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RESEARCH ARTICLE

ANTIMICROBIAL SENSITIVITY PATTERN OF ESCHERICHIA COLI ISOLATES FROM VARIOUS CLINICAL SAMPLES IN A TERTIARY CARE HOSPITAL

Anupama S. Wyawahare¹, Jyotsna K Mishra² and Manjushree V. Mulay³

1. Professor Microbiology Department.
2. Assistant Professor Microbiology Department.
3. Professor and Head, Microbiology Department.

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Abstract

E Coli is the most commonly encountered human pathogen which has been associated with various clinical manifestations. Analyzing resistance pattern of Escherichia coli to commonly prescribed antibiotics helps to decide empirical therapy. The study was conducted from January 2015 to December 2018. Total of 2135 E coli isolates were recovered from various clinical specimens. In our study antimicrobial susceptibility pattern of 1925 E coli isolates was studied. Maximum no of E coli were isolated from urine 867 [40.60%] followed by skin & soft tissue specimens 691 [32.36%], stool specimens 179 [8.38%], Respiratory Tract specimens 129 [6.04%], and blood 59 [2.76%]. Out of 867 E coli isolates from urine specimens maximum susceptibility was found against Fosfomycin 806 [92.96%] followed by Amikacin 753 [86.85%], Ertapenem 702 [80.96%], Gentamicin 563 [64.93%] and Nitrofurantoin 518 [59.74%]. Most isolates of E coli from UTI, SSTI, RTI, BSI are susceptible to Carbapenems, Amikacin and Cefoperazone/Sulbactam. Increasing resistance to oral antimicrobial agents is a serious issue. Improved facilities for microbiology laboratories and judicious use of antimicrobial agents is need of the hour.

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Introduction:-

E Coli is the most commonly encountered human pathogen which has been associated with various clinical manifestations like UTI, diarrhea, abdominal infections, pneumonia, meningitis, wound and soft tissue infections, bacteremia etc¹. There are reports from different regions of India and other countries on antimicrobial sensitivity pattern of E coli isolated from various clinical samples like urine^{2,3,4,5}, skin and soft tissue infections⁶, stool^{7,8}, sputum⁹, blood¹⁰. The prevalence of ESBL producing E coli is increasing and resistance to E coli varies in different geographical regions¹¹. Analyzing resistance pattern of Escherichia coli to commonly prescribed antibiotics in the clinical practice is essential and helpful in improving the efficacy of empirical treatment. With this background present study was carried out to study antimicrobial sensitivity pattern of Escherichia coli isolates from various clinical samples in our hospital.

Corresponding Author:- Anupama s. Wyawahare

Address:- Professor, Microbiology Department, MGM Medical College, Auranagabd [Maharashtra].

Material and Methods:-

This cross sectional study was carried out after approval of institutional ethical committee. The study was conducted from January 2015 to December 2018. All *E. coli* isolates from various clinical samples like skin and soft tissue, urine, respiratory tract specimens, stool and blood isolated during study period were included in the study. Repeat isolates from same patient and specimen were excluded.

All clinical samples received in the microbiology department were inoculated on blood agar & MacConkey agar. After overnight incubation at 37 °C colony morphology was observed. *E. coli* produce Circular, grey, moist colonies with or without hemolysis on blood agar and lactose fermenting flat colonies on MacConkey agar. Smear was prepared from pure colonies and stained by Gram stain^{1,12}, inoculum was prepared as per manufacturer's instructions and *E. coli* isolates were identified in Vitek 2 compact system using ID Card and AST card of Biomerieux Co¹³. Antimicrobial susceptibility pattern against following antimicrobial agents was studied.

Sample	Name of antimicrobial agents
Urinary isolates	Ampicillin, Amoxycillin-Clavulanic Acid, Amikacin, Ciprofloxacin, Cefalotin, Cefixime, Cefoxitin, Ceftriaxone, Ertapenem, Fosfomycin, Gentamicin, Meropenem, Nalidixic Acid, Nitrofurantoin, Norfloxacin, Ofloxacin, Piperacillin-Tazobactam, Trimethoprim Sulfamethoxazole
All Other isolates	Ampicillin, Amoxycillin-Clavulanic Acid, Amikacin, Ciprofloxacin, Ceftriaxone, Cefuroxime, Cefepime, Cefoperazone-Sulbactam, Ertapenem, Gentamicin, Imipenem, Meropenem, Piperacillin-Tazobactam, Trimethoprim Sulfamethoxazole

Total of 2135 *E. coli* isolates were recovered from various clinical specimens. Out of 2135 isolates; antimicrobial susceptibility pattern of 1925 isolates which were recovered from specimens like skin & soft tissue, urine, respiratory tract specimens, stool and blood was studied.

