Advancing Hospital Environment Health: Harnessing Microbiome Insights for Targeted Monitoring and Mitigation of Antimicrobial Resistance

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Abstract: Antimicrobial Resistance (AMR) is a major problem of our century. Antibiotic misuse and indiscriminate, overly aggressive cleaning practices contribute heavily to the proliferation of resistant bacteria. After the COVID-19 pandemic, cleaning protocols have become more intensive, trying to sterilise the environment and our bodies, following the *old hygiene hypothesis*: "clean is better". However, bacteria are fundamental for our life: we co-evolved over millions of years as a holobiont, influencing each other's biology and modelling our immune system. Most of them are beneficial and only the pathogenic ones are hazardous to global health.

Hospital environments can be defined as the hotspots for the artificial selection and spread of multidrug-resistant bacteria due to the extreme cleaning protocols and the high antibiotic usage. As part of the ANTHEM project, we aim to characterise hospital microbial communities using a biomolecular approach based on human and environmental sampling, DNA extraction, sequencing, and bioinformatic analysis, including taxonomic reconstruction and statistical tests.

Preliminary results have shown us the microbial community structure harboured by specific hospital environments. Our first aim is to find target bacteria that can be used as biomarkers to ensure the hospital environment's health, identify any critical issue, and quantify biological risks to reduce and monitor the spread of AMR bacteria and antibiotic resistance genes (ARG) in hospital settings. Based on our microbiome characterisation, the project's long-term aim is to build a fast and easy-to-use technological device grounded on biomolecular techniques. Finally, the design of this monitoring device will allow policymakers to define targeted cleaning protocols to eradicate pathogens from the environment without resorting to counterproductive strategies. Ultimately, this approach ensures a safer environment for patients and visitors while curbing the propagation of AMR bacteria and Healthcare-Associated Infections (HAIs).

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