

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

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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?

Workflow carried out by the group

- Comparative genomic analysis of UPEC strains
- Investigation of sequence types, antibiotic resistance genes, and virulence factors

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.

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 | QEXN000000000 | DCIMCH | F (D)* | ST-59 | O1:H7 |
| NGE4 | QFAZ000000000 | DCIMCH | A | ST-4204 | O6:H10 |
| NGE5 | RCIF000000000 | DCIMCH | B1 | ST-10987 (Ounknown ST) | O59:H20 |
| NGE6 | RCIE000000000 | DCIMCH | E (B2) | ST-219 | O138:H48 |
| NGE7 | QFRN000000000 | DCIMCH | B2 | ST-131 | O46:H4 (O25:H4) |
| NGE9 | QFRT000000000 | DCIMCH | EC control fail (B2) | ST-219 | O138:H48 |
| NGE16 | QFTM000000000 | ISH | B2 | NA (ST-131) | O25:H4 |
| NGE22 | QFXA000000000 | ISH | A | ST-4204 | O6:H10 |
| NGCE33 | RBWA000000000 | DCIMCH | C (A) | ST-410 | O8:H9 |
| NGCE94 | RAZR000000000 | DCIMCH | B1 (A) | ST-448 (ST-361) | O188:H19 (O9:H30) |
| NGCE100 | RAZQ000000000 | DCIMCH | A (B1) | ST-361 (ST-448) | H30:09 (Ounknown:H7) |

