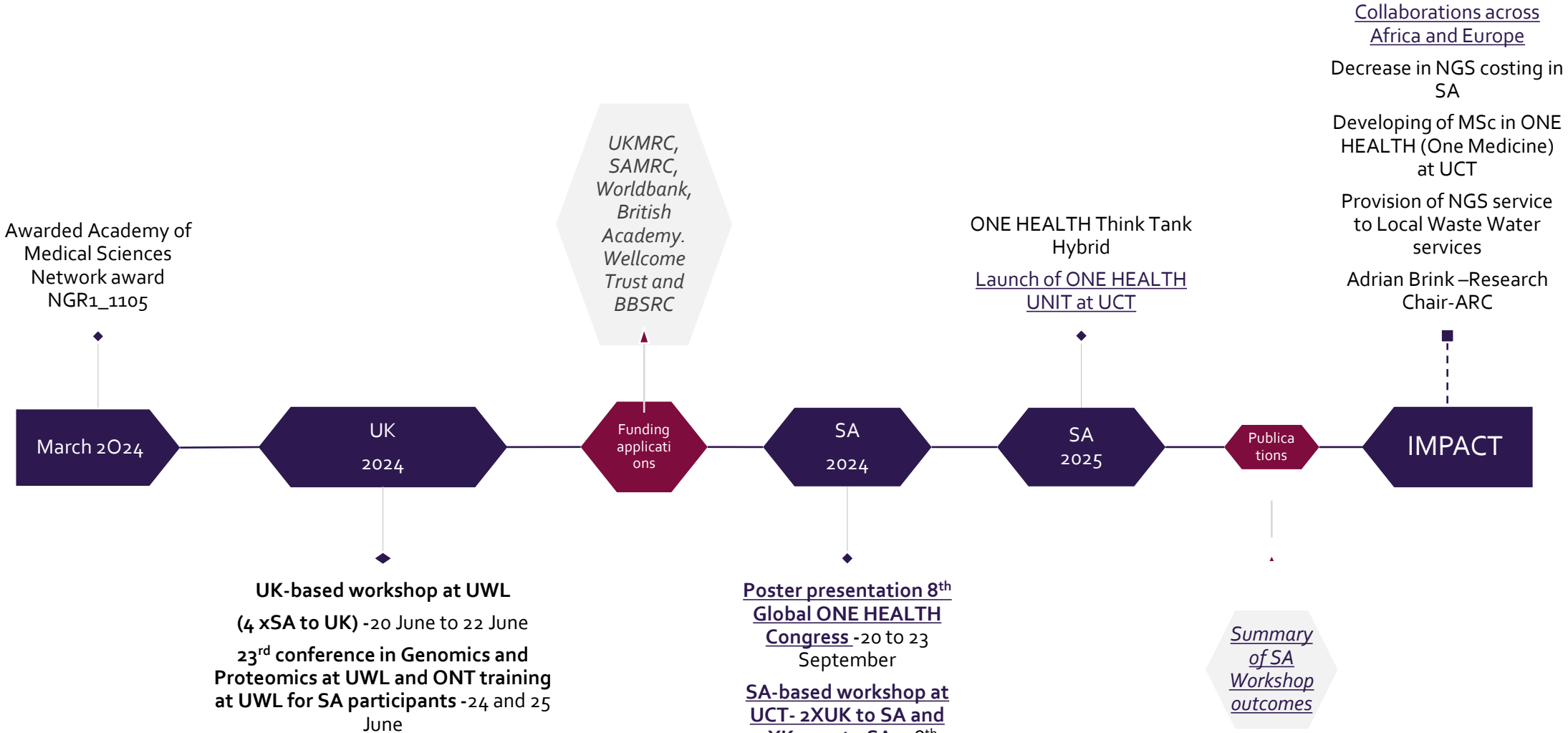
ONE HEALTH NETWORK Milestones



Research challenges through the LMIC lens: Addressing key issues for introducing next-generation sequencing (NGS) across a One Health continuum in South Africa

