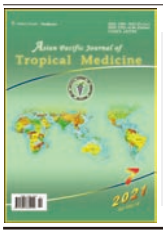

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Antibacterial resistance patterns of *Acinetobacter baumannii* complex: The results of Isfahan Antimicrobial Resistance Surveillance-1 Program

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ABSTRACT

Objective: To determine the antibiotic resistance patterns of the *Acinetobacter* (*A.*) *baumannii* complex isolates that cause the confirmed infection.

Methods: The present descriptive study was performed from March 2016 to March 2018 in three referral hospitals in Isfahan, Iran. All *A. baumannii* complex strains isolated from different clinical samples were identified by conventional phenotypic methods and antibiotic susceptibility pattern was detected. After the clinical investigation, contaminated samples were excluded and the source (hospital/community) and site of the infection were determined. Data on antibiotic susceptibility testing were extracted from WHONET software and analysis was done with SPSS.

Results: From 254 patients who had confirmed *A. baumannii* complex infection, 158 (62.20%) cases were male, 27 (10.63%) were less than 20 years old, 172 (67.72%) had healthcare-associated infections and 96 (37.79%) were admitted in intensive care units. The most frequent infection was bloodstream infections (111, 43.70%). Our results showed that most of the isolates were resistant to most of the antibiotics (more than 75.00%) and a lower rate of non-susceptibility was observed against minocycline (20, 44.44%) and colistin (0%). The rate of multidrug-resistant isolates was 88.97%. There was no significant difference between resistance of *A. baumannii* complex isolates according to age. However, the resistance to amikacin and minocycline and the rate of multidrug resistance (MDR) were significantly different between males and females. In patients with healthcare associated infection (HAI), MDR isolates were significantly different regarding admission in ICU ward. Resistance to levofloxacin and ciprofloxacin were lower in isolates from patients with bloodstream infections in comparison to other diagnoses.

Conclusions: In our study, a high level of antibiotic resistance was detected in both community-acquired and healthcare-associated *A. baumannii* complex infections. Appropriate antibiotic prescription in a clinical setting is an essential need for the control and prevention of *A. baumannii* resistant infections.

KEYWORDS: *Acinetobacter baumannii*; *Acinetobacter* infections; Anti-bacterial agents; Drug resistance; Iran

Significance: The *Acinetobacter baumannii* complex can cause community-acquired infections (CAIs) and healthcare-associated infections (HAIs). Because of the high-level resistance to various antimicrobial agents, it has become a global health threat. In the present study, a high level of antibiotic resistance was detected in both CAIs and HAIs caused by *Acinetobacter baumannii* complex; however, multidrug-resistant isolates were more common in HAIs.

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1. Introduction

Acinetobacter species are Gram-negative, oxidase negative, non-motile coccobacilli that are ubiquitous in the environment. The *Acinetobacter* (*A.*) *baumannii* complex consists of several genospecies. They are genetically related and phenotypically indistinguishable by using phenotypic methods and molecular methods for accurate identification[1]. Almost 80% of the isolates which cause human diseases belong to *A. baumannii*[2], who can cause both community-acquired infections (CAIs) and healthcare-associated infections (HAIs)[3,4]. According to the World Health Organization and Centers for Disease Control and Prevention definitions, HAIs are the infections occurring in patients during the process of care in a care facility such as hospitals which was not present or incubating at the time of admission[5,6].

Infections caused by *A. baumannii* are frequently reported from intensive care units where they are implicated as the cause of ventilator-associated pneumonia. However, it can cause other infections including bacteremia, septicemia, endocarditis, urinary tract infection, secondary meningitis, and infections of the skin, soft tissue, and prosthetic devices[2,7–9]. Since contamination with transient or normal flora can occur during clinical sample collection procedures, the distinction between contamination and confirmed infection could be a problem and false-positive culture results in increased length of patients with antibacterial use and costs of preclinical investigation[10].

