BMJ Open

Risk factors and drug resistance of adult community-onset urinary tract infections caused by *Escherichia coli*-producing extended-spectrum β-lactamase in the Chongqing region, China: a retrospective case–control study

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To cite: Zhou Y, Long B, Liu H-L, *et al*. Risk factors and drug resistance of adult community-onset urinary tract infections caused by *Escherichia coli*-producing extended-spectrum β-lactamase in the Chongqing region, China: a retrospective case–control study. *BMJ Open* 2024;**14**:e090665. doi:10.1136/bmjopen-2024-090665

► Prepublication history for this paper is available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-090665).

Received 01 July 2024
Accepted 15 October 2024

Check for updates

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ABSTRACT

Objective To evaluate the prevalence, resistance and risk factors of community-onset urinary tract infections (COUTIs) caused by extended-spectrum β-lactamase-producing *Escherichia coli* (ESBL-EC) for providing a basis for the selection of clinical therapeutic agents.

Design A retrospective case–control study.

Setting The Affiliated Dazu Hospital of Chongqing Medical University (also known as The People's Hospital of Dazu Chongqing), a 1000-bed tertiary hospital in China.

Data and participants This study encompassed adult patients diagnosed with community-acquired urinary tract infections (UTIs) caused by *E. coli* between May 2017 and December 2022 with exclusion criteria including incomplete clinical data, disagreement to participate in the study, hospitalisation duration exceeding 48 hours prior to confirmation of diagnosis and prior history of urinary tract infection caused by *E. coli*.

Outcome measures The risk factors for COUTIs caused by ESBL-EC were evaluated using a case–control design, defining patients who were diagnosed with UTIs and had an ESBL-positive urine culture as the case group and patients who were diagnosed with UTIs and had an ESBL-negative urine culture as the control group. Perform drug susceptibility testing and resistance analysis on isolated ESBL-EC.

Results In total, 394 cases of COUTIs caused by *E. coli* were included; 192 cases were ESBL-positive with a detection rate of 48.7% (192/394). Parenchymal tumour, history of urolithiasis stone fragmentation, history of urological surgery, hospitalisation within 6 months, indwelling catheter outside the hospital and antibiotic use (mainly third-generation cephalosporins) were the factors significantly associated with COUTIs caused by ESBL-EC ($p<0.05$) through logistic regression for univariate analysis. Multivariate analysis revealed that a history of urolithiasis stone fragmentation (OR=2.450; 95% CI: 1.342 to 4.473; p=0.004), urological surgery (OR=3.102; 95% CI: 1.534 to 6.270; p=0.002), indwelling catheter outside hospital (OR=2.059; 95% CI: 1.025 to 4.133; p=0.042), hospitalisation within 6 months (OR=2.127; 95% CI: 1.207 to 3.748; p=0.009) and use of third-generation cephalosporins (OR=1.903; 95% CI: 1.069 to 3.389; p=0.029) were the independent risk factors for COUTIs caused by ESBL-EC. The results of the drug susceptibility testing revealed that ESBL-EC exhibited the highest resistance rates to ampicillin, ceftriaxone and cefixime, all at 100%. Mezlocillin followed with a resistance rate of 98.7%. On the other hand, ESBL-EC strains displayed the highest sensitivity to carbapenem antibiotics (imipenem, meropenem, ertapenem) and amikacin, all at 100%. Sensitivity rates were also high for cefotetan at 96.6%, piperacillin/tazobactam at 95.3% and nitrofurantoin at 87.9%.

Conclusions Our results revealed high ESBL-EC detection rates. COUTIs caused by ESBL-EC are more likely to occur in patients with parenchymal tumour, a history of urolithiasis stone fragmentation, a history of urological surgery, hospitalisation within 6 months, indwelling catheter outside the hospital and use of third-generation cephalosporins. These patients were highly resistant to penicillins, cephalosporins and quinolones.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study focused on community-acquired urinary tract infections (UTIs) in patients, 62% of whom were≥60 years. Results are applicable to elderly community dwellers.
⇒ Using a case–control design, this study examined factors associated with extended-spectrum β-lactamase-producing *Escherichia coli* UTIs including comorbidities, surgical history, recent antibiotic usage and indwelling catheters outside the hospital.
⇒ The study used the double-disk diffusion method for confirmation of bacterial phenotypes without conducting genetic sequencing at the molecular level.
⇒ This retrospective study relies on existing data, potentially limited by incompleteness, bias and confounding factors.