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INTRODUCTION

The COVID-19 pandemic starkly illustrates that without significant changes, the threat of both known and emerging pathogens, including a potential 'Disease X,' remains imminent (1). Zoonotic diseases, which constitute more than 60% of known human infectious pathogens, pose substantial health and economic burdens globally. In South Africa, endemic diseases and pandemic threats such as COVID-19 have exposed vulnerabilities within the health systems, highlighting the need for robust genomic surveillance at the human-animal-environment interface. This is particularly crucial given the high incidence of foodborne diseases—WHO estimates that 600 million people fall ill and 420,000 die each year due to foodborne illnesses, with an associated economic burden of approximately $110 billion (2). Specifically, the dairy sector in low- and middle-income countries (LMICs) incurs losses up to $95.2 billion annually due to poor farm hygiene and milk handling practices, underscoring the importance of enhanced surveillance and biosecurity (3). By focusing on integrating a One Health approach into genomic studies—particularly in the surveillance of foodborne diseases and antimicrobial resistance (AMR) pathogens—we can begin to address these complex health challenges more effectively, improving predictions and prevention strategies to strengthen regional and global health security.

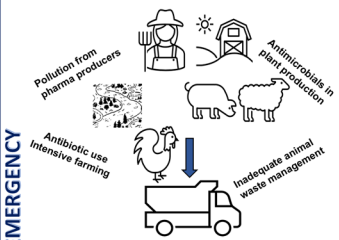
Research hypothesis: A holistic One Health (OH) systems approach, encompassing diverse environments (water, air, and surfaces) and ecosystems, will enable the identification of key points of emergence and transmission nodes of zoonotic pathogens and AMR in SA. This requires an innovative sampling and sequencing approach, on a farm and along the production chain of its products to processing plants, to improve early detection of pathogens with epidemic potential. The interventions will enhance surveillance by linking products to data from hospitalized patients, contributing to reducing food loss, waste, and healthcare costs. This will inform the development of targeted interventions by mapping the emergence, transmission, and dissemination of pathogens across human, animal, and environmental interfaces, thereby improving public health responses and economic outcomes.

Critical issues: Securing **funding** is critical to ensure all aspects of the work are supported. Adequate **consumables** must be sourced to facilitate smooth laboratory operations (directly attributed to funding security). Robust **bioinformatics** support is essential for data analysis, while **training** is required to equip staff with necessary skills. Ensuring the proper **infrastructure** is in place will provide the foundation for operations, and fostering skills diversity across the team will enhance collaborative efforts. Lastly, **political willpower** is crucial for garnering support and driving the initiative forward at higher levels.

THE GLOBAL AMR EMERGENCY

AMR DRIVERS (FARM TO FORK)

Farming practices



AMR microbes shared via trade partners

Chemical Disinfection Practice, Inappropriate antibiotic use and waste management

Poor knowledge (AMR drivers in relation to chemical disinfection and antibiotics)

SOLUTION

SUSTAINABLE SURVEILLANCE NEEDED

CHALLENGES

Funding	• ONE HEALTH Initiatives – relatively poorly funded. • Funding is project-by-project and short-term • Limitations interdisciplinary and cross-continental collaborative funding (4).
Consumables	• NGS consumables and equipment are expensive. • Links to requirement for funding for R&D, training and education, implementation, data analysis systems and curation, industry/government initiatives towards change to facilitate sustainable biovigilance systems.
Bioinformatics	• Require integrated data tools linking bioinformatics pipeline to environmental science discoveries • Data easily translated by clinicians, veterinarians, scientists and policymakers
Training	• Education of farmers and industry role players (Need EVIDENCE to educate and convince role-players about link between AMR and farming practices) • Skills diversity (Law and Science) • Community involvement – training in sample collection and regulations
Infrastructure	• Mobile laboratories, POC devices, Household survey teams, • On-site surveillance activities with community/role-player buy-in
Political Willpower	• Training to understand challenges and all role players to involve • Enforcement of in-country and cross-border biosafety regulations with trade partners