The bacterium can use different mechanisms of resistance, leading to the emergence of strains that are resistant to all classes of antibiotics[8]. Because of the high-level resistance to various antimicrobial agents and the easily spread from one patient to another and also persisting in the environment for a long time, it has become a global health threat. Up-to-date data on the local susceptibility pattern of isolates is necessary for appropriate antimicrobial therapy and control of hospital outbreaks. Several studies have assessed on the antibiotic susceptibility pattern of *A. baumannii* strains isolated from Iranian patients[11]. In most of these studies, the power of the study was low due to the small sample size and inclusion of contaminated samples in the analysis of the results. Besides, there is no plan to differentiate between CAI from HAI. Due to these limitations, we decided to study the prevalence and pattern of antibiotic resistance of *A. baumannii* complex isolated from patients with conformed infections admitted to three referral hospitals in Isfahan province in the central region of Iran who participate in the Isfahan Antimicrobial Resistance Surveillance-1 (IAS-1) Program.

2. Materials and methods

2.1. Study design

This study is a part of a local surveillance survey entitled "IAS-1" which was performed for two years (March 2016 to March 2018) in Isfahan, Iran. In the IAS-1 Program, in addition to registering antibiotic susceptibility of clinical isolates, it was targeted to exclude contaminated samples, determine hospital/community source of infection and site of the infection by collaboration with trained infectious control nurses and physicians in the participant medical centers[12]. Three major referral hospitals that enrolled in the study were Al-Zahra, Dr. Shariati, and Dr. Gharazi hospitals. They had more than 1 300 beds totally and their laboratories had achieved approved quality credit from the Iranian Ministry of Health for the microbiological report and were collaborators of the World Health Organization in the Global Antimicrobial Resistance Surveillance System Program. They receive more than 21 500 samples per year and all of the microbiological data was gathered in WHONET software version 5.6.

2.2. Bacterial isolation, phenotypic tests, and antibiotic susceptibility testing

From March 2016 to March 2018, all clinical samples (such as blood, urine, and other urinary tract samples, central nervous system fluid, upper and lower respiratory tract secretions, skin and soft tissue, *etc*.) from hospitalized patients suspected to infection in three participate hospitals were cultured. These samples were received from different wards; however, were considered as intensive care units and non-ICU wards in this study. Non-ICU wards included emergency rooms, surgeries, medicines, and pediatrics.

Identification of *A. baumannii* was made by routine conventional methods such as oxidase test, API 20 NE kit (version 6.0, bioMerieux, Marcy L Etoile, France), and growth in 42 ℃[13]. Since routine phenotypic identification tests were not able to differentiate between baumannii and non-baumannii, so all isolates were considered *A. baumannii* complex.

Antibiotic susceptibility testing was performed by disk diffusion in Mueller-Hinton agar and was interpreted according to the Clinical Laboratory Standard Institute guidelines (CLSI 2016 and 2017[14,15]. Laboratories have assessed the sensitivity of isolates to the following class of antibiotics: Penicillin-penicillinase inhibitors (ampicillin-sulbactam 10/10 μg), aminoglycosides (gentamicin 10 μg or amikacin 30 μg), cephalosporins (cefotaxime 30 μg or ceftriaxone 30 μg or cefepime 30 μg, and ceftazidime 30 μg), fluoroquinolones (ciprofloxacin 5 μg or levofloxacin 5 μg), folate inhibitors (trimethoprim-sulfamethoxazole 1.25/23.75 μg), carbapenems

(imipenem 10 μg or meropenem 10 μg) and tetracycline (minocycline 30 μg). Dehydrated antibiotic discs were commercially prepared from MAST, Merseyside, UK. Minimum inhibitory concentrations of colistin were determined by the E-test strips (Liofilchem, Roseto Degli Abruzzi, Italy) according to the manufacturer's instructions. The methods and kits were checked repeatedly (every three months) to be the same in all participant microbiology laboratories. Reference strains, including *Escherichia coli* ATCC 25922 and *Pseudomonas aeruginosa* ATCC 27853 were used for quality control testing. Isolates resistant to at least one agent in three or more antimicrobial categories were recognized as multidrug-resistant (MDR)[16,17].

