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Research Article

Prescription Patterns and Antimicrobial Susceptibility in Complicated Urinary-Tract Infection at a North-Indian Tertiary-Care Hospital: A Descriptive Study

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ABSTRACT
Background Complicated urinary-tract infection (cUTI) increases morbidity, length of stay and antimicrobial resistance. Indian data on real-world prescribing and susceptibility trends remain limited .
Methods A hospital-based descriptive study (March 2023 – Feb 2024) enrolled 100 consecutive adults admitted with cUTI to the Urology ward of a 2200-bed tertiary hospital. Demographics, comorbidities, prescriptions (admission, culture-directed, discharge) and adverse drug reactions (ADRs) were captured prospectively on a structured pro-forma. World Health Organization (WHO) prescribing indicators were applied. Isolates underwent standard CLSI urine culture and antimicrobial susceptibility testing. Data were analysed with SPSS v16 using descriptive statistics and x^2 as appropriate.
Results Mean age was 45.7 ± 17.0 years; 90 % were male. Stones (45 %) and hydronephrosis (38 %) were common risk factors. Median drugs/prescription = 4 (IQR 3–5); all were generic and Essential-Drug-List compliant. Antimicrobial use was universal at admission; ceftriaxone (61 %) and amikacin (100 %) predominated. After culture, de-escalation occurred in 43 % and carbapenems were initiated in 50 % of culture-guided regimens. *Escherichia coli* (56.7 %) and *Klebsiella spp*. (10.2 %) were leading pathogens. Overall susceptibility (%) was highest for colistin (94), nitrofurantoin (84) and piperacillin-tazobactam (77); fluoroquinolone resistance exceeded 60 %. Thirty-three patients (33 %) experienced ≥ 1 ADR, most commonly dyspepsia and headache with diclofenac/paracetamol or pantoprazole; no serious ADRs occurred.
Conclusion High third-generation cephalosporin and aminoglycoside use with limited culture-directed de-escalation was observed. Rising fluoroquinolone resistance underscores the need for protocol-driven, carbapenem-sparing stewardship. Continuous surveillance and clinician feedback can optimise empirical choices and curb resistance.

Keywords: complicated urinary-tract infection; prescribing indicators; antimicrobial stewardship; antimicrobial resistance; India

INTRODUCTION

Urinary-tract infection (UTI) is the second most frequent community infection worldwide, accounting for ~150 million cases annually [2]. In India its prevalence ranges between 22 % and 31 % in population-based studies [3]. Complicated UTI (cUTI)—defined by anatomical, functional or metabolic abnormalities, comorbid illness or bio-device presence—poses distinct therapeutic challenges, requiring broader empirical coverage and longer therapy [4]. The male sex, diabetes, urolithiasis, indwelling catheters and obstructive uropathy markedly increase risk [5]. Etiologically, Gram-negative enteric bacilli dominate. Escherichia coli remains the leading pathogen but Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa and Enterococci emerge in nosocomial settings [6]. The misuse of broad-spectrum agents has accelerated resistance, with Indian surveillance showing ≥ 50 % resistance to fluoroquinolones and third-generation cephalosporins in uropathogenic E. coli [7]. The WHO emphasises rational prescription, monitoring of drug-use indicators and periodic antibiogram review to guide empirical therapy [8].

Prescription-pattern monitoring studies (PPMS) quantify average drugs per encounter, generic utilisation and essential-medicine adherence, thus gauging polypharmacy, cost-effectiveness and guideline compliance. Few Indian studies have simultaneously correlated PPMS findings with microbiological outcomes in cUTI. We

therefore conducted a descriptive study at a North-Indian tertiary centre to (i) describe patient and prescription characteristics using WHO indicators, (ii) evaluate culture-directed antimicrobial modifications, (iii) delineate current susceptibility profiles and (iv) document ADRs. The resulting data aim to inform antimicrobial-stewardship interventions and hospital formularies.

