Genotype–phenotype correlation of β-lactamase-producing uropathogenic *Escherichia coli* (UPEC) strains from Bangladesh

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Presentation outline

Biological question being investigated

Workflow carried out by the group

Overview of the group's documentation

Results comparison

Biological question being investigated

Background:

- **E. coli** as a common pathogen in clinical settings.
- **UPEC strains** cause urinary tract infections (UTIs).
- **UTIs** are among the most prevalent infections worldwide.

Biological question investigated:

- How do 11 UPEC strains from Dhaka and Sylhet, Bangladesh compare to each other and to other available UPEC strains at a genomic level?
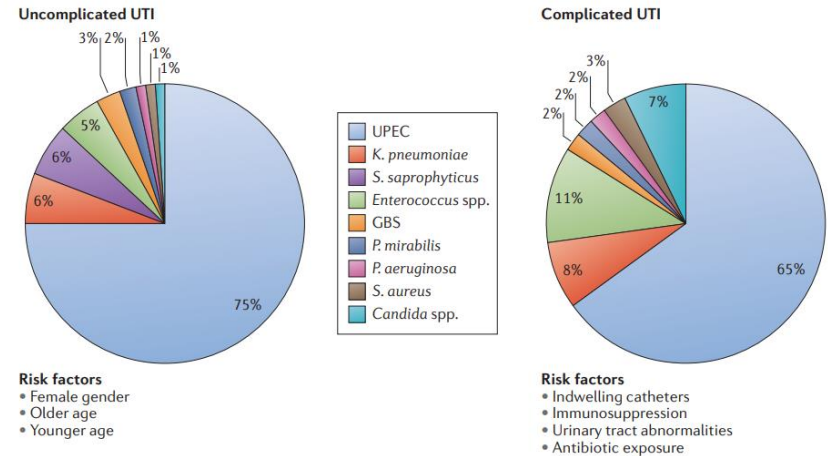
Source: Flores-Mireles, A., Walker, J., Caparon, M. *et al.* Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol* 13, 269–284 (2015). https://doi.org/10.1038/nrmicro3432

Workflow carried out by the group

➢ **Investigation of sequence types, antibiotic resistance genes, and virulence factors.**

➢ **Comparative genomic analysis of UPEC strains.**

Overview of the group's documentation

- **Comparative Genomic Analysis**: Comparative study of 11 UPEC strains from Dhaka and Sylhet, Bangladesh, examining their genomic characteristics against each other and existing UPEC strains.

- **Diversity in Sequence Types**: MLST confirmed the strains belong to ST59, ST131, ST219, ST361, ST410, ST448, and ST4204, including a novel sequence type.

- **Antibiotic Resistance and Virulence**: Identification of antibiotic resistance genes blaNDM-5, blaNDM-7, blaCTX-M-15, and blaOXA-1, with significant virulence heterogeneity observed within UPEC phylogroups.

- **Reproduced and compared**: Table 3 and heat maps (data and code-GitHub repository).

- https://github.com/ukabuye/BCB546-Spring2024-FinalProject.git

Results comparison

Table 3. De novo prediction of phylogroups, MLST types and serotypes of the sequenced UPEC isolates

Strain	Accession Number	Hospital	Phylogroups	MLST Type	Serotype
NGE3	QEXN00000000	DCIMCH	F (D)*	ST-59	O1:H7
NGE4	QFAZ00000000	DCIMCH	A	ST-4204	O6:H10
NGE5	RCIF00000000	DCIMCH	B1	ST-10987 (Ounknown ST)	O59:H20
NGE6	RCIE00000000	DCIMCH	E (B2)	ST-219	O138:H48
NGE7	QFRN00000000	DCIMCH	B2	ST-131	O46:H4 (O25:H4)
NGE9	QFRT00000000	DCIMCH	EC control fail (B2)	ST-219	O138:H48
NGE16	QFTM00000000	ISH	B2	NA (ST-131)	O25:H4
NGE22	QFXA00000000	ISH	A	ST-4204	O6:H10
NGCE33	RBWA00000000	DCIMCH	C (A)	ST-410	O8:H9
NGCE94	RAZQ00000000	DCIMCH	B1	ST-448	O188:H19 (Ounknown:H7)
NGCE100	RAZR00000000	DCIMCH	A	ST-361	H30:09