Result:-

Total of 2135 *E. coli* isolates were recovered from various clinical specimens. Antimicrobial susceptibility pattern of total 1925 isolates was studied. Out of 2135 isolates maximum isolates [70.02%] were from IPD followed by [16.01%] from ICU and [13.95%] from OPD area.

Maximum no of *E. coli* were isolated from urine 867 [40.60%] followed by skin & soft tissue specimens 691 [32.36%], stool specimens 179 [8.38%], Respiratory Tract specimens 129 [6.04%], and blood 59 [2.76%]. Total 210 [9.83%] *E. coli* isolates were from other specimens which include various body fluids, bile, ear swab etc. Due to insignificant no of isolates from each of the other specimens antimicrobial susceptibility pattern of these *E. coli* isolates is not studied.

Table No 1:- Antimicrobial susceptibility pattern of *E. coli* isolates from urine specimens [N=867].

Name Of Antimicrobial Agent	No Of S Isolates [%]	No Of R Isolates [%]
Ampicillin	78 [11.28]	789 [91.0]
Amoxycillin-Clavulanic Acid	276 [31.83]	591 [68.16]
Amikacin	753 [86.85]	114 [13.14]
Ciprofloxacin	178 [20.53]	689 [79.46]
Cefalotin	80 [9.22]	787 [90.77]
Cefixime	126 [14.53]	741 [85.46]
Cefoxitin	435 [50.17]	432 [49.82]
Ceftriaxone	151 [17.41]	716 [82.58]
Ertapenem	702 [80.96]	165 [19.03]
Fosfomycin	806 [92.96]	61 [7.03]
Gentamicin	563 [64.93]	304 [35.06]
Meropenem	80 [9.22]	787 [90.77]
Nitrofurantoin	518 [59.74]	349 [40.25]
Nalidixic Acid	175 [20.18]	692 [79.81]
Norfloxacin	171 [19.72]	696 [80.27]
Ofloxacin	163 [18.80]	704 [81.19]
Piperacillin-Tazobactam	440 [50.74]	427 [49.25]

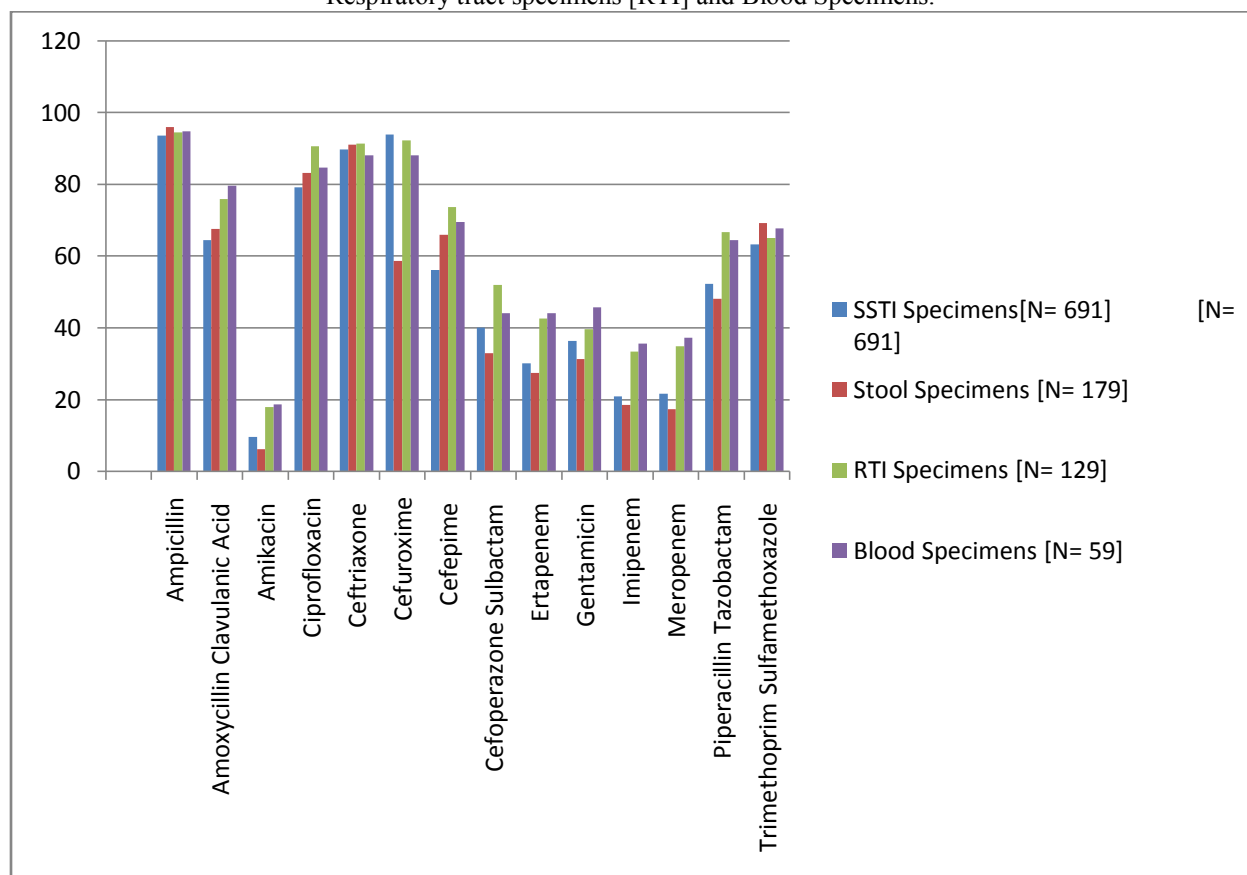
Trimethoprim Sulfamethoxazole	331[38.17]	536[61.82]
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Out of 867 E coli isolates from urine specimens maximum susceptibility was found against Fosfomycin 806 [92.96 %] followed by Amikacin 753 [86.85 %], Ertapenem 702[80.96%], Gentamicin 563[64.93 %] and Nitrofurantoin 518[59.74%] Refer to Table No 1

