ORIGINAL RESEARCH

Distribution and Drug Resistance of Common Pathogens Causing Lower Respiratory Tract Infection in Xinjiang Region

Lixia Wang, BM; Huan Guo, BM; Leyan Qu, BM; Guozhen Wang, BM; Jianjiang Luo, MM

ABSTRACT

Objective • This study aims to analyze the composition and distribution of pathogenic bacteria in lower respiratory tract infections (LRTI) and their antimicrobial resistance patterns in a hospital in Xinjiang, to guide more effective antibiotic selection and inform clinical management.

Methods • We retrospectively analyzed 545 strains isolated from various clinical specimens like sputum and blood, collected between June 2020 and June 2023, using the LIST system. The strains were subjected to drug resistance testing, and statistical analyses included *t* tests and Chi-square tests.

Results • Among gram-negative bacilli, Acinetobacter baumannii dominated, accounting for 32.11%, followed by Pseudomonas aeruginosa, accounting for 18.35%. Among gram-positive bacteria, thrombin-negative staphylococcus was at the top of the list, followed by Staphylococcus aureus. Among Acinetobacter baumannii (AB), carbapenem-resistant Acinetobacter baumannii plays a dominant role. The sensitivity rate of these strains to tigecycline and amikacin could reach more than 80%. The sensitivity of Pseudomonas aeruginosa (PA) to piperacillin, gentamicin, imipenem, meropenem, ciprofloxacin and levofloxacin ranged from 50% to 80%. It is worth mentioning that the sensitivity rate of PA to amikacin, cefoperazone, and tobramycin exceeded 80%. Amikacin was more than 60% sensitive to carbapenem, β-lactam inhibitors, tigecycline, quinolones, and aminoglycosides of ESBL producing Klebsiella pneumoniae. Among gram-positive coccus, methicillin-resistant coagulase-negative staphylococcus was 100% sensitive to duration, e, tigecycline, and vancomycin. In addition, the susceptibility rate of these strains to rifampicin and linezolid was greater than 70%.

Conclusions • In patients with lower respiratory tract infection (LRTI) in a hospital in Xinjiang, the most common pathogenic bacteria are gram-negative bacilli, mainly Acinetobacter baumannii and Pseudomonas aeruginosa. Both resistant and non-resistant strains showed sensitivity to amikacin and tigecycline. Additionally, staphylococcus accounted for half of the total number of gram-positive bacteria, among which methicillin-resistant strains were more sensitive to vancomycin and linezolid. (*Altern Ther Health Med.* [E-pub ahead of print.])

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INTRODUCTION

Lower respiratory tract infection (LRTI), defined as pneumonia or bronchiolitis in global disease and injury studies, is one of the leading causes of morbidity and mortality worldwide.[1] Nearly 2.38 million people die from infections every year, making it the sixth leading cause of death in all age groups and one of the major health problems in developing countries. Bacterial infection is the primary cause of LRTI, excluding viral infections.[2] In recent years, there has been increasing concern about antibiotic resistance (AMR). AMR is a serious threat to the prevention and treatment of bacterial infections, mainly caused by poor management, inadequate treatment, and the overuse of antibiotics without medical supervision.[3] AMR and related morbidity and mortality continue to increase, and some studies have also found that bacterial resistance to antibiotics is associated with longer hospital stays and increased hospital costs.[4] A recent study predicted that AMR could cause 10 million deaths a year by 2050. As a result, economic simulations predict that by 2030, the world will suffer annual losses of between $1 and $3.4 trillion due to the effects of AMR.[5] This shows that AMR not only affects human health

but also has a profound impact on the global economy. Therefore, it is of great value to study the drug resistance of pathogenic bacteria causing LRTI.

