0.2%)	2 (0.5%)
Citrobacter freundii	2 (0.5%)	0 (0%)	2 (0.5%)
Cryptococcus laurentii	1 (0.2%)	0 (0%)	1 (0.2%)
Enterobacter species	4 (1.0%)	1 (0.2%)	5 (1.2%)
Enterococcus faecalis	12 (3.0%)	5 (1.2 %)	17 (4.2%)
Enterococcus species	1 (0.2%)	0 (0%)	1 (0.2%)
Escherichia coli	46 (11.5%)	86 (21.4%)	132 (32.9%)
Geotrichum species	1 (0.2%)	0 (0%)	1 (0.2%)
Klebsiella ozaenae	1 (0.2%)	0 (0%)	1 (0.2%)
Klebsiella pneumonia	43 (10.7%)	55 (13.7%)	98 (24.4%)
Proteus mirabilis	5 (1.2%)	5 (1.2%)	10 (2.5%)
prototheca species	4 (1.0%)	6 (1.5%)	10 (2.5%)
Ps fluor/putida ****	1 (0.2%)	0 (0%)	1 (0.2%)
Pseudomonas aeruginosa	15 (3.7%)	14 (3.5%)	29 (7.2%)
Raoultella ornithinolytica	0 (0%)	1 (0.2%)	1 (0.2%)
Rhodococcus equi	0 (0%)	1 (0.2%)	1 (0.2%)
Serratia marcescens	2 (0.5%)	0 (0%)	2 (0.5%)
Staphylococcus aureus	4 (1.0%)	1 (0.2%)	5 (1.2%)
Streptococcus agalactiae	0 (0%)	3 (0.7%)	3 (0.7%)
Streptococcus pneumoniae	1 (0.2%)	1 (0.2%)	2 (0.5%)
Vibrio spp.	0 (0%)	1 (0.2%)	1 (0.2%)
Total	190 (47.4%)	211 (52.6%)	401 (100%)
p value	0.019		

Antibiotic sensitivity and resistance patterns

Table 3: Organisms' sensitivity and resistance to antibiotics: out of the 401 UTI patients, only 317 patients had a sensitivity lab request, while the remaining (n=84) had only a urine analysis lab request. The sensitivity lab requests showed that 72.9% (n=231) of the organisms were sensitive to tigecycline, followed by amikacin, meropenem, and imipenem with percentages of 72.6% (n=230), 72.2% (n=229), and 71.6% (n=227), respectively. Most of the organisms were resistant to ampicillin with a percentage of 52.4% (n=166), followed by ciprofloxacin, TMP/SMX, and levofloxacin with 46.1% (n=146), 43.2% (n=137), and 42.0% (n=133), respectively. In a similar study at King Fahad Specialist Hospital, Buraydah, KSA, significant resistance to the commonly prescribed TMP+SMX and ciprofloxacin compared to absolute sensitivity to the less prescribed nitrofurantoin [3, 19]. Overall, resistance to ampicillin was 37.7%, followed by SMX/TMP (21.3%), nitrofurantoin (1.1%), ciprofloxacin (5.5%), and levofloxacin (5.1%), as reported by Guneysel *et al*. [20, 21]. These findings have important implications: the high resistance to traditionally popular oral UTI antibiotics (ampicillin, co-trimoxazole, and even ciprofloxacin) means they may no longer be suitable for empirical therapy in this setting, as they would fail in a significant fraction of cases. Instead, clinicians might need to rely on alternatives with better susceptibility profiles – albeit those are often broader-spectrum or parenteral agents, raising other concerns.

Table 3. The antibiotic sensitivity and resistance patterns in isolated organisms (n=317)