2.3. Identification of confirmed infection, CAI, and HAI

If *A. baumannii* complex strains were isolated from a patient with clinical symptoms and para clinical findings of infection, it was considered as a confirmed pathogen. Otherwise, the isolate was considered as a contaminant or colonizer isolate. Clinical symptoms and para clinical findings of infection are presented in the supplementary table. If the patient showed a new clinical symptom of infection (such as fever, erythema/swelling of the surgical site, or any change in the general condition of the patient) after 48 hours or more after hospitalization or within 30 days after having surgery infection is considered as an HAI[18,19]. In other cases, infection is assumed as a CAI.

2.4. Statistical analysis

Data on antibiotic susceptibility testing, age group, admission ward, site of infection, and hospital/community acquisition were extracted from WHONET software Version 5.6, and analysis was done with SPSS Version 20.0. Continuous variables were compared using a one-way analysis of variance. Variables were analyzed by the *Chi*-square test. A *P*-value of <0.05 was considered statistically significant.

3. Results

Totally 539 *A. baumannii* complex isolates were enrolled in the study. Two hundred and eighty-five (52.87%) isolates were determined as a contaminant or colonizer isolates and excluded from

Table 1. The characteristic of healthcare-association infections and community-association infection [*n* (%)].

Parameters		HAI*	CAI*	Total
Sex	Male	99 (62.66)	59 (37.34)	158 (62.20)
	Female	73 (76.00)	23 (24.00)	96 (37.80)
Age groups	<20 years	21 (77.77)	6 (22.23)	27 (10.63)
	>20 years	151 (66.52)	76 (33.48)	227 (89.37)
Infection type	Blood stream infection	65 (58.55)	46 (41.45)	111 (43.70)
	Urinary tract infection	25 (64.10)	14 (35.90)	39 (15.35)
	Surgical site infection	26 (83.87)	5 (16.13)	31 (12.20)
	Pneumonia/pulmonary empyema	29 (70.73)	12 (29.27)	41 (16.14)
	Meningitis	21 (100.00)	-	21 (8.27)
	Other infections	6 (54.54)	5 (45.46)	11 (4.33)
Wards	Intensive care unit	86 (89.58)	10 (10.42)	96 (37.79)
	Non-Intensive care unit	86 (54.43)	72 (45.57)	158 (62.21)

*Data were expressed as number (percentage).

Table 2. Antibacterial resistance of *Acinetobacter baumannii* in accordance to the source of the infection in Isfahan Iran 2016-2018: Results of IAS-1 study [% (NRI/TES)].

Antibiotic agents	Source of the infection*		*Chi* square	*P*-value#	Total
	Healthcare-associated infections	Community-acquired infections			
Ampicillin/sulbactam	78.75 (63/80)	71.88 (23/32)	0.88	0.346	76.79 (86/112)
Ceftazidime	95.18 (158/166)	92.11 (70/76)	0.90	0.342	94.21 (228/242)
Ceftriaxone	92.00 (46/50)	100.00 (19/19)	-	0.569&	94.20 (65/69)
Cefepime	92.90 (157/169)	87.01 (67/77)	2.25	0.134	91.06 (224/246)
Imipenem	85.29 (29/34)	63.03 (75/119)	6.02	**0.014**	67.97 (104/153)
Meropenem	96.93 (158/163)	88.16 (67/76)	7.24	**0.007**	94.14 (225/239)
Amikacin	81.55 (137/168)	66.22 (49/74)	6.79	**0.009**	76.86 (186/242)
Gentamicin	77.78 (14/18)	62.50 (5/8)	-	0.640&	73.08 (19/26)
Ciprofloxacin	95.06 (77/81)	63.16 (24/38)	20.51	**<0.01**	84.87 (101/119)
Levofloxacin	94.57 (87/92)	37.21 (16/43)	53.30	**<0.01**	76.30 (103/135)
Trimethoprim/sulfamethoxazole	90.36 (75/83)	72.72 (24/33)	5.87	**0.015**	85.34 (99/116)
Colistin	0.00 (0/124)	0.00 (0/42)	-	-	0.00 (0/166)
Minocycline	60.71 (17/28)	17.65 (3/17)	7.95	**0.005**	44.44 (20/45)
Multidrug-resistant	94.19 (162/172)	78.05 (64/82)	14.74	**<0.01**	88.98 (226/254)

