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Challenges of AMR research based on One Health approach in Colombia: a case study of Low and Middle-Income Country

Pilar Donado-Godoy MV, MSc, PhD

Webinar Series -June 9 2022

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- Risk Factors of AMR development in Colombia
- General framework of the fight against AMR in Colombia
- AMR Research Initiative of Agrosavia-Sanger
- Colombian Strategic AMR Research Agenda
- Four concluding remarks

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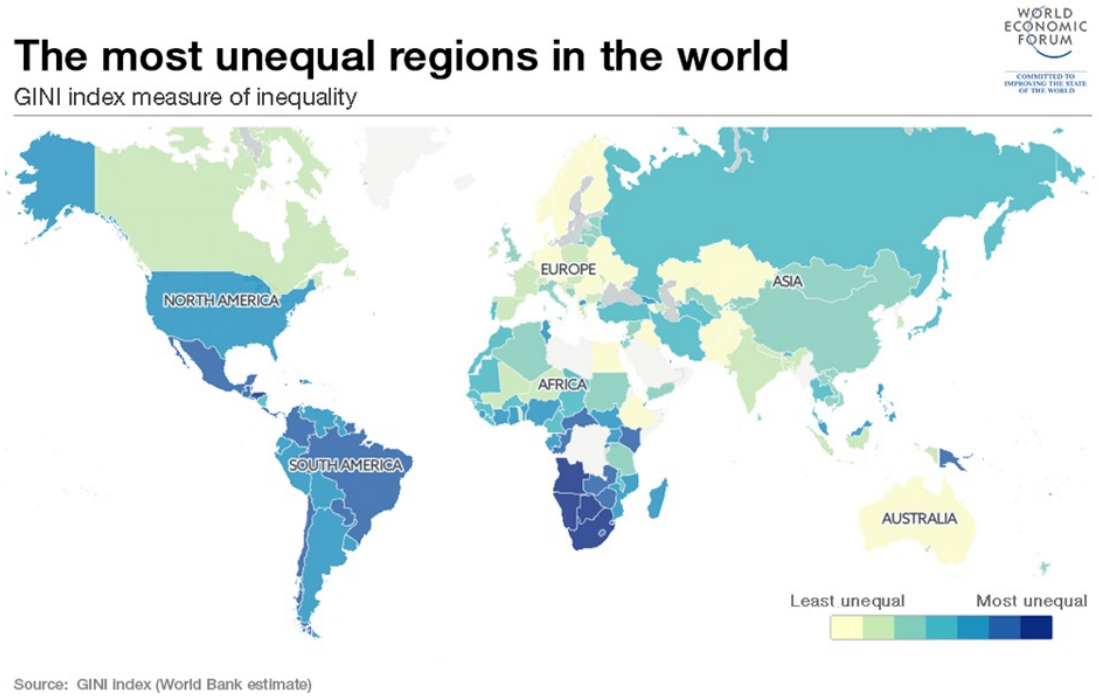
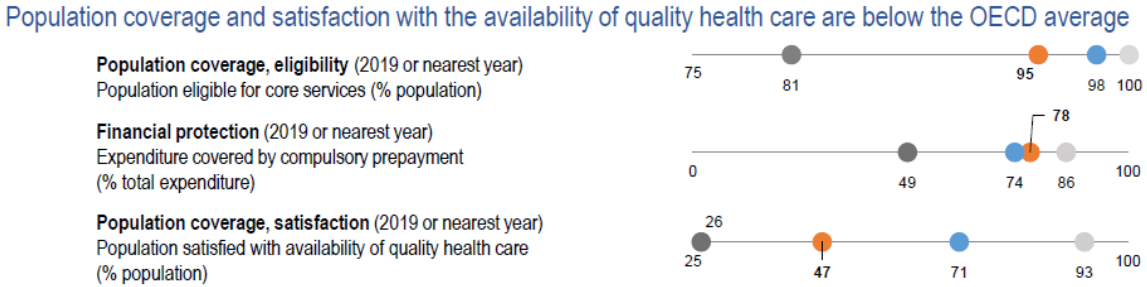
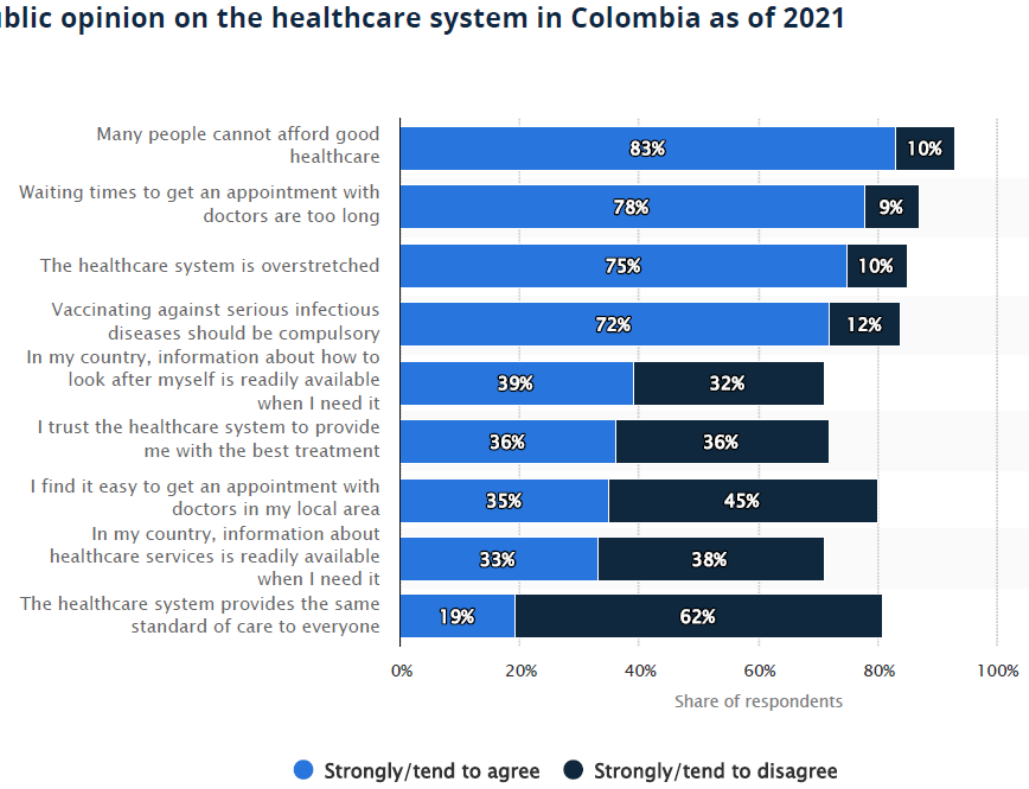
Colombia…

- **Population: 50 M**
- **1,141,748 km^2**
- **Second largest biodiversity in the world**
- **GDP per capita 2020: 5,334 USD /capita**
- **Index Gini 2020: 54.1**
- **Urban population 2020: 81.4%**
- **Internal Displaced Population 2021: 5.2M**
- **Immigrated Population 2021: > 2 M**



