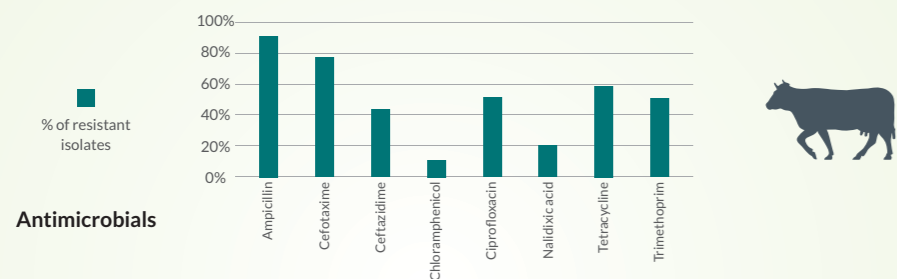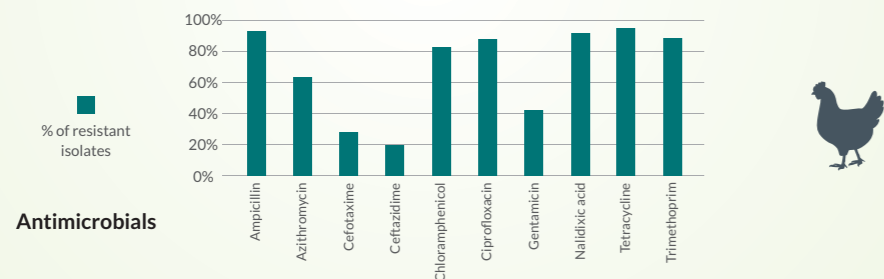**The stacked graphs below display the resistance levels of bacteria targeted in different animal species against the panel of antibiotics.**
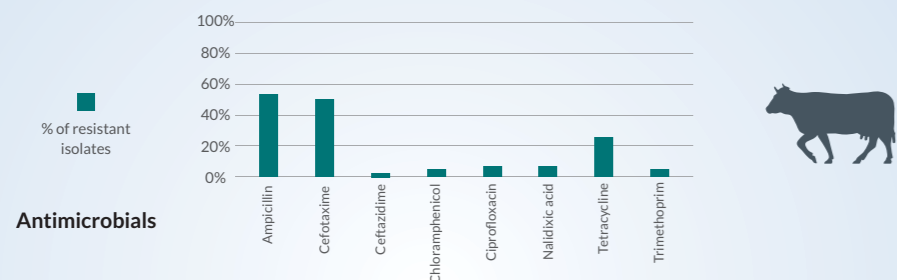
Cattle & Buffalo isolates - AMR levels in isolates of *Escherichia coli*
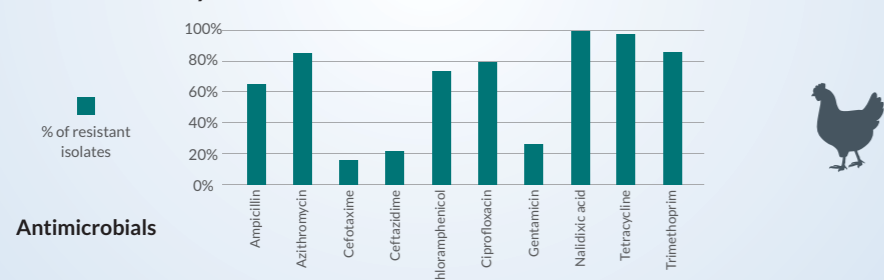

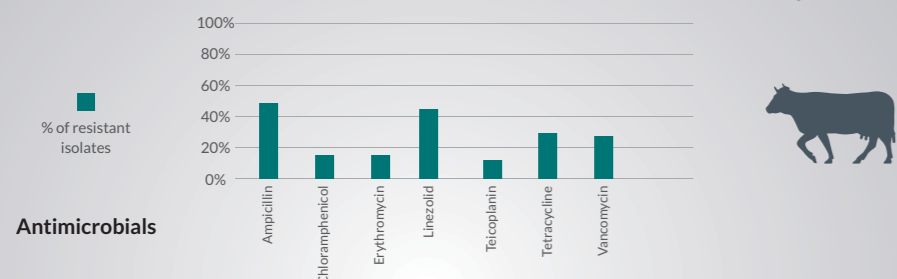Poultry isolates - AMR levels in isolates of *Escherichia coli*