*Parentheses indicate originally published values that do not match with the reproduced values

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Antibiotic resistance phenotype
of β-lactamase producing uropathogenic *E. coli* strains 46 strains from Dhaka hospital

Snapshot of the data frame

Python packages used:
- pandas
- seaborn
- Matplotlib

DHAKA HOSPITAL ID	STRAIN ID	GENDER	AGE	SAMPLE TYPE	ESBL	Amikacin	Amoxyclave	Aztreonam
77827	NGCE-002	MALE	28	URINE	-	S	R	S
78463	NGCE-003	FEMALE	39	URINE	-	S	S	S
78773	NGCE-004	MALE	64	URINE	-	S	R	S
77937	NGCE-005	FEMALE	18	URINE	-	S	R	S
79078	NGCE-006	MALE	24	URINE	-	S	S	S
78156	NGCE-007	FEMALE	71	URINE	-	S	R	S
80245	NGCE-009	MALE	35	URINE	-	S	R	S

Data Processing

Heatmap for the 46 strains from Dhaka Hospital
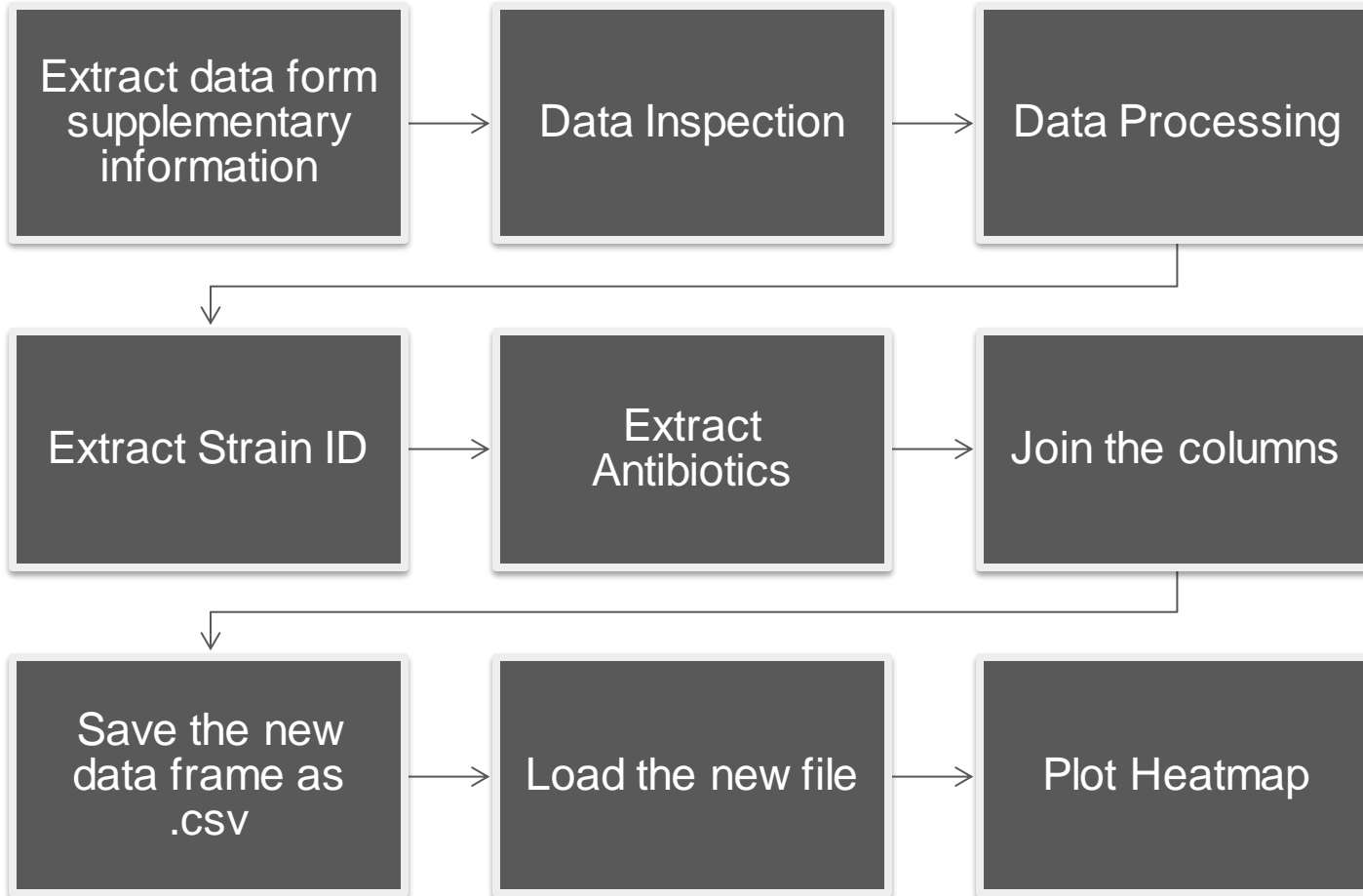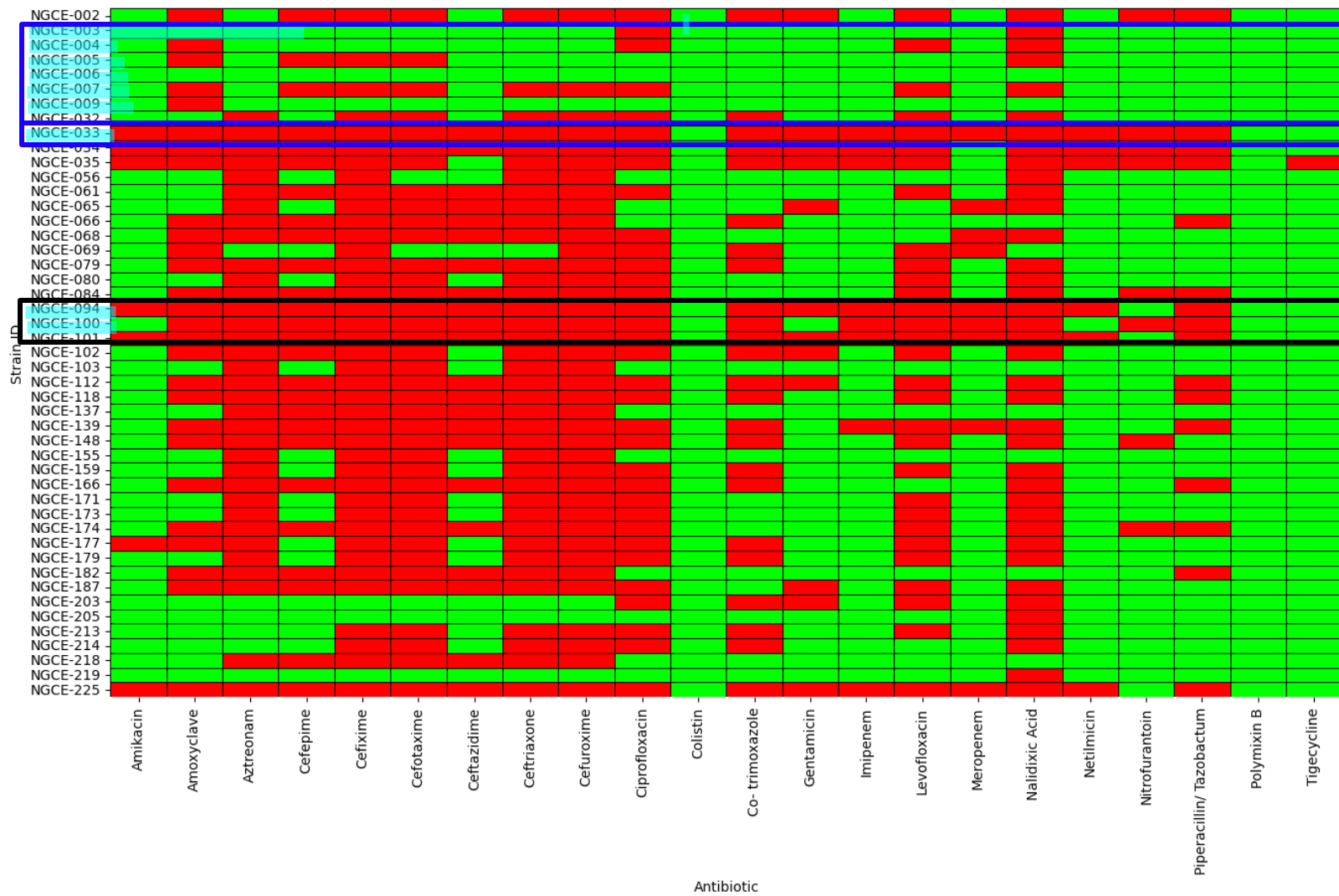
E. coli strain data from Sylhet hospital.

