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Research Article

Antimicrobial Susceptibility Sensitivity Pattern in Positive Urine Culture for Urinary Tract Pathogens from Tertiary Care Hospital

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Abstract

Hospital specific monitoring studies aims to determine the prevalence of the type of microorganisms that causes urinary infections and to assess the antimicrobial sensitivity pattern. A hospital based short term prospective cross-sectional study was conducted at Sagar Hospital, Bengaluru from August to October 2020. Antimicrobial susceptibility in MIC test was performed for the isolated pathogens by using automated VITEK compact method and stratification was done according to ICU and NON-ICU patients with over 260 urine culture tests of the suspected in-patient for urinary tract infection. All antimicrobial susceptibility data was analyzed using WHONET software 5.6. Sixty-six urine culture tests showed culture positive, 41 from non-ICU and 23 from ICU. Gram-negative bacilli E.Coli (61% in ICU, 52% IN non-ICU) was the most prevalent bacterium, followed by Klebsiella pneumoniae ss. pneumoniae (9% in ICU, 20% IN non-ICU), and Candida albicans 9% prevalence was seen only in ICU isolates. The study shows that the rate of resistance towards ampicillin (100%) was high among gram negative isolates and penicillin (100%) among gram positive isolates. The susceptibility was favorable towards polymixinB, colistin in gram negative organisms and nitrofurantoin, vancomycin in gram positive organisms. The present study revealed that E.Coli is the predominant bacterial pathogen. It also demonstrates there is an increasing resistance to ampicillin (88.2%) and ESBL (90%) among UTI pathogens. While, polymixin B (100%) and colistin was found most effective among gram negative and nitrofurantoin was most effective among gram positive organisms.

Keywords: Antibiotic, antimicrobial resistance, urinary tract infection

INTRODUCTION

Urinary tract infections (UTIs) are one of the most frequent microbial diseases encountered in medical practice affecting people of all ages [1]. Worldwide, UTIs' prevalence was evaluated to be around 150 million persons per year viz., 21.8% [2]. According to the forgoing analysis of UTI study/pattern, it is perceived that infection of the urinary tract is more common among women due to shorter urethra and hormonal changes compared to men [3]. Indication from Large global surveys conveys that the nature of UTI pathogens varies between the community and hospital setting [4]. On comparing the studies overseas, data on UTIs and quality of life in Europe are limited. The prevalence of UTI increases with age, and in women aged over 65 is approximately double the rate seen in the female population overall [5].

UTIs refer to the appearance of microbial pathogens within the urinary tract. It is classified as cystitis (at bladder), pyelonephritis (kidney) or bacteriuria (urine) based on the site of infection. They are asymptomatic or symptomatic [6]. Many different microorganisms that cause UTI's are categorised as [7]: gram positive bacteria (Enterococcus faecalis, staphylococcus saprophyticus, and staphylococcus agalactiae) , gram negative bacteria (E.Coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus merabellus) and fungus (candida albicans) [8].

For the simplification, threshold-based assessment, a standardized scheme has been introduced in which the degree of drug effectiveness is characterized as "susceptible," "intermediate," or "resistant," depending on the MIC value. According to the ISO 20776-1 standard [7,8], these terms are defined as follows:

"Susceptible (S): A bacterial strain is said to be susceptible to a given antibiotic when it is inhibited in vitro by a concentration of this drug that is associated with a high likelihood of therapeutic success."

"Intermediate (I): The sensitivity of a bacterial strain to a given antibiotic is said to be intermediate when it is inhibited in vitro by a concentration of this drug that is associated with an uncertain therapeutic effect."

