Integrated

Antimicrobial Resistance Surveillance

in West Bank Wastewater:

Control and Mechanisms

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Failing to address AMR could result in:

Source of the information in the figure [1]

The political and epidemiological conditions in the occupied Palestinian territory intensify AMR, increasing the demand for antibiotics and posing a pressing threat to public health. Immediate and strategic interventions are imperative to mitigate the impending crisis, necessitating a fundamental reshaping of the epidemiological paradigm surrounding AMR.

1 *O'Neill J. Tackling drug-resistant infections globally: final report and recommendations. 2016 19 May.*

Introduction:

Antimicrobial medicines, crucial for treating various diseases, are facing a rising global health threat due to antimicrobial resistance (**AMR**). Microorganisms are becoming resistant, which reduces the effectiveness of medical interventions, making treatment riskier and costlier, and impacting patients' quality of life [2] (Figure 1). While **AMR** has primarily been addressed in healthcare, a **One-Health** approach emphasizes the importance of interdisciplinary efforts, including environmental surveillance, to comprehensively tackle the **AMR** crisis [3]. (Figure 2) Resistance emergence is a natural outcome of microorganisms facing environmental pressure, like antimicrobial medicines, leading them to acquire genes and share them with other organisms [4]. Factors such as improper antimicrobial use, overuse, and disposal contribute to antimicrobial resistance. Additionally, poor infection control, sanitation, limited access to clean water, environmental contamination, and the interaction among infected humans and animals play roles in spreading resistant organisms and genes. Recognizing the environment as a reservoir of resistance underscores its significance for monitoring **AMR** prevalence and estimating the risk of future infections [4].

Figure 1: *AMR impacts 12 of 17 UN SDGs*

2 *Antimicrobial resistance and the United Nations sustainable development cooperation framework: Guidance for United Nations Country teams*. World Health Organization; 2021. https://www.who.int/publications/i/item/9789240036024

3 Tripartite and UNEP support OHHLEP's definition of "One Health". Joint Tripartite (FAO, OIE, WHO) and UNEP Statement. World Health Organization. December 1, 2021. Accessed February 20, 2024. https://www.who.int/news/item/01-12-2021-tripartite-and-unep-support-ohhlep-s-definition-of-one-health

4 Abukhattab S, Hosch S, Abu-Rmeileh NM, Hasan S, Vonaesch P, Crump L, Hattendorf J, Daubenberger C, Zinsstag J, Schindler T. Whole-genome sequencing for One Health surveillance of antimicrobial resistance in conflict zones: a case study of Salmonella spp. and Campylobacter spp. in the West Bank, Palestine. Applied and environmental microbiology. 2023 Sep 28;89(9):e00658-23.