| SYLHET HOSPITAL ID	STRAIN ID	GENDER	AGE	SAMPLE TYPE	ESBL	Amoxycillin	Azithromycin	Cefixime	Ceftazidime	Ceftriaxone	Colistin	Doxycycline	Gentamicin	Imipenem	Mecillinam	Meropenem	Polymixin B	Trimethoprim	Cefoxitin
88185	NGCE-010	FEMALE	47	URINE	-	S	R	R	S	R	S	R	S	S	R	S	S	R	R
147975	NGCE-012	MALE	73	URINE	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S
147661	NGCE-013	FEMALE	19	URINE	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S
146156	NGCE-014	MALE	34	URINE	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S
146605	NGCE-015	FEMALE	44	URINE	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S
147639	NGCE-016	MALE	36	URINE	-	R	S	R	S	S	S	S	S	S	R	S	S	S	R
Q-020	NGCE-019	FEMALE	23	URINE	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Q-27118	NGCE-020	MALE	41	URINE	-	R	R	R	S	S	S	R	S	S	R	S	S	R	R

Source: processed data from the Sylhet Hospital data on extracted E. coli strain genomes

Demographics of the Sylhet Hospital data
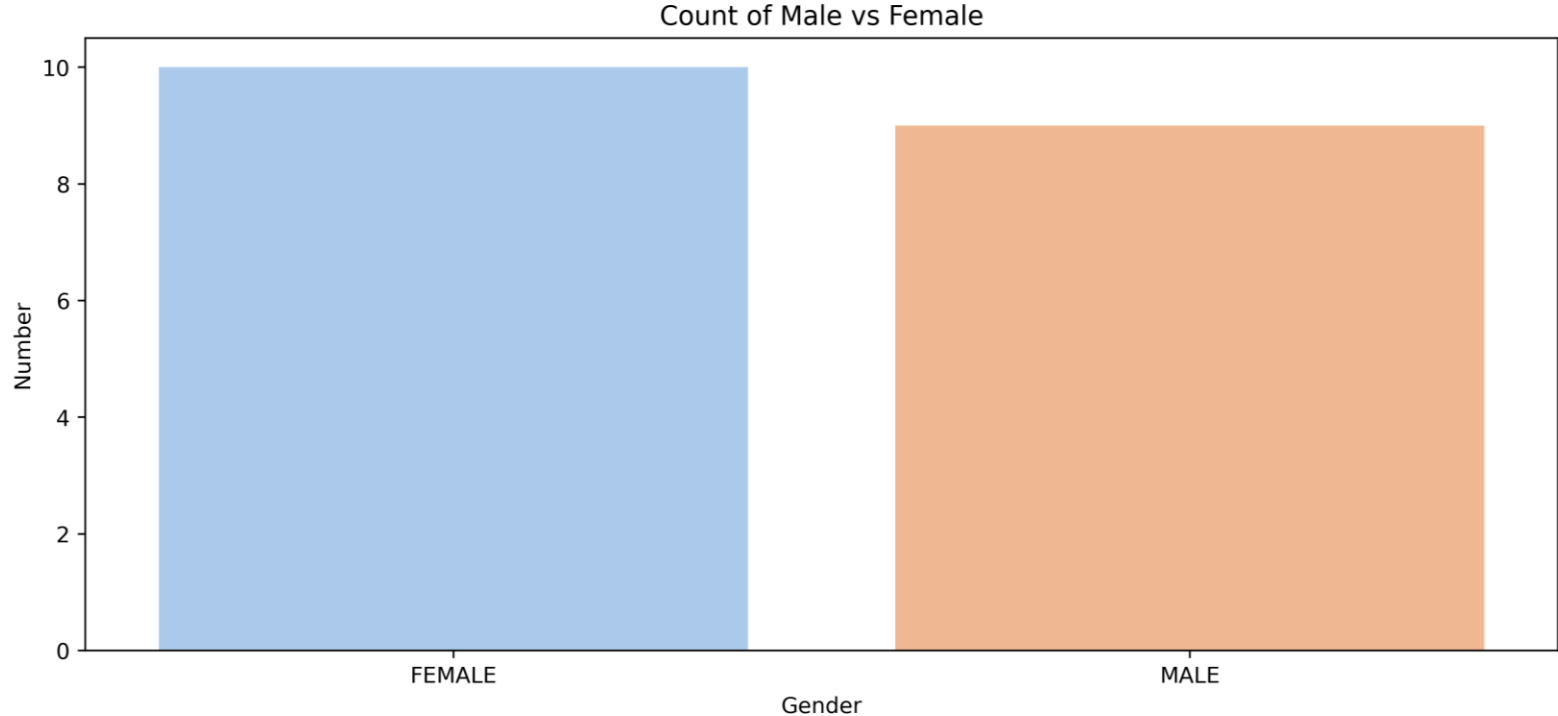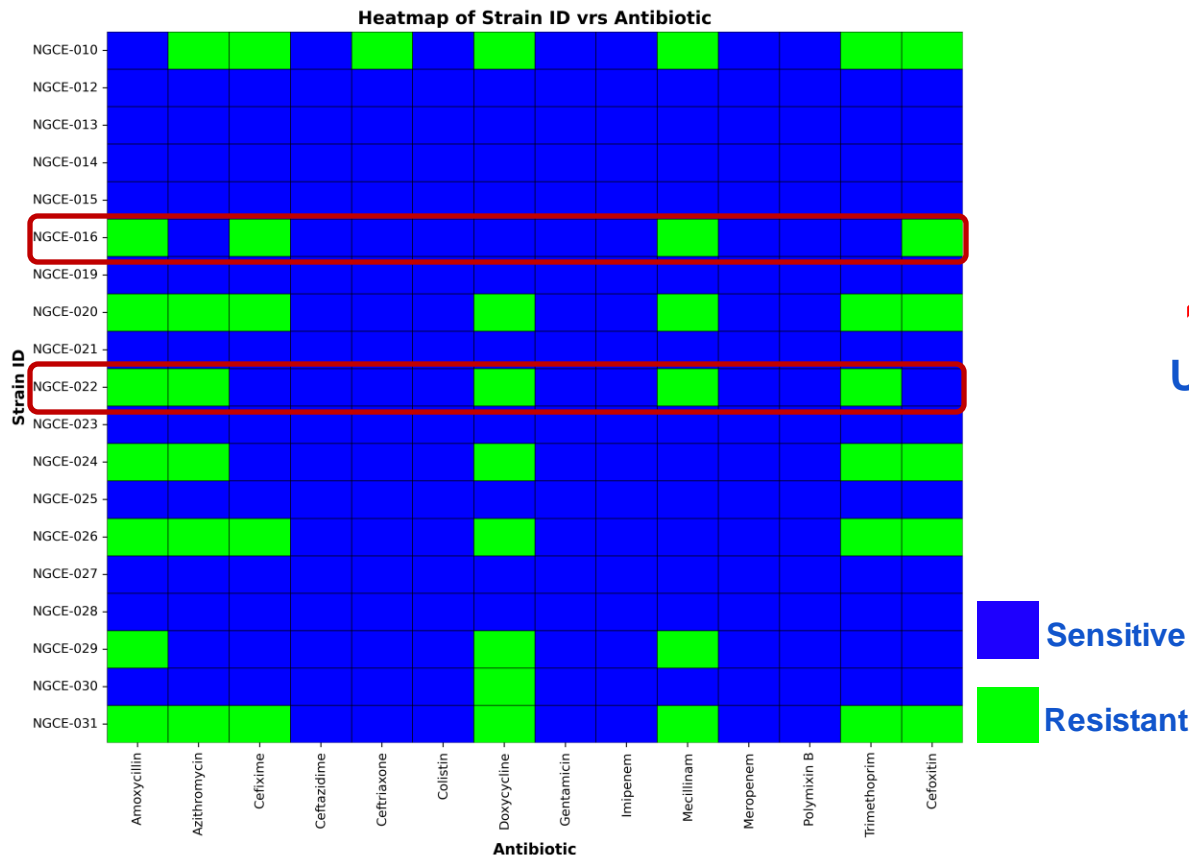