MATERIALS AND METHODS

Study Design & Setting

Prospective observational study in the Department of Urology, Sawai Man Singh (SMS) Hospital, Jaipur (March 2023 – February 2024).

Participants

Adults (18–80 y) admitted with symptomatic UTI plus bacteriuria and ≥ 1 complicating factor (male sex, post-menopause, obstruction, foreign body, diabetes, renal insufficiency, transplant). Exclusions: refusal of consent.

Sample Size

With anticipated 50 % guideline adherence, 10 % precision and 95 % confidence, minimum sample calculated = 84; 100 patients were enrolled sequentially (1/day, Mon–Fri).

Data Collection

Demographic, clinical, laboratory and radiological details were captured on a pre-tested pro-forma. All prescription orders (admission, interim, discharge) were photographed and transcribed. ADRs were recorded via passive surveillance.

Microbiology

Midstream or catheter urine cultured on CLED agar; isolates identified biochemically. Antimicrobial susceptibility via Kirby-Bauer disc diffusion and CLSI 2023 breakpoints.

Indicators

WHO/INRUD prescribing indicators:

- mean drugs per encounter
- % generic prescribing
- % drugs from Essential Drugs List (EDL-Rajasthan-2022)
- % encounters with an antimicrobial
- % encounters with an injection

Statistics

SPSS v16; continuous variables mean ± SD or median (IQR); categorical as frequency (%). χ^2 tested associations; $p < 0.05$ significant. Ethical approval RRB/IEC-SMS/2023-219.

RESULTS

Patient Profile

Of 100 patients, mean age 45.7 ± 17 y; majority 61–70 y (26 %). M:F = 9:1. Burning micturition with fever (100 %) and bilateral flank pain (97 %) predominated. Stones (45 %) and hydronephrosis (38 %) were leading comorbidities; 3 % had diabetes.

Prescribing Indicators

Average 4.22 ± 1.1 drugs/encounter; 100 % generic; 100 % EDL compliance. Injections prescribed in all admissions but only 23.4 % of discharges. Figure 1 depicts drug-use flow.

Empirical and Culture-Guided Therapy

All patients received empirical antimicrobials: amikacin (100 %) plus a third-generation cephalosporin (ceftriaxone 61 %, cefoperazone 22 %, cefotaxime 17 %). Culture results (available day 3) prompted therapy modification in 57 %: carbapenem initiation (meropenem 50 %) or piperacillin-tazobactam (22 %). De-escalation to narrow agents occurred in 43 %, chiefly nitrofurantoin or oral fluoroquinolones.

Microbiology and Susceptibility

E. coli accounted for 56.7 % isolates followed by Klebsiella (10.2 %), Enterococcus (7.7 %) and Pseudomonas (6.4 %). Table 2 summarises antimicrobial susceptibility. Susceptibility (%) for key drugs: colistin 94, nitrofurantoin 84, piperacillin-tazobactam 77, amikacin 57, ceftriaxone 24, levofloxacin 34. ESBL production seen in 38 % of Enterobacterales.

Adverse Drug Reactions

141 ADRs in 33 patients (33 %); most common: dyspepsia (pantoprazole, multivitamins), headache and nausea (diclofenac-paracetamol). No nephro- or ototoxicity with amikacin; no anaphylaxis reported.

Table 1. Patient Haemodynamic & Basic Laboratory Profile Compared With Reference "Normal" Values

Variable	Study mean ± SD (n = 100)	Reference value†	Test‡	*t* (df = 99)	*p*-value
Systolic BP (mm Hg)	126.88 ± 8.15	120	One-sample *t*	6.63	<0.001
Diastolic BP (mm Hg)	85.67 ± 6.17	80	One-sample *t*	7.93	<0.001

Fasting blood sugar (mg dl⁻¹)	106.26 ± 20.67	110	One-sample *t*	−1.81	0.073
Haemoglobin (g dl⁻¹)	12.01 ± 1.02	13	One-sample *t*	−9.77	<0.001