APPROACHES

Funding	• Innovative, targeted funding strategies • Development of ONE HEALTH networks though smaller funding calls (5) • Facilitating the development of proposals for larger funding applications to implement research hypothesis (data generation, analysis, ongoing tools and skills development, data dissemination) • shift towards funding long-term, sustainable partnerships • Specific funding for community and regulatory engagement
Consumables	• Smaller, mobile NGS systems (DNA extraction, POC NGS devices (e.g, Oxford Nanopore technology) are promising tools for the biovigilance continuum.
Bioinformatics	• Dedicated funding towards skills development
Training	• Strategic funding strategies for cross-disciplinary training with up-to-date access to all relevant tools and systems to analyse big data
Infrastructure	• Use of small, simple, mobile and easy to use devices
Political Willpower	• Continuous engagement with political role players (local government and higher) • Policy development

EXPECTED OUTCOMES

Funding	• Farmers, Industry and government provided with evidence of the AMR- Industry practices, optimise buy-in to sustainable practices • Evidence regarding profit vs sustainability. • Informed role players, community engagement and training
Consumables	• Synergistic relationship between farmers, testing facilities, industry and government to participate in funding initiatives • Enable provision of sustainable surveillance, with technology that can easily be adapted to new and cheaper NGS methods.
Bioinformatics	• Developing integrative skills (bioinformatics, biostatistics, epidemiological modelling, GIS)
Training	• Environmental Science: to assess and manage the impact of antibiotic residues and resistant bacteria on environment. • Agricultural Science: Knowledge and research of sustainable farming practices and animal husbandry, to reduce the reliance on antibiotics • Microbiology and Epidemiology: expertise on human disease, clinical practice and AMR, IPC, engagement with general practitioners to inform and improve knowledge and practices • Data Science and Bioinformatics: Analyse and interpret large datasets, trends in AMR patterns, supporting surveillance via GIS etc. • Behavioural Science: Understanding human behaviour and knowledge promoting AMR • Communication, Education: Raise awareness, educate, advocate for policy changes. • Public Health: To design and implement appropriate education programs, surveillance systems, infection control measures. • Medical and Veterinary Expertise: improvement of animal disease practices, IPC and engagement with farmers to inform and improve knowledge and practices
Infrastructure	• Sustainable funding enable access to point of care testing, with trained, mobile teams on the ground
Political Willpower	• Policy and Regulation: Developing and enforcing regulations

References

1. Mipatrini, D., et al. (2022). 'Disease X—time to act now and prepare for the next pandemic threat. *European Journal of Public Health*, 32(6), 841–842. https://doi.org/10.1093/eurpub/ckac065

2. World Health Organization. (n.d.). Food safety. *WHO*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/food-safety

3. Kapoor, S., Goel, A. D., & Jain, V. (2023). Milk-borne diseases through the lens of one health. *Frontiers in Microbiology, 14*, Article 1041051. https://doi.org/10.3389/fmicb.2023.1041051

4. Reza, H. M., et al. (2024). Establishing equitable partnerships between the Global North and Global South. *The Lancet*, 404(10454), 746–747. https://doi.org/10.1016/S0140-6736(24)00407-2

5. Cole *et al*. 2024, Lessons identified for Equitable Partnership Working, Network Grant report GCRFNGR8\118

Acknowledgments and contacts

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UK-South Africa partnership on Biovigilance utilising next-generation sequencing (NGS) technology across the One Heath continuum

The Academy of Medical Sciences

Networking Grant Scheme Round 1 (NGR1\1105)
University of Cape Town 28 October 2024