Table No 2:- Antimicrobial susceptibility pattern of E coli isolates from Skin & soft tissue [SSTI], Stool, Respiratory tract specimens [RTI] and Blood Specimens.

Name Of Antimicrobial Agent	SSTI Specimens [N= 691]		Stool Specimens [N= 179]		RTI Specimens [N= 129]		Blood Specimens [N= 59]	
	No Of S Isolate S [%]	No Of R Isolates [%]	No Of S Isolate S [%]	No Of R Isolates [%]	No Of S Isolate [%]	No Of R Isolates [%]	No Of S Isolates [%]	No Of R Isolates [%]
Ampicillin	44 [6.36]	647 [93.63]	7 [3.91]	172 [96.08]	7 [5.42]	122 [94.57]	3 [5.08]	56 [94.91]
AmoxycillinClavulanic Acid	245 [35.45]	446 [64.54]	58 [32.40]	121 [67.59]	31 [24.03]	98 [75.96]	12 [20.33]	47 [79.66]
Amikacin	625 [90.44]	66 [9.55]	168 [93.85]	11 [6.14]	106 [82.17]	23 [17.82]	48 [81.35]	11 [18.64]
Ciprofloxacin	144 [20.83]	547 [79.16]	30 [16.75]	149 [83.24]	12 [9.30]	117 [90.69]	9 [15.25]	50 [84.74]
Ceftriaxone	75 [10.85]	616 [89.14]	16 [8.93]	163 [91.06]	11 [8.52]	118 [91.47]	7 [11.86]	52 [88.13]
Cefuroxime	42 [6.07]	649 [93.92]	74 [41.34]	105 [58.65]	10 [7.75]	119 [92.24]	7 [11.86]	52 [88.13]
Cefepime	303 [43.84]	388 [56.15]	61 [34.07]	118 [65.92]	34 [26.35]	95 [73.64]	18 [30.50]	41 [69.49]
CefoperazoneSulbactam	414 [59.91]	277 [40.08]	120 [67.03]	59 [32.96]	62 [48.06]	67 [51.93]	33 [55.93]	26 [44.06]
Ertapenem	483 [69.89]	208 [30.10]	130 [72.62]	49 [27.37]	74 [57.36]	55 [42.63]	33 [55.93]	26 [44.06]
Gentamicin	440 [63.67]	251 [36.32]	123 [68.71]	56 [31.28]	78 [60.46]	51 [39.53]	32 [54.23]	27 [45.76]
Imipenem	547 [79.16]	144 [20.83]	146 [81.56]	33 [18.43]	86 [66.66]	43 [33.33]	38 [64.40]	21 [35.59]
Meropenem	542 [78.43]	149 [21.56]	148 [82.68]	31 [17.31]	84 [65.11]	45 [34.88]	37 [62.71]	22 [37.28]
PiperacillinTazobactam	330 [47.75]	361 [52.24]	92 [51.39]	87 [48.60]	43 [33.33]	86 [66.66]	21 [35.59]	38 [64.40]
Trimethoprim Sulfamethoxazole	254 [36.75]	437 [63.24]	55 [30.72]	124 [69.27]	45 [34.88]	84 [65.11]	19 [32.20]	40 [67.79]

Figure No 3:- Antimicrobial susceptibility pattern of E coli isolates from Skin & soft tissue [SSTI], Stool, Respiratory tract specimens [RTI] and Blood Specimens.