*Data were expressed as [% (NRI/TES)]; NRI: the number of resistant isolates; TES: total examined strains (resistance percentage). Bold items represent statistically significant difference. #Pearson *Chi* square test, otherwise &Fishers' exact.

Table 3. Antibacterial resistance of *Acinetobacter baumannii* in accordance to the age and sex of the patients in Isfahan Iran 2016-2018: Results of IAS-1 study [% (NRI/TES)].

Antibiotic agents	Age of patients (years)		*Chi* square	*P*-value[#]	Sex of patients		*Chi* square	*P*-value[#]
	<20	>20			Male	Female		
Ampicillin/sulbactam	100.00 (8/8)	75.00 (78/104)	2.60	0.107	71.83 (51/71)	87.50 (35/40)	3.60	0.058
Ceftazidime	92.59 (25/27)	94.44 (204/216)	0.15	0.697	93.24 (138/148)	95.74 (90/94)	0.66	0.417
Ceftriaxone	87.50 (7/8)	95.08 (58/61)	-	0.396[&]	95.45 (42/44)	90.00 (18/20)	-	0.583[&]
Cefepime	92.59 (25/27)	90.90 (200/220)	0.08	0.772	88.74 (134/151)	94.19 (81/86)	1.93	0.165
Imipenem	33.33 (1/3)	80.00 (40/50)	-	0.125[&]	66.67 (22/33)	90.00 (18/20)	3.66	0.056
Meropenem	88.46 (23/26)	94.86 (203/214)	1.73	0.189	93.06 (134/144)	96.51 (83/86)	1.21	0.272
Amikacin	83.33 (20/24)	75.34 (165/219)	0.76	0.383	70.20 (106/151)	86.81 (79/91)	8.70	**0.003**
Gentamicin	57.14 (4/7)	78.95 (15/19)	1.24	0.266	68.75 (11/16)	80.00 (8/10)	-	0.668[&]
Ciprofloxacin	77.78 (7/9)	85.45 (94/110)	0.38	0.537	81.58 (62/76)	90.70 (39/43)	1.78	0.182
Levofloxacin	88.89 (8/9)	74.80 (95/127)	0.91	0.341	7 1.05 (54/76)	80.00 (44/55)	1.35	0.244
Trimethoprim/ sulfamethoxazole	84.62 (11/13)	85.44 (88/103)	0.01	0.937	82.19 (60/73)	90.70 (39/43)	1.56	0.211
Colistin	0.00 (0/19)	0.00 (0/147)	-	-	0.00 (0/92)	0.00 (0/65)	-	-
Minocycline	0.00 (0/2)	46.51 (20/43)	-	0.495[&]	32.14 (9/28)	64.71 (11/17)	4.54	**0.033**
Multidrug-resistant	75.00 (21/28)	86.28 (195/226)	2.49	0.114	62.66 (99/158)	45.83 (44/96)	6.87	**0.009**

NRI: number of resistant isolates; TES: total examined strains (resistance percentage). Bold items represented statistically significant. [#]Pearson *Chi* square test, otherwise [&]Fishers' exact.