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

Antibiogram results of 46 strains from Dhaka hospital

Snapshot of the data frame

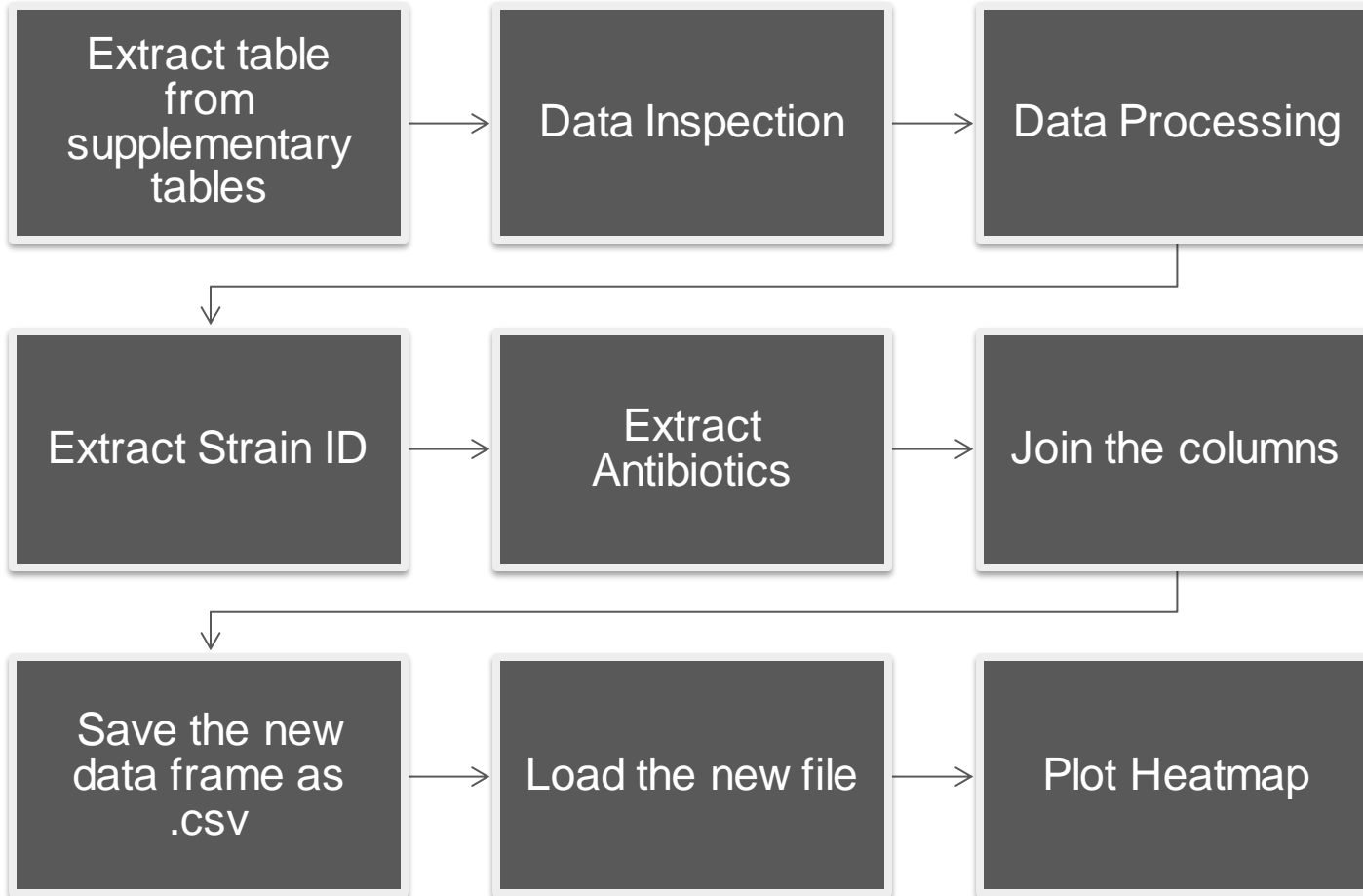
Python packages

used:

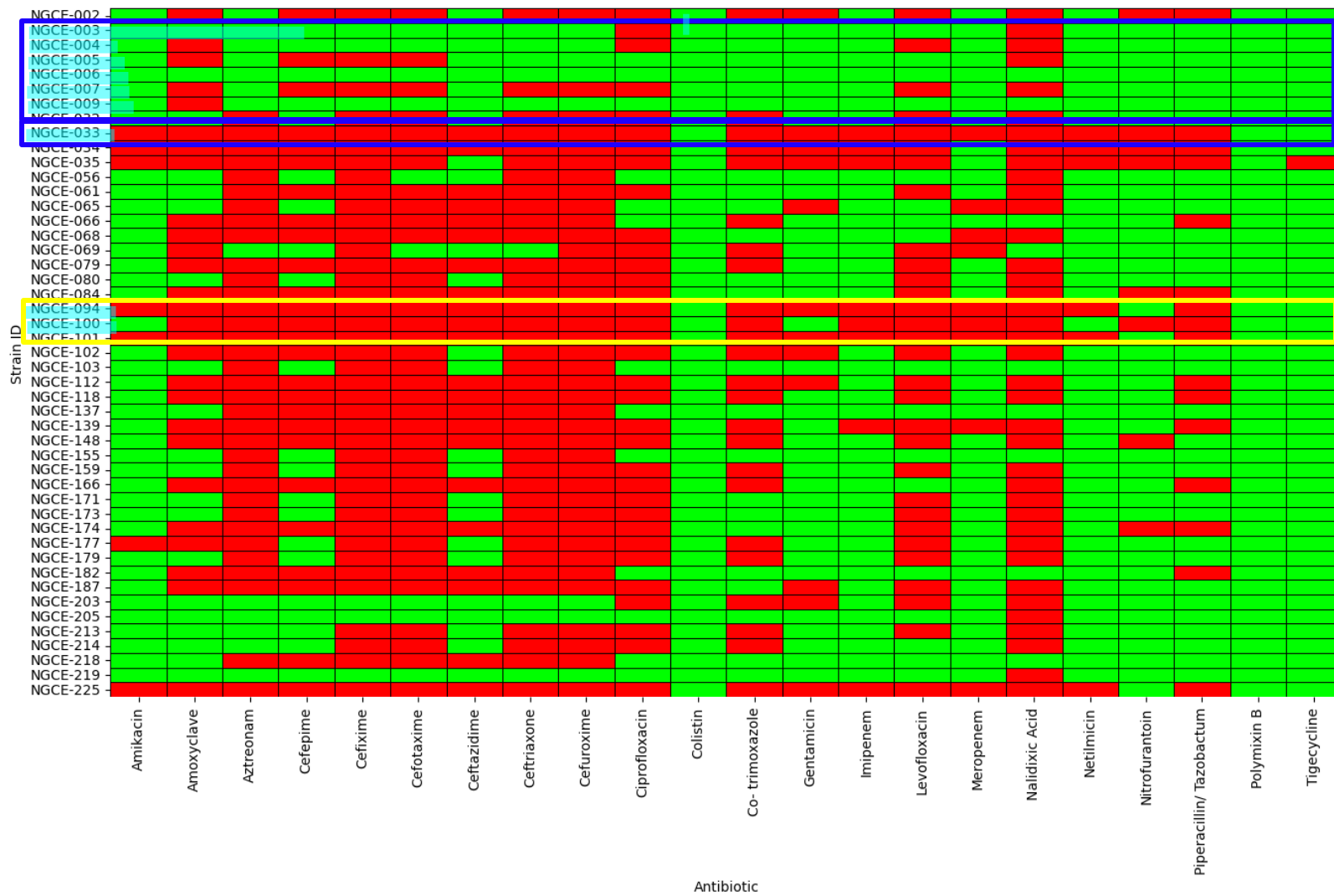
- pandas
- seaborn
- Matplotlib

| | | | | | ESBL | Amikacin | Amoxyclave | Aztreonam |
|-------------------|-----------|--------|-----|-------------|------|----------|------------|-----------|
| DHAKA HOSPITAL ID | | | | SAMPLE TYPE | | | | |
| | STRAIN ID | GENDER | AGE | | | | | |
| 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 |