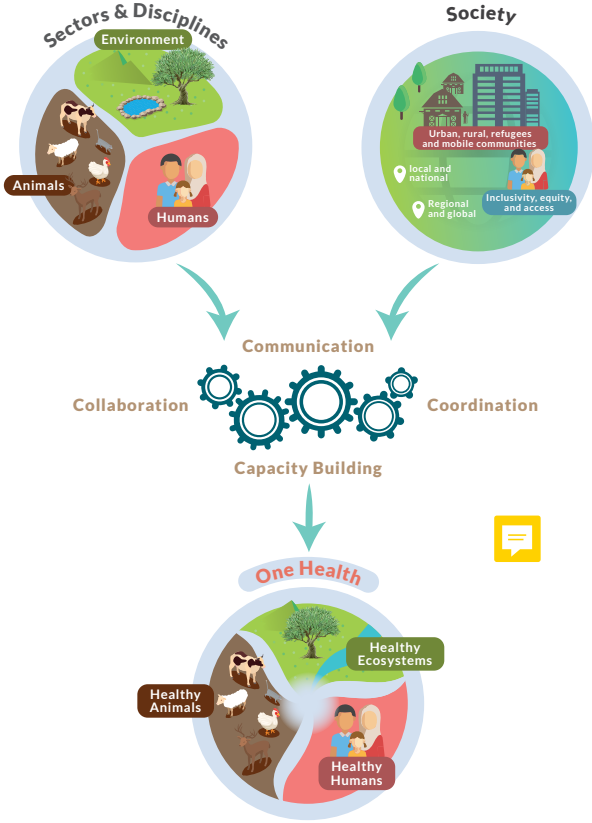
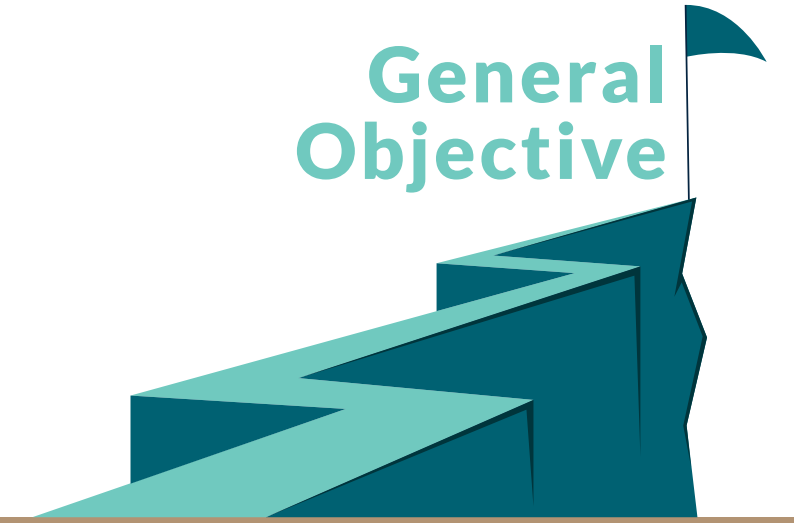


Figure 2: *Derived from the WHO (2021) and adapted to the Palestinian Context. One Health approach advocates for a sustainable and well-being future by emphasizing collaboration, communication, coordination, and capacity building* [3].

*"**One Health** is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems."* [3]

3 Tripartite and UNEP support OHHLEP's definition of "One Health". Joint Tripartite (FAO, OIE, WHO) and UNEP Statement. World Health Organization. December 1, 2021. Accessed February 20, 2024. https://www.who.int/news/item/01-12-2021-tripartite-and-unep-support-ohhlep-s-definition-of-one-health

General Objective



To establish a comprehensive framework for addressing **AMR** through a **One Health** approach for a larger-scale evidence-based initiative by implementing a holistic and integrated **One Health** strategy for **AMR** in Palestine.

Specific objectives:

1. To investigate the frequency, spatial distribution and main hotspots of anthropogenic **AMR** in the West Bank, Palestine.

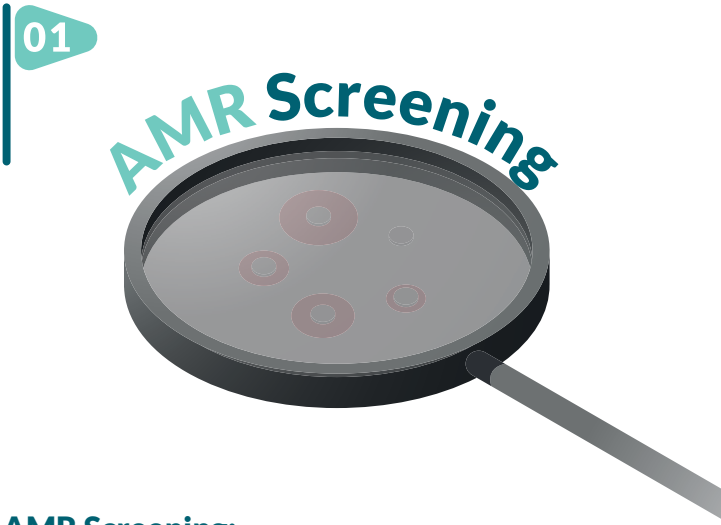
2. To understand the impact of rapid urbanization and intensive food production on **AMR** in the West Bank, Palestine.