Colombian Health System

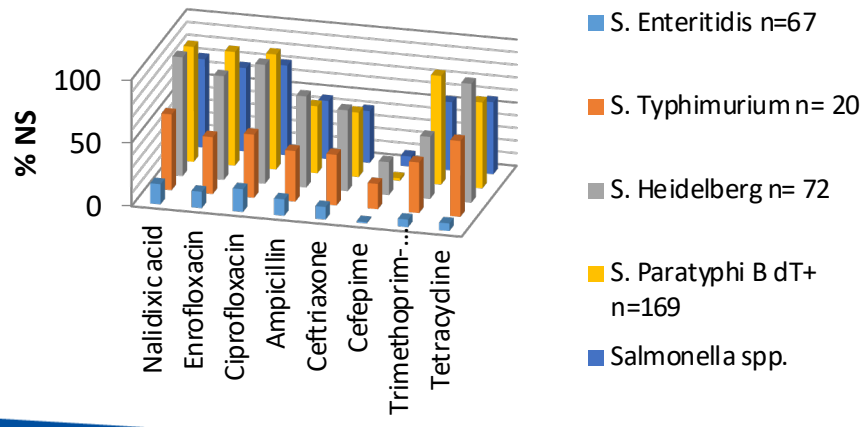




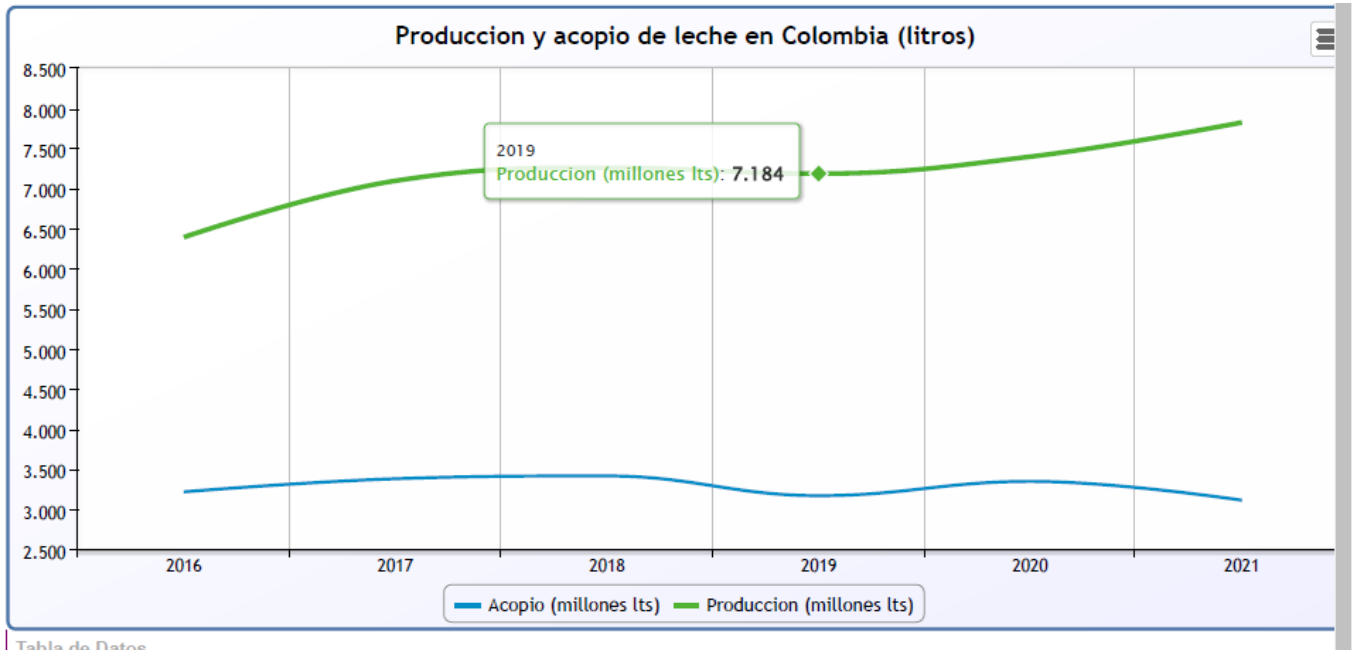
- **Inequality in health system coverage**
- **Population in need of health assistance 2021: > 3M**
- **Defined-daily-dose (DDD) of Carbapenem in Colombia is 20 times higher than in Europe and North America**
- **The Health System under pressure to offer similar quality for all sectors of the population that promote the overuse of Abx.**

Colombian Agri-food Sector

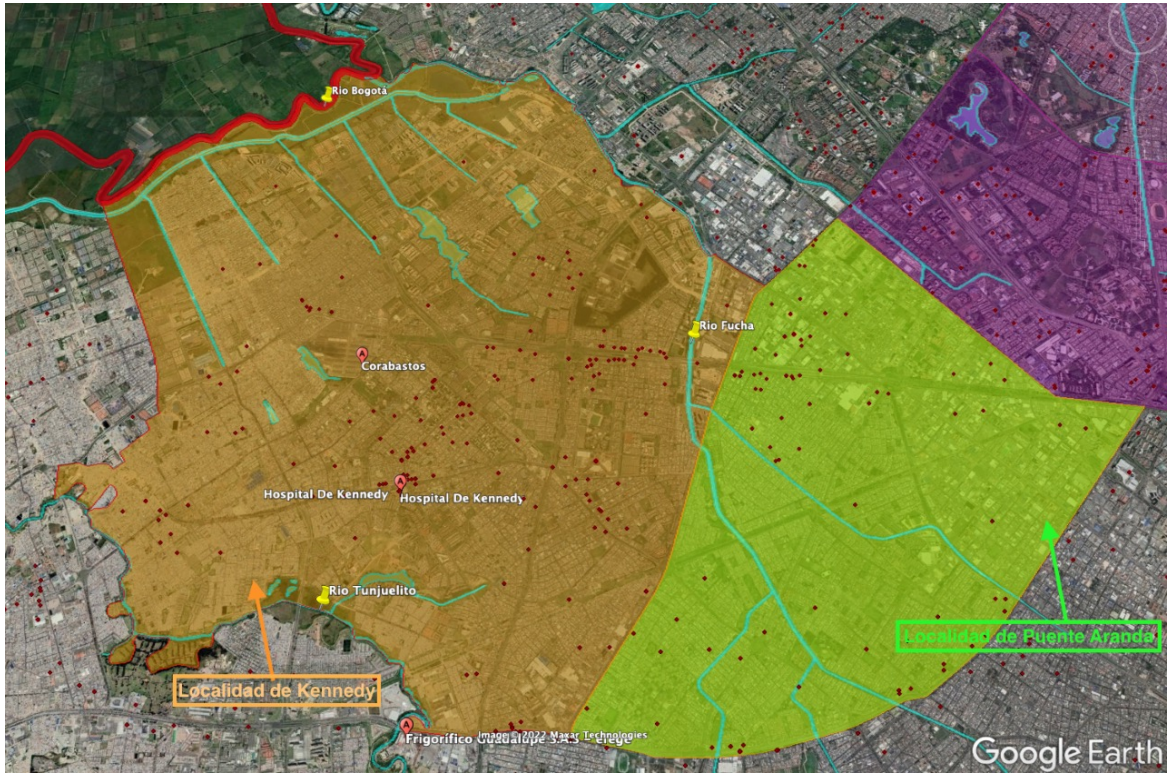
- **Significant informality in agri-food markets**
- **Antibiotic stewardship difficult**
- **Examples of resistance profiles- Salmonella**