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TOWARDS NEXT GENERATION SEQUENCING (INCLUDING METAGENOMICS)

across a ONE HEALTH spectrum in SOUTH AFRICA & UK

STEWARDSHIP for the COMMON GOOD

PROFESSOR LIONEL GREEN-THOMPSON, DEAN FHS, UCT

PROF HERMINE MKRTCHYAN

BIO-VIGILANCE AROUND the GLOBE

WE NEED TO COME TOGETHER TO FIND & IMPLEMENT Solutions

TRANSLATE SEQUENCING & METAGENOMICS into ACTION & POLICY

PROF ADRIAN BRINK

HEALTHY HUMANS

- INCLUDE QUALITATIVE RESEARCH
  - SOCIO, CULTURAL, BEHAVIOURAL FACTORS

WATER & SANITATION

- DISEASE SURVEILLANCE linked to CLIMATE CHANGE

ENABLING OPPORTUNITIES

- NETWORK of LIKE-MINDED PEOPLE
- FRAMEWORKS for COLLABORATION
- LEARNING from SUCCESSFUL CASES

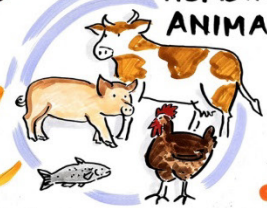
MULTI-DISCIPLINARY

INTEGRATED APPROACH

BREAKING the SILOS...

- ENDEMIC ZOONOSES & AMR in RURAL SETTINGS
- NEW TRAININGS & COURSES
- STREAMLINING & PRIORITISATION

HEALTHY ANIMALS



- WATER-BORNE ZOONOSES
  - IDENTIFY & PRIORITIZE SUSCEPTIBLE ENVIRONMENTAL RESERVOIRS
- ANTIMICROBIAL RESISTANCE PREVALENCE & TRANSMISSION BETWEEN ANIMALS & HUMANS

- REAL-TIME METAGENOMIC RESULTS for CLINICAL USE
  - SPECIES
  - ANTIBIOTIC RESISTANCE
- GLOBALLY, COLLABORATIVE APPROACHES that INCLUDE LMICS

NETWORKS

- DATA SHARING
- JOINT FUNDING
- RESEARCH FRAMEWORKS

HEALTHY ENVIRONMENTS

Come join the ONE HEALTH THINK TANK!

NGS: EARLY WARNING SYSTEMS

CHALLENGES to IMPLEMENTATION:

- FUNDING
- INFRASTRUCTURE
- POLICY
- BUY-IN (CULTURAL)
- SKILLS & CAPABILITY

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COMMENT Open Access

Advancing one health surveillance in South Africa

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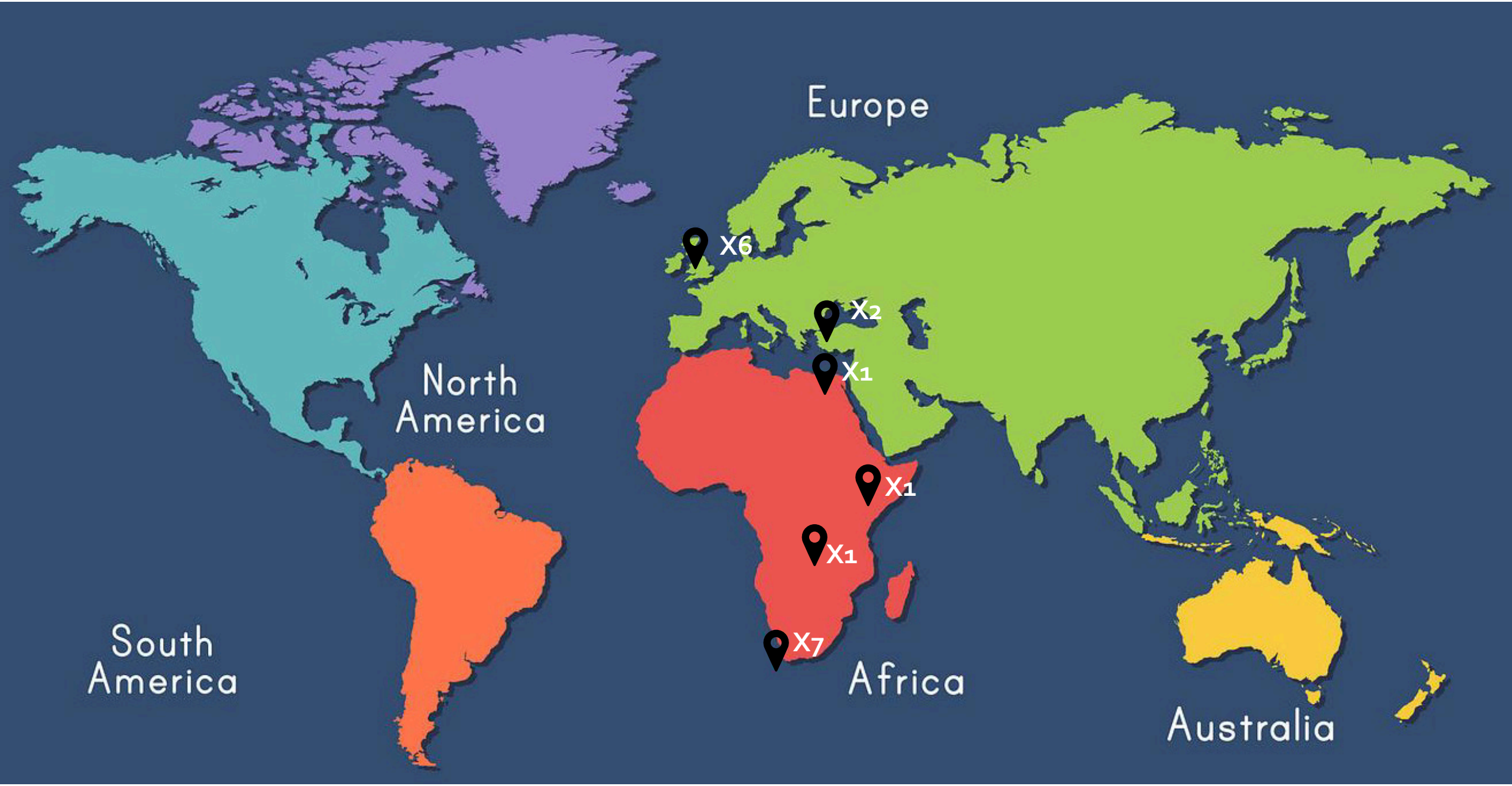
Abstract
Antimicrobial resistance (AMR) and zoonotic diseases are global public health threats with serious implications for human, animal, and environmental health. In South Africa, AMR and zoonotic disease outbreaks pose significant threats to public health and food security. Despite a robust AMR surveillance system for human health, the absence of a national routine surveillance program for livestock hinders a comprehensive One Health (OH) approach. The 2024 UK-South Africa workshop in Cape Town convened key stakeholders from human and animal health, environmental sciences, and food production to address these challenges. Discussions focused on integrating OH surveillance, leveraging Next-Generation Sequencing (NGS) for early outbreak detection, and improving food and water safety. Workshop outcomes emphasized the necessity of cross-sector collaboration to enhance AMR monitoring and outbreak preparedness. Stakeholder engagement, particularly within agricultural communities, was identified as critical for OH implementation. Participants highlighted the need for culturally sensitive engagement strategies, qualitative research methods, and policy reforms to drive adoption. Lessons from tuberculosis (TB) and HIV programs informed strategies for fostering compliance and integrating OH principles into veterinary education, particularly in antimicrobial stewardship. Challenges such as resource limitations, bioinformatics capacity gaps, and resistance to new technologies were addressed through recommendations for joint consortia, leveraging existing infrastructure, and targeted training. Aligning OH initiatives with consumer-driven concerns, such as water quality monitoring, was also identified as a key opportunity. Moving forward, translating research into action will require sustained collaboration, policy alignment, and community engagement. Strengthening OH surveillance can enhance South Africa's ability to prevent and control infectious diseases, ensuring long-term public health resilience and food security.

Keywords One health, Community engagement, Next generation sequencing, Antimicrobial resistance, Early warning systems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