

Global Trends in Antimicrobial Resistance in Animals

Prof. Thomas Van Boeckel

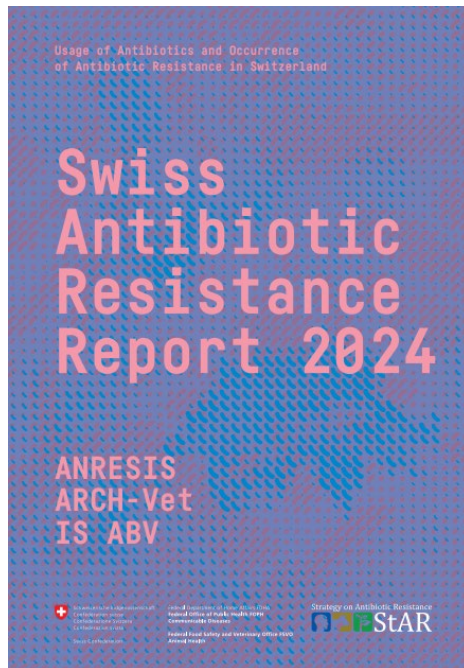
One Health Institute
University of Zürich

14.10.2025