U.Georgia 2010-2012



Numerous potential AMR Hotspots



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Research and innovation play a crucial role In the Global Action Plan (GAP) in RAM

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Improved awareness of AMR and behaviour change among policy-makers, farmers, veterinary and health workers, food industry, general public	1	Increased awareness and understanding Training and professional education Strengthened veterinary services
Strengthened knowledge and evidence base used for policy and practice decisions	2	Monitoring antimicrobial use Surveillance for AMR **Research on AMR and antimicrobial use**
Reduced incidence of infection in health facilities, farms and communities as well as reduced environmental contamination,due to effective prevention	3	IPC in human health care Good animal health and management practices WASH and immunization
Optimized use of antimicrobials in human and animal health, with growth promotion phased out	4	Optimized antimicrobial use and regulation Legislation and regulations to prevent environmental contamination
Increased R&D on new medicines, diagnostics, vaccines and other inventions. Sustainable investments	5	Estimated resource needs and economic case Coordinated efforts, priorities and incentives **More investment in relevant R&D**

National Action Plan (NAP)

- **In progress – Initiation date**
- **Technical Board**
- **Embryonic OH approach**
- **Low visibility of research activities in NAP**

Surveillance & Research Activities

- **Progressive deployment of infrastructure and new technologies**
- **INS, ICA, INVIMA**
- **Hospitals and IPS (health service providers) – Private - Public**
- **EPS (Health Management Organizations) – Private**
- **National Genomic Center – 2022**
- **Agrifood and environmental sectors lag behind**

- **No national strategic agenda yet**
- **Less than 30 research teams involved**
- **Limited participation in international consortiums**
- **Few innovation niches**
- **Oportunistic approach**
- **Limited financing**

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What is Agrosavia?
Colombian Institute of Agricultural Research

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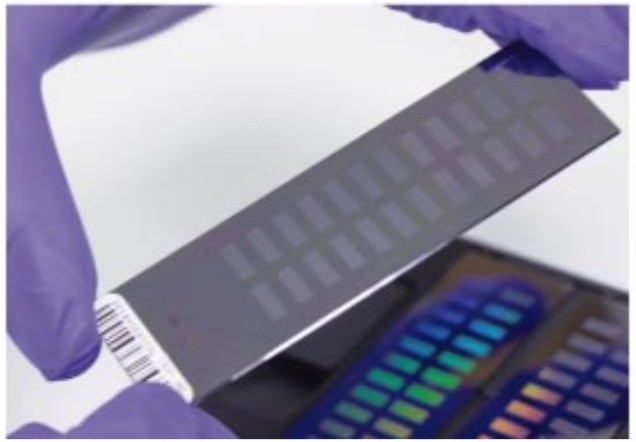
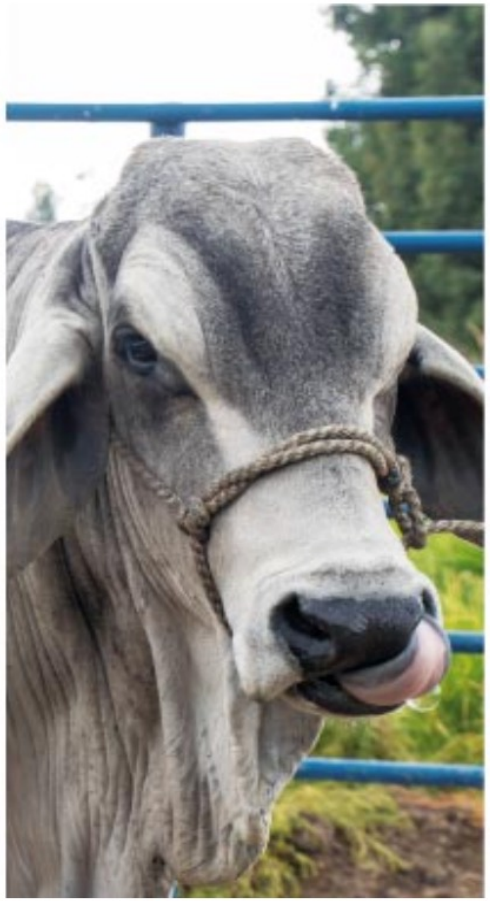
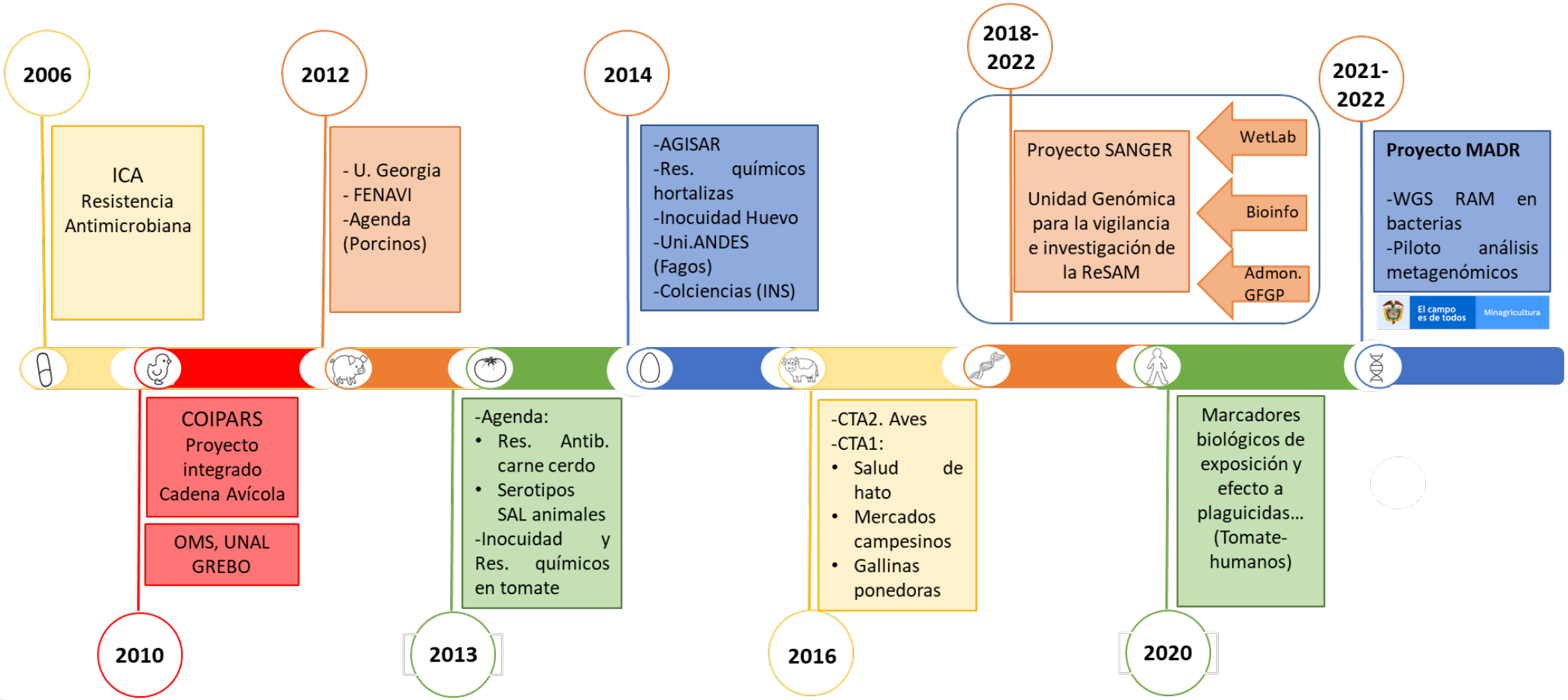