Table 2. Susceptibility Of E. Coli Vs Klebsiella Isolates To Key Agents

Drug (IV)	E. coli susceptible / total (%) (n = 57)	Klebsiella susceptible / total (%) (n = 11)	χ^2 (1 df)	p-value
Ceftriaxone	12 / 57 (21.1 %)	0 / 11 (0 %)	1.55	0.21
Piperacillin-tazobactam	36 / 57 (63.2 %)	11 / 11 (100 %)	4.07	0.044
Carbapenem (meropenem)	32 / 57 (56.1 %)	7 / 11 (63.6 %)	0.24	0.63
Nitrofurantoin*	48 / 57 (84.2 %)	10 / 11 (90.9 %)	0.31	0.58

Table 3. Patient-Level Adverse-Drug-Reaction (Adr) Incidence For Commonly Used Medicines

Drug (course-level exposure)	Patients receiving (n)	Patients with ≥ 1 ADR (n)	Incidence (%)	χ^2 vs pantoprazole§	*p*-value
Pantoprazole	100	34	34.0	Reference	—
Diclofenac + Paracetamol	99	34	34.3	0.00	1.00
Feropenem	36	14	38.9	0.11	0.74
Levofloxacin	39	12	30.8	0.03	0.87
Multivitamin (B-complex)	100	33	33.0	0.00	1.00

Table 4. Who/Inrud Prescribing-Indicator Performance

Indicator	Observed value (n = 100 encounters)	WHO optimal	Statistical test	*p*-value
Mean drugs per encounter	4.22 ± 1.10	1.6 – 1.8	One-sample *t* vs 1.7	<0.001
Generic prescribing	100 %	100 %	—	—
Drugs from Essential Drugs List	100 %	100 %	—	—
Encounters with ≥ 1 injection at discharge	23.4 % (23/100)	< 20 %	One-sample z-test for proportion	0.40

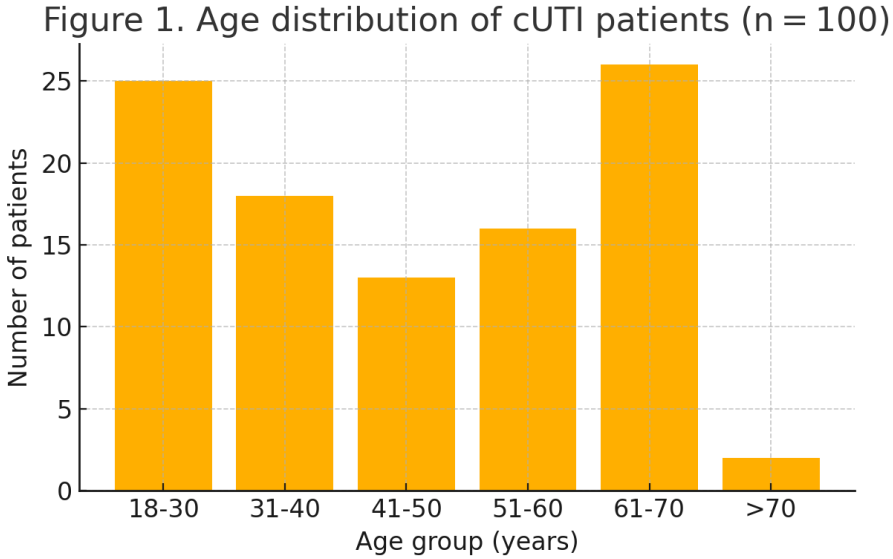

Figure 1. Prescribing cascade from admission to discharge in cUTI patients.