AMR is widely found in various departments of a hospital in Xinjiang.[6] Hospital-acquired pneumonia and ventilator-associated pneumonia are major nosocomial infections worldwide, particularly due to the increasing incidence of multidrug-resistant (MDR) gram-negative bacteria. While global studies on diseases, injuries, and risk factors indicate the need for quantifying antimicrobial resistance, relevant statistics are still lacking.[7] In addition, studies have shown that the pathogenic bacteria of LRTI and their antibiotic sensitivity are different in different geographical locations.[8] Therefore, understanding the distribution and drug resistance characteristics of common clinical pathogens in this area is of great significance for formulating an empirical anti-infective treatment plan, guiding the clinical selection of antibiotics, and improving the clinical efficacy of infectious diseases. Based on the above situation, this study will initially analyze the distribution and drug resistance of common pathogens causing lower respiratory tract infections in Xinjiang. This will help in the rational selection of drugs and provide more ideas and a theoretical basis for the clinical diagnosis, treatment, and management of drug resistance in LRTIs.

PATIENTS AND METHODS

Research object

Bacteria culture-positive strains in sputum, whole blood, pleural fluid, and lung lavage fluid samples from the laboratory department of a hospital in Xinjiang were collected through the test LIST system of a hospital in Xinjiang from June 2020 to June 2023, and a total of 545 strains meeting the inclusion criteria were screened through the electronic medical records and imaging system software of a hospital in Xinjiang, and their drug resistance was reviewed.

Clinical Diagnosis

The diagnosis of respiratory tract infection in hospitals should be carried out in strict accordance with the Diagnostic Criteria for Hospital Infection.[9] Lower respiratory tract infection refers to patients with cough, thickened phlegm, lung rales, and other related symptoms, accompanied by fever, leukocytosis, and an increased proportion of neutrophils. X-ray examination revealed inflammatory infiltration in the patient's lungs. In addition, if the patient has chronic airway disease in the stable stage of secondary acute infection, etiology changes, and X-ray chest examination found that there are significant changes or new changes compared with the admission, it can also be diagnosed as lower respiratory infection. For etiological diagnosis, the patient's sputum needs to be screened, and if the same pathogen is isolated twice, the presence of the pathogen can be determined. Patients ' stool samples were selected for bacterial culture, and the number of pathogenic bacteria was observed to be more than 105 cfu/mL. Significant pathogenic bacteria can be observed in blood samples and pleural effusion samples of patients. The collection of pathogenic bacteria in the airway secretions of the patient showed that the number was more than 105 cfu/mL, and the pathogens isolated by bronchial alveolar lavage exceeded 105 cfu/mL. Bacterial culture was conducted on the secretions collected from the respiratory tract of the patient, and 105 cfu/mL of isolated pathogens were found. The basic diseases of the patient included COPD and, bronchiectasis, etc. The amount of pathogenic bacteria collected exceeded 105 cfu/mL. In the sputum samples of patients, pathogens outside the respiratory tract or some special pathogens were found in the sputum samples. Complete immunobiological and histopathological evidence was present in all patients.

Inclusion criteria

One bacterial culture in sputum, blood, pleural fluid, lung lavage fluid, and other specimens of a patient aged 14 or above in the intensive care unit of a hospital in the Xinjiang region was positive and met the diagnostic criteria. These positive blood or sputum samples have been cultured multiple times, with bacterial colony growth greater than 107 cfu/L, ruling out contamination and false-positive pathogens.

Exclusion Criteria

In the process of study, we need to eliminate the following types of cases: duplicate strains isolated from the same part of the same patient, strains with uncertain resistance, Cases with incomplete clinical data, And imaging changes of the lower respiratory tract due to non-infectious causes such as pulmonary embolism, heart failure, pulmonary edema, lung cancer, etc. By excluding these cases, we can more accurately analyze the pathogenic bacteria distribution and drug resistance characteristics of lower respiratory tract infections and provide more reliable information for clinical diagnosis and treatment.

