Antimicrobial Resistance Research Group (AMR RG)

What is AMR RG?

The Antimicrobial Resistance Research Group (AMR RG) is an interdisciplinary group of researchers and health practitioners aiming at unravelling the growing challenge of antimicrobial drugs. Research programmes are funded by the Cambridge – Africa ALBORADA Research Fund, Academy of Medical Sciences (AMS), Africa Research Excellence Fund (AREF) and the Fleming Fund.

What is AMR?

Antibiotic-resistant infections are emerging as one of the leading threats to public health. These resistance occurs when microbes survive exposure to antimicrobials that would otherwise have killed them or stopped their growth. Therefore, AMR makes infections harder to treat and increases the risk of disease spread, severe illness and death. Of particular importance is the rapid global spread of multi- and pan-resistant bacteria (superbugs) that cause infections which are not treatable with existing antimicrobial medicines such as antibiotics.

Each year, 700,000 people die of AMR. If no actions are taken, the death toll could rise even higher to as many as 10 million deaths annually by 2050, with the low and middle income countries being disproportionately vulnerable. Furthermore, there is a real economic impact of the microbe fouling medical devices, water supply systems, and agriculture and livestock production. Our group seeks to play a dominant role in addressing these unmet needs.

For further information about the AMR global problem, the following links may be of interest:

https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

https://www.worldbank.org/en/topic/health/brief/antimicrobial-resistance-amr

https://www.health.go.ke/wp-content/uploads/2017/04/Kenya-AMR-Containment-Policy-_Final_April.pdf

What does AMR RG do?

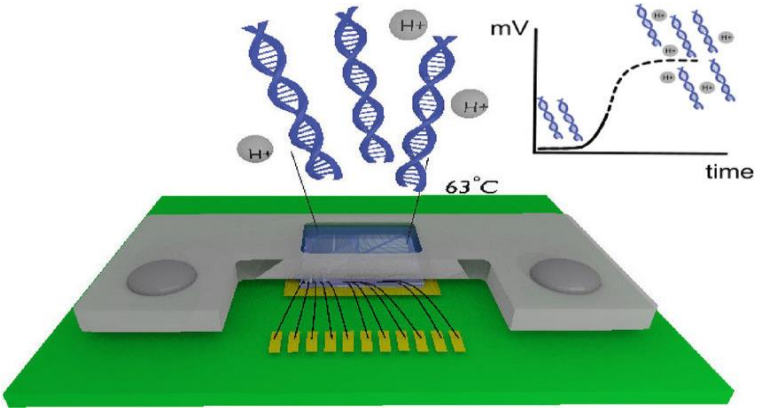
AMR RG leverages the scientific and clinical strengths of MMUST and its collaborators to develop transformative approaches to identify, respond to and manage AMR. Our AMR programs are focused towards monitoring of antimicrobial resistant microbes; developing diagnostic devices and supporting antimicrobial stewardship programs. We are also conducting epidemiological studies on diseases of poverty and one health strategies in combating resistant microbes.

Our Projects

Our research studies attempt to understand microbial pathogens that cause drug resistant infections. Of particular interest is enteric infections, urinary tract infections and infections associated with surgical wounds and trauma.

With our collaborators, we utilize genome sequence analysis and sequence typing to understand genetic relationships of these bacteria. This helps us understand the factors that lead to the development of antibiotic resistance as well as the way the infections are spread.

Digital diagnostics



This is a collaborative research under the Digital Diagnostics for Africa Network DiDiagnostics4Africa. We are developing loop – mediated isothermal amplification (LAMP) assays to be incorporated into the lacewing platform to detect waterborne pathogens namely; *Salmonella*, Shigella, pathogenic *Escherichia coli* and *Vibrio cholera*. These microbes are important pathogens that are responsible for majority of gastrointestinal and extraintestinal infections in sub-Sahara Africa. By improving diagnostic tools, we can reduce unnecessary prescription of antimicrobials. We envisage using the lacewing platform on-site and at point of care for environmental monitoring and at healthcare facilities respectively to detect waterborne pathogens.