INTRODUCTION

Urinary tract infections (UTIs) are characterised by high incidence rates, frequent recurrence, a predisposition among certain populations and bacterial resistance, among

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other notable features, is one of the most common infections in the community with urinary-derived *Escherichia coli* being the most predominant pathogenic bacteria. *E. coli* has shown more complex changes in drug resistance, more rapid geographical variation and a faster transmission rate with the widespread use of antimicrobials. The establishment of long-term surveillance and analysis of drug resistance in *E. coli* are being focused on globally to find a faster treatment method for *E. coli* infections and control the epidemic of novel drug-resistant strains.[1 2]

The current worldwide prevalence of extended-spectrum β-lactamase-producing *E. coli* (ESBL-EC) in the community is increasing causing a significant issue in clinical diagnosis and treatment.[1 2] Laboratory studies have reported that ESBL-producing Enterobacteriaceae can produce several β-lactamases to hydrolyse broad-spectrum β-lactamase antibiotics, thus leading to resistance to penicillins and cephalosporins.[3] Moreover, genes encoding ESBL can be transferred in different species of plasmid-mediated Enterobacteriaceae;[4] therefore, bacteria carrying ESBL genes usually comprise additional genes or gene mutations that mediate resistance to multiple antibiotics.[5]

Reviewing the literature over the past 20 years approximately, we found reports about the genetic and epidemic characteristics, drug resistance patterns and susceptibility factors of *E. coli* from China, the USA, the UK, Australia, Spain, Turkey, Jordan and other countries;[6–14] the results from these studies have been used in the empirical treatment and development of related drugs in the clinic. In China, a well-established surveillance system for drug-resistant bacteria was formed quite late; therefore, relatively few reports about the bacteria are available and more surveillance data and laboratory studies are still required to help doctors choose the appropriate treatment. Thus, we here retrospectively analysed cases of community-onset urinary tract infections (COUTIs) caused by *E. coli* within the past 5 years in the Chongqing region, China, evaluated the drug resistance and clinical characteristics of ESBL-EC and analysed the risk factors for COUTIs caused by ESBL-EC by performing a case–control study in ESBL-positive and ESBL-negative patients.

METHOD

Environment and population

The People's Hospital of Dazu Chongqing, Dazu District, Chongqing, China, is a national tertiary general hospital integrating medical, teaching, scientific research, preventive healthcare, first aid and rehabilitation with a bed capacity of 1000 and receives more than 8000 patients per year. The Dazu district, located in the western part of Chongqing, has a resident population of 856 000 and the region has a high degree of population ageing with a large population suffering from common diseases such as diabetes, cardiovascular disease, respiratory disease and cancer.

Study design and materials

We here retrospectively reviewed patients diagnosed with COUTIs caused by *E. coli* from May 2017 to December 2022. We collected data including sex, age, admission time, sample collection time, clinical manifestations and risk factors (including underlying disease, history of urological surgery, hospitalisation within 6 months, antibiotic use within 6 months and indwelling catheter outside hospital) through electronic medical records, examination reports and telephone call back visits.

The risk factors for COUTIs caused by ESBL-EC were evaluated using a case–control design, defining patients who were diagnosed with UTIs and had an ESBL-positive urine culture as the case group and patients who were diagnosed with UTIs and had an ESBL-negative urine culture as the control group, using logistic regression for univariate analysis. Multivariate analysis was performed for variables with significant differences ($p<0.05$).

Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) Patients older than 18 years; (2) those with urine collection done before admission or within 48 hours of admission; (3) those with a positive urine culture with a growth of 10^5 CFU (Colony-forming Unit) /mL; (4) those with a clinical diagnosis of UTI.