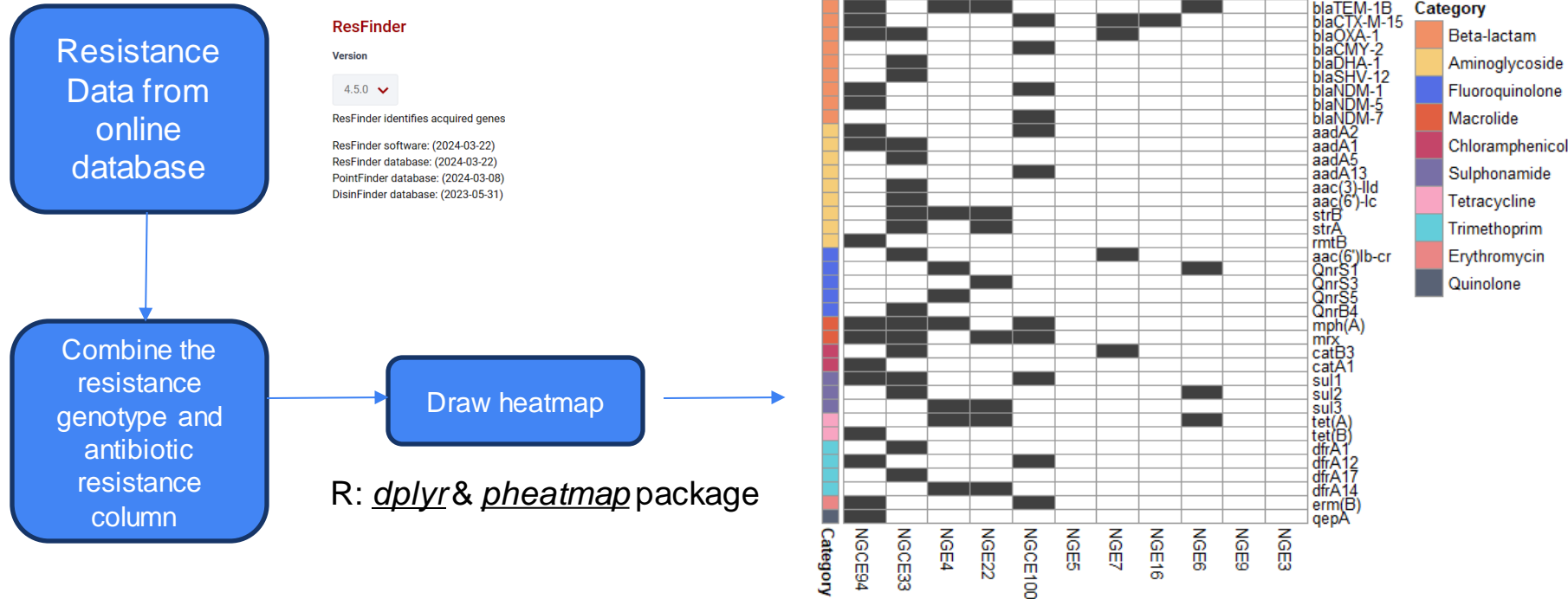
Data Processing



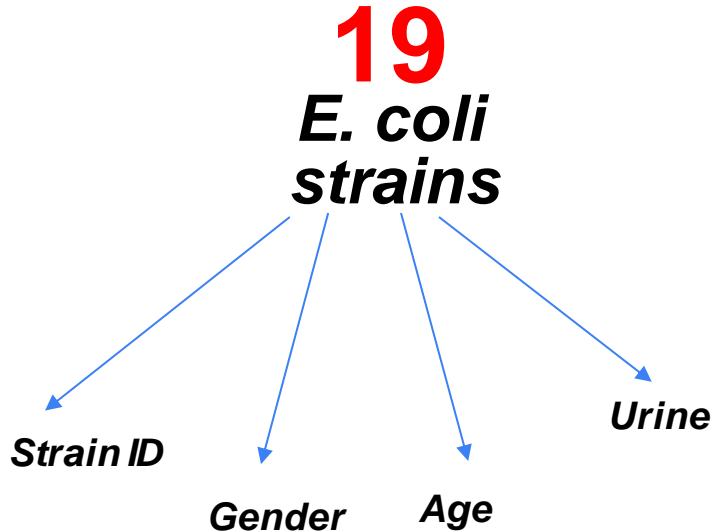
Heat map for the 46 strains from Dhaka Hospital



Antibiotic Resistance and Virulence



E. coli strain data from Sylhet hospital.



| | SYLHET HOSPITAL ID | STRAIN ID | GENDER | AGE | SAMPLE TYPE |
|----|--------------------|-----------|--------|------|-------------|
| 2 | 88185 | NGCE-010 | FEMALE | 47.0 | URINE |
| 3 | 147975 | NGCE-012 | MALE | 73.0 | URINE |
| 4 | 147661 | NGCE-013 | FEMALE | 19.0 | URINE |
| 5 | 146156 | NGCE-014 | MALE | 34.0 | URINE |
| 6 | 146605 | NGCE-015 | FEMALE | 44.0 | URINE |
| 7 | 147639 | NGCE-016 | MALE | 36.0 | URINE |
| 8 | Q-020 | NGCE-019 | FEMALE | 23.0 | URINE |
| 9 | Q-27118 | NGCE-020 | MALE | 41.0 | URINE |
| 10 | Q-27183 | NGCE-021 | FEMALE | 65.0 | URINE |
| 11 | Q-260 | NGCE-022 | MALE | 68.0 | URINE |
| 12 | Q-149714 | NGCE-023 | FEMALE | 32.0 | URINE |
| 13 | Q-458 | NGCE-024 | MALE | 81.0 | URINE |
| 14 | Q-149777 | NGCE-025 | FEMALE | 17.0 | URINE |
| 15 | Q-084 | NGCE-026 | MALE | 12.0 | URINE |
| 16 | Q-149517 | NGCE-027 | FEMALE | 3.0 | URINE |
| 17 | Q-14 | NGCE-028 | MALE | 45.0 | URINE |
| 18 | Q-295 | NGCE-029 | FEMALE | 2.0 | URINE |
| 19 | Q-903 | NGCE-030 | MALE | 42.0 | URINE |
| 20 | Q-079 | NGCE-031 | FEMALE | 33.0 | URINE |