"Resistant (R): A bacterial strain is said to be resistant to a given antibiotic when it is inhibited in vitro by a concentration of this drug that is associated with a high likelihood of therapeutic failure." [9-13]

Antimicrobial agents are classified based on proposed mechanism of action as follows: agents that inhibit synthesis of bacterial cell walls like imipenam, including the b-lactam class and other agents such as vancomycin; agents that act directly on the cell membrane to increase permeability and cause leakage of intracellular compounds; agents that disrupt function of ribosomal subunits to reversibly inhibit protein synthesis (e.g., chloramphenicol, the tetracyclines, erythromycin, and clindamycin); agents that bind to the 30S ribosomal subunit and alter protein synthesis (e.g., the aminoglycosides); agents that affect bacterial nucleic acid metabolism by inhibiting RNA polymerase (e.g., rifampin) or topoisomerase (e.g., the quinolones); the antimetabolites, including trimethoprim and the sulfonamides, which block essential enzymes of folate metabolism [14-16]. The only antibiotic tested with an overall resistance rate below 10 % was Imipenem. Resistance rates of all antibiotics tested other than imipenem against the total bacterial spectrum were higher than 10 % in all regions. Resistance to almost all pathogens was lowest in North Europe, and there is no single year where an outbreak of resistance has been detected [17]. The objective of the study was the hospital specific monitoring studies to determine the prevalence of the type of microorganisms that causes urinary infections and to assess the antimicrobial sensitivity pattern and to improve the empirical therapy of UTI's which depend on the expectedness of the agents causing UTI, knowledge of their resistance patterns and to help authorities to formulate antibiotic prescription policies.

METHODOLOGY

A hospital based short term prospective cross-sectional study was conducted at Sagar clean-catch midstreamurine samples from patients diagnosed clinically to be having UTI on the basis of symptoms were inoculated for 24 hours onto plates of various growth media such as Mc conkey agar plates and blood agar, etc. which was incubated at 35°C-37°C. Out of which 64 samples showed growth suggestive of significant bacteria, with colony count >105cfu/ml. other 194 samples showed no growth and were tested negative. In 64 samples, 41 samples from Non-ICU and 23 from ICU.

Each bacterial organism grows into a cluster called colony and individual colonies are isolated/inoculated onto new separate media creating pure samples [18]. The cultured bacteria is identified based on their characteristics of colony growth and appearance as well as biochemical testing (gram stain) of the individual colonies.

Further the antimicrobial susceptibility testing is done by VITEK-2 System which uses plastic reagent cards that contain microliter quantities of antibiotics and test media in a 64 well format. Each well contains individual test substrates. Substrates measure various metabolic activities such as acidification, alkalization, enzyme hydrolysis and growth in the presence of inhibitory substances. Identification card is chosen according to the results obtained from biochemical testing. Antibiotic sensitivity card is selected accordingly

Table 1: Results from biochemical testing determines the selection of the Identification card

Identification	VITEK-2 Card
Gram negative bacilli GNB	GN Card
Gram positive coco GPC	GP Card
Yeast	YST Card
Anaerobes and cornebacteria	ANC Card
Neisseria and haemoplilus	NH Card
Gram positive bacilli	BCL Card

Table 2: Antibiotic sensitivity card is selected accordingly

GNB	AST N280 Card (for lf colonies)
	AST N281 Card (for NLF colonies)
GPC	AST GP628 Card(for staphylococcus spp and enterococcus spp)
	AST ST01 Card (streptococcus spp)
YST	AST YS07 (for yeast AST)

Further, cards are inoculated with microorganism suspension and placed into special rack (cassette). The transfer tube is inserted into the corresponding suspension tube. The filled cassette is placed manually or automatically into vacuum chambers station. After the vacuum is applied and air is reintroduced into station , the org suspension is forced through the transfer tube into micro channels that fill all the test wells. Card is incubated on-line at 35.50C (+/-10C). Each card is removed from the carousel incubator once every 15mins and transported to optical system for reaction readings and then returned to the incubator until the next read time. During incubation, each test reaction is read every15mins to measure turbidity, colored products of substrate metabolism. Test reaction is then read and targeted therapy is given.