Identification and drug resistance test of pathogenic bacteria

The isolated pathogens were identified by the AP120NE microbiological identification instrument of French Biology-Merieux Company, and the corresponding reagents were used, all operations were strictly in accordance with the instructions. The drug susceptibility test was conducted by the K-paper method, and the results were determined according to the 2019CLSI/NCCLS standard. A double-disc collaborative test detected ultra-broad spectrum β-lactamase, and cefoxitin was used instead of methicillin for MRS Strain detection. The drug sensitivity test paper and M-H medium are from Oxoid UK. The quality control strains were selected as Escherichia coli (ATCC25922), Klebsiella pneumoniae (ATCC700603), Staphylococcus aureus (ATCC25923), Candida albicans (ATCC10231), Pseudomonas aeruginosa (ATCC9027), Staphylococcus epidermis (ATCC12228), Klebsiella pneumoniae (ATCC12228). ATCC700603), Acinetobacter Baumannii (ATCC19606) and Citrobacter Fredii standard strains (ATCC43864), all the quality control

Table 1. June 2020 - June 2023 resulted in lower respiratory tract infection pathogens distribution

Bacteria	Number (cases)	Proportion (%)
Gram-negative bacilli	449	82.3
Klebsiella pneumoniae	74	13.58
Stenotrophomonas maltophilia	24	4.40
Escherichia coli	23	4.22
Enterobacter cloacae	9	1.65
Klebsiella acidogenes	9	1.65
Serratia marcescens	6	1.10
Haemophilus influenzae	4	0.73
Burkholderia cepacia	4	0.73
Other bacilli	21	3.86
Acinetobacter baumannii	175	32.11
Pseudomonas aeruginosa	100	18.35
Gram-positive coccus	96	17.62
Enterococcus avium	3	0.55
Enterococcus faecalis	2	0.37
Other streptococcus	8	1.48
Coagulase negative grape balls	47	8.62
Staphylococcus aureus	17	3.12
Enterococcus faecium	10	1.83
Streptococcus pneumoniae	6	1.10
Moraxella mucositis	3	0.55

strains were kept in our laboratory. Electronic medical records, examination systems and imaging system software collected the clinical data of patients' demographic characteristics and pathogen resistance.

Statistical analysis

Without considering the co-infection of other sites, the cases with positive bacterial culture and meeting the diagnostic criteria were counted, and the composition ratio was compared and statistically analyzed by using EXCEL software, such as screening and summing.

RESULTS

Comparison of pathogen distribution

Among the 545 strains, 418 strains were from sputum, blood all over 114 strains of source, 9 strains from the water, 4 strains from alveolar lavage fluid. These strains were mainly Gram-negative bacilli, with a total of 23 species. Among them, Acinetobacter baumannii ranked first, followed by pseudomonas aeruginosa, and Klebsiella pneumoniae ranked third. The number of stenotrophomonas maltophilia and Escherichia coli decreased significantly compared with the first three, while the number of other gram-negative bacteria was not significantly different. In addition, there are 21 species of gram-positive cocci. Among them, thrombin-negative staphylococcus ranked first, followed by Staphylococcus aureus, and Streptococcus pneumoniae were rare in patients in our intensive care unit. See Table 1.

Sensitivity analysis of drug resistance

This study involved 175 strains of Acinetobacter baumannii (AB), among which carbapenem-resistant Acinetobacter baumannii (CRAB) accounted for 143 strains. Minocycline sensitivity is less than 30%. Only tigecycline and amikacin were more than 80% sensitive. The sensitivity of Pseudomonas aeruginosa (PA) to amikacin, cefoperazone and tobramycin was 80% or above. Traditionally effective drugs such as piperacillin, gentamicin, imipenem, meropenem, ciprofloxacin, levofloxacin have sensitivity rates between 50% and 80%. The susceptibility rate of cefepime, ceftazidime and other third and fourth generation cephalosporus was also higher than 50%. Ticacillin acid, ampicillin and other enzyme inhibitors were completely resistant. Among the 100 strains, 2 strains were pandrug-resistant. Klebsiella pneumoniae (KP) is a common cause of pneumonia. There were 74 strains in this study, of which 2 were ESBLS-producing and carbapenem intermediate or drug-resistant, and 7 were carbapenem intermediate or drug-resistant and 27 were ESBLSproducing. The ESBLS-producing carbapenem intermediate or drug-resistant strains were only 100% sensitive to amikacin, gentamicin and levofloxacin. Carbapenem intermediate or drug-resistant strains were only completely sensitive to tigecycline, followed by amikacin. Esbls-producing strains were more than 90% sensitive to amicacin, tigacycline, cefotetan and imipenem, and more