The exclusion criteria were as follows: (1) Patients with incomplete clinical data; (2) those who did not agree to provide case information for participation in the study; (3) those who were hospitalised for more than 48 hours before diagnosis; (4) patients with a history of recurrent urinary tract infections caused by *E. coli* (only the sample data from the first episode of infection was included).

Microbiological methods

The strain identification was conducted using matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry (VITEK MS IND MALDI-TOF, BioMérieux, France). The isolated *E. coli* were initially screened using the conventional paper chip diffusion method to detect the susceptibility to broad-spectrum β-lactamase antibiotics. The phenotypic confirmation of ESBL-EC was performed using the double-disk diffusion method according to the Clinical and Laboratory Standards Institute performance standards.

Antimicrobial susceptibility testing

The minimum inhibitory concentration was determined according to the Clinical and Laboratory Standards Institute guidelines[15] and the standard strain *E. coli* ATCC 25922 was used as the control strain. Drugs including ampicillin, ampicillin/sulbactam, piperacillin/tazobactam, meloxicillin, cefuroxime, cefoperazone/sulbactam, cefotetan, ceftazidime, ceftriaxone, cefixime, cefepime, cefotaxime, aztreonam, imipenem, meropenem, ertapenem, gentamicin, tobramycin, amikacin, levofloxacin, ciprofloxacin, nitrofurantoin and cotrimoxazole were tested.

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Table 1 Clinical presentation and proportion of ESBL-positive patients

Symptoms		Number	Per cent (%)
Urinary irritation	Urinary frequency	65	33.9
	Urinary urgency	56	29.2
	Odynuria	49	25.5
Dysuria		11	5.7
Haematuresis		19	9.9
Lumbago		28	14.6
Renal buckle pain		21	10.9
Fever		35	18.2
Chilly		16	8.3
Shiver		6	3.1
Dizzy		12	6.3
Headache		18	9.4
Nausea		11	5.7
Vomit		17	8.9
Belly distention		14	7.3
Diarrhoea		2	1.0

ESBL, extended-spectrum β-lactamase.

Statistical analysis

Analyses were performed using SPSS V.26.0 (IBM, Armonk, New York, USA). Count data were expressed as numbers and percentages and χ^2 tests were performed. Measurements that met normal distribution were presented as mean±SD and were subjected to a t-test. Binary logistic regression was used to analyse the risk factors for COUTIs caused by ESBL-EC and p<0.05 was considered statistically significant.

RESULTS

Detection rate

A total of 394 cases diagnosed with COUTIs caused by *E. coli* were included. Among them, 192 cases were ESBL-positive with a detection rate of 48.7% (192/394).

Clinical characteristics of ESBL-positive patients

Of the 192 ESBL-positive patients, 50 were men accounting for 26.0% (50/192). The mean patient age was 64±13 years and 62.0% (119/192) of the patients were 60 years and older. The vast majority of patients had underlying comorbidities including diabetes, hypertension, parenchymal tumours, prostatic hyperplasia and others.

The main clinical symptoms included urinary tract irritation signs (urinary frequency: 65, urinary urgencies: 56 and odynuria: 49), dysuria (11), haematuria (19), lumbago (28), pain with percussion in the renal area (21) and fever (35); the detailed results are shown in table 1.

Risk factors

Univariate analysis showed that parenchymal tumour, history of urolithiasis stone fragmentation, history of urological surgery, hospitalisation within 6 months, indwelling catheter outside the hospital and antibiotic use (mainly third-generation cephalosporins) within 6 months were factors significantly associated with COUTIs caused by ESBL-EC (p<0.05, see table 2).

Multivariate analysis of these factors revealed that a history of urolithiasis stone fragmentation, urological surgery, indwelling catheter outside the hospital, hospitalisation within 6 months and use of third-generation cephalosporins were independent risk factors for COUTIs caused by ESBL-EC (see table 3).