RESULTS

Over a 3 months period, a total number of 260 urine culture test of the suspected in-patient for urinary tract infection was done. Out of which 66 urine culture tests showed culture positive, 41 from non-ICU and 23 from ICU. Gram-negative bacilli E.Coli (61% in ICU, 52% IN non-ICU) was the most prevalent bacterium, followed by Klebsiella pneumoniae ss. pneumoniae (9% in ICU, 20% IN non-ICU), and Candida albicans 9% prevalence was seen only in ICU isolates. The study shows that the rate of resistance towards ampicillin (100%) was high among gram negative isolates and penicillin (100%) among gram positive isolates. The susceptibility was favorable towards polymyxin B, colistin in gram negative organisms and nitrofurantoin, vancomycin in gram positive organisms.

Table 3: ICU Data projecting number of isolates of organisms showing resistance and sensitivity percentage

ORGANISMS	NO OF ICU ISOLATES	RESISTANCE	INTERMEDIATE	SENSITIVITY
Candida albicans	2	Caspofungin (0%)	Nil	Amphotericin b (100%)
E.Coli	14	Ciprofloxacin (94.1%)	Amoxicillin (17.6%)	Colistin (100%)
Enterococcus faecalis	2	Penicillin (100%)	Ciprofloxacin (0%)	Levofloxacin (100%)
Klebsiella pneumoniae	2	Ampicillin (88.2%)	Imipenem (20%)	Colistin (100%)
Proteus mirabilis	1	Ciprofloxacin (94.1%)	Amoxicillin/clavulanic acid (17.6%)	Amikacin (76.5%)
Pseudomonas aeruginosa	2	Ciprofloxacin (94.1%)	Ciprofloxacin (5.9%)	Cefoperazone/salbactam (20%)