Out of 691 isolates from SSTI ; 689 [99.71%] were susceptible to Amikacin 625 [90.44 %] followed by Imipenem 547[79.16%] Meropenem 542 [78.43 %], Cefoperazone-Sulbactam 414[59.91] and maximum resistance was seen against Cefuroxime 649[93.92%] Ampicillin 647 [93.63%] Ceftriaxone 616 [89.74%] Ciprofloxacin 547 [79.16 %] Trimethoprim Sulfamethoxazole 437 [63.24 %] cefepime 388 [56.15%] Piperacillin tazobactam 361 [52.24%].

Out of 179 isolates from stool specimens; 168 [93.85%] were susceptible to Amikacin Followed By Meropenem 148 [82.68%], Imipenem 146 [81.56%], Ertapenem 702 [80.96%] Cefoperazone Sulbactam 414 [59.91%] Most of the isolate were resistant to Ampicillin 172 [96.08%] followed by Ceftriaxone 163 [91.06%]

Out of 129 isolates from respiratory tract specimens like sputum, bronchoalveolar lavage etc maximum susceptibility was found against Amikacin 106 [82.17%] Followed By Imipenem 86 [66.66%], Meropenem 84 [65.11%], Gentamicin 78 [60.46%], Cefoperazone Sulbactam 67 [48.06%] and out of 59 isolates from blood majority of isolates were susceptible to Amikacin 48 [81.35%] followed By Imipenem 38 [64.40%], Meropenem 37 [62.71 %], Cefoperazone Sulbactam 33 [55.93%] and Ertapenem 33 [55.93%]. Refer to Table No 2

Discussion:-

E Coli is the most commonly isolated human pathogen which has been associated with various clinical manifestations in man. Emergence of resistant organisms is ultimately increasing economic burden by increasing hospital stay of the patient. In present study, we tried to understand antimicrobial susceptibility pattern of E coli in our institute in order to suggest empiric therapy for infections due to E coli. In present study among urinary isolates highest susceptibility was found against Fosfomycin 806 [92.96 %] followed by Amikacin 753 [86.85 %], Ertapenem 702 [80.96%], Gentamicin 563 [64.93%] and Nitrofurantoin 518 [59.74%] The isolates showed high level of resistance to Ampicillin 789 [91.0%], followed by Meropenem 787 [90.77%] Cefalotin 787 [90.77%], Cefixime 741 [85.46%] Ceftriaxone 716 [82.58%], Ofloxacin 704 [81.19%] Norfloxacin 696 [80.27%]. Similar

resistance pattern was observed by Kulkarni et al. However in their study ; E coli showed comparative good susceptibility against to Imipenem (96.71%), Nitrofurantoin (92.41%), Amikacin (90.89%), , Piperacillin&Tazobactam (80.76%), They reported that out Of the total 395 E. coli isolates, 170 (43%) were MDR. The isolates showed high level of resistance to Ampicillin (82.53%), Cefuroxime (72.41%), Amoxicillin&Clavulanic acid (71.90%), Ceftriaxone (66.58%), Ciprofloxacin (65.82%), and Cefepime (57.47%)⁴

In our study drug resistance may be due to overuse & misuse of antibiotics. Susceptibility to commonly used agents like Nitrofurantoin 349 [40.25%] and Piperacillin-tazobactam 427 [49.25%] is very less and it is quite alarming situation with very few options left for treatment of urinary tract infection.