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

Demographics of the Sylhet Hospital data

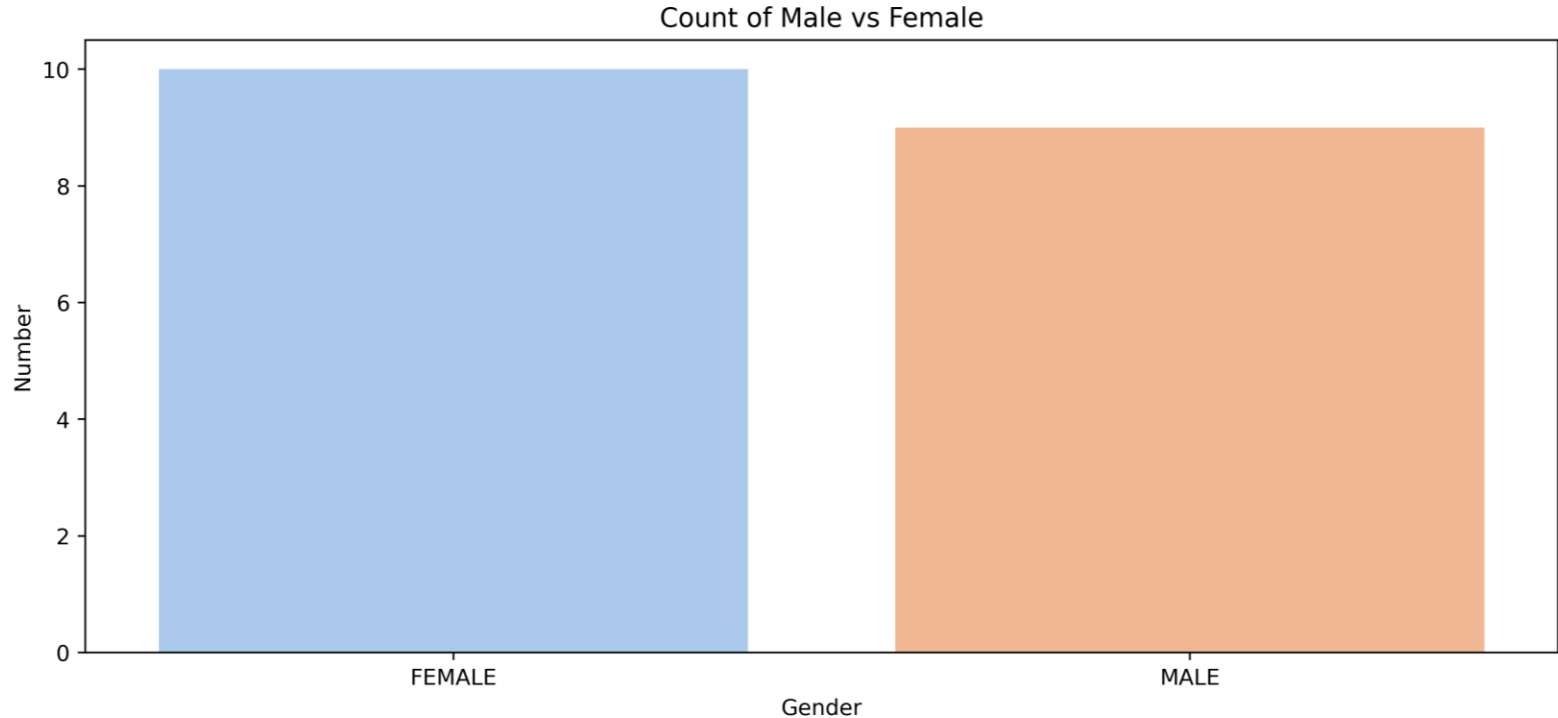


Figure: Bar graph of count based on Gender on the processed data from the Sylhet Hospital data on extracted *E. coli* strain genomes