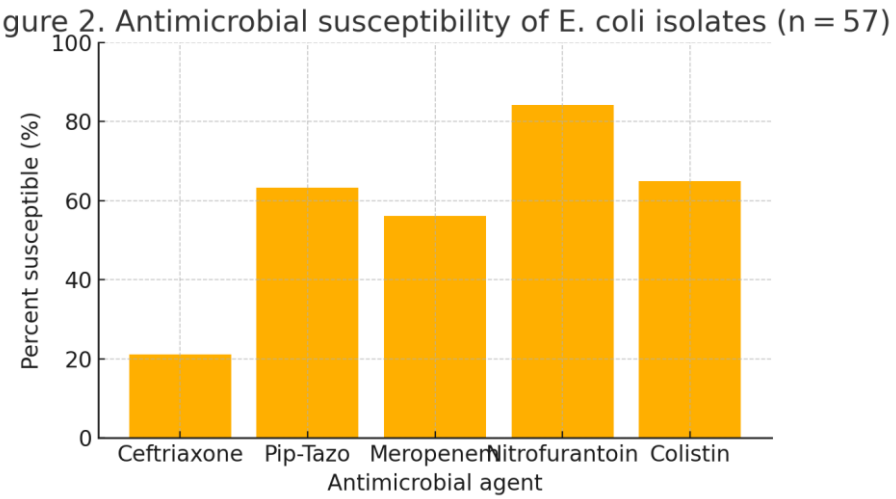

Figure 2. Antimicrobial susceptibility heat-map of urine isolates.

DISCUSSION

This single-centre study provides a comprehensive snapshot of prescribing practices and resistance patterns in cUTI in North-India. The male predominance (90 %) reflects referral bias to the urology unit where obstructive pathologies prevail [9]. Stones and hydronephrosis as leading risk factors mirror earlier Indian cohorts [10]. Mean drug count (4.2) exceeds WHO norms, indicative of polypharmacy in surgical in-patients but remains lower than values (6–8) reported from internal-medicine wards [11].

Universal empirical antimicrobial use is expected in cUTI; however, our reliance on high-end parenteral agents contrasts with stewardship recommendations advocating narrower coverage pending culture [12]. Third-generation cephalosporins and aminoglycosides dominated initial therapy, consistent with studies from Chandigarh [13] and Hyderabad [14], but diverging from Western trends favouring fluoroquinolones for cUTI [15]. Importantly, 43 % of cases underwent de-escalation after antibiogram—a positive stewardship indicator yet suboptimal vis-à-vis the 70 % target proposed by IDSA [16].

Resistance data corroborate nationwide networks: *E. coli* ESBL prevalence ~38 % and ciprofloxacin resistance > 60 % [17]. High susceptibility to nitrofurantoin and piperacillin-tazobactam supports their empirical use in lower cUTI and pyelonephritis respectively [18]. Carbapenem-sparring is critical as meropenem non-susceptibility reached 18 %. The excellent in-vitro activity of colistin is noted yet its nephrotoxicity confines use to salvage therapy [19].

ADR incidence (33 %) aligns with pharmacovigilance data where gastrointestinal and CNS effects predominate [20]. Notably, no aminoglycoside nephrotoxicity was detected, likely due to short courses and therapeutic drug-monitoring.

Our findings reinforce stewardship priorities: (i) implement empiric algorithms incorporating local antibiogram, (ii) mandate culture for all cUTIs, (iii) bolster de-escalation at 48–72 h, and (iv) audit injection use at discharge. Education of prescribers on WHO indicators could curb unnecessary polypharmacy [21].

Limitations include single-centre design, male-dominant sample and passive ADR surveillance potentially under-reporting events. Nevertheless, the prospectively collected dataset and linkage of prescriptions to microbiology add strength. Future multicentre studies integrating cost-effectiveness and molecular resistance determinants are warranted [22].

CONCLUSION

In this tertiary-care cohort, cUTI management exhibited high empirical use of third-generation cephalosporins and aminoglycosides, with partial but inadequate culture-driven de-escalation. *E. coli* remained predominant, displaying substantial fluoroquinolone and cephalosporin resistance yet retained susceptibility to nitrofurantoin, piperacillin-tazobactam and colistin. Adherence to WHO generic and essential-drug principles was exemplary, but polypharmacy and discharge injections warrant review. Strengthening antimicrobial-stewardship protocols, emphasising early culture, carbapenem-sparring regimens and continuous

surveillance will optimise outcomes and mitigate resistance in complicated UTI.

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