From 2006 up to now…

Two milestones



Strategic Landscape

Research entities
Agrosavia, Universities

National Authorities

National network : Main actors

Pilot Program in the Poultry Chain

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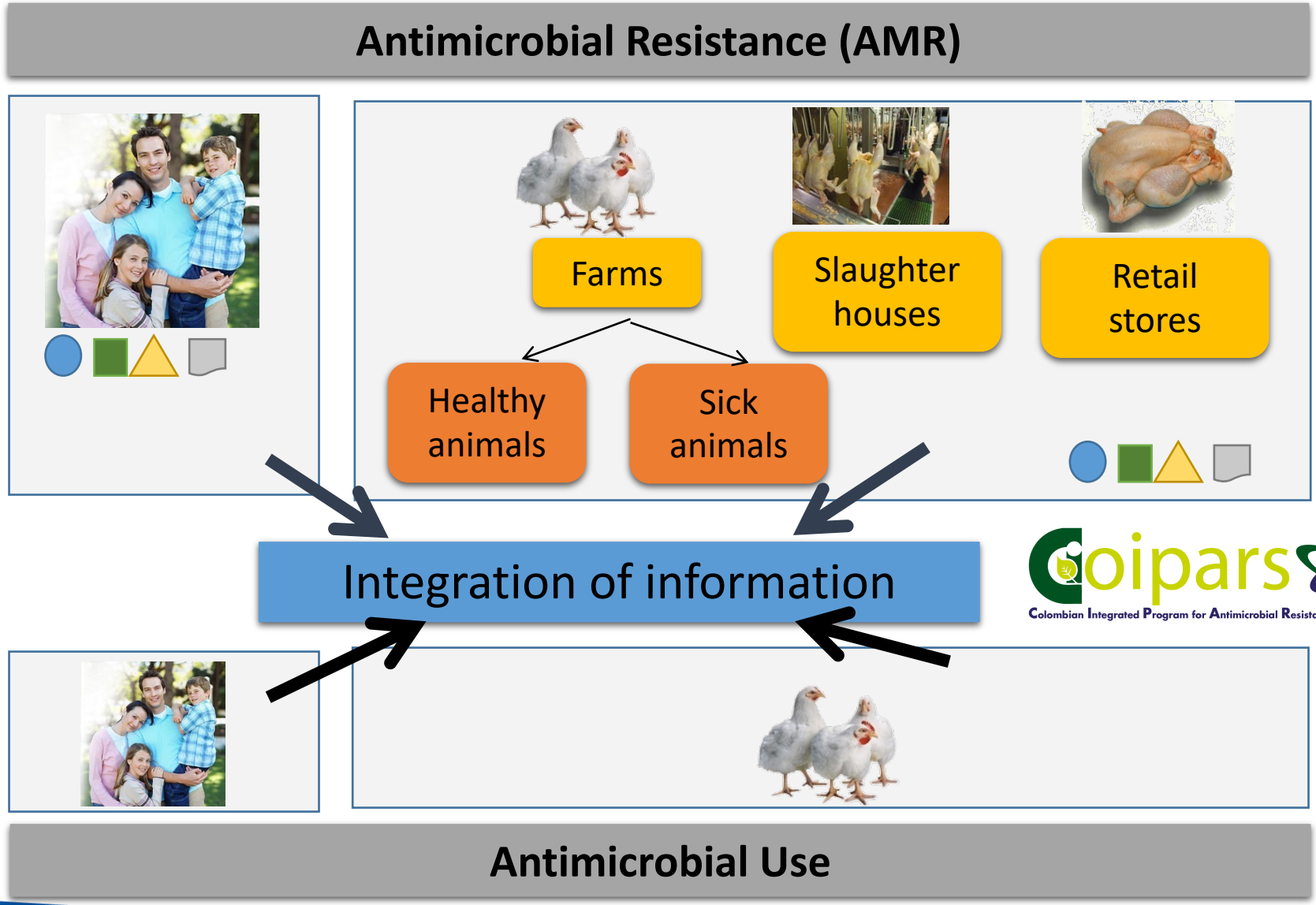
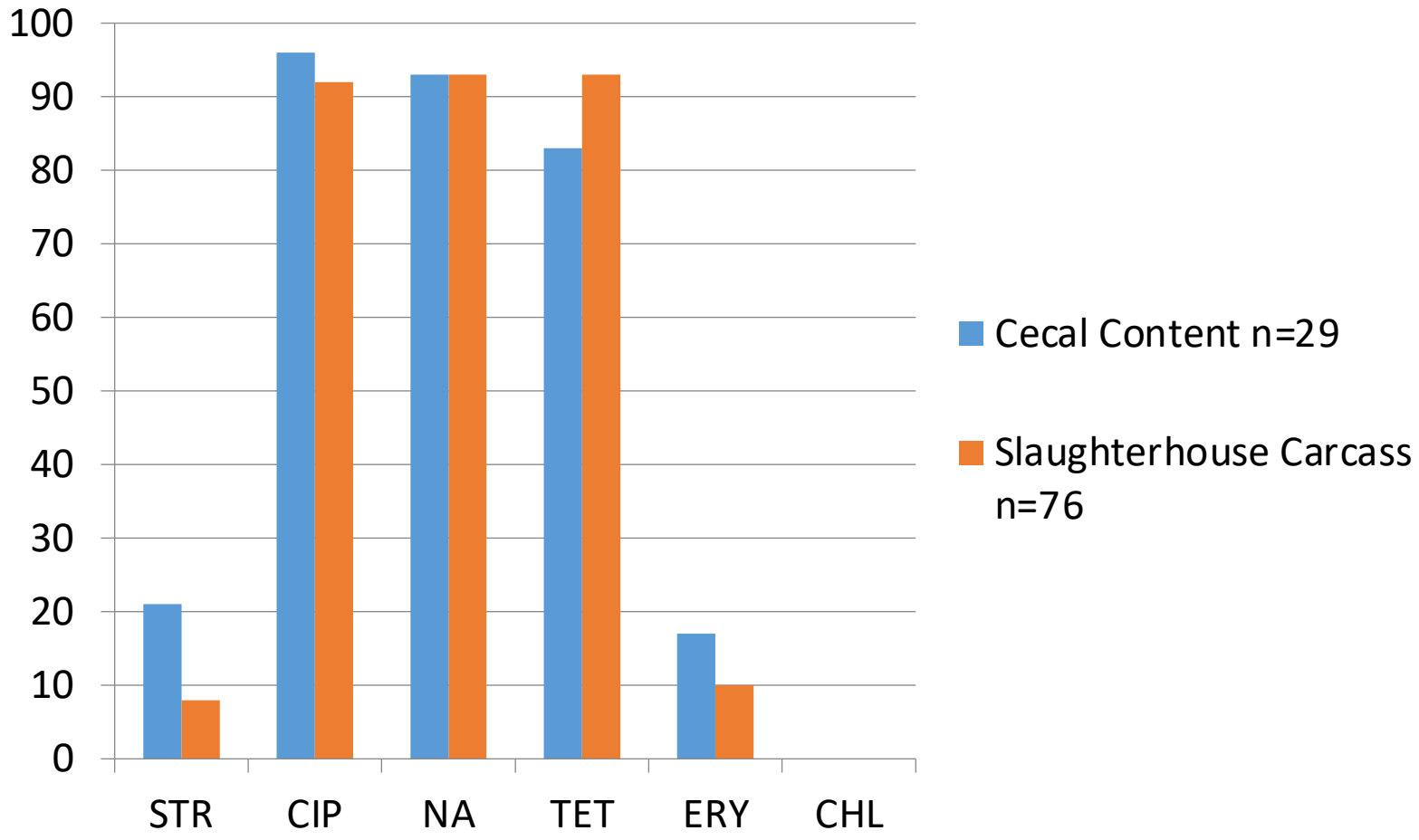


AMRCampylobacter sp.