Table 4. Antibacterial resistance of *Acinetobacter baumannii* in patients with HAIs in accordance to admission ward in Isfahan Iran 2016-2018: Results of IAS-1 study [% (NRI/TES)].

Antibiotic agents	Intensive care unit	Non-intensive care unit	*Chi* square	*P*-value[#]
Ampicillin/sulbactam	71.05 (27/38)	85.71 (36/42)	2.56	0.109
Ceftazidime	96.39 (80/83)	93.98 (78/83)	-	0.720[&]
Ceftriaxone	93.94 (31/33)	88.24 (15/17)	-	0.597[&]
Cefepime	95.29 (81/85)	90.48 (76/84)	1.49	0.223
Imipenem	93.33 (14/15)	78.95 (15/19)	-	0.355[&]
Meropenem	97.65 (83/85)	96.15 (75/78)	-	0.671[&]
Amikacin	81.40 (70/86)	80.49 (66/82)	0.02	0.881
Gentamicin	77.78 (7/9)	77.78 (7/9)	-	1.000[&]
Ciprofloxacin	97.22 (35/36)	93.33 (42/45)	-	0.625[&]
Levofloxacin	100.00 (41/41)	90.20 (46/51)	-	0.063[&]
Trimethoprim/sulfamethoxazole	95.45 (42/44)	84.62 (33/39)	-	0.139[&]
Colistin	0.00 (0/65)	0.00 (0/59)	-	-
Minocycline	60.00 (9/15)	61.54 (8/13)	0.007	0.934
Multidrug-resistant	94.79 (91/96)	84.18 (133/158)	6.46	**0.011**

NRI: the number of resistant isolates; TES: total examined strains (resistance percentage). Bold items represent statistically significant difference. [#]Pearson *Chi* square test, otherwise [&]Fishers' exact.

Table 5. Antibacterial resistance of *Acinetobacter baumannii* complex accordance to diagnosis in Isfahan Iran 2016-2018: Results of IAS-1 study [% (NRI/TES)].

Antibiotic agents	Bloodstream infection	Pneumonia/empyema	Urinary tract infection	Surgical site infection	Meningitis
Ampicillin/sulbactam	73.68 (28/38)	74.07 (20/27)	87.50 (14/16)	88.24 (15/17)	70.00 (7/10)
Ceftazidime	96.26 (103/107)	100.00 (39/39)	94.44 (34/36)	90.00 (27/30)	90.00 (18/20)
Ceftriaxone	100.00 (20/20)	100.00 (14/14)	100.00 (13/13)	83.33 (5/6)	84.62 (11/13)
Cefepime	92.59 (100/108)	90.00 (36/40)	91.89 (34/37)	87.10 (27/31)	90.48 (19/21)
Imipenem	83.33 (10/12)	88.89 (16/18)	61.54 (8/13)	75.00 (6/8)	100.00 (1/1)
Meropenem	95.19 (99/104)	100.00 (40/40)	86.11 (31/36)	93.10 (27/29)	95.24 (20/21)
Amikacin	80.00 (84/105)	76.92 (30/39)	73.68 (28/38)	70.00 (21/30)	80.95 (17/21)
Gentamicin	57.14 (4/7)	80.00 (4/5)	0.00 (0/1)	100.00 (3/3)	77.78 (7/9)
Ciprofloxacin	70.45 (31/44)	95.00 (19/20)	91.30 (21/23)	91.30 (21/23)	100.00 (2/2)
Levofloxacin	55.56 (40/72)	100.00 (23/23)	100.00 (16/16)	100.00 (17/17)	100.00 (2/2)
Co-trimoxazole	83.33 (35/42)	92.31 (24/26)	80.00 (12/15)	77.78 (14/18)	100.00 (10/10)
Colistin	0.00 (0/71)	0.00 (0/31)	0.00 (0/26)	0.00 (0/23)	0.00 (0/13)
Minocycline	42.86 (3/7)	56.25 (9/16)	15.38 (2/13)	83.33 (5/6)	50.00 (1/2)
Multidrug-resistant	84.68 (94/111)	97.56 (40/41)	87.18 (34/39)	96.77 (30/31)	90.48 (19/21)

