

# Emergence of Extended Spectrum $\beta$ -lactamases producing *Escherichia coli* among urinary tract infected patients from tertiary hospital in Nepal

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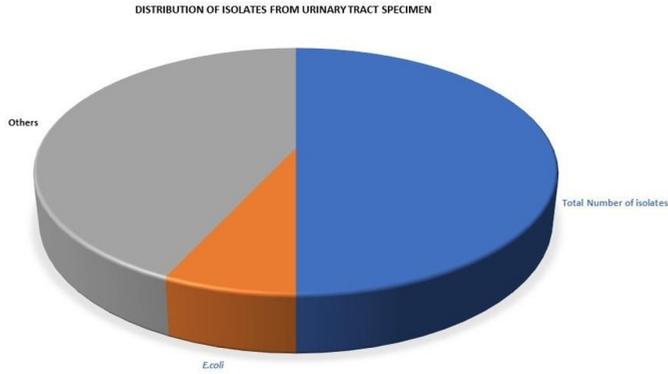
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**Abstract** *Escherichia coli*, a growing health concern, produces extended spectrum  $\beta$ -lactamases (ESBL), which are causing public health onset infections in multiple countries. Geographical variations in the distribution and prevalence of ESBL-synthesizing *E. coli* have been observed, with India reporting the largest proportion (61%). The worldwide dissemination of ESBL-producing bacteria, along with the restricted availability of effective treatments, could exacerbate antibiotic resistance. The identification of ESBL synthesizing *E. coli* is crucial for its characterisation and epidemiology in specific geographical regions. In Nepal, a developing nation, research shows a high prevalence of antibiotic-resistant bacteria, particularly the ESBL strain. Our study aimed to identify ESBL-producing *E. coli* from patients with urinary tract complications from a tertiary hospital in Nepal. Out of 125 *E. coli* isolates, 15.6% were female and 1.2% male. The highest resistance was detected for ampicillin, ceftazolin, cefotaxime, and ceftazidime, while less resistance was observed against nitrofurantoin, gentamicin, and imipenem. The study found that 51 (40.8%) *E. coli* isolates produced ESBLs, indicating a higher level of ESBL production among urinary tract infection patients.

**Keywords:** *Escherichia coli*, ESBL, AMR, Urinary tract infection

*Escherichia coli* that produces extended spectrum  $\beta$ -lactamases (ESBL) is widely acknowledged as a growing health concern to public health. The global incidence of ESBL synthesizing *E. coli* is on the rise, and public health onset infections caused by these bacteria are a significant clinical issue in multiple countries [1]. Geographical variations in the distribution and prevalence of ESBL-synthesizing *E. coli* have been observed, with the largest proportion (61%) reported in multicentre research conducted in India [2]. The worldwide dissemination of *E. coli* strains that produce ESBL enzymes, along with the restricted availability of effective treatments for these bacteria, is a worrisome issue that could exacerbate the current problem of antibiotic resistance [3]. The identification of ESBL synthesizing *E. coli* is crucial for its characterisation and also role in epidemiology is important in a particular geographical region. ESBL producing bacteria especially from Enterobacteriaceae family has been classified as a critical priority pathogen by the World Health Organisation for the purpose of researching and developing novel antibiotics. This is because these bacteria have become resistant to the main types of antibiotics [4]. Nepal is a developing nation located in Southeast Asia and research has shown a high prevalence of antibiotic-resistant bacteria, particularly the ESBL strain in different settings [3]. Further the increasing trends of ESBL and carbapenem resistant bacterial pathogens has been notice in Nepal also [5]. Thus, this study is aimed to identify the ESBL producing *E. coli* from patients having urinary tract complications from tertiary hospital in Nepal.

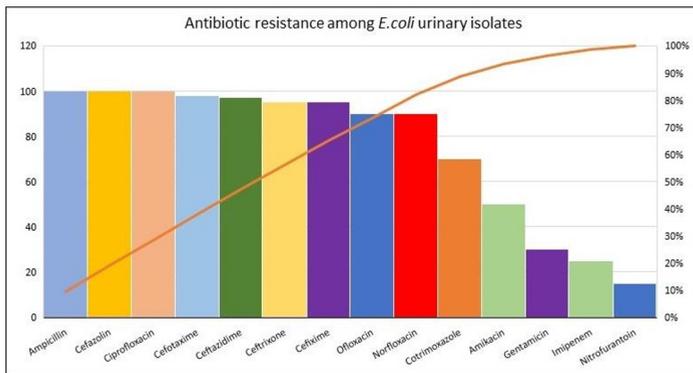
Nine hundred urine samples were received from different department of the hospital during January to September 2023. Among them 320 were male and 580 were female patient samples. After culturing using standard media and biochemical identification test for identification of *E. coli*, 125 number of samples showed *E. coli* growth (**Figure-1**).