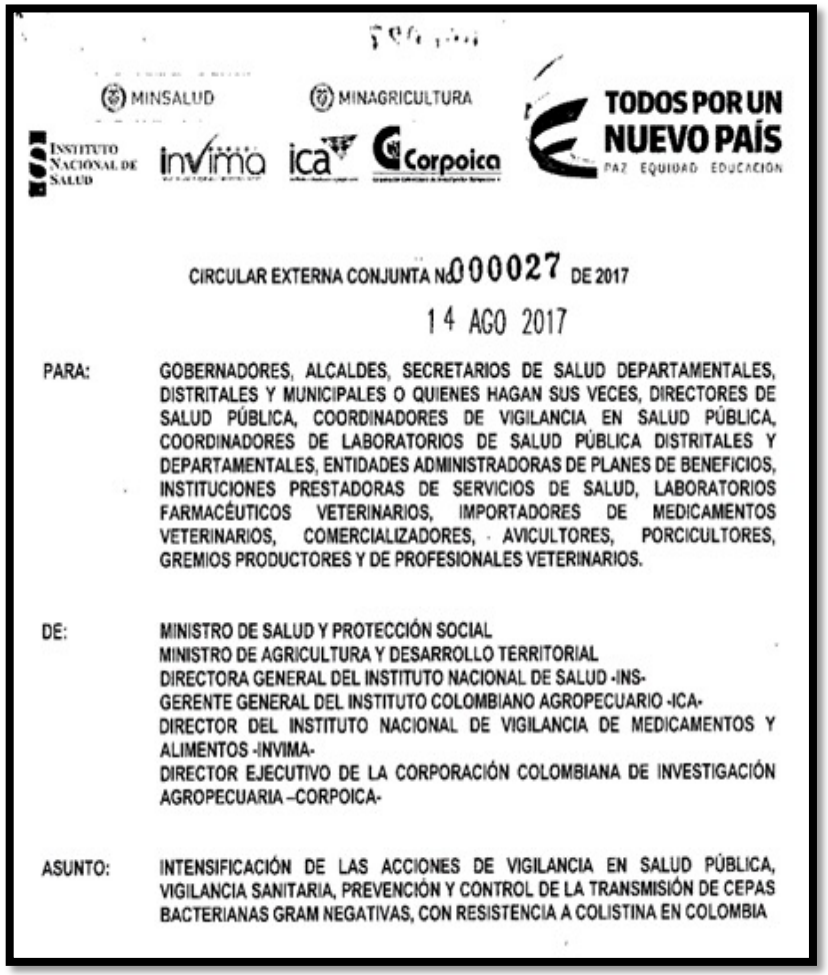


Fenavi
2012-2013

Highlighted results

The results of AGROSAVIA's research on AMR have contributed to decision-making based on data- Public Policy

- **Circular No. 000027 of 2017. Prohibition of the use of colistin in the animal industry**
- **Alert - Detection of the optr-A gene in poultry isolates for the first time in the Americas (Linezolid)**
- **Senzibilitation of the agricultural sector**
- **Development of international networking (AGISAR, PULSENET)**



MINSALUD MINAGRICULTURA TODOS POR UN NUEVO PAÍS PAZ EQUIDAD EDUCACIÓN

INSTITUTO NACIONAL DE SALUD invima ica Corpoica

CIRCULAR EXTERNA CONJUNTA No. 000027 DE 2017

14 AGO 2017

PARA: GOBERNADORES, ALCALDES, SECRETARIOS DE SALUD DEPARTAMENTALES, DISTRITALES Y MUNICIPALES O QUIENES HAGAN SUS VECES, DIRECTORES DE SALUD PÚBLICA, COORDINADORES DE VIGILANCIA EN SALUD PÚBLICA, COORDINADORES DE LABORATORIOS DE SALUD PÚBLICA DISTRITALES Y DEPARTAMENTALES, ENTIDADES ADMINISTRADORAS DE PLANES DE BENEFICIOS, INSTITUCIONES PRESTADORAS DE SERVICIOS DE SALUD, LABORATORIOS FARMACÉUTICOS VETERINARIOS, IMPORTADORES DE MEDICAMENTOS VETERINARIOS, COMERCIALIZADORES, AVICULTORES, PORCICULTORES, GREMIOS PRODUCTORES Y DE PROFESIONALES VETERINARIOS.

DE: MINISTRO DE SALUD Y PROTECCIÓN SOCIAL
MINISTRO DE AGRICULTURA Y DESARROLLO TERRITORIAL
DIRECTORA GENERAL DEL INSTITUTO NACIONAL DE SALUD -INS-
GERENTE GENERAL DEL INSTITUTO COLOMBIANO AGROPECUARIO -ICA-
DIRECTOR DEL INSTITUTO NACIONAL DE VIGILANCIA DE MEDICAMENTOS Y ALIMENTOS -INVIMA-
DIRECTOR EJECUTIVO DE LA CORPORACIÓN COLOMBIANA DE INVESTIGACIÓN AGROPECUARIA –CORPOICA-

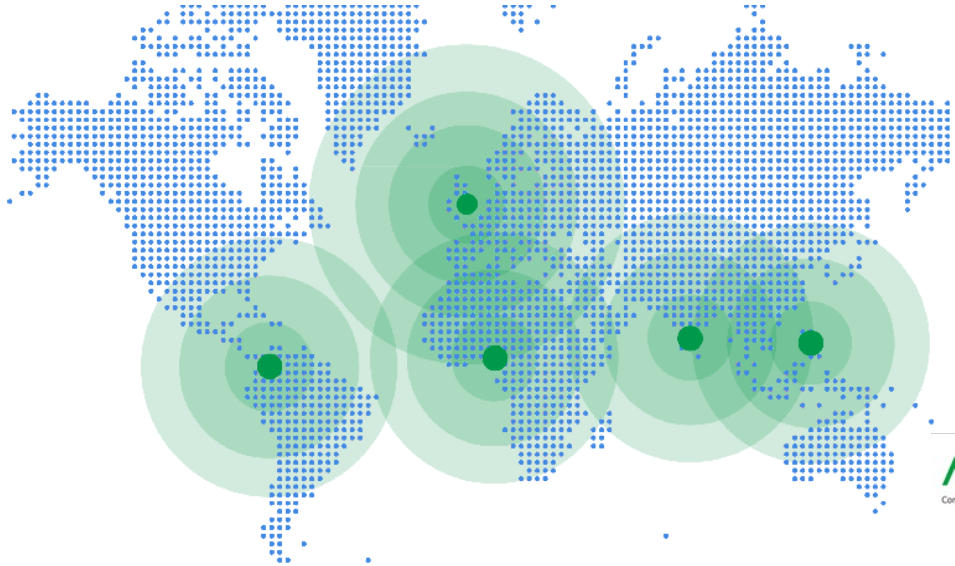
ASUNTO: INTENSIFICACIÓN DE LAS ACCIONES DE VIGILANCIA EN SALUD PÚBLICA, VIGILANCIA SANITARIA, PREVENCIÓN Y CONTROL DE LA TRANSMISIÓN DE CEPAS BACTERIANAS GRAM NEGATIVAS, CON RESISTENCIA A COLISTINA EN COLOMBIA