Drug resistance analysis

The results of drug sensitivity testing revealed high resistance rates of ESBL-EC to the penicillin drugs, ampicillin and mezlocillin, with resistance rates of 100% and 98.7%, respectively. There was considerable variation in the resistance of ESBL-EC to cephalosporins. Specifically, the resistance rates to ceftriaxone and cefixime both reached 100% whereas the resistance rate to cefotetan was 0% with a sensitivity rate of 96.6%. This indicates the potential value of cefotetan in the treatment of infections caused by ESBL-EC.

ESBL-EC showed the highest sensitivity to carbapenems with sensitivity rates of 100% for imipenem, meropenem and ertapenem, following the carbapenems, cefotetan, piperacillin/tazobactam and nitrofurantoin exhibited sensitivity rates of 96.6%, 95.3% and 87.9%, respectively (see table 4).

DISCUSSION

UTI caused by ESBL-EC, characterised by bacterial resistance and recurrence, is one of the most common infections in the community; it has a high treatment difficulty. ESBL-EC can be genetically encoded to produce ESBL and degraded β-lactamase antibiotics are widely used in the clinic making the bacteria resistant to these antibiotics.[3] Furthermore, it is also possible to spread drug-resistant genes to other bacteria by transfer nature plasmid vectors or by mechanisms such as homologous recombination leading to multidrug resistance.[4] Over the past 20 years, ESBL-EC has widely spread worldwide and is no longer restricted to infections in hospital wards and the prevalence of COUTIs caused by ESBL-EC is continuously increasing.[1 2]

Epidemiological studies have shown marked differences in the transmission of ESBL-EC, mainly because ESBL-EC has a high genetic diversity and diverse resistant strains may dominate in different regions and populations.[1] To understand the spread and differences of COUTIs caused by ESBL-EC in various regions in the last two decades, we referred to a large and reliable literature. Two studies in China reported the prevalence of ESBL-EC in COUTIs.[6 7] In 2021, a prospective multicentre study in East China[6]

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Table 2 Univariate analysis of the risk factors in ESBL-positive patients

Risk factors	All patients (%)	ESBL-negative (%)	ESBL-positive (%)	P value
Total	394	202 (51.3)	192 (48.7)	
Gender (male)	109 (27.9)	59 (29.2)	50 (26.0)	0.483
Advanced age (≥60 years)	227 (57.6)	108 (53.5)	119 (62.0)	0.088
Underlying diseases and comorbidity				
Diabetes	161 (40.9)	86 (42.6)	75 (39.1)	0.479
Hypertension	142 (36.0)	68 (33.7)	74 (38.5)	0.314
Parenchymal tumour	43 (10.9)	17 (8.4)	26 (13.5)	**0.025**
Urinary bladder carcinoma	13 (3.3)	4 (2.0)	9 (4.7)	0.144
Prostatic cancer	4 (1.0)	0 (0.0)	4 (2.1)	0.999
Benign prostatic hyperplasia	29 (7.4)	10 (5.0)	19 (9.9)	0.065
Urolithiasis stone fragmentation	43 (10.9)	15 (7.4)	28 (14.6)	**0.025**
Urological surgery	58 (14.7)	21 (10.4)	37 (19.3)	**0.014**
Hospitalisation (within 6 months)	80 (20.3)	26 (12.8)	54 (28.1)	**<0.001**
ICU hospitalisation (within 6 months)	11 (2.8)	4 (2.0)	7 (3.6)	0.323
Indwelling catheter outside hospital	54 (13.7)	19 (9.4)	35 (18.2)	**0.002**
Antibiotic use (within 6 months)	110 (27.9)	41 (20.3)	69 (35.9)	**<0.001**
Second-generation cephalosporins	20 (5.1)	9 (4.5)	11 (5.7)	0.566
Third-generation cephalosporins	67 (17.0)	24 (11.9)	43 (22.4)	**0.006**
Quinolone antibiotics	35 (8.9)	17 (8.4)	18 (9.4)	0.492