Cattle & Buffalo isolates - AMR levels in isolates of *Salmonella*
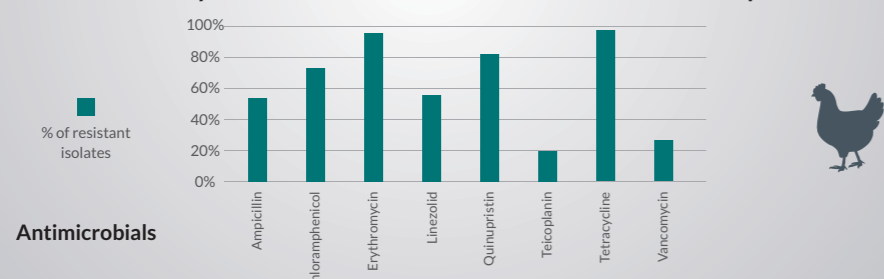

Poultry isolates - AMR levels in isolates of *Salmonella*

Cattle & Buffalo isolates - AMR levels in isolates of *Enterococcus sp.*

Poultry isolates - AMR levels in isolates of *Enterococcus sp.*

Quality Assurance Measures

- Sample collection, bacterial isolation, identification, and antimicrobial sensitivity testing (AST) were conducted as per the Clinical and Laboratory Standards Institute (CLSI) guidelines and ISO standards.

- Capacity building of the staff from national reference laboratories was conducted on sample collection, bacterial isolation, identification, and AST of the targeted pathogens.

Way Forward

1. Foster continuous collaboration through workshops and conferences to discuss the report's findings and practical implications, building on the successful dissemination of the report.

2. Maintain support and advocacy meetings with the Animal Husbandry Commissioner (AHC) office for implementing recommendations and incorporating a robust monitoring and evaluation framework.

3. Enable relevant stakeholders at federal and provincial levels to implement targeted interventions based on the report's recommendations, while extending surveillance activities to other food animals and production phases and enhancing data collection and analysis capabilities to support efficient surveillance.

4. Identify needs and conduct capacity-building programs for veterinarians, farmers, and animal health personnel, aligning with the transfer of diagnostic abilities from federal to provincial levels.

5. Share data with public health partners to holistically integrate national AMR surveillance efforts, ensuring a comprehensive approach to addressing AMR.

6. Collaboratively develop funding mechanisms at the government level to sustain AMR surveillance activities in the livestock sector, promoting long-term sustainability and effectiveness.

In response to the critical threat of AMR, Pakistan's government, in alignment with the AMR NAP, has successfully conducted surveillance in healthy food animals. Moving forward, the emphasis is on continuous collaboration, capacity-building, and sustainable funding to combat AMR effectively and ensure the well-being of both human and animal populations.