“NIHR-UK -Global Health Research Unit on Genomic Surveillance of Antimicrobial Resistance”

Objective: Intelligent global surveillance of pathogenic bacteria using whole genome sequencing through appropriate testing and analysis, at sentinel surveillance sites located in strategically relevant countries.

Scope

1. **Specialized human resource**
2. **Acquisition of state-of-the-art equipment**
3. **Workflow implementation for WGS**
   - **End-to-end Laboratory**
   - **Computational capacity for bioinformatic analysis**
4. **Validated bioinformatic procedures**
5. **GOLD Certification in Good Financial Practices**



1’200.242 GBP

Highlighted results

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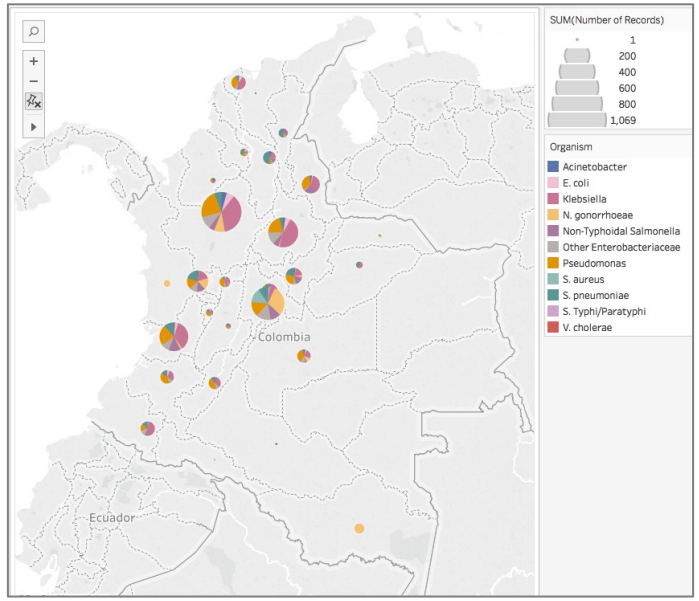
Scope- Technical results

1. **Sequencing and analysis of zoonotic bacteria and ESKAPE: ~4,000**

- **Massive collection of high-resolution information 506 Gb of information**

2. **Knowledge results**

- **Detection of high-risk clones, emerging variants, and identification of endemic clones**
- **Description of RAM mechanisms**
- **Dissemination of AMR genes important in public health and veterinary medicine**



Regional distribution of sequenced isolates.


Clinical Infectious Diseases
SUPPLEMENT ARTICLE
Good Financial Grant Practice: A Tool for Developing ng Institutional Financial and Grant pacity in Global Health

Clinical Infectious Diseases
SUPPLEMENT ARTICLE
Integrating Scalable Genome Sequencing Into Microbiology Laboratories for Routine Antimicrobial Resistance Surveillance

Analysis
BMJ Global Health
Whole-genome sequencing as part of national and international surveillance programmes for antimicrobial resistance: a roadmap
NIHR Global Health Research Unit on Genomic Surveillance of AMR

Clinical Infectious Diseases
SUPPLEMENT ARTICLE
Overcoming Data Bottlenecks in Genomic Pathogen Surveillance

Complexity of Genomic Epidemiology of Carbapenem-Resistant Klebsiella pneumoniae Isolates in Colombia

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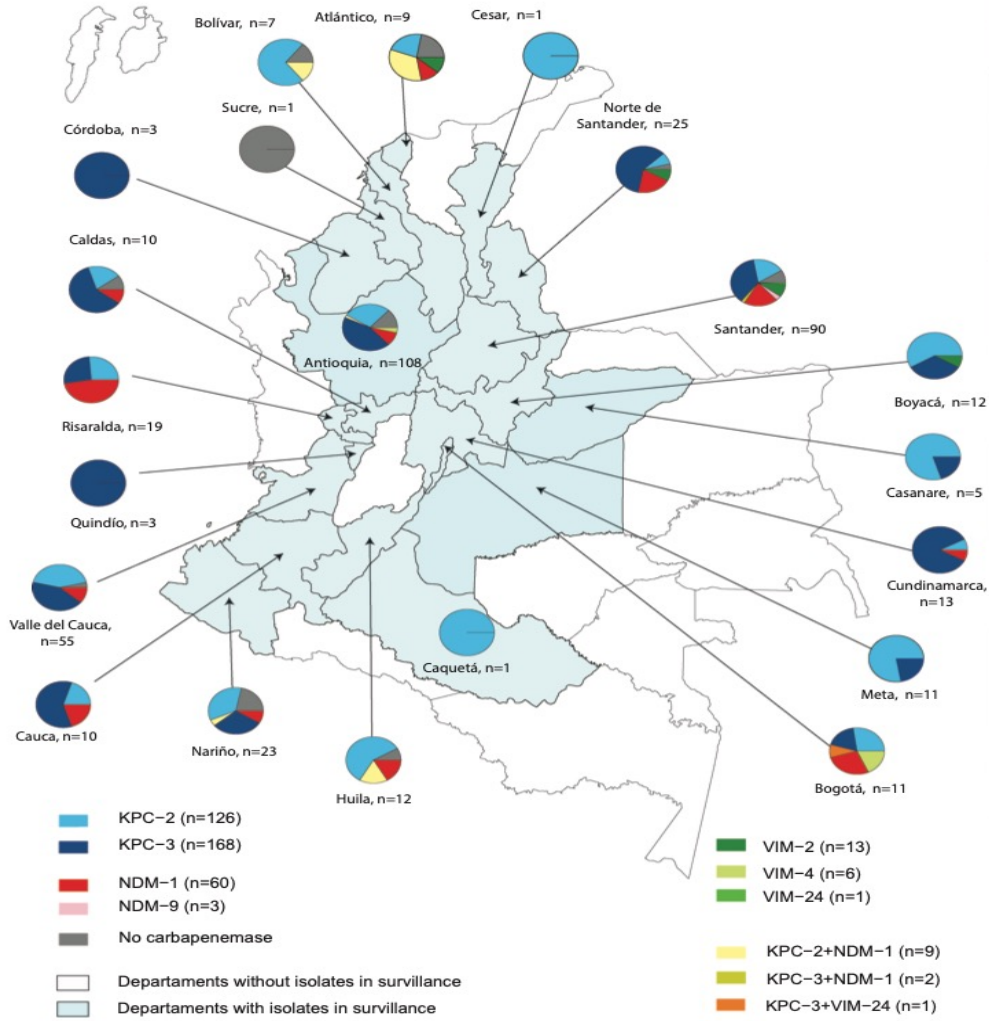
Carbapenamase genes identified in 389 of 425 CRKP isolates