Bold values signifies a univariate analysis, and P value less than 0.05 in the table is listed in bold form, it presents that patients with parenchymal tumor, history of urolithiasis stone fragementation, history of urological surgery, indwelling catheter outside hospital, hospitalization within 6 months and third-generation cephalosporins use are factors significantly associated with COUTIs caused by ESBL-EC
ESBL, extended-spectrum β-lactamase; ICU, intensive care unit.

reported the prevalence of ESBL-EC in communities in detail comprising 1760 UTI cases from 19 hospitals; the detection rate of ESBL Enterobacteriaceae was 37.2%. The detection rate of community-acquired ESBL-EC cases was 22% in a retrospective study from Tongren Hospital, Beijing, China.[7] A similar pattern has been reported in several European countries with a study from the Glasgow region of Scotland, UK, published in 2011 indicating a detection rate of ESBL Enterobacteriaceae of 7.5% in urine samples.[8] The detection rate of ESBL-EC in COUTIs increased from 0.47% in 2000 to 1.7% in 2014 in Spain.[9] A 9-year retrospective Australian study revealed a 44% increase in the proportion of ESBL-EC in individuals with UTIs caused by *E. coli* from 4.6% in 2006 to 6.6% in 2014.[10] The prevalence of ESBL-EC has also been reported in countries in West Asia with a report from Turkey in 2019 revealing a 50.5% detection rate of ESBL-EC in UTIs.[11] In 2018, a two-centre cross-sectional study from Amman in Jordan reported a detection rate as high as 62%.[12] A multicentre study from North America reported a 3.9% detection rate of ESBL-EC in patients with community-associated infections[13] and another study from California reported a 5.9% detection rate in patients with UTIs.[14] In the present study, we reviewed all cases of COUTIs caused by *E. coli* in the Chongqing region over the past 5 years and found that the detection rate of ESBL-EC was 48.7% which was higher than that in East China and Beijing, much higher than that in the UK, Spain, Australia and the USA; and lower than that in Turkey and Jordan.

Table 3 Multivariate analysis of the risk factors in ESBL-positive patients

	OR	95% CI	P value
Parenchymal tumour	1.801	0.882 to 3.678	0.107
Urolithiasis stone fragmentation	2.450	1.342 to 4.473	**0.004**
Urological surgery	3.102	1.534 to 6.270	**0.002**
Indwelling catheter outside hospital	2.059	1.025 to 4.133	**0.042**
Hospitalisation (within 6 months)	2.127	1.207 to 3.748	**0.009**
Third-generation cephalosporins	1.903	1.069 to 3.389	**0.029**

Bold values presents that patients with urolithiasis stone fragementation, urological surgery, indwelling catheter outside hospital, hospitalization within 6 months and third-generation cephalosporins use are more likely to be infected by ESBL-positive EC.
ESBL, extended-spectrum β-lactamase.

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Table 4 Analysis of resistance in ESBL-positive patients

Antibiotics	Resistance (%)	Sensitivity (%)	Intermediate (%)
Ampicillin	100	0	0
Ampicillin/sulbactam	65.1	23.5	11.4
Piperacillin/tazobactam	2.7	95.3	2
Mezlocillin	98.7	1.3	0
Cefuroxime	76.5	23.5	0
Cefoperazone/sulbactam	12.1	76.5	11.4
Cefotetan	0	96.6	3.4
Ceftazidime	44.3	52.3	4.6
Ceftriaxone	100	0	0
Cefixime	100	0	0
Cefepime	41.6	58.4	0
Cefotaxime	64.4	35.6	0
Aztreonam	66.4	33.6	0
Imipenem	0	100	0
Meropenem	0	100	0
Ertapenem	0	100	0
Gentamicin	43.6	56.4	0
Tobramycin	16.1	64.4	19.5
Amikacin	0	100	0
Levofloxacin	73.8	10.7	15.5
Ciprofloxacin	77.8	18.8	3.4
Furadantin	3.4	87.9	8.7
Trimethoprim/sulfamethoxazole	62.4	37.6	0

ESBL, extended-spectrum β-lactamase.