Antimicrobial Resistance Surveillance in
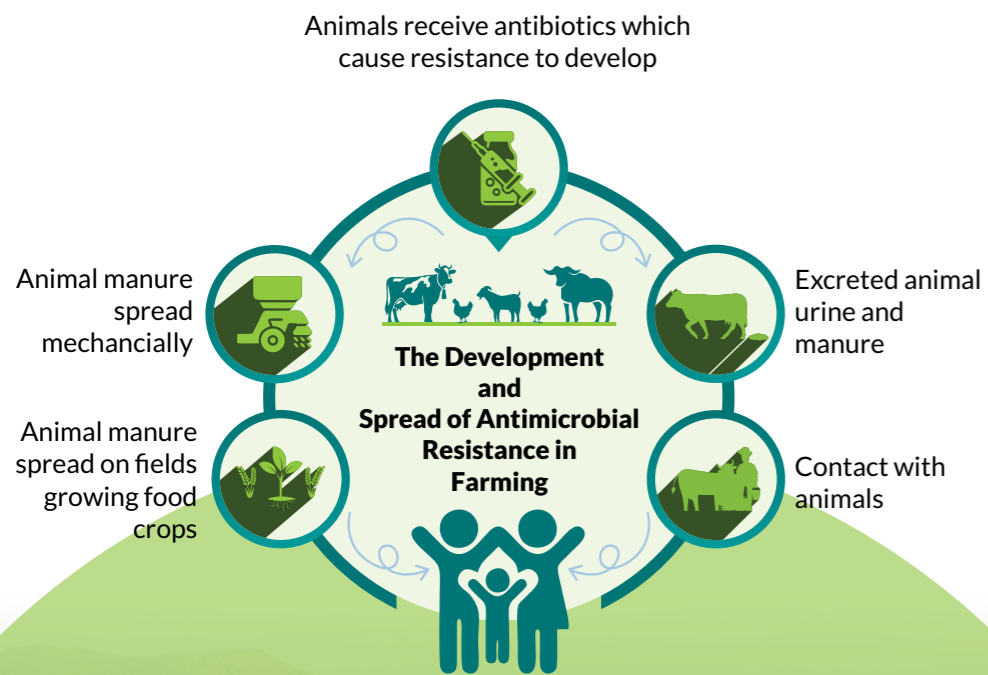
HEALTHY FOOD ANIMALS

Pakistan National AMR Surveillance Program Highlights

Introduction

Antimicrobial Resistance (AMR) has emerged as a silent pandemic, contributing five million deaths globally each year, including 60,000 in Pakistan, and hindering progress towards the 2030 Sustainable Development Goals. The primary cause of AMR is the improper use of antimicrobials in humans and animals, including unnecessary prescriptions and use as growth promotors in livestock. This misuse has led to the emergence of antimicrobial resistant bacteria in humans and animals and are maintained in the environment. Resistance in foodborne zoonotic pathogens exacerbate the issue, contributing to the burden of illness and food security. Mitigating AMR risks requires a One Health approach.

Pakistan, with its large population and production of significant livestock, faces a heavy AMR burden. To combat this, the government launched a National Action Plan (NAP) in 2017. Supported by the Fleming Fund Country Grant Pakistan, a surveillance study was conducted from July 2020 to December 2022 aimed to establish AMR monitoring systems, improve epidemiological skills, and estimate AMR prevalence in poultry and livestock, focusing on critical antimicrobials identified by the WHO.

Animals receive antibiotics which cause resistance to develop

Animal manure spread mechanically

Excreted animal urine and manure

The Development and Spread of Antimicrobial Resistance in Farming

Animal manure spread on fields growing food crops

Contact with animals

In response to identified needs, a AMR surveillance study was conceived as a proof-of-concept of the AMR NAP. The primary objective of this surveillance study was to inaugurate a monitoring and surveillance initiative for AMR in healthy food animals.

Study Objectives

01 To pilot the AMR surveillance methodologies in animals including sample collection and processing, laboratory testing (bacterial culture and recovery), data management, analysis and reporting. This also served as training for relevant staff for improved microbiological and epidemiological capacities.

02 To generate baseline estimates of the prevalence of resistance in target bacteria from healthy slaughtered poultry and large ruminants using a panel of antimicrobials used in humans and animals.

