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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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A 2015 CDC report highlighted the need for a One Health (OH) program to strengthen collaboration between human and veterinary health sectors in South Africa (SA) [1]. Nearly a decade later, gaps remain in cross-sector cooperation, policy integration, and surveillance technologies [1]. The current antimicrobial resistance (AMR) surveillance system in humans, supported by public and private laboratories, provides comprehensive data on AMR in patient blood cultures for ESKAPE* pathogens [2].

In contrast, no national AMR surveillance exists for livestock. SA's agricultural sector likely faces a significant AMR burden, with large-scale farmers—responsible for 80% of the national meat supply—at critical risk. Additionally, zoonotic outbreaks such as the *Listeriosis* and the continued spread of *Salmonella* spp. highlight the need for an OH surveillance approach that integrates human, environmental, and animal health [3, 4].

In November 2024, a UK-South Africa workshop in Cape Town explored strategies to implement OH surveillance in SA. This two-day participatory workshop showcased presentations from OH related projects from variety of backgrounds (Veterinary, Engineering, Environmental, Water, Human Health and Social Sciences) (see Fig. 1). It concluded with an interactive workshop that was followed by an online follow up survey. The focus included minimising zoonotic outbreaks, improving food and water security, and understanding AMR transmission within the OH continuum.

Conventional surveillance techniques rely on clinical reporting, syndromic surveillance, and laboratory-based diagnostics, but these methods often face delays in detection and limited integration across sectors. Next-Generation Sequencing (NGS) offers a transformative tool, enabling high-resolution, real-time pathogen identification, AMR profiling, and source tracking across human, animal, and environmental samples [5, 6]. The workshop brought together key stakeholders from human and animal health, water management, and environmental sciences to discuss research findings and explore how NGS could enhance food production safety, water quality, and early biovigilance (warning) systems. Although the concept of leveraging the power of genomics to prevent and control infectious diseases has been highlighted before [7], discussions at the workshop aimed to identify barriers, set research priorities, and foster collaborations benefiting affected populations. While participants emphasized the importance of expanded sequencing capabilities, they stressed the urgent need for a holistic approach supported by community engagement and policy alignment.

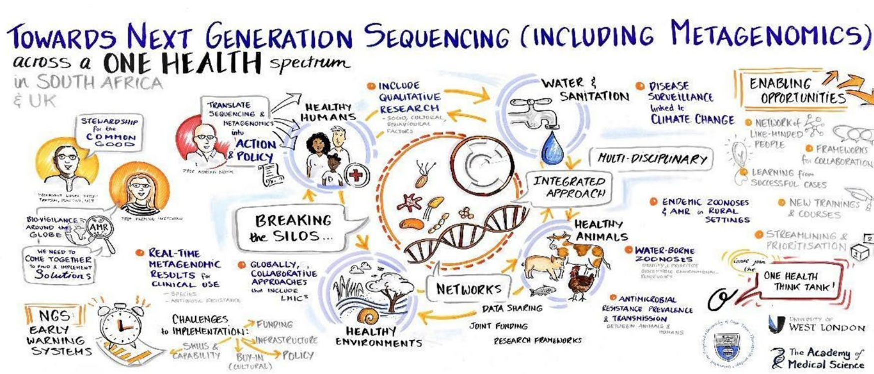

Fig. 1 Next generation sequencing (NGS) for leveraging one health surveillance (picture developed by sonja niederhumer grom graphic harvest)