Table 2. Resistance sensitivity analysis of Acinetobacter baumannii

Antibiotics	total	Drug resistance		Sensitivity	
		quantity	Proportion (%)	quantity	Proportion (%)
Doxycycline	42	37	88.10	5	11.90
Nitrofurantoin	75	75	100.00	0	0
Cotrimoxazole	143	105	73.43	38	26.57
Ciprofloxacin	143	143	100.00	0	0
Gatifloxacin	26	23	88.46	0	0
Meropenem	45	45	100.00	0	0
Minocycline	41	15	36.59	12	29.27
Piperacillin/Tazobactam	17	16	94.12	0	0
gentamicin	128	121	94.53	3	2.34
tetracycline	1	1	100.00	0	0
Tigacycline	132	7	5.30	113	85.61
cefepime	143	130	90.91	4	2.80
Cefoperazone/Sulbactam	38	31	81.58	1	2.63
ceftriaxone	127	122	96.06	0	0
cefotaxime	1	1	100.00	0	0
ceftazidime	50	49	98.00	1	2.00
cefotetan	9	9	100.00	0	0
cefoxitin	112	112	100.00	0	0
cefazolin	120	120	100.00	0	0
tobramycin	141	122	86.52	19	13.48
Imipenem	143	143	100.00	0	0
Levofloxacin	143	68	47.55	5	3.50
amikacin	142	15	10.56	123	86.62
Amoxicillin/clavulanic acid	112	112	100.00	0	0
Ampicillin	124	124	100.00	0	0
Ampicillin/sulbactam	11	7	63.64	1	9.09
aztreonam	122	122	100.00	0	0

Table 3. Analysis of Drug resistance Sensitivity of Pseudomonas aeruginosa

Antibiotics	total	Drug resistance		Sensitivity	
		quantity	Proportion (%)	quantity	Proportion (%)
Amoxicillin/clavulanic acid	1	1	100.00	0	0
Ampicillin	88	88	100.00	0	0
Ampicillin/sulbactam	84	84	100.00	0	0
aztreonam	8	3	37.50	4	50.00
furantoin	50	49	98.00	0	0
Cotrimoxazole	87	87	100.00	0	0
Ciprofloxacin	100	25	25.00	65	65.00
Meropenem	11	4	36.36	6	54.55
piperacillin	6	0	0	3	50.00
Piperacillin/Tazobactam	93	17	18.28	48	51.61
gentamicin	58	8	13.79	44	75.86
Tigacycline	1	0	00	0	0
Ticacillin/clavulanic acid	5	2	40.00	0	0
cefepime	99	25	25.25	65	65.66
Cefoperazone/Sulbactam	5	1	20.00	4	80.00
ceftriaxone	88	87	98.86	0	0
ceftazidime	95	30	31.58	55	57.89
cefotetan	88	85	96.59	3	3.41
cefoxitin	1	1	100.00	0	0
cefazolin	89	88	98.88	1	1.12
tobramycin	94	13	13.83	78	82.98
Imipenem	100	37	37.00	59	59.00
Levofloxacin	99	20	20.20	69	69.70