In present study Out of 691 isolates from SSTI ; majority of isolates were susceptible to Amikacin 625 [90.44 %] followed by Imipenem 547 [79.16%] Meropenem 542 [78.43 %], Cefoperazone-Sulbactam 414 [59.91%] and maximum resistance was seen against Cefuroxime 649 [93.92%] Ampicillin 647 [93.63%] Ceftriaxone 616 [89.74%], Ciprofloxacin 547 [79.16%], Trimethoprim-Sulfamethoxazole 437 [63.24%], Cefepime 388 [56.15%] Piperacillin-Tazobactam 361 [52.24%]

In a study on SSTI ; Zarrin Afroz et al observed that out of 38 isolates of E. coli from SSTI most of the isolates 34 (89.4%) showed resistance to Ampicillin, Cefuroxime, Cephalexin & Ceftriaxone and least resistance was found against Imipenem (2.63%)¹⁴. Our results are almost similar to this study however we found decrease in susceptibility to Imipenem over the years.

In developing countries *Escherichia coli* is identified as an important cause of paediatric diarrhea. We observed that out of 179 isolates from stool specimens; 168 [93.85%] were susceptible to Amikacin Followed By Meropenem 148 [82.68%], Imipenem 146 [81.56%], Ertapenem 702 [80.96%] Gentamicin 123 [68.71%] Cefoperazone- Sulbactam 414 [59.91%] Most of the isolate were resistant to Ampicillin 172 [96.08%] followed by resistance to Ceftriaxone 163 [91.06%] Our findings are in alignment with a study by Natarajan et al.

In a study on diarrhoeagenic *Escherichia coli* [DEC] isolates they reported that E Coli exhibited resistance for Ceftriaxone 33 (49.2%) Followed By Co Trimoxazole 29 (43.2%), Tetracycline 24 (35.8%), Levofloxacin 22 (32.8%), Ciprofloxacin 20 (29.8%), Ceftazidime 18 (26.2%), Gentamicin 13 (19.4%), Chloramphenicol 9 (13.4%), Amikacin 5 (7.4%), And Cefoperazone-Sulbactam 5 (7.4%)⁸.

In a study by Ashis Kumar Saha & his colleagues on antimicrobial susceptibility of sputum samples highest susceptibility of E coli reported to Carbapenem group (72.91% -- 85.41%) followed by Tigecycline (70.83%), Polymixin B (68.75%), Colistin (64.58%), Chloramphenicol and Amikacin (62.4%), Netilmicin (60.41%), but only 41.66% to Piperacillin-tazobactam.⁹ In Our study out of 129 isolates from respiratory tract specimens like sputum, bronchoalveolar lavage etc maximum susceptibility was found against Amikacin 106 [82.17%] followed By Imipenem 86 [66.66%], Meropenem 84 [65.11%], Gentamicin 78 [60.46%], Cefoperazone Sulbactam 67 [48.06%]

Blood stream infections vary from minor infections to life-threatening sepsis and cause a significant public health problem. Treatment of Blood stream infections is becoming difficult due to the increasing trend of antibiotic resistance. In present study Out of 59 isolates from blood majority of isolates were susceptible to Amikacin 48 [81.35%] followed By Imipenem 38 [64.40%], Meropenem 37 [62.71%], Cefoperazone Sulbactam 33 [55.93%] and Ertapenem 33 [55.93%]

ESBL production is most common mechanism of acquiring drug resistance in E coli and ESBL strains have been associated with resistance to other non β -lactam antibiotics like the aminoglycosides¹¹. Most of the patient by the time they reach tertiary care hospital receive broad spectrum antibiotics and usually treatment is given without performing culture & sensitivity. From our study it is evident that most of the E coli isolates are from IPD & ICU areas and antimicrobial agents of choice for empirical therapy are very few. Most isolates from UTI, SSTI, RTI, BSI are susceptible to Carbapenems, Amikacin and Cefoperazone Sulbactam and Nitrofurantoin can be used against Urinary isolates. In Indian scenario microbiology laboratories are not available except in some large hospitals and few private settings. This applies particularly to rural areas where injudicious use of antibiotic is common. Thus, we recommend that antimicrobial susceptibility testing should be made mandatory before giving higher antibiotics in tertiary care and all laboratories must have facility for performing culture and sensitivity.

Conclusion:-

This study provides data on antimicrobial susceptibility pattern of E coli from various clinical samples. In present most of the E coli isolates are from IPD & ICU areas. Usually culture sensitivity of samples is not advised for OPD patients most of the times due to financial constraint. In our study most isolates of E coli from UTI, SSTI, RTI, BSI are susceptible to Carbapenems, Amikacin and Cefoperazone-Sulbactam. Nitrofurantoin can still be suggested against Urinary isolates. Increasing resistance to oral antimicrobial agents is a serious issue. Improved facilities for microbiology laboratories and judicious use of antimicrobial agents is need of the hour.

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Conflicts Of Interest:

There are no conflicts of interest.

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