**Figure-1** This shows the distribution of *Escherichia coli* isolates among all samples received from patients of urinary tract infection.

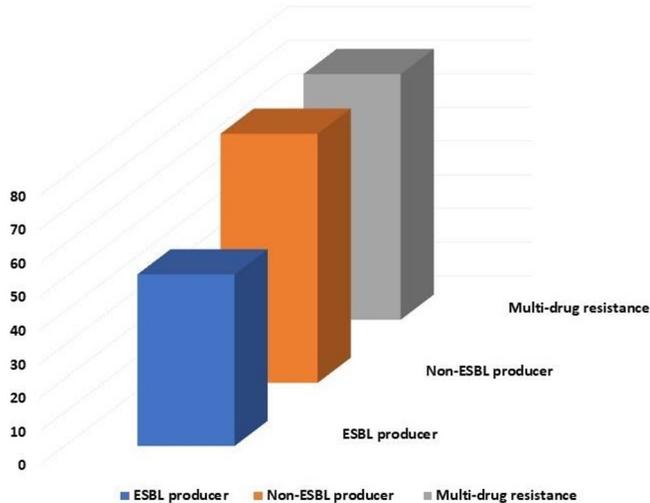
Further, these clinical *E. coli* isolates were used for antimicrobial sensitivity testing as per the guidelines of CSLI (Clinical and Laboratory Standards Institute). Furthermore, these isolates were used to identify the ESBL synthesizers on the basis of the screening methods using antibiotics cefotaxime (30µg) and ceftazidime (30µg) using phenotypical confirmatory assessment. This test was done by means of ESBL kit (Hi-Media). Here, we use combination of antibiotics and beta-lactamase inhibitor likewise ceftazidime (30µg) and ceftazidime plus clavulanic acid (30/10 µg). A more them or equal to 5mm zone of inhibition in diameter for any of the used antibiotic drugs tested in grouping with clavulanic acid from its inhibiting zone alone has been confirmed as ESBL synthesizers [2].

In our study out of 125 of *E. coli* isolates, the incidence rate of (15.6%) urinary tract infection was found in female and 1.2% were detected in male. Among these isolates of *E. coli*, highest resistance was detected for ampicillin, cefazolin (80%), followed by cefotaxime (78.4%) and ceftazidime (77.6%). However, the less resistance was observed found against nitrofurantoin (12%) followed by gentamicin (24%) and imipenem (20%) (**Figure-2**).



**Fig. 2** This figure shows the distribution of different antibiotic resistance *Escherichia coli* isolates.

The overall 73 isolates were found to be multidrug resistance in urinary tract isolated *E. coli*. Among these isolates 51 (40.8%) isolates of *E. coli* were observed to producing ESBLs (**Figure-3**).



**Figure-3** This figure shows the proportion of ESBL producers and Multidrug resistance *Escherichia coli* isolates.

This data reveals that the higher level of ESBL production isolates of *E. coli* circulating among urinary tract infection patients. Further, the expression of virulence factors among these isolates may hinder effective drug treatment for *E. coli* infected patients. Although the *E. coli* was the major uro-pathogen in our study but other pathogen also need consideration such as *Klebsiella pneumoniae* and *Acinetobacter sp.*

The previous studies observed a greater occurrence of *E. coli*, with *K. pneumoniae* being the subsequent most prevalent [3-7]. A study by Karn et al. [6] observed a reduced occurrence of *K. pneumoniae* and *P. aeruginosa* in urinary infections whereas we have only identified *E. coli*. However, our study identifies that, females had a higher incidence of culture positivity in urinary tract infections, with a greater prevalence of *E. coli*. Consistent results were obtained by different studies. Another investigation by Shrestha et al. [7] revealed that *E. coli* is the most prevalent organism. The high prevalence of positive urine cultures in females can be related to the longer urethra and the proximity of the urethral opening to the anus in females, which increases the likelihood of urinary tract infections in females [8]. Further, the majority of ESBL *E. coli* exhibited susceptibility to imipenem and nitrofurantoin. ESBL synthesizers exhibited resistance to ampicillin drug and medicines from the cephalosporin group. These results bring into line with analogous studies documented in Nepal (9-11). The third-generation cephalosporins resistance was observed in *E. coli*, thus necessitates the usage of carbapenems as primary treatment option for severe infections caused by this pathogen in various settings. Carbapenems are considered the final line of defence for managing severe community- and hospital-acquired infections [12]. Considering the previous studies and our study it has been revealed that there is rise in ESBL producing *E. coli*, therefore necessary or suitable steps essential to be considered and frame for active policies to terminate unsuitable use of antimicrobial drugs. Further, implementation of strong surveillance programme for detection of *E. coli* or other bacterial pathogens is the need of hour and there should also be given emphasis to monitor ever-changing antimicrobial drug patterns.

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