Demographics of the Sylhet Hospital data

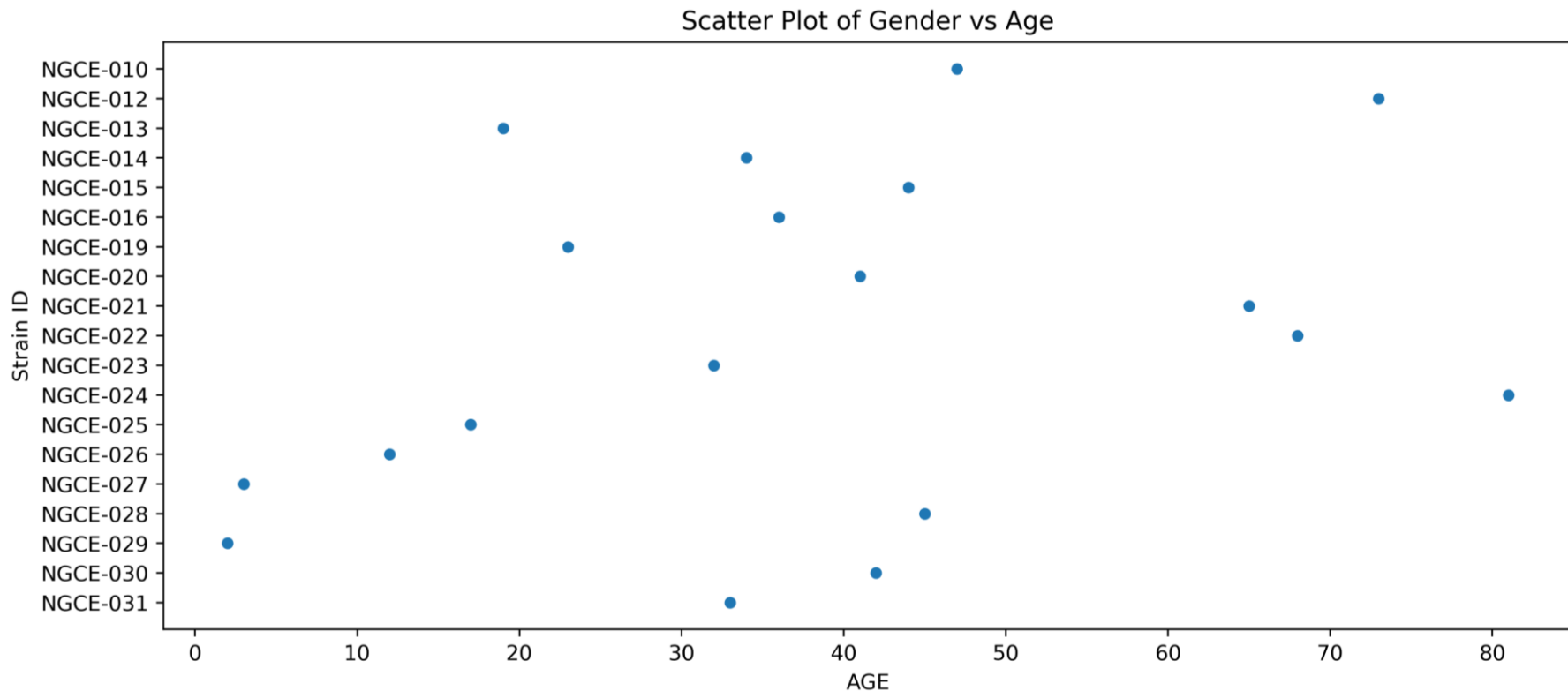


Figure: Bar graph of count based on Gender on the processed data from the Sylhet Hospital data on extracted *E. coli* strain genomes

Heatmap of Strain ID vrs Antibiotic

