

Master 2 Internship Proposal

Bioinformatics and Computational Biology

Longitudinal analysis of gut microbiome dynamics following antibiotic exposure using shotgun metagenomics

Duration: 6 months (from Jan 2027)

Location: UFR Santé, Université de Rouen Normandie, 22 Boulevard Gambetta, Rouen, France

Research unit: INSERM UMR 1311 - DYNAMICURE

Supervision: Dr Nassim Boutouchent & Prof. Kévin Alexandre

Context. Urinary tract infections (UTIs) are among the major indications for antibiotic use worldwide¹. However, exposure to antibiotics can disrupt the gut microbiota and exert a selective pressure favoring antimicrobial resistance². Further, recent studies have highlighted differences in the extent of these disruptions and subsequent recovery depending on the antibiotic used and between individuals^{3,4}. The prospective observational ABIME study investigates these dynamics in patients treated for UTIs. More than 150 stool samples have been collected longitudinally, before, during, and after exposure to different antibiotics. These samples have been sequenced using shotgun metagenomics and are available for analysis.

Objective. The main objective is to characterize the microbial and functional dynamics of the gut microbiome following exposure to several antibiotics used to treat UTIs.

Missions. The intern will mainly contribute to the computational analysis of the metagenomes, including: (i) data processing (quality control, human read removal, taxonomic profiling, ...); (ii) identification and characterization of functional genes, particularly antimicrobial resistance genes; and (iii) microbial diversity and statistical differential abundance analyses.

Profile and required skills. We are looking for a Master 2 or final-year engineering student in bioinformatics, computational biology, biostatistics, or a related field. Competence in at least one programming language and experience with Linux are required. Basic knowledge of statistics and molecular biology is also required. Experience with Git, HPC environments, or workflow managers would be an advantage but could also be learned during the internship.

Recruitment. To apply, please send a CV and a short cover letter outlining your academic background and relevant experience to nassim.boutouchent@chu-rouen.fr and kevin.alexandre@inserm.fr.

References.

1. Timm, M. R., Russell, S. K. & Hultgren, S. J. Urinary tract infections: pathogenesis, host susceptibility and emerging therapeutics. *Nat Rev Microbiol* **23**, 72–86 (2025).
2. Palleja, A. *et al.* Recovery of gut microbiota of healthy adults following antibiotic exposure. *Nat Microbiol* **3**, 1255–1265 (2018).
3. Anthony, W. E. *et al.* Acute and persistent effects of commonly used antibiotics on the gut microbiome and resistome in healthy adults. *Cell Reports* **39**, 110649 (2022).
4. Olivares, C. *et al.* A modelling framework to characterize the impact of antibiotics on the gut microbiota diversity. *Gut Microbes* **17**, 2442523 (2025).