Figure: Bar graph of count based on Gender on the processed data
from the Sylhet Hospital data on extracted E. coli strain genomes

Demographics of the Sylhet Hospital data

Scatter Plot of Gender vs Age
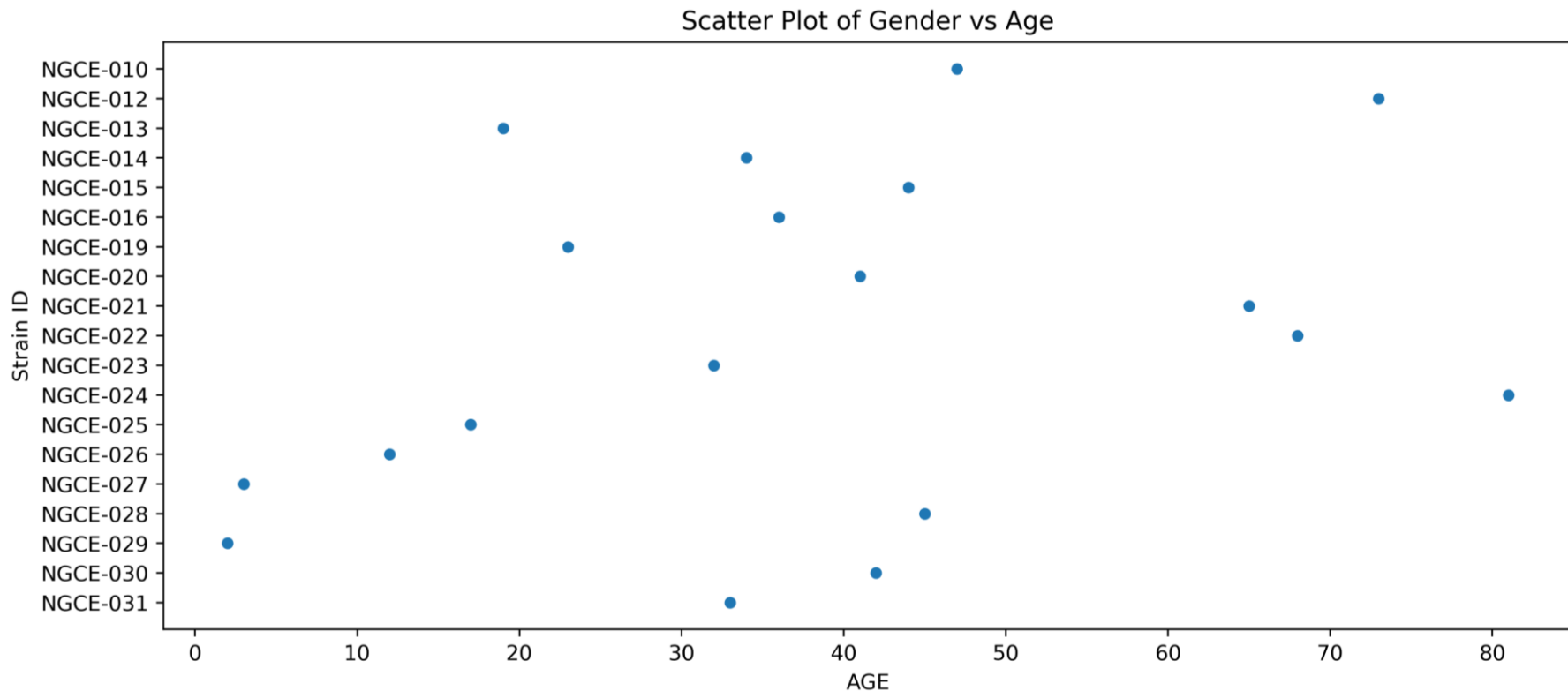
Figure: Scatterplot of count based on Gender on the processed data from the Sylhet Hospital data on extracted E. coli strain genomes