NRI: the number of resistant isolates; TES: total examined strains (resistance percentage).

the study. Of 254 patients who had conformed *A. baumannii* complex infection, 158 (62.20%) cases were male, 27 (10.63%) were under 20 years old, and 172 (67.72%) had HAIs. Ninety-six (37.79%) patients were admitted to ICU wards, and 86 of them (89.58%) have HAIs. The most frequent diagnosis was bloodstream infections (sepsis or bacteremia) (111, 43.70%), pneumonia/pulmonary empyema (41, 16.14%), urinary tract infection (39, 15.35%), surgical site infections (31, 12.20%), meningitis (21, 8.26%) and other infections (11, 4.33%), respectively (Table 1).

According to disk diffusion method for detection of antibiotic-resistant pattern of *A. baumannii* complex isolates, the results showed high level resistance to ceftazidime (94.21%), ceftriaxone (94.20%), meropenem (94.14%), cefepime (91.06%), trimethoprim/sulfamethoxazole (85.34%), ciprofloxacin (84.87%), amikacin (76.85%), ampicillin-sulbactam (76.79%), levofloxacin (76.29%) and imipenem (67.97%). A lower rate of non-susceptibility was observed against minocycline (44.44%). No resistance to colistin was detected by the E-test method. The rate of MDR isolates was 88.97% (Table 2).

The resistance to levofloxacin, minocycline, meropenem, amikacin, imipenem, ciprofloxacin, trimethoprim/sulfamethoxazole, and rate of MDR was significantly more frequent in patients with HAI in comparison to those with CAI (Table 2).

There was no significant difference between resistance of *A. baumannii* complex isolates according to the age of patients (<20 *versus* >20 years). However, the resistance to amikacin and minocycline and the rate of MDR were significantly different between males and females (Table 3). In patients with HAI, MDR isolates was significantly different regarding admission in ICU ward (ICU *versus* non-ICU) (Table 4).

Resistance to levofloxacin and ciprofloxacin and resistance to minocycline were lower in isolates from patients with bloodstream infections and urinary tract infections, respectively, compared to patients admitted with other diagnoses (Table 5).

4. Discussion

Our study revealed that *A. baumannii* complex strains in our region are highly resistant to many antibiotic agents. Resistance is more frequent in strains isolated from patients with HAIs. Previous studies were conducted in mixed clinical specimens from patients with both CAI and HAI. In addition, contaminant/colonizer isolates were not recognized and excluded from the analysis. Thus the results could have sampling biases. In this study, we excluded these kinds of isolates by simple practical guidelines prepared by the scientific committee of the IAS-1 study and contribution with infection control nurses and physicians in enrolled hospitals[12].

About 53% of *A. baumannii* complex strains in our study were recognized as contaminant or colonizer organisms. *A. baumannii* was not considered as a common source of contamination of culture media. However, some previous reports suggested that the isolate would be specimen contamination[20,21].

More than 90% of isolates in our study were resistant to cephalosporins and meropenem and these agents may be unsuitable for empiric treatment of *A. baumannii* infections in our region. Also, in the sub-analysis of the antibiotic susceptibility pattern resistance to most of the antibiotic classes was significantly more frequent in patients with HAI in comparison to those with CAI. In a report of 647 clinical isolates from China, the resistance of *A. baumannii* isolates to cefepime, ceftazidime, and imipenem was 74.5%, 76%, and 71.4%, respectively[22]. In another study from India, more than 90% of *A. baumannii* isolates were resistant to ceftazidime, cefepime, meropenem, and imipenem[23]. It seems that the resistance of *A. baumannii* strains to cephalosporins and carbapenems in Iran is alarmingly high. As discussed in other studies, most of the carbapenem-resistant *A. baumannii* strains are MDR and even pan-drug resistant. Restriction of inappropriate usage of these antibiotics in hospital settings by appropriate stewardship programs may help to decrease the production and spread of resistance in *A. baumannii* strains in the area.