Table 4. Analysis of Drug resistance Sensitivity of Klebsiella pneumoniae

Antibiotics	total	Drug resistance		Sensitivity	
		quantity	Proportion (%)	quantity	Proportion (%)
amikacin	27	2	7.41	25	92.59
Amoxicillin/clavulanic acid	3	2	66.67	0	0
Ampicillin	27	27	100.00	0	0
Ampicillin/sulbactam	25	23	92.00	0	0
aztreonam	27	15	55.56	12	44.44
Ertapenem	25	0	0	25	100.00
furantoin	10	4	40.00	2	20.00
Cotrimoxazole	27	19	70.37	8	29.63
Ciprofloxacin	25	6	24.00	17	68.00
chloramphenicol	6	2	33.33	4	66.67
Meropenem	6	0	0	5	83.33
Piperacillin/Tazobactam	27	2	7.41	21	77.78
gentamicin	27	20	74.07	7	25.93
tetracycline	6	4	66.67	2	33.33
Tigacycline	1	0	0	1	100.00
cefepime	27	8	29.63	16	59.26
cefuroxime	6	6	100.00	0	0
cefmetazole	2	0	0	1	50.00
Cefoperazone/Sulbactam	5	2	40.00	3	60.00
ceftriaxone	27	24	88.89	2	7.41
cefotaxime	1	1	100.00	0	0
ceftazidime	27	10	37.04	12	44.44
cefotetan	24	1	4.17	23	95.83
cefoxitin	2	1	50.00	1	50.00
cefazolin	26	26	100.00	0	0
cefazoxime	3	2	66.67	0	0
tobramycin	24	8	33.33	5	20.83
Imipenem	27	0	0	26	96.30
Levofloxacin	27	6	22.22	21	77.78

Table 5. Analysis of Drug resistance Sensitivity of Escherichia coli

Antibiotics	total	Drug resistance		Sensitivity	
		quantity	Proportion (%)	quantity	Proportion (%)
amikacin	18	0	0	18	100.00
Amoxicillin/clavulanic acid	2	0	0	1	50.00
Ampicillin	18	17	94.44	3	5.56
Ampicillin/sulbactam	16	15	96.25	3	6.25
aztreonam	20	13	65.00	4	35.00
Ertapenem	19	0	0	19	100.00
furantoin	7	1	14.29	3	57.14
Cotrimoxazole	20	14	70.00	4	30.00
Ciprofloxacin	18	2	11.11	13	83.33
chloramphenicol	4	1	25.00	3	75.00
Meropenem	4	0	0	3	75.00
Piperacillin/Tazobactam	20	1	5.00	14	90.00
gentamicin	20	16	80.00	4	20.00
tetracycline	4	2	50.00	2	50.00
Tigacycline	2	0	0	2	100.00
cefepime	20	6	30.00	5	40.00
cefuroxime	5	5	100.00	0	0
cefmondor	5	5	100.00	0	0
Cefoperazone/Sulbactam	4	2	50.00	1	25.00
ceftriaxone	21	19	90.48	3	9.52
ceftazidime	20	9	45.00	10	50.00
cefotetan	18	1	5.56	17	94.44
cefoxitin	2	0	0	2	100.00
cefazolin	19	19	100.00	0	0
cefazoxime	4	1	25.00	0	0
tobramycin	19	8	42.11	1	25.00

than 60% sensitive to ertapenem, ciprofloxacin, chloramphenicol, meropenem, piperacillin, cefoperazone and levofloxacin. There were 23 strains of Escherichia coli (Eco) causing lower respiratory tract infection, and the detection rate of ESBLS-producing strains was 86.95%. In contrast, the detection rate of non-ESBLS-producing strains was 13.05%. The sensitivity of ESBLS-producing strains showed that amicacin, imipenem, ertapenem and tigecycline had the highest sensitivity rate of up to 100%, ciprofloxacin, piperacillin and cefotetan were more than 80%, and chloramphenicol and meropenem were 60-80%. There were 47 strains of thrombin-negative staphylococcus (CNS), of which 21 strains were methicillin-resistant coagulase-