- **bla_{KPC} in 294 isolates**
- **bla_{NDM} in 63 isolates**
- **bla_{VIM} in 20 isolates**
- **co-production of $_{blaKPC+NDM}$ in 11 isolate**
- **co-production of $bla_{KPC+VIM}$ in 1 isolate**



Installed and Validated Capacities

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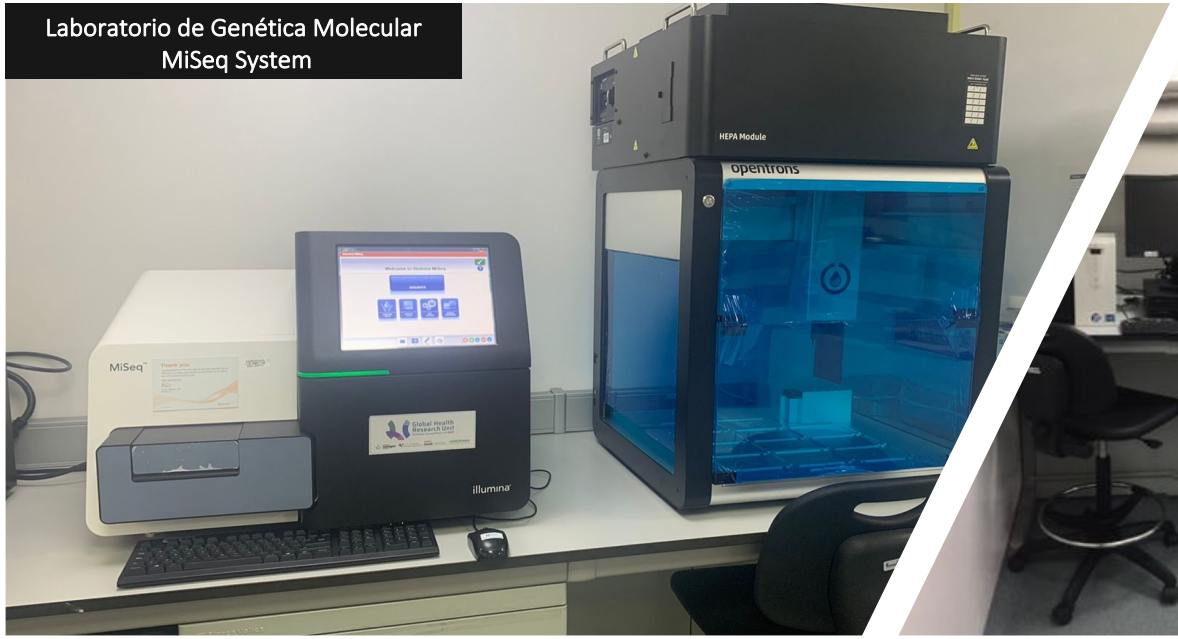

Laboratorio de Genética Molecular
MiSeq System

Laboratorio de Microbiología Pecuaria
Vitek 2 Compact

Laboratorio de Microbiología Pecuaria
MinION Mk1C

Departamento de Tecnologías de Información
Servidor 188 RAM– 44 TB

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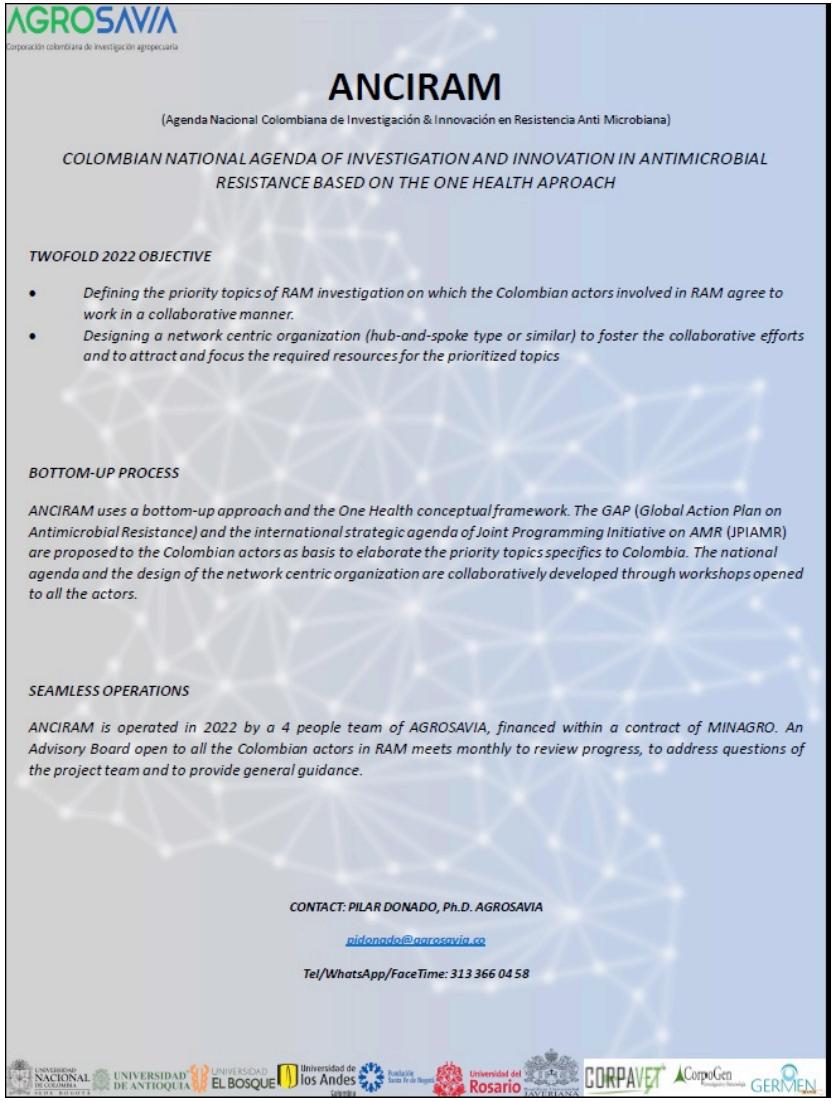
ANCIRAM Initiative

COLOMBIAN NATIONAL AGENDA OF INVESTIGATION AND INNOVATION IN ANTIMICROBIAL RESISTANCE BASED ON THE ONE HEALTH APROACH

- **Bottom-up approach**
- **One Health Framework**
- **GAP and Strategic Research Agenda of JPIAMR**
- **Connection with Quadripartite Initiative (WHO/FAO/OIE/UNEP)**
- **Network Centric Organization**



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ANCIRAM

(Agenda Nacional Colombiana de Investigación & Innovación en Resistencia Anti Microbiana)

COLOMBIAN NATIONAL AGENDA OF INVESTIGATION AND INNOVATION IN ANTIMICROBIAL RESISTANCE BASED ON THE ONE HEALTH APROACH

TWOFOLD 2022 OBJECTIVE

- *Defining the priority topics of RAM investigation on which the Colombian actors involved in RAM agree to work in a collaborative manner.*
- *Designing a network centric organization (hub-and-spoke type or similar) to foster the collaborative efforts and to attract and focus the required resources for the prioritized topics*

BOTTOM-UP PROCESS

ANCIRAM uses a bottom-up approach and the One Health conceptual framework. The GAP (Global Action Plan on Antimicrobial Resistance) and the international strategic agenda of Joint Programming Initiative on AMR (JPIAMR) are proposed to the Colombian actors as basis to elaborate the priority topics specifics to Colombia. The national agenda and the design of the network centric organization are collaboratively developed through workshops opened to all the actors.

