



# **Prevalence of Infections, the Rate of Bacterial Resistance and Antibiotics Use in Al-kharj: Narrative Review**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Aim:** The present review aimed to describe the rate of different infections, the rate of bacterial resistance and antibiotics use in Al-kharj.

**Methodology:** This was a narrative review that included searching Web of science for the keywords "infections" or "bacterial resistance" or "antibiotics use" and "Al-kharj" from 1st of January 2015 to 14th of October 2021.

**Results:** Searching Web of science for the keywords resulted in 29 papers that was conducted during the study period and investigate the rate of different infections, the rate of bacterial resistance or the use of antibiotics in Al-kharj. So, 29 articles were included in the present review.

**Conclusion:** Most of the studies about infections included only some types of infections and most of the conducted studies about the use of antibiotics focused only on the outpatient setting. More studies are needed to explore the rate of other infections and to describe the prescribing of antibiotics in other hospital settings.

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## 1. INTRODUCTION

Antibiotics can save lives if used wisely, but any time antibiotics are used, they can cause adverse events and contribute to the development of antibiotic resistance. Centers for Disease Control and Prevention reported that in U.S. doctors' offices and emergency departments, at least 28% of antibiotic courses prescribed annually are unnecessary, which makes improving the prescribing and the use of antibiotics a national priority [1].

Antibiotic resistance occurs when bacteria change in response to the usage of these drugs. Bacteria, not animals or humans, become antibiotic-resistant. These bacteria may infect animals and humans, and the infections they cause are harder to manage than those caused by nonresistant bacteria. Antibiotic resistance results in higher medical costs, increased mortality rate, and prolonged hospital stays [2].

Centers for Disease Control and Prevention reported that Antibiotic resistance is one of the biggest public health challenges of our time and that in the U.S., at least 2.8 million persons get an antibiotic-resistant infection yearly, and more than 35,000 people die [3]. In Al-kharj, there were several articles studies the infections, bacterial resistance and the use of antibiotics. So, in the present review we aimed to describe the rate of different infections, the rate of bacterial resistance and antibiotics use in Al-kharj.

## 2. METHODOLOGY

This was a narrative review that included searching Web of science for the keyword "infections" or "bacterial resistance" or "antibiotics use" and "Al-kharj" from 1<sup>st</sup> of January 2015 to 14<sup>th</sup> of October 2021.

Al-kharj is one of the important governorates in the Kingdom of Saudi Arabia and is located in the southeast of the capital Riyadh within an area of 19,790 km<sup>2</sup>.

Web of Science is a website that provides subscription-based access to multiple databases that provide comprehensive citation data for many different academic disciplines. The studies that were published before 2015 or after 14<sup>th</sup> of October 2021 were excluded from the study.

Moreover, the study included original articles only, the review articles were excluded from the study.

The searching process for the papers that were conducted during the determined period and that studied the rate of different infections, the rate of bacterial resistance or the use of antibiotics in Al-kharj resulted in 29 included papers.

## 3. RESULTS AND DISCUSSION

### 3.1 Infections in Al-Kharj

A previous study found that the most common bacterium that caused infections in a university hospital in Al-Kharj city was *Escherichia coli* and the most common fungus pathogen was candida albicans [4]. Ahmed et al reported that rate of healthcare associated infections (HAIs) in 2019 in a military hospital in Al-kharj was low (0.43%) and that central line associated bloodstream infections rate was 1.15 per 1000 central line days, the rate of catheter associated urinary tract infections was 1.00 per 1000 catheter days, the rate of ventilator associated pneumonia was 2.11 per 1000 ventilator days, and surgical site infections (SSIs) rate was 0.41 % [5].

Abujheisha et al stated that in the intensive care unit (ICU) at king Khalid hospital in Al-Kharj, respiratory samples showed the highest rate of positive growth (40.3%) followed by urine (20.96%) and that about 91.94 % of the isolates were gram-negative and 8.06% were gram-positive [6]. *Klebsiella pneumoniae* was the most frequently isolated Gram-negative bacteria (28%) followed by *Pseudomonas aeruginosa* (21%) [6]. Eltayeb et al studied the frequency of bacterial and parasitic infections among food handlers in different restaurants in Al-kharj and informed that about 32% of the fingernail and stool samples showed positive culture for different bacterial species, of which, 10% were harboring *Staphylococcus aureus*. *Escherichia coli* (17%) was the main bacteria isolated from stool specimens, followed by *Citrobacter* (12%) and *Pseudomonas aeruginosa* (3%) [7].