Table 6. Drug resistanceSensitivity analysis of Methicillin-resistant Coagulase-negative staphylococci

Antibiotics	total	Drug resistance		Sensitivity	
		quantity	Proportion (%)	quantity	Proportion (%)
Oxacillin	20	20	100.00	0	0
furantoin	10	0	0	10	100.00
Cotrimoxazole	21	15	71.43	6	28.57
erythromycin	21	17	80.95	4	19.05
Ciprofloxacin	21	15	71.43	3	14.29
clindamycin	21	15	71.43	5	23.81
/Dafoptin	21	0	0	21	100.00
rifampicin	21	1	4.76	19	90.48
Linezolid	20	1	5.00	19	95.00
Moxifloxacin	21	8	38.10	5	23.81
Penicillin G	18	18	100.00	0	0
gentamicin	21	8	28.57	12	57.14
tetracycline	21	8	38.10	13	61.90
Tigacycline	21	0	0	21	100.00
vancomycin	21	0	0	21	100.00
Levofloxacin	21	20	96.19	4	19.05

negative staphylococcus (MRCNS). The sensitivity rate of furantoin, e, tigacycline and vancomycin was 100%, and the sensitivity rate of rifampicin and linezolid was more than 90%. There were 3 strains resistant to methicillin and clindamycin, and the sensitivity rate to furantoin, e, rifampicin, linezolid, tetracycline, tigacycline and vancomycin was 100%, and the sensitivity rate to gentamicin and levofloxacin was more than 55%. There were 17 strains of coagulase positive staphylococcus aureus (SA), of which 8 strains were methicillin-resistant Staphylococcus aureus (MRSA) and 3 strains were clindamycin resistant. The sensitivity rate of methicillin-resistant Staphylococcus aureus to dapupramycin, furotoin, cotrimoxazole, e, linezolid, tegacycline, teicolanin and vancomycin was 100%, and the sensitivity rate to rifampicin and gentamicin was more than 70%. See Table 2, Table 3, Table 4, Table 5, Table 6.

DISCUSSION

A case study of lower respiratory tract infection was carried out in severe patients in a hospital in Xinjiang. The results showed that among the common pathogenic bacteria, Acinetobacter baumannii (AB) and Pseudomonas aeruginosa (PA) had a higher proportion of infections. These strains can be isolated from sputum, whole blood, pleural fluid, and other samples, indicating a wide range of infections. Among them, sputum samples accounted for a large proportion, indicating a high positive detection rate and serving as the main source of pathogenic bacteria for lower respiratory tract infections. As for the treatment of Acinetobacter baumannii infection, this study found that the main strain was carbapenem resistant Acinetobacter baumannii (CRAB), which belonged to multi-drug resistant bacteria (MDR) and required multiple antibiotic combined treatment. In previous studies, sulbactam has been considered to have a certain effect on carbapenem-resistant acinetobacter baumannii infection, so treatment guidelines recommend tigecycline-based combination therapy combined with high-dose sulbactam sodium.[10] In addition, according to the research results in China, amikacin combined with tigecycline can improve the antibacterial efficiency and has a synergistic effect.[11] Therefore, combined with the results of our hospital's drug sensitivity and treatment guidelines, we recommend the

use of multi-drug combination therapy such as tigecycline, polymyxin, and amikacin to deal with lower respiratory tract infections.Pseudomonas aeruginosa is one of the six ESKAPE pathogens and one of the main causes of nosocomial infections.[12] This pathogen has the ability to develop resistance to all available antibiotics and thus poses a great problem for treatment.