Study Design

The overview of the study design is summarised below:

Target animal species
- Healthy commercial broiler poultry
- Large ruminants (cattle and buffalo) intended for human consumption

Sampling sites
- Nine Peripheral Sentinel Laboratories (PSLs)
- Sample collected through active surveillance

Specimen collected
- Caecal /faecal contents

Data Collection Timeline
- July 2020 - December 2022

Sample processing
- National Veterinary Laboratory (NVL)
- National Reference Laboratory for Poultry Diseases (NRLPD)
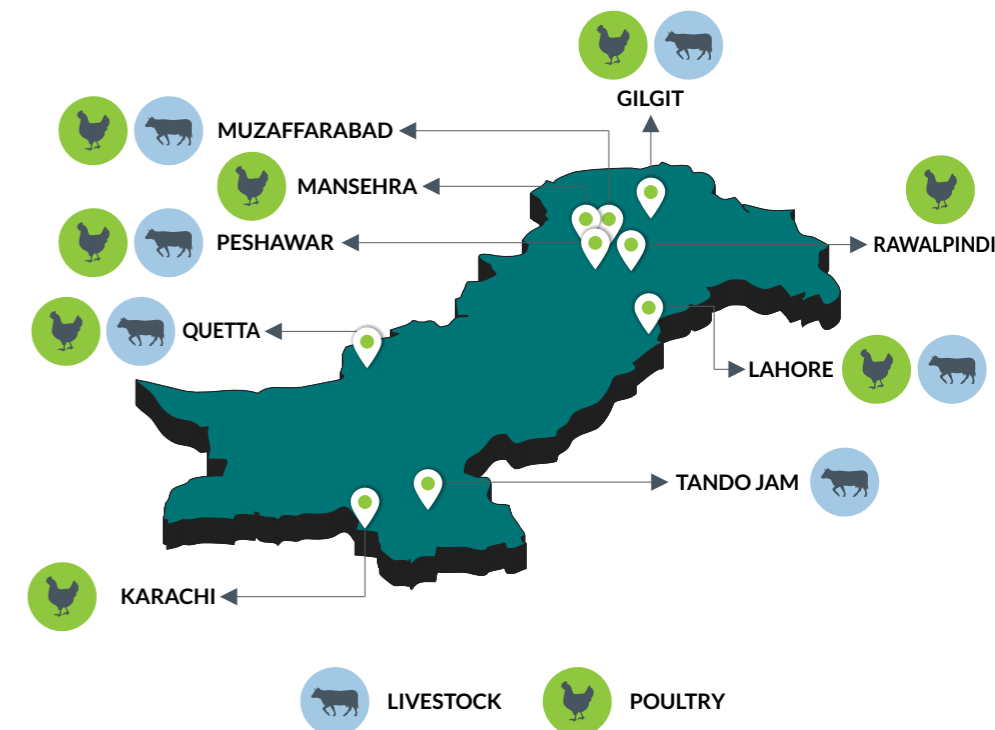
Targeted bacteria
- *Escherichia coli*
- *Enterococcus spp.*
- *Salmonella spp.*

Antimicrobial Sensitivity Testing (AST)

- Panel of WHO's Highest Priority Critically Important Antimicrobials (HP-CIA's), and highly important antimicrobials (HIA)

The study samples were collected from the following sentinel sites:

GILGIT

MUZAFFARABAD

MANSEHRA

PESHAWAR

RAWALPINDI

QUETTA

LAHORE

TANDO JAM

KARACHI

LIVESTOCK   POULTRY

Study Results

The study has recovered *E. coli, nontyphoidal Salmonella* and *Enterococcus* spp. from the samples obtained from poultry and ruminants. The percentage of isolates varied depending on the laboratory and animal host species as indicated in the table below:

National Reference lab receiving samples	Samples received (n)	Animal host species	Isolates obtained		
			E. coli n (%)	Salmonella n (%)	Enterococcus n (%)
National Veterinary Laboratory	3,474	Cattle and buffaloes	1,237 (35%)	44 (1.3%)	560 (16.1%)
National Reference Lab for Poultry Diseases	2,317	Poultry	1,456 (63%)	417 (18%)	300 (13%)

Resistance to antimicrobials deemed as critically important in human medicine were frequently detected in bacteria from both animal host species. Of important concern, resistance to highest priority antimicrobials including ciprofloxacin and ceftazidime were detected in *E. coli and Salmonella*, as well as vancomycin-resistant *Enterococcus* spp. (poultry only).