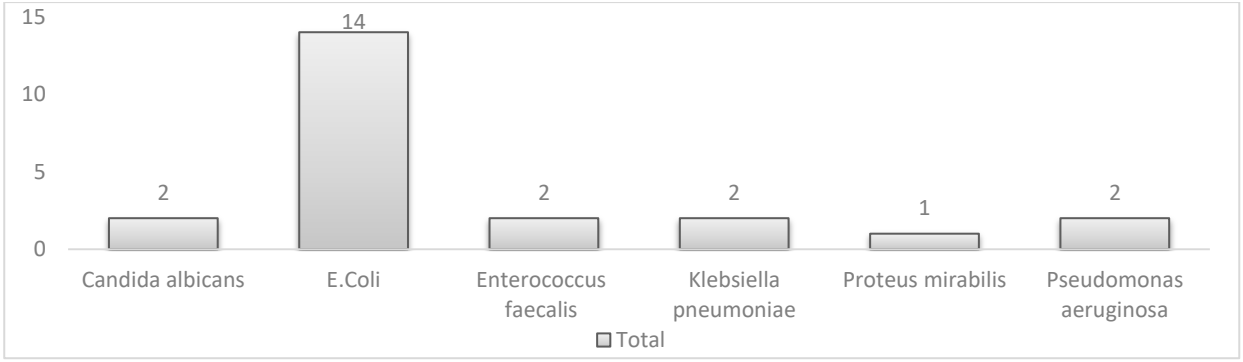

Figure 1: Number of Isolated Organism In ICU

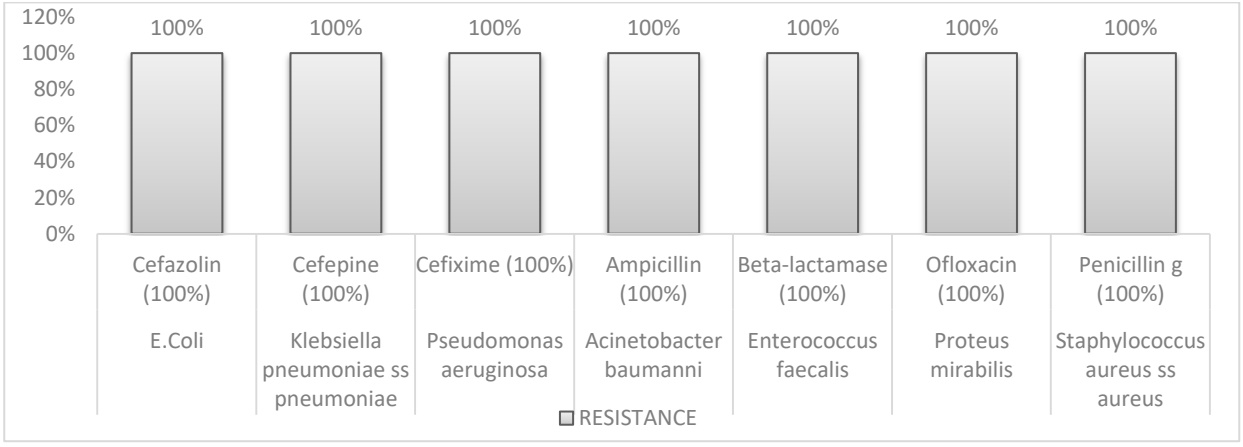

Figure 2: Resistance Pattern in ICU Data

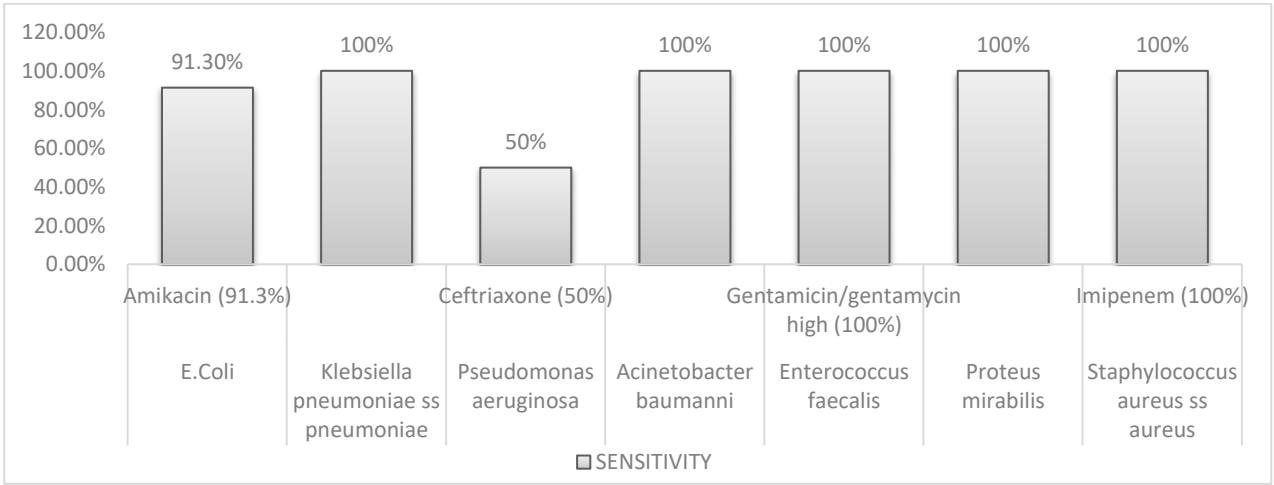

Figure 3: Sensitivity Pattern In ICU Data

Table 4: Non-ICU Data projecting number of isolates of organisms showing resistance and sensitivity percentage