In our investigation, the resistance rate of the *A. baumannii* complex to ampicillin/sulbactam was 76.79%. Un-susceptibility to this agent was similar in CAIs and HAIs. In three different studies from our city Isfahan and Shiraz, Iran, the rate of un-susceptibility to this agent was 33.9%, 92%, and 94.9%, respectively[7,24,25]. Differences in target population and inclusion of contaminant and/or colonizer isolates may be the cause of this significant dissimilarity. These high-level un-susceptibility of *A. baumannii* may be a sign of inappropriate advice of the antibiotic in clinical settings.

In our study, 76.79% of the isolates were resistant to amikacin. Aminoglycoside resistance was significantly more prevalent in isolates from HAI in comparison to CAI. Similar results were reported from other studies in Iran during recent years[7,24–28]. In other recent *A. baumannii* antimicrobial resistance surveys in China, and the USA, un-susceptibility was reported to be 66.3% and 45.7%, respectively[22,29]. This agent could be a choice for the treatment of *A. baumannii* infections after documentation of susceptibility of the strain to it.

Our research showed that 85.34% of *A. baumannii* isolates were resistant to trimethoprim-sulfamethoxazole. The resistance rate was significantly higher in patients with HAIs in comparison to those with CAIs. In two reports from India and one study in China resistance to this antibiotic was 80%, 73.3%, and 61.1%,

respectively[22,23,30]. This agent should be considered in the treatment of *A. baumannii* infections especially CAIs.

In the present study resistance to ciprofloxacin and levofloxacin was 84.87% and 76.30%, respectively. The susceptibility of isolated *A. baumannii* strains to these agents was significantly higher in CAI. In recent reports from Iran, more than 90% of *A. baumannii* strains were resistant to ciprofloxacin[7,24,25,27]. Resistance rates of 75.3% and 96% to ciprofloxacin were recognized in one study in China during 2013-2014 and one report in India in 2012-2016, respectively[22,23]. Exclusion of contaminant isolates and differentiation of CAIs from HAIs in our study revealed that fluoroquinolones could be a good choice for the treatment of *A. baumannii* infections acquired from community settings in our hospitals.

In our study, all isolated *A. baumannii* strains showed susceptibility to colistin. In a recent systematic review on the susceptibility of *A. baumannii* to colistin in Iran, a resistance rate of 4% had been estimated[11]. In China and India resistance rate of 3% and 0% to colistin had been reported, respectively[22,30]. Susceptibility of all *A. baumannii* isolates to colistin necessitates the meticulous implementation of stewardship programs in hospitals that use this agent logically and appropriately. This can save the agent for the treatment of pan-drug resistant Gram negatives. Our results showed that 89.0% of Acinetobacter isolates in accordance to the source of the infection were MDR. In two previous reports from Iran, MDR rate of 95% and 100% was detected in *A. baumannii* strain[7,24]. Continuous surveillance of *A. baumannii* strains is necessary and essential.

In conclusion, high-level resistance to antibiotics was detected in both community-acquired and healthcare-associated *A. baumannii* isolates. More sensitivity to colistin, minocycline, and levofloxacin was detected in CAIs; respectively. In HAIs colistin was the single acceptable agent for empiric treatment of the infections. Appropriate antibiotic prescription in a clinical setting is an essential need for the control and prevention of *A. baumannii* associated infections.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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Authors' contributions

SN.M. was the main investigator and proposed the main idea, designed the study, wrote the protocols and guidelines and revised the manuscript. S.R. was project manager and collected the data. ZN analyzed the data and wrote the first draft of the manuscript. B.A., AC, and RK were members of the scientific committee. P.A., N.A., and Z.N. were members of the executive committee.

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