A study about the bacterial isolates in the ICU of a military hospital in Al-kharj found that only 6.15% bacterial isolates were collected from ICU and that most of the bacteria that were found in the ICU were gram-positive bacteria [8]. The study also showed that the most common

bacteria that were found were *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* [8]. Moreover, Ahmed et al stated that in a military hospital in Al-Kharj, the percentage of *Candida* species in the 2 years was 6.21% of isolates [9]. They reported also that 40.87% of the *Candida* isolates were *Candida albicans* isolates and that the majority of *Candida* cultures were collected from wound, pus, skin or vagina and to lesser extent urine and lower respiratory tract [9]. Another study about the rate of surgical site infection after caesarean delivery in a military hospital in Al-kharj found that surgical site infections (SSIs) rate was about 1.2 % [10].

A study among clinical culture results in a military hospital in 2018 showed that the most common isolated bacteria were *Escherichia coli* bacteria and *Pseudomonas aeruginosa* [11]. The study also found that gram negative bacteria were collected mainly by urine culture while gram positive bacteria were collected mainly from wound, pus or skin cultures [11]. Furthermore, Qamer et al stated that among pregnant women attending an antenatal clinic at a teaching hospital in Al- Kharj, about 32.4% were seropositive for specific anti *Toxoplasma gondii* IgG antibodies and 1% were seropositive for IgM and that seroprevalence of *Toxoplasma gondii* antibodies was high among pregnant women [12].

A recent study showed that the most common gram negative bacteria in a public hospital during a period of 4 years from 2015-2018 was *Escherichia coli* (23.80% of gram negative bacteria) [13]. Ahmed and Mahmoud found that regarding wound and skin infections in a military hospital, the most common bacteria that were isolated from blood, pus or skin specimens were *Staphylococcus aureus* bacteria (34.93%) followed by *Pseudomonas aeruginosa* (16.64%), *Escherichia coli* (15.49%) and *Group B Streptococcus* (11.53%) [14].

Regarding the rate of ESKAPE pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa* and *Enterobacter* spp.) in a Public Hospital in Al-kharj, a previous study found that ESKAPE pathogens cause nearly half the infections that were caused by bacteria and that the most common ESKAPE pathogen was *Klebsiella pneumoniae*, followed by *Pseudomonas aeruginosa* [15].

### 3.2 Resistance

A previous study was conducted in a university hospital in Al-Kharj city and found that there was a low resistance rate to imipenem, gentamicin, amikacin, and meropenem for the studied bacteria and high resistance rate for some antibiotics such as tetracycline, erythromycin, and ampicillin [4]. Abujheisha et al stated that intensive care unit at king Khalid hospital in Al-Kharj, all isolates of *Providencia* spp., *Pseudomonas aeruginosa*, *Enterobacter* spp., *Serratia* spp., *Acinetobacter* spp., and *Citrobacter* spp. were multi-drug resistant (100%) while 71.4% of *Proteus mirabilis* isolates and 69% of *Klebsiella pneumoniae* isolates were multi-drug resistant [6]. They also reported that extended spectrum beta lactamase producing bacteria were confirmed in 39 isolates out of 47 multi-drug resistant gram-negatives; among them, 28.2% were *Klebsiella pneumoniae* and 25.64% isolates of *Pseudomonas aeruginosa*. Resistance to carbapenems was detected in 23 isolates of multi-drug resistant gram-negative bacteria (48.94%); among them, 10 isolates of *Pseudomonas aeruginosa* (43.48%), and 6 isolates each of *Acinetobacter* spp. and *Klebsiella pneumoniae* (26.1%) [6].

Eltayeb et al conducted a study about the frequency of bacterial and parasitic infections among food handlers in different restaurants in Al-kharj and said that all *Staphylococcus aureus* and *coagulase-negative Staphylococcus* species isolates were uniformly susceptible to vancomycin and that about 75% of *Staphylococcus aureus* isolates were resistant to penicillin [7]. Another study about the antimicrobial resistance of ESKAPE pathogens in a Public Hospital in Al-kharj found that *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were multidrug resistant and that *Acinetobacter baumannii* bacteria were extensively drug resistance [15]. Moreover, a previous study found that *Providencia* species were highly resistant to the majority of the tested antibiotics and that only few antibiotics were effective against *Providencia* such as piperacillin/tazobactam, meropenem, imipenem, amikacin, and ertapenem [16]. Moreover, another study reported that the resistance of several gram negative bacteria particularly *Providencia* and *Acinetobacter* to levofloxacin and ciprofloxacin is high [17].