The high detection rate of ESBL-EC in the community may be associated with the clinical characteristics of the local infected population and the previous healthcare and antibiotic usage patterns of patients. In the present study, the proportion of ESBL-positive female patients was 74% which was much higher than that of male patients. This finding is consistent with those of two reports from East China and Beijing where the number of ESBL-positive female patients was more than 80%.[6 7] Moreover, women are more susceptible to UTIs for reasons associated with the physiological anatomy and oestrogen levels of women.[16 17] In terms of anatomy, the female urethra is relatively shorter than that of men and closer to the anus increasing the chance of bacterial migration from the intestine to the urinary tract. Postmenopausal women are more susceptible to ascending UTIs due to changes in the urinary and vaginal microbiota because of reduced oestrogen levels with blooms of enterobacterial flora.[17] Oral or topical oestrogen preparations are used to prevent recurrent UTIs in postmenopausal women.[17 18] In the present study, most women were infected with COUTIs caused by ESBL-EC and the patients' age was mainly over 60 years old which is consistent with the fact that menopausal women are more susceptible to UTIs.

In the present study, the mean age of the patients was (64±13) years and 62.0% (119/192) of the patients were aged 60 years and older. The vast majority of patients had underlying comorbidities including diabetes, hypertension, urinary stones, parenchymal tumours and others. Regarding the risk factors, 19.3% of patients had a history of urological surgery, 18.2% had an indwelling catheter outside the hospital, 28.1% were hospitalised within 6 months and 35.9% used antibiotics within 6 months.

Univariate analysis revealed that parenchymal tumour, history of urolithiasis stone fragmentation, history of urological surgery, hospitalisation within 6 months, indwelling catheter outside the hospital and antibiotic use (mainly third-generation cephalosporins) within 6 months were factors significantly associated with COUTIs caused by ESBL-EC ($p<0.05$). Multivariate analysis revealed that a history of urolithiasis stone fragmentation, urological surgery, indwelling catheter outside the hospital, hospitalisation within 6 months and use of third-generation cephalosporins were independent risk factors for COUTIs caused by ESBL-EC. Although these findings are similar to those of previous studies,[6 7 10–13 19] there are still some differences. Furthermore, age is one of the possible risk factors[10 11] and ESBL-positive patients were

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older than ESBL-negative patients in our study; however, the age difference was not statistically significant in the regression analysis (p=0.088). Prostatic hyperplasia is one of the possible risk factors[6] and more patients with prostatic hyperplasia were ESBL-positive than ESBL-negative; however, the difference was not significant in the regression analysis (p=0.065). Clinically, patients with prostatic hyperplasia present with urinary tract obstruction and urine retention and need more frequent catheterisation manoeuvres which undoubtedly increases the risk of ESBL-EC infection. Nonetheless, our findings did not include prostatic hyperplasia as one of the independent risk factors, possibly due to the low sample size of male patients and a smaller number of patients with prostatic hyperplasia. This led to some deviation in the statistical results.

The most difficult part of UTI treatment is the increase in bacterial resistance and the multidrug resistance of ESBL-EC makes the choice of therapeutic agents narrower and limited which in turn increases the difficulty of treatment. In the present study, we statistically evaluated the results of susceptibility testing in 192 ESBL-positive patients. The results showed that carbapenems including imipenem, meropenem and ertapenem had very strong antimicrobial activity in vitro with 100% sensitivity. Aminoglycoside antimicrobials showed a wide variation in the antimicrobial activity; the sensitivity of amikacin was excellent, reaching 100% and that of gentamicin and tobramycin was 64.4% and 54.4%, respectively. Nitrofurantoin, a nitrofuran, had a sensitivity of 87.9%. The sensitivity of piperacillin/tazobactam was 95.3%.