	Sensitive	Partial sensitive	Resistance
Amikacin	230 (72.6%)	2 (0.6%)	58 (18.3%)
Amox/K Clav	158 (49.8%)	18 (5.7%)	78 (24.6%)
Amp/Sulbactam	97 (30.6%)	34 (10.7%)	119 (37.5%)
Ampicillin	68 (21.5%)	3 (0.9%)	166 (52.4%)
Aztreonam	147 (46.4%)	2 (0.6%)	60 (18.9%)
Cefazolin	104 (32.8%)	0 (0%)	41 (12.9%)
Cefepime	155 (48.9%)	1 (0.3%)	96 (30.3%)
Cefotaxime	124 (39.1%)	0 (0%)	55 (17.4%)
Cefoxitin	179 (56.5%)	6 (1.9%)	68 (21.5%)
Ceftazidime	149 (47.0%)	5 (1.6%)	60 (18.9%)
Cefuroxime	114 (36.0%)	3 (0.9%)	101 (31.9%)
Ciprofloxacin	152 (47.9%)	10 (3.2%)	146 (46.1%)
Colistin	25 (7.9%)	2 (0.6%)	0 (0%)
Daptomycin	24 (7.6%)	0 (0%)	0 (0%)
Ertapenem	198 (62.5%)	2 (0.6%)	55 (17.4%)
Fosfomycin	2 (0.6%)	0 (0%)	1 (0.3%)
Fusidic Acid	2 (0.6%)	1 (0.3%)	0 (0%)
Gent. Synergy	6 (1.9%)	0 (0%)	10 (3.2%)
Gentamicin	207 (65.3%)	11 (3.5%)	77 (24.3%)
Imipenem	227 (71.6%)	11 (3.5%)	42 (13.2%)
Levofloxacin	173 (54.6%)	11 (3.5%)	133 (42.0%)
Linezolid	23 (7.3%)	0 (0%)	0 (0%)
Meropenem	229 (72.2%)	3 (0.9%)	55 (17.4%)
Moxifloxacin	2 (0.6%)	0 (0%)	1 (0.3%)
Mupirocin	3 (0.9%)	0 (0%)	0 (0%)
Nitrofurantoin	178 (56.2%)	26 (8.2%)	70 (22.1%)
Norfloxacin	152 (47.9%)	7 (2.2%)	127 (40.1%)
Oxacillin	2 (0.6%)	0 (0%)	1 (0.3%)

Penicillin	23 (7.3%)	0 (0%)	1 (0.3%)
Pip/Tazo	217 (68.5%)	12 (3.8%)	53 (16.7%)
Rifampin	17 (5.4%)	0 (0%)	4 (1.3%)
Strep. Synergy	8 (2.5%)	0 0 0%)	8 (2.5%)
Synercid	6 (1.9%)	1 (0.3%)	14 (4.4%)
Teicoplanin	19 (6.0%)	0 (0%)	1 (0.3%)
Tetracycline	10 (3.2%)	0 (0%)	14 (4.4%)
Tigecycline	231 (72.9%)	9 (2.8%)	7 (2.2%)
Tobramycin	194 (61.2%)	7 (2.2%)	86 (27.1%)
Trimeth/Sulfa	133 (42.0%)	0 (0%)	137 (43.2%)
Vancomycin	23 (7.3%)	0 (0%)	2 (0.6%)

Empirical prescription patterns

Table 4 shows that the commonly used empirical antibiotics at BCH were ciprofloxacin, cephalosporins (like ceftriaxone or oral cefuroxime), nitrofurantoin, amoxicillin-clavulanate, and occasionally aminoglycosides. The highest drug prescribed was ceftriaxone 1g, with frequency of 38 (24.1%), followed by ciprofloxacin, which was prescribed 18 times (11.4%). Both levofloxacin 500 mg and meropenem 1g were prescribed 13 times (8.2%). The dosing was in line with standard recommendations, and multiple agents were often chosen to cover Gram-negative bacilli effectively [22-24]. In a cross-sectional, hospital-based study, the appropriateness of empirical use of antibiotics according to the antimicrobial susceptibility results from 500 inpatients in King Fahad Specialist Hospital (KFSH) at Qassim region, 58% of the antibiotics used empirically were appropriately prescribed [25-27]. While this approach likely improved immediate coverage, it also raises concerns for contributing to antibiotic resistance, highlighting a need to balance adequate empiric therapy with stewardship principles.