In this study, we found that Pseudomonas aeruginosa had a certain sensitivity to antibiotics recommended by treatment guidelines. However, it should be noted that enzyme inhibitors such as ticarcillin and ampicillin were completely resistant to Pseudomonas aeruginosa.[13] This suggests that treating pseudomonas aeruginosa infections with these drugs alone may not have good results. β-lactamase inhibitor complex is superior to cephalosporin antibiotics alone in the treatment of Pseudomonas aeruginosa infection. In addition, among aminogasaccharide antibiotics, amikacin has the best sensitivity to Pseudomonas aeruginosa.[14] Intravenous combination therapy with piperacillin or ceftazidime and aminoglycoside has been the standard treatment for severe Pseudomonas aeruginosa infections. However, after prolonged antibiotic treatment, Pseudomonas aeruginosa may become resistant to multiple antibiotics, especially in intensive care units or in cases where susceptible patients persist for a long time, which makes treatment more difficult. Ceftazidime may be an effective treatment option for pandrug-resistant Pseudomonas aeruginosa.[15] The study suggests that novel cephalosporin inhibitor combinations, ceftazidime, and ceflozam may be valuable options for treating severe infections caused by pandrug-resistant strains. These new drugs may provide new and effective options for treating Pseudomonas aeruginosa infections.

For ESBLS-producing enterobacteriaceae (ultra-broad spectrum β-lactamase), drug susceptibility tests showed that tigecycline and carbapenems remained the recommended treatment options. In addition, amikacin, chloramphenicol, ciprofloxacin, levofloxacin, piperacillin, cefotetan, cefoxitin, cefoperazone and other antibiotics also showed good sensitivity in this study. Studies have shown that high doses of amikacin successfully treat ventilator-associated pneumonia and intraperitoneal infections. In addition, the combination of amikacin and meropenem confirmed the synergistic effect of the combination regimen in vitro in four cases of ventilator-associated pneumonia. However, it is important to note that this combination may cause renal toxicity, so the risks and benefits need to be carefully evaluated when used. Amikacin inhalants combine the potent in vitro activity of amikacin against gram-negative bacteria with the high concentration obtained in the lower airway when administered. This provides a novel adjunctive inhalation therapy for the treatment of hospital-acquired and ventilator-associated pneumonia. The combination of amikacin and meropenem extended the duration of action and validated the effectiveness of amikacin as an adjunct drug in the treatment of pneumonia caused by Acinetobacter baumannii.

CONCLUSION

Taken together, amikacin shows similar, if not better, sensitivity compared to most available antibiotics, especially against E. coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa. In addition, in this study, methicillin-resistant coagulase-negative staphylococcus were completely sensitive to furantoin, Dafoptin, tigacycline, and vancomycin, while rifampicin and linezolid were found to be more sensitive. However, due to the low blood concentration and high urinary tract concentration of furantoin, it is often used for urinary tract infections and is not recommended to treat lower respiratory tract infections. Therefore, tigecycline, vancomycin, and linezolid are recommended. In methicillin-resistant Staphylococcus aureus infection, tetracycline, glycopeptide antibiotics, dalfopristin, and cotrimoxazole are recommended, while furazolidone is not.In addition, the results of this study also suggest that in addition to traditional empirical drugs, rifampicin is also highly sensitive to gentamicin. These findings provide important information for clinicians when treating infections caused by different bacteria.

ETHICAL COMPLIANCE

The ethics committee of Hospital of Traditional Chinese Medicine, Xinjiang Medical University approved this study.

CONFLICT OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

AUTHOR CONTRIBUTIONS

LW and JL designed the study, HG and LQ collected the data, HG, LQ and GW analyzed the data, and LW and JL prepared the manuscript. All authors read and approved the final manuscript.

FUNDING

State Key Laboratory of Pathogenesis, Prevention, Treatment of Central Asian High Incidence Diseases Fund. The mechanism of NLRP3 inflammasome activation involved in the progression of pulmonary tuberculosis-associated COPD disease and the regulation of Th1/ Th2 immunomodulation (SKL-HIDCA-2022-).

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