Antibiotic resistance phenotype of β-lactamase producing uropathogenic *E. coli* strains at Sylhet hospital

Heatmap of Strain ID vrs Antibiotic

~10.52%

UPEC strains in Sylhet hospital

Sensitive

Resistant

Antibiotic resistance genotype

highly resistant ST4204 strains

Genotype-phenotype correlation for antibiotic resistance

THANK

YOU
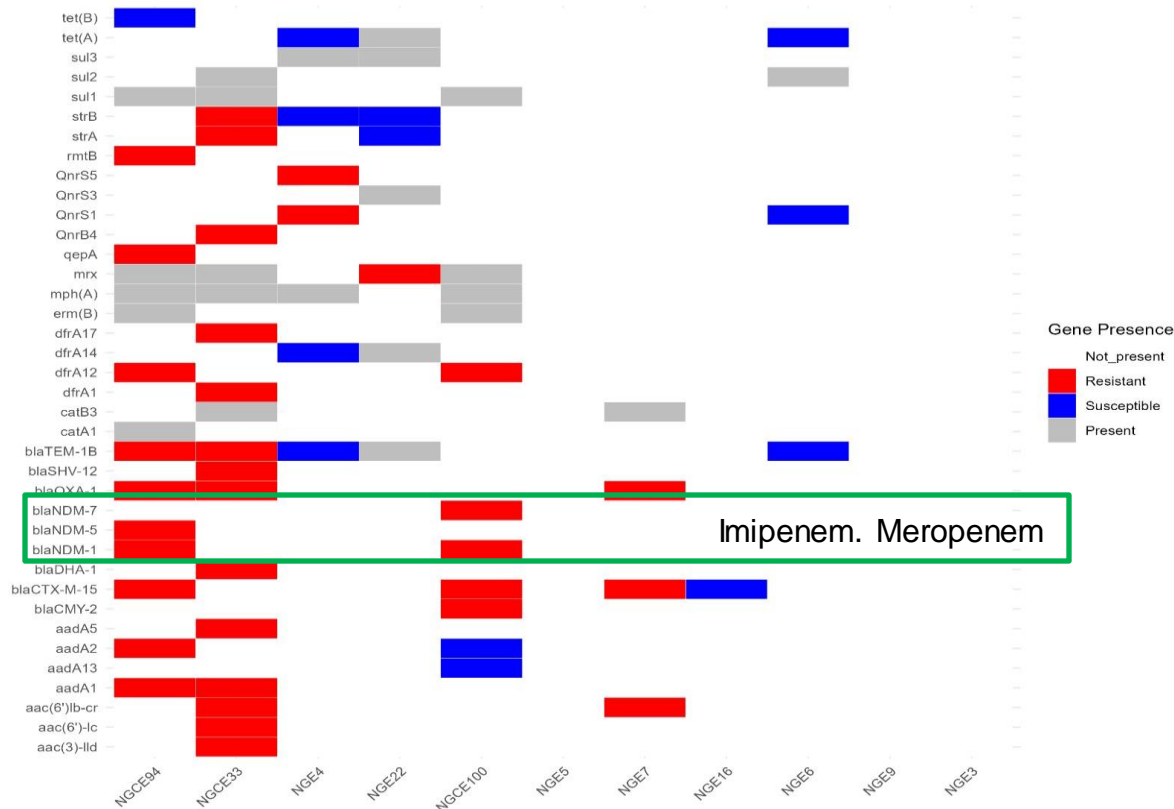
Your questions are welcome...