Table 4. The empirical antibiotics prescribed for urinary tract infection (n=158)

Drug:	Dose	Frequency (%)	Mean of duration (days)
Amikacin	500 mg	1 (0.6%)	3.0
Amoxicillin	250 mg	1 (0.6%)	3.0
Amoxicillin-clavulanic acid IV	1.2 g	2 (1.3%)	3.0
Amoxicillin-clavulanic acid	625 mg	3 (1.9%)	6.7
Azithromycin	250 mg	3 (1.9%)	3.3
	500 mg	3 (1.9%)	4.0
Cefalexin	250 mg	2 (1.3%)	6.5
Cefazolin	1 g	3 (1.9%)	6.3
Cefepime	2 g	1 (0.6%)	7.0
Ceftazidime	1 g	6 (3.8%)	5.7
	2 g	5 (3.2%)	6.0
Ceftriaxone	1 g	38 (24.1%)	4.6
	2 g	7 (4.4%)	3.1
Cefuroxime	500 mg	1 (0.6%)	7.0
Ciprofloxacin	500 mg	18 (11.4%)	7.3
Imipenem	500 mg	6 (3.8%)	8.7
Levofloxacin	500 mg	13 (8.2%)	5.6
	750 mg	5 (3.2%)	6.8
Meropenem	1 g	13 (8.2%)	7.5
	2 g	1 (0.6%)	5.0
Metronidazole	500 mg	2 (1.3%)	6.0
	500 mg	1 (0.6%)	1.0
Moxifloxacin	400 mg	4 (2.5%)	6.8
PIP-TAZO *	2225 mg	3 (1.9%)	7.0
	4500 mg	5 (3.2%)	5.6
Tigecycline	100 mg	3 (1.9%)	11.7
	50 mg	2 (1.3%)	6.5
TMP-SMX **	960 mg	5 (3.2%)	6.4
Vancomycin	500 mg	1 (0.6%)	3.0
TOTAL		158 (100%)	

* PIP-TAZO: piperacillin/tazobactam
** TMP-SMX: trimethoprim/sulfamethoxazole

Definitive treatment patterns

Table 5 shows the most frequently used definitive antibiotics. The highest drug prescribed was ciprofloxacin 500mg, with frequency of 40 (15.2%), followed by meropenem 1g, which was prescribed 25 times (9.5%). Then, amoxicillin-clavulanic acid 625mg was prescribed 23 times (8.7%). Ceftriaxone, the 4th most prescribed drug, was given 17 times (6.4%), with doses of 1 g. The treatment durations were generally about one to two weeks, tailored to infection severity, which is consistent with recommended practices. The definitive treatment patterns demonstrate an appropriate response to lab findings: broad-spectrum empiric therapies were commonly narrowed down to more specific, effective agents once the pathogen was identified. This tailored approach helps avoid unnecessary prolonged exposure to broad antibiotics and can improve clinical outcomes. However, it relies on proper follow-up of culture results. The data suggest that in the majority of cases at BCH, follow-up was done and therapy was adjusted accordingly (which is good practice). Nevertheless, there might have been cases where initial therapy was continued despite culture results – those instances, if any, underscore the importance of consistent follow-up.

Table 5. The antibiotics prescribed for the treatment of urinary tract infection (n=264)

Drug:	Dose	Frequency (%)	Mean of duration (days)
Amikacin	750 mg	1 (0.4%)	14.0

Amoxicillin	250 mg	1 (0.4%)	7.0
Amoxicillin-clavulanic acid	1000 mg	1 (0.4%)	5.0
	625 mg	23 (8.7%)	7.4
Ampicillin	1 g	2 (0.8%)	7.0
Azithromycin	250 mg	1 (0.4%)	5.0
	500 mg	2 (0.8%)	5.0
Caspofungin	50 mg	1 (0.4%)	1.0
Cefazolin	1 g	3 (1.1%)	6.7
	500 mg	1 (0.4%)	3.0
Cefepime	1 g	1 (0.4%)	5.0
Ceftazidime	1 g	16 (6.1%)	8.0
	2 g	6 (2.3%)	7.5
Ceftriaxone	1 g	17 (6.4%)	5.6
	2 g	8 (3.0%)	8.5
Cefuroxime	250 mg	10 (3.8%)	7.7
	500 mg	4 (1.5%)	9.3
Ciprofloxacin	250 mg	3 (1.1%)	9.3
	500 mg	40 (15.2%)	7.2
Colistin	9 MIU	1 (0.4%)	7.0
Doxycycline	100 mg	1 (0.4%)	7.0
Erythromycin	500 mg	1 (0.4%)	3.0
Gentamicin IV	1 mg/kg	1 (0.4%)	6.0
Gentamicin	400 mg	1 (0.4%)	7.0
Imipenem	500 mg	6 (2.3%)	6.2
Levofloxacin	500 mg	13 (4.9%)	6.0
	750 mg	3 (1.1%)	5.7
Meropenem	500 mg	1 (0.4%)	6.0
	1 g	25 (9.5%)	8.1
	2 g	2 (0.8%)	8.5
Metronidazole	500 mg	3 (1.1%)	9.3
Moxifloxacin	400 mg	2 (0.8%)	6.5
Nitrofurantoin	100 mg	7 (2.7%)	9.7
PIP-TAZO *	2225 mg	6 (2.3%)	8.2
	4500 mg	14 (5.3%)	8.7
Tigecycline	100 mg	7 (2.7%)	7.3
	50 mg	10 (3.8%)	8.7
TMP-SMX **	480 mg	1 (0.4%)	7.0
	960 mg	12 (4.5%)	7.4
Vancomycin	500 mg	3 (1.1%)	5.0
	750 mg	1 (0.4%)	5.0
	1 g	2 (0.8%)	3.5
TOTAL:		264 (100.0%)	