Ahmed et al found that the rate of resistance of *Pseudomonas aeruginosa* in numerous settings

in a public hospital in Al-kharj was high for some cephalosporin antibiotics, penicillin antibiotics, nitrofurantoin, trimethoprim, and ertapenem and was low for piperacillin, aminoglycoside, and colistin [18]. Qamar et al conducted a study about the resistance pattern of extended spectrum beta-lactamase producing Isolates at a tertiary care hospital in Al-kharj and stated that the most frequent sample was urine, followed by swabs, pus and body fluids [19]. They also informed that the organisms had low resistance rate to meropenem, imipenem, gentamicin, amikacin, and piperacillin/tazobactam, while cefepime, amoxicillin / clavulanic acid, nitrofurantoin and ciprofloxacin showed an intermediate susceptibility for extended spectrum beta-lactamase producing *enterobacteriaceae* [19]. Moreover, they said that ceftazidime, norfloxacin, and trimethoprim/sulfamethoxazole were found to be the least effective in their study [19].

Ahmed and Abujheisha reported that regarding the resistance of gram positive bacteria to fusidic acid in Al-kharj, the resistance rate is very high for *Enterococcus faecalis* (100 %), and low for *Staphylococcus aureus* (37.5 %) and Methicillin-resistant *Staphylococcus aureus* (25 %) [20]. Another study found that the resistance of *Pseudomonas aeruginosa* and *Acinetobacter baumannii* to colistin in a public hospital in Al-kharj is low [21]. Furthermore, a study found that some medications such as vancomycin, linezolid still very effective in treating infections caused by *staphylococcus* [22]. Regarding the bacterial resistance to ceftazidime in a military hospital in Al-kharj, a study found that the susceptibility rate of gram negative bacteria to ceftazidime in 2020 was more than 50% except *Enterobacter cloacae* (susceptibility rate=0) and that the resistance of *Escherichia coli* to ceftazidime was increased from 36% in 2020 to 48% in 2021 [23].

### 3.3 Antibiotics Use

A study showed that the most prescribed antibiotics by emergency department of a maternity and children hospital were metronidazole (45.59%) and ceftriaxone (42.65%) and that metronidazole IV was the most commonly prescribed antibiotic (38.73%) by inpatient department for surgery patients followed by ceftriaxone (38.73%) [24]. Moreover, the study showed that vancomycin vial (43.75%) was the most commonly prescribed antibiotic by critical care unit for surgery patients and that the most commonly prescribed antibiotic in the outpatient department and day-case unit for

surgery patients was fusidic acid ointment (35.00%) [24].

Ahmad et al reported that regarding the appropriateness of surgical antimicrobial prophylaxis practices in a public hospital, there is a problem in choosing the appropriate antibiotics for surgical prophylaxis in the hospital and that the duration of antibiotic use in the hospital was largely inappropriate [25]. Another study was conducted in the outpatient department about the prescribing of different medications (not only antibiotics) for surgical patients and found that the most prescribed medication was paracetamol (21.32%) followed by amoxicillin/clavulanic acid (12.85%), ciprofloxacin (12.85%), and metronidazole (6.27%) [26].

Another studies were conducted to describe the prescribing of outpatient doxycycline and topical gentamicin [27,28]. Doxycycline was prescribed largely in the emergency department followed by obstetrics & gynecology department mainly by resident physicians [27]. Topical gentamicin was prescribed mainly by residents of the emergency department [28]. In addition to that, a study was conducted to describe the seasonal variation in an outpatient antibiotic prescription rates in Al-kharj and found that about 27.84% of the prescriptions in 2017 were in spring season and about 26.64% of the prescriptions in 2018 were in autumn [29]. The study also showed that in the 2 years, total number of antibiotics prescriptions were 5348 in spring followed by 5097 in autumn [29].

Another studies about the use of azithromycin, cefuroxime, and metronidazole were conducted [30-32]. From January 2018 to June 2018, 541 outpatients received azithromycin mainly as a suspension (55.64%) [30]. The study also showed that most of the patients received azithromycin for 3 days (88.17%) [30]. Among the 316 Outpatient who received cefuroxime in a Public Hospital in Al-kharj, the majority of cefuroxime prescriptions include tablet dosage form (81.96%) and about 62.03% of the outpatient prescriptions were prescribed by the emergency department [31]. Regarding the prescribing of metronidazole in the Outpatient Setting of a Public Hospital in Al-kharj, most of metronidazole prescriptions were regular and were prescribed mainly by residents [32].

### 4. CONCLUSION

There were several studies about the infections rate, the resistance rate and antibiotics use.

These studies showed that antibiotics were used frequently and that the resistance rate was high for some types of bacteria. Nonetheless, most of the studies included only some types of infections such as healthcare-associated infections and there was a lack in studying other type of infections. Moreover, most of the conducted studies focused on the use of antibiotics in the outpatient setting and there was a lack in studying other settings. More studies are needed to explore the rate of other infections and to describe the prescribing of antibiotics in other hospital settings.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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