The treatment guidelines on multidrug-resistant bacteria issued by the Infectious Diseases Society of America in 2022 indicated that carbapenems have strong antibacterial activity against ESBL-producing Enterobacteriaceae and can be the first choice of treatment for pyelonephritis and complicated UTI caused by ESBL-producing Enterobacteriaceae.[5] In addition, piperacillin/tazobactam, a commonly used empirical therapeutic agent demonstrated good antibacterial activity against multiple ESBL-producing Enterobacteriaceae.[20] However, compared with the in vitro efficacy of carbapenems, piperacillin/tazobactam is slightly less effective[5] which is consistent with the results of our study. It is important to note that the prevalence of carbapenem-resistant Enterobacteriaceae is also constantly increasing[21] and that repeated carbapenem use is a major contributing factor to the increasing prevalence of carbapenem-resistant Enterobacteriaceae.[22] Therefore, we preferentially use piperacillin/tazobactam for some patients with COUTIs caused by ESBL-ECs who are less symptomatic, thus reducing the frequency of carbapenem use.

Currently, the commonly used cephalosporins for the treatment of infections are not very effective in treating infections caused by ESBL-EC. In the present study, only the second-generation cephalosporin cefotetan had a high sensitivity (96.6%); third-generation cephalosporins have developed obvious resistance and the resistance for ceftriaxone and cefixime reached 100%. Combined with the risk factor analysis in this study, the use of third-generation cephalosporins is an independent risk factor for COUTIs caused by ESBL-EC and we assume that there may be a situation of transitional third-generation cephalosporin use in this region and that the widespread use of third-generation cephalosporins will induce the emergence of new ESBL strains. Thus, the use of third-generation cephalosporins should be reduced in response to community-acquired infections, particularly COUTIs caused by ESBL-EC to avoid inducing more ESBL-producing.

The study has some limitations. First, our investigation focused on patients with COUTIs excluding those with hospital-acquired urinary tract infections. Therefore, we could not compare the difference of epidemiological data between COUTIs and hospital-acquired UTIs. Second, we only compiled statistics and analysed the drug resistance in the ESBL-positive group without comparing the differences in drug resistance between the ESBL-positive and ESBL-negative groups. Third, we employed the double-disk synergy test to confirm the phenotype of ESBL-producing *E. coli* strains without conducting gene sequencing at the molecular level. Consequently, the resistance genes and virulence genes of ESBL-producing *E. coli* as well as the correlation between them were not identified. Fourth, this study is retrospective and relies on existing data which may be subject to issues such as data quality, selection bias and confounding factors. Additionally, due to limitations in sample size, we did not perform a prior sample size calculation. Instead, we simply included all eligible samples from the past 5 years which may have reduced the statistical power of our findings.

CONCLUSIONS

The positive detection rate of COUTIs caused by ESBL-EC in this study was high; history of urolithiasis stone fragmentation, urological surgery, indwelling catheter outside the hospital, hospitalisation within 6 months and use of third-generation cephalosporins were independent risk factors for COUTIs caused by ESBL-EC. The susceptibility profile suggested significant resistance to penicillins, cephalosporins and quinolones; however, carbapenems and amikacin showed 100% sensitivity.

Acknowledgements We acknowledge to all members of the public and patients who have shown interest in and participated in this research. We acknowledge all healthcare workers involved in the diagnosis and treatment of patients in Dazu, Chongqing. We thank the clinical laboratory department from The People's Hospital of Dazu District and we thank Medjaden for its assistance in the preparation of this manuscript.

Contributors Y-IZ and B-IL conceived the study. H-LL and Y-IZ collected the data. HL-L and JW analysed the data. B-IL and Y-IZ wrote this article. JW and HX revised it. HX supervised study conduct. All the authors have read and approved the final version of this manuscript. JW are responsible for the overall content (as guarantor).

Funding The study was supported by The First batch of key Disciplines On Public Health in Chongqing (YWBF2022072).

Competing interests None declared.

BMJ Open: first published as 10.1136/bmjopen-2024-090665 on 29 October 2024. Downloaded from http://bmjopen.bmj.com/ on June 12, 2025 at Agence Bibliographique de l Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study was approved by the Ethics Commission of The People's Hospital of Dazu District (No. 2023LLSC0309). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data is available upon reasonable request from the corresponding author JW (2861914532@qq.com).

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