SEAMLESS OPERATIONS

ANCIRAM is operated in 2022 by a 4 people team of AGROSAVIA, financed within a contract of MINAGRO. An Advisory Board open to all the Colombian actors in RAM meets monthly to review progress, to address questions of the project team and to provide general guidance.

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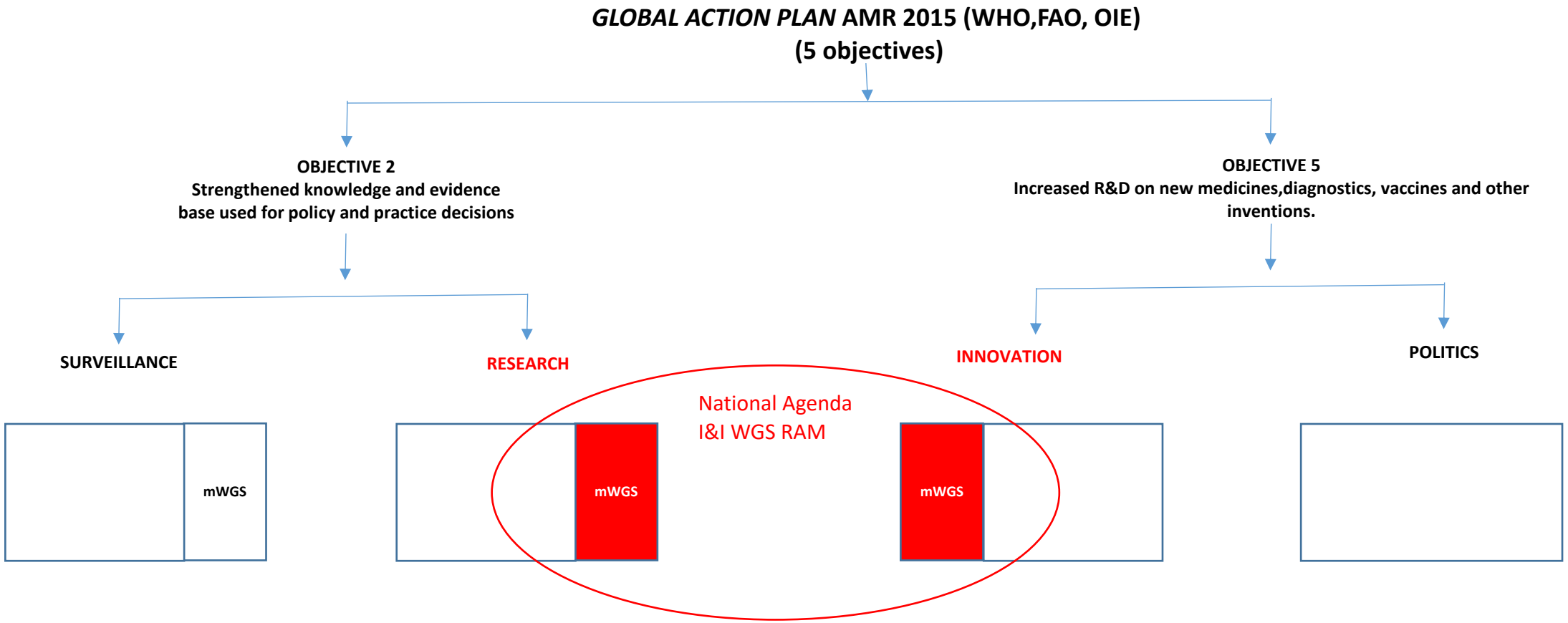
ANCIRAM Initiative



ANCIRAM Initiative

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Pre-selected Research Themes

Innovation

- Find new antimicrobials and targets
- Develop alternatives for antimicrobials
- Improve the efficacy of new and existing diagnostic tools to more effectively distinguish between infections, and/or detect antimicrobial susceptibility
- Improve the use of rapid diagnostics in appropriate One Health settings

Research

- Unravel the complex dynamics of selection and transmission of antimicrobial resistance
- Identify factors responsible for the persistence and spread of resistant organisms and resistance elements
- Determine and model the contribution of contamination sources, environmental reservoirs and exposure routes on the emergence and spread of AMR

ANCIRAM Initiative

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Challenges

- **Change RAM research specialists into strategic contributors**
- **Foster a collaborative approach between groups who are used to compete for limited resources**
- **Financing of research activities**

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Four Concluding Remarks

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<u>Concluding Remark 1:</u>

In Colombia like in others LMICs, exist specific risks for AMR development due to challenges on health systems, informality in agri-food markets and lack of infrastructures

Four Concluding Remarks

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<u>Concluding Remark 2:</u>

In Colombia like in others LMICs, the One Health Approach is highly relevant since livestock production systems generate much greater contact between humans, animals and the natural environment than in HICs.

Four Concluding Remarks

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<u>Concluding Remark 3:</u>

In Colombia like in others LMICs, genetic approaches for mapping transmission across the One Health continuum are indispensable tools that need to be developed in a coordinated way at national levels and in collaboration with international organizations.

Four Concluding Remarks

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<u>Concluding Remark 4:</u>

In Colombia like in others LMICs, AMR development is a complex problem with characteristics of nonlinearity, emergence, positive and negative feedback and adaptation, which requires a customization of One Health research implementation including more bottom-up approach and specific innovation routes.

nature microbiology

REVIEW ARTICLE

https://doi.org/10.1038/s41564-022-01124-w

A bottom-up view of antimicrobial resistance transmission in developing countries

Odion O. Ikhimiukor[1], Erkison Ewomazino Odih[1,2], Pilar Donado-Godoy[3] and Iruka N. Okeke[1]✉

Antimicrobial resistance (AMR) is tracked most closely in clinical settings and high-income countries. However, resistant organisms thrive globally and are transmitted to and from healthy humans, animals and the environment, particularly in many low- and middle-income settings. The overall public health and clinical significance of these transmission opportunities remain to be completely clarified. There is thus considerable global interest in promoting a One Health view of AMR to enable a more realistic understanding of its ecology. In reality, AMR surveillance outside hospitals remains insufficient and it has been very challenging to convincingly document transmission at the interfaces between clinical specimens and other niches. In this Review, we describe AMR and its transmission in low- and middle-income-country settings, emphasizing high-risk transmission points such as urban settings and food-animal handling. In urban and food production settings, top-down and infrastructure-dependent interventions against AMR that require strong regulatory oversight are less likely to curtail transmission when used alone and should be combined with bottom-up AMR-containment approaches. We observe that the power of genomics to expose transmission channels and hotspots is largely unharnessed, and that existing and upcoming technological innovations need to be exploited towards containing AMR in low- and middle-income settings.

GRACIAS

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