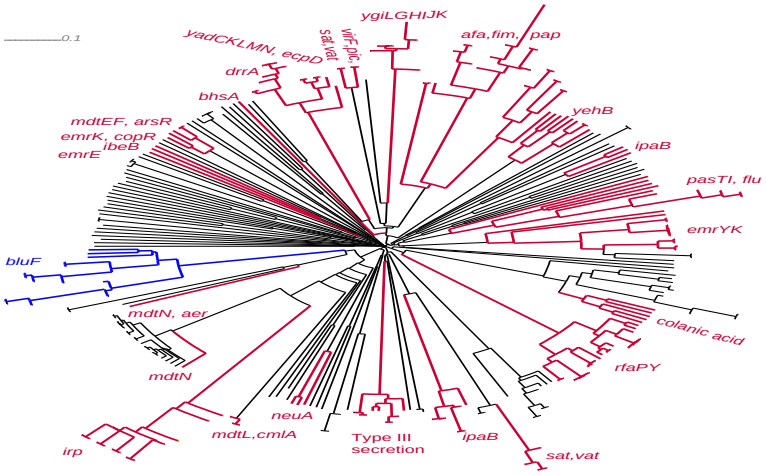
Lacewing platform is a cartridge-based, isothermal, electrochemical DNA biosensor which offers opportunities if tapped into to mitigate this challenge. The technology can support existing waterborne pathogens monitoring programs by offering an on-site confirmation of the presence of pathogens identification and characterization. The technology further allows for connectivity to a smart phone, allowing for cloud data storage with geo-location tagging. This allows for epidemiological monitoring, surveillance and tracking of pathogens including mapping for outbreak hotspots. The

advantages for this technology include; it being less labour intensive, and may only require about 30 minutes to confirm and characterize pathogens associated with water sources in rural settings in Africa. Traditional culture methods (TCMs) for detection of these pathogens take up to five days to know presumptive tests for the bacteria tested. Additionally, the sensitivity for TCMs is quite low.

Antimicrobial Stewardship program

This is a collaborative project between MMUST/Kakamega County Referral Hospital (KCTRH) and Cambridge Global Health Partnerships (CGHP). The project aims at strengthening antimicrobial stewardship (AMS) programs at KCTRH. The partnership focuses on surgical wards at KCTRH, and disseminate knowledge and processes more widely throughout the hospital. Studies have shown that incidences of surgical site infections (SSI) are higher in LMICs. Yet, infection surveillance data are poor including the lack of local guidelines for antibiotic prophylaxis. Education to improve appropriate antibiotic prophylaxis is associated with reduction of SSI in LMICs.

Epidemiological studies



Our studies are focused on bacterial pathogens responsible for diarrheal, urinal tract and nosocomial infections. We attempt to understand the emerging pathogen trends, risk factors, transmission pathways and the levels of AMR within different matrices involved. Our approach is based on the one-health strategy, with an interest in the role of mobile elements in the spread of AMR genes.

Ongoing studies include characterizing *Staphylococcus aureus* associated with wounds, with special attention to personal hygiene with infections of Methicillin resistant *Staphylococcus aureus* (MRSA). The second study focuses on the understanding of the relationship between antibiotic use and emerging AMR trends among *Enterobacterecieae* at the KCTRH surgical wards. Finally, the third study is a longitudinal assessment of *Pseudomonas aeruginosa* associated with surgical wounds, to understand the risk factors, emerging AMR and ARG trends.

Publications

Sifuna Anthony Wawire, Oleg N Reva, Thomas J O'Brien, Wendy Figueroa, Victor Dinda, William A Shivoga, Martin Welch. Virulence and antimicrobial resistance genes are enriched in the plasmidome of clinical Escherichia coli isolates compared with wastewater isolates from western Kenya

Evans Anubi Boge, Peter Nyongesa, Patrick Okoth, Anthony Wawire Sifuna. Biofilms and Antimicrobial Susceptibility Profiles of Escherichia coli Recovered from Wastewater Treatment Plants in Kakamega Municipality, Kenya

Our Partners and Collaborators

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