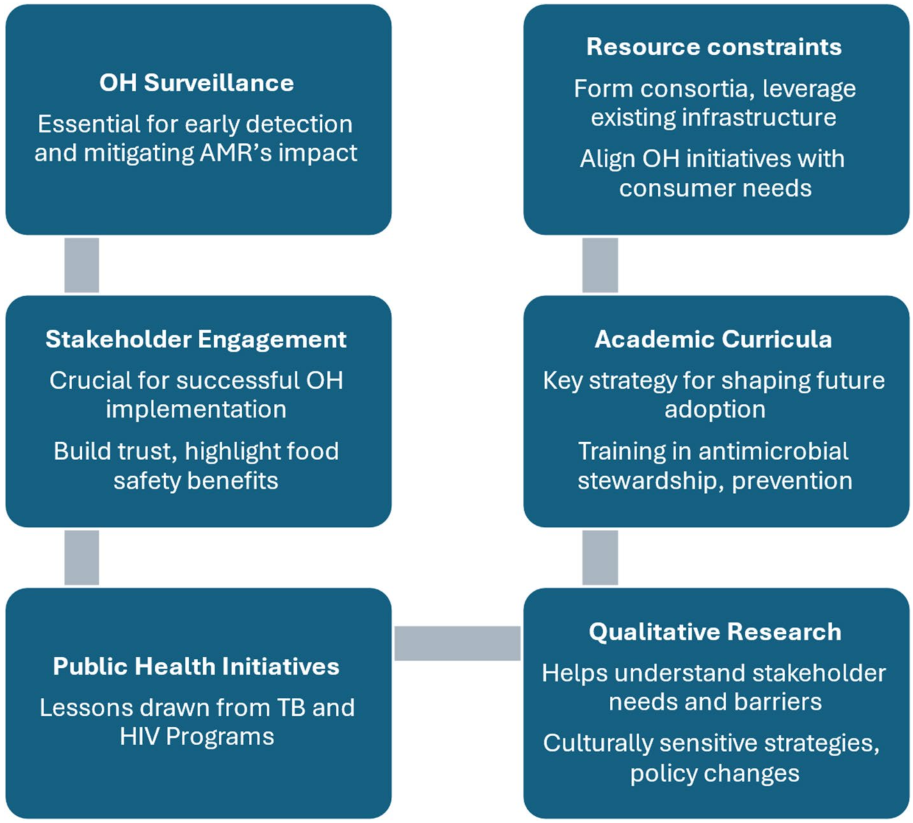

Fig. 2 Schematic summarizing workshop discussion points and post workshop online questionnaire

1 Workshop outcomes (see Fig. 2)

1. OH surveillance is essential for early outbreak detection. Integrating surveillance across human, animal, and environmental sectors can mitigate AMR's impact on public health and food safety. Tailor-made interventions were identified as critical for informed decision-making and cost savings. A post-workshop survey reinforced these priorities, with participants citing challenges such as inadequate awareness, limited data and NGS access, and gaps in monitoring systems.
2. Stakeholder engagement was deemed crucial for successful OH implementation. A ***bottom-up*** approach was recommended to build trust, particularly among farmers and agricultural businesses. Highlighting NGS's value in food safety and cost reduction was seen as a key strategy. Attendees emphasized the importance of personal communication in overcoming resistance to new technologies and influencing their adoption.
3. The workshop underscored the role of qualitative research, including anthropological and social science methods, in understanding stakeholder needs and barriers. Culturally sensitive engagement strategies and market-driven incentives were identified as potential enablers of OH adoption. Policy changes, such as improved ministerial governance and functional surveillance systems, were also highlighted as critical drivers of progress.
4. Participants drew lessons from successful public health initiatives, including tuberculosis (TB) and HIV programs [8]. Using these as potential models for engaging stakeholders and ensuring compliance in OH surveillance efforts.

5. Integrating OH concepts into academic curricula was identified as a key strategy for shaping future adoption. Participants suggested incorporating these principles into training programs for veterinarians, emphasizing antimicrobial stewardship (AMS) and infection prevention strategies adapted from medical and pharmaceutical sectors. Training veterinary students on the sustainable use of antimicrobials and the impact of AMR within the OH context could significantly reduce AMR transmission via animals, the environment, and food products.
6. Resource constraints, limited bioinformatics capacity, and cultural resistance were recurring themes. Participants recommended forming joint consortia, leveraging existing infrastructure, and targeted training—particularly for industry partners interested in adopting NGS practices. Additionally, aligning OH initiatives with consumer-driven needs, such as water quality monitoring, was seen as a critical opportunity.

Translating OH research priorities into action is vital for developing evidence-based policies that prevent and control infectious diseases. Strengthening national capacity for biological incident response requires a holistic approach that integrates human, animal, and environmental health perspectives. The workshop reinforced the transformative potential of OH surveillance in addressing AMR and zoonotic threats within SA's health and agricultural sectors. By prioritizing community engagement, leveraging advanced technologies, enhancing training programs, and aligning initiatives with public health objectives, stakeholders can build a resilient framework for sustainable food safety and water security. Integrating OH principles into policy and education will be crucial for ensuring long-term impact and strengthening regional health security.

Abbreviations

OH	One Health
SA	South Africa
AMR	Antimicrobial resistance
ESKAPE* pathogens	**Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, Enterobacter spp.*
NGS	Next generation sequencing
TB	Tuberculosis
HIV	Human immunodeficiency virus

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Author contributions
Widaad Zemanay (WZ): summarized data from the workshop, drafted and finalized the work Mahmoud Elthoth (ME): Substantively revised the work, approved it and takes responsibility for contributions within.Adrian Brink (AB): Substantively revised the work, approved it and takes responsibility for contributions within.Hermine Mkrtchyan (HM): Substantively revised the work, approved it and takes responsibility for contributions within.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Clinical trial number
Not applicable.

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