ORGANISMS	NO OF Non-ICU Isolates	RESISTANCE	INTERMEDIATE	SENSITIVITY
E. Coli	23	Cefazolin (100%)	Nitrofurantoin (27.3%)	Amikacin (91.3%)
Klebsiella pneumoniae ss pneumoniae	9	Cefepine (100%)	Meropenem (8.7%)	Levofloxacin (100%)
Pseudomonas aeruginosa	3	Cefixime (100%)	Ceftriaxone (50%)	Ceftriaxone (50%)
Acinetobacter baumanni	2	Ampicillin (100%)	Cefepime (0%)	Doripenem (100%)
Enterococcus faecalis	2	Beta-lactamase (100%)	Ampicillin (0%)	Gentamicin/gentamycin high (100%)
Proteus mirabilis	2	Ofloxacin (100%)	Piperacillin/tazobactum (17.4%)	Colistin (100%)
Staphylococcus aureus ss aureus	2	Penicillin g (100%)	Cofoxitin (0%)	Imipenem (100%)

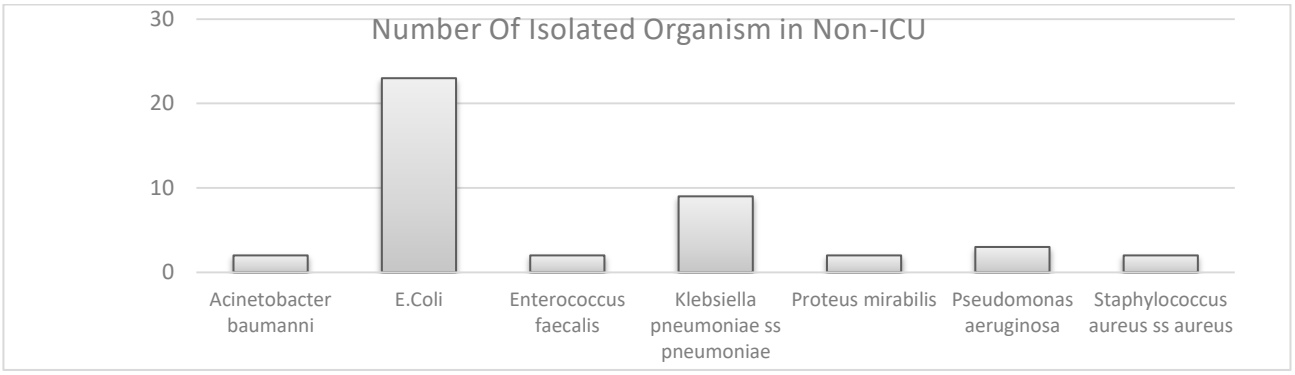

Figure 4: Number of Isolated Organism In Non-ICU Data

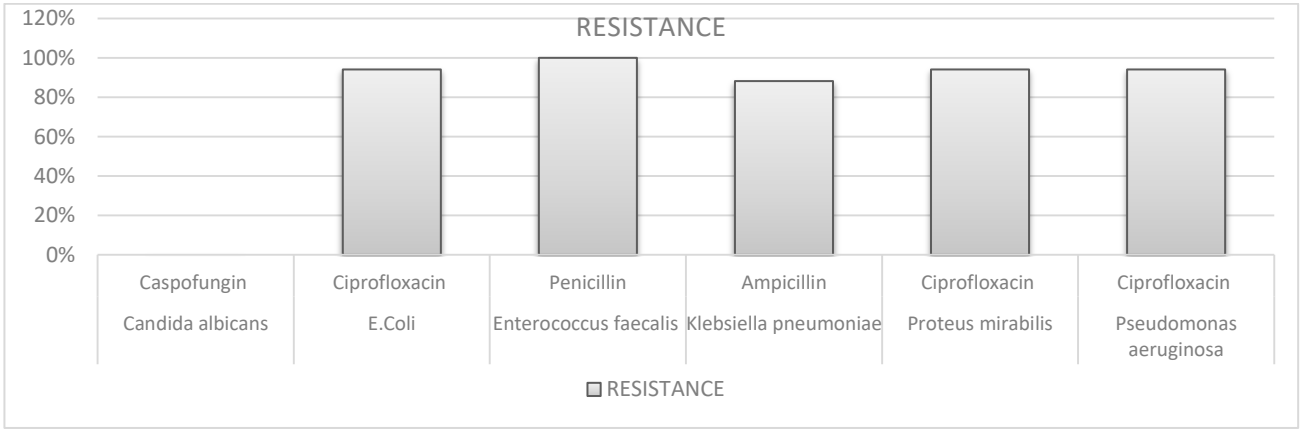

Figure 5: Resistance Pattern in Non-ICU Data

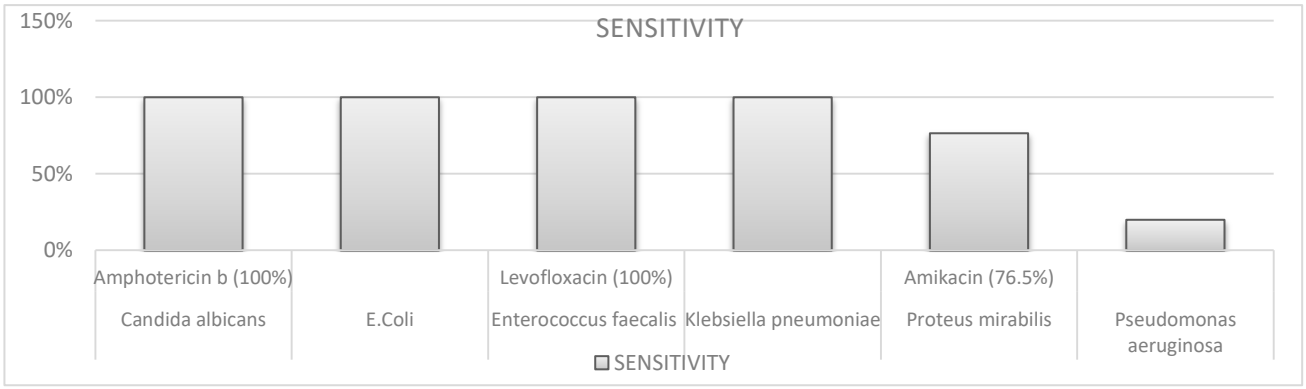

Figure 6: Sensitivity Pattern in Non-ICU Data

CONCLUSION

Short term surveys of this nature will give a clear idea about the bacteriologic profile in a given hospital as well as their antibiotic sensitivity profile. This study will act as a support to commence empirical antibiotic treatment in patients with urinary infections. These data suggest that effective utilization of prophylaxis has the potential to ease the burden of UTIs on both individual patients and society.

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CONFLICTS OF INTEREST

Authors declare that there are no conflicts of interest in relation to the publication on this manuscript.

REFERENCES

1. Kunin CM. Chemoprophylaxis and suppressive therapy in the management of urinary tract infections. Journal of Antimicrobial Chemotherapy. 1994 May 1; 33(suppl_A):51-62. https://doi.org/10.1093/jac/33.suppl_A.51

2. Gupta K, Sahm DF, Mayfield D, Stamm WE. Antimicrobial resistance among uropathogens that cause community-acquired urinary tract infections in women: a nationwide analysis. Clinical infectious diseases. 2001 Jul 1; 33(1):89-94. https://doi.org/10.1086/320880

3. Nickel JC. Practical management of recurrent urinary tract infections in premenopausal women. Rev Urol. 2005 Winter; 7(1):11-7. PMID: 16985802; PMCID: PMC1477561.

4. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. Therapeutic advances in urology. 2019 Mar; 11:1756287219832172. https://doi.org/10.1177/1756287219832172

5. Rosen DA, Hooton TM, Stamm WE, Humphrey PA, Hultgren SJ. Detection of intracellular bacterial communities in human urinary tract infection. PLoS Med. 2007 Dec 18; 4(12):e329. https://doi.org/10.1371/journal.pmed.0040329

6. Nerurkar A, Solanky P, Naik SS. Bacterial pathogens in urinary tract infection and antibiotic susceptibility pattern. Journal of Pharmaceutical and Biomedical Sciences. 2012; 21(21). https://doi.org/10.4314/ejhs.v21i2.69055

7. Iso.org. 2021. Susceptibility testing of infectious agents and evaluation of performance of antimicrobial susceptibility test devices — Part 1: Broth micro-dilution reference method for testing the in vitro activity of antimicrobial agents against rapidly growing aerobic bacteria involved in infectious diseases. [online] Available at: <https://www.iso.org/obp/ui/#iso:std:iso:20776:-1:ed-2:v2:en> [Accessed 10 August 2021].

8. Skow MA, Vik I, Høye S. Antibiotic switch after treatment with UTI antibiotics in male patients. Infectious Diseases. 2020 Jun 2; 52(6):405-12. https://doi.org/10.1080/23744235.2020.1736329

9. Wang G, Hindler JF, Ward KW, Bruckner DA. Increased vancomycin MICs for Staphylococcus aureus clinical isolates from a university hospital during a 5-year period. Journal of clinical microbiology. 2006 Nov; 44(11):3883-6. https://doi.org/10.1128/JCM.01388-06

10. Rodloff A, Bauer T, Ewig S, Kujath P, Müller E. Susceptible, intermediate, and resistant–the intensity of antibiotic action. Deutsches Ärzteblatt International. 2008 Sep; 105(39):657-662. https://dx.doi.org/10.3238%2Farztebl.2008.0657

11. Beardsley JR, Williamson JC, Johnson JW, Ohl CA, Karchmer TB, Bowton DL. Using local microbiologic data to develop institution-specific guidelines for the treatment of hospital-acquired pneumonia. Chest. 2006 Sep 1; 130(3):787-93. https://doi.org/10.1378/chest.130.3.787

12. Kiem S, Schentag JJ. Relationship of minimal inhibitory concentration and bactericidal activity to efficacy of antibiotics for treatment of ventilator-associated pneumonia. InSeminars in respiratory and critical care medicine 2006 Feb (Vol. 27, No. 01, pp. 051-067). Copyright© 2006 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. https://doi.org/10.1055/s-2006-933674

13. O'Rourke A, Beyhan S, Choi Y, Morales P, Chan AP, Espinoza JL, Dupont CL, Meyer KJ, Spoering A, Lewis K, Nierman WC. Mechanism-of-Action Classification of Antibiotics by Global Transcriptome Profiling. Antimicrobial Agents and Chemotherapy. 2020 Feb 21; 64(3). https://doi.org/10.1128/AAC.01207-19

14. Bush K, Jacoby GA. Updated functional classification of β-lactamases. Antimicrobial agents and chemotherapy. 2010 Mar; 54(3):969-76. https://doi.org/10.1128/AAC.01009-09

15. Gumbo T. Chapter 48: general principles of antimicrobial therapy. Goodman & Gilman's the pharmacological basis of therapeutics. 12th ed. New York: McGraw-Hill Medical. 2010.

16. Tandogdu Z, Cek M, Wagenlehner F, Naber K, Tenke P, van Ostrum E, Johansen TB. Resistance patterns of nosocomial urinary tract infections in urology departments: 8-year results of the global prevalence of infections in urology study. World journal of urology. 2014 Jun; 32(3):791-801. https://doi.org/10.1007/s00345-013-1154-8

17. Wilson ML, Gaido L. Laboratory diagnosis of urinary tract infections in adult patients. Clinical infectious diseases. 2004 Apr 15; 38(8):1150-8. https://doi.org/10.1086/383029

18. Mandal J, Acharya NS, Buddhapriya D, Parija SC. Antibiotic resistance pattern among common bacterial uropathogens with a special reference to ciprofloxacin resistant Escherichia coli. Indian J Med Res. 2012 Nov; 136(5):842-9. PMID: 23287133; PMCID: PMC3573607.