**Exercise 4**

**Antimicrobial Drug Resistance**

The DrugBank database is a unique bioinformatics and cheminformatics resource that combines detailed drug data with comprehensive drug target information (which is available at https://www.drugbank.ca/). DrugBank combines detailed drug (i.e. chemical, pharmacological and pharmaceutical) data with comprehensive drug target (i.e. sequence, structure, and pathway) information.

Antimicrobial Resistance (AMR) is a global health problem that contributes to tens of thousands of deaths per year. The various bioinformatics software and tools can be used to study drug resistance. The most common approaches to compare the input data with the AMR reference databases rely on BLAST and Hidden Markov Model searches, among others. BLAST-based tools can give different outputs based on default settings for gene length and percentage of similarity. The Comprehensive Antibiotic Resistance Database (CARD;https://card.mcmaster.ca) is a curated resource providing reference DNA and protein sequences, detection models and bioinformatics tools on the molecular basis of bacterial antimicrobial resistance (AMR). BLAST in CARD is used for analysis of molecular sequences. BLAST gives results using microbial sequences that are already identified as drug resistant. It gives % identity, E-value and alignment of query sequence with CARD reference sequences. RGI in CARD is used identifying resistance genes in query sequence.

**Task:**

> Analyze commonly used antibiotics in drugbank like amoxicillin, Ceftriaxone and Ciprofloxacin.

>Retrieve target sequences (protein sequences) of antibiotics Clindamycin and Azithromycin.

> Analyze these sequences using BLAST in Comprehensive Antibiotic Resistance Database.