3. To assess the most important pathways fostering **AMR** sharing between human, animal, environmental, wildlife, water and food sources.

4. To investigate what interventions can be implemented in Palestine to limit the impact of **AMR** transmission pathways.

Project approach and expected outcomes:

01



AMR Screening:

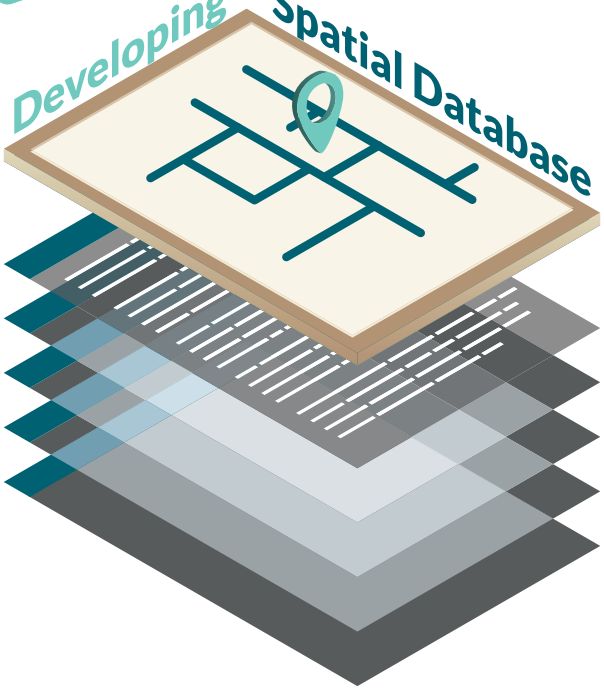
- Collect samples from urban, rural, and refugee areas over a period of 24 months, with the anticipation of identifying 1-6 expected hotspots as will be illustrated in the methods section.
- Analyse prevalence of resistance mechanisms.

Outcomes

AMR hotspot detection, microbial risk assessment, informed healthcare decisions, and centralized sample archive.

02

Developing Spatial Database



Developing Spatial Database:

- Illustrate GPS mapping of AMR hotspots.
- Database includes geographical locations, sample details, tests, and contamination levels.
- Establish geospatial model with aerial photos and land cover layers.

Outcomes

Predict impacted areas and serve as an early warning system.

03

Prevention and Mitigation:

- Steering committee with government experts, academics, private sector, and civil society.
- Systematic review for waste treatment solutions.
- Stakeholders propose context-specific solutions.
- Focus group discussions consider local context.

Outcomes

Evidence-based recommendations guide sustainable interventions.

04

Institutional Analysis:

- Qualitative and quantitative analysis of existing governance arrangements.
- Analysis of epistemic communities and political economy dynamics.

Outcomes

Describe policy space for advancing governance architectures and guiding impact assessments.

AMR Screening

Resistant Bacteria

Resistant Genome

Multidrug Resistant Pathogen

AMR Screening Methodology

We will implement a comprehensive sampling strategy, using wastewater-based surveillance system for AMR in the West Bank. The process involves three main steps.

Sampling Locations:

- Samples will be systematically collected from expected hotspots situated across three governorates in the West Bank (South, Middle, and North) for 24 months.
- The designated hotspots encompass a variety of critical settings, including Healthcare Facilities, Industries, Animal Production Farms, Households, and Springs water, from Urban, Rural, and Refugee camps.

Laboratory Analysis:

- The collected samples will be transported to the laboratory for further analysis.
- In the lab, we will conduct DNA extraction, followed by advanced techniques like Shotgun Metagenomics and Whole-Genome Sequencing. These methods will be employed to assess the diversity and abundance of antimicrobial resistance within the sewage systems across the three regions in the West Bank.

Innovative Intervention Competition:

- Expected hotspots will be the focus of a competitive initiative at the national level.
- The aim is to encourage the development of innovative interventions to effectively mitigate AMR in these specific sites.

ONE HEALTH for AMR

Antimicrobial Resistance

Partnerships

Strengthen

Our Efforts and

Increase

Our Impact.

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