* PIP-TAZO: piperacillin/tazobactam
** TMP-SMX: Trimethoprim/sulfamethoxazole

Number of antibiotics per patient

Figure 2 depicts the distribution of the number of different antibiotics each patient received over the course of their UTI treatment. The majority of patients were treated with only a single antibiotic (monotherapy) for their UTI – these are likely uncomplicated cases where the empiric antibiotic was effective, or cases where a single definitive antibiotic sufficed after culture results. Approximately 245 (61%) of patients fell into this one-antibiotic category. However, a substantial proportion of patients received two antibiotics during their treatment course (either sequentially or concurrently). For example, about 65 (16%) of patients were exposed to two different antibiotics. Notably, **Figure 2** also shows a smaller yet significant fraction of patients who received three or more different antibiotics for their UTI. Perhaps around 16 patients (4%) received 3 antibiotics.

Figure 2 indicates that while many UTI patients were managed with a single well-chosen antibiotic, a significant portion needed multiple antibiotics, highlighting the dynamic nature of UTI treatment in practice. The need for switches (one antibiotic to another) in many cases underscores the importance of getting the initial antibiotic choice right and the value of culture guidance. It also suggests that improvement in empirical therapy (using local resistance data) could reduce the frequency of multiple antibiotic use. Notably, the polypharmacy trend observed calls for careful antibiotic stewardship: each additional antibiotic should be justified by clinical need, and efforts should be made to streamline therapy whenever possible to minimize unnecessary drug exposure.

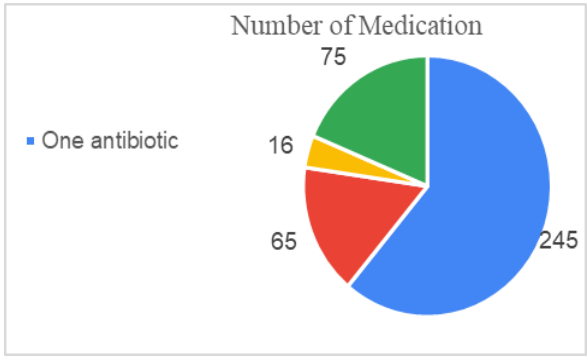

Figure 2. The number of antibiotic drugs prescribed for each patient (n=401)

Conclusion

The analysis of UTI cases at Buraidah Central Hospital (2021–2022) reveals a pattern of common pathogens and troubling antibiotic resistance, alongside prescribing practices that attempt to address these challenges. E. coli was the leading cause of UTIs, and together with other Gram-negative bacteria, it exhibited high resistance to several standard antibiotics (notably ampicillin, co-trimoxazole, and fluoroquinolones). Physicians at BCH have responded by using broader antibiotics empirically, but this strategy, while ensuring initial coverage, has likely further driven resistance. A significant portion of patients required changes in antibiotic therapy, underscoring the importance of culture

results and suggesting room for improvement in initial antibiotic selection. Overall, UTIs at BCH mirror the global scenario: common infections complicated by increasing antimicrobial resistance, necessitating thoughtful management.

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Conflict of interest: None

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Ethics statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Qassim Region Research Ethics Committee, registered at the National Committee of Bio and Med. Ethics (NCBE), numbered (607-42-2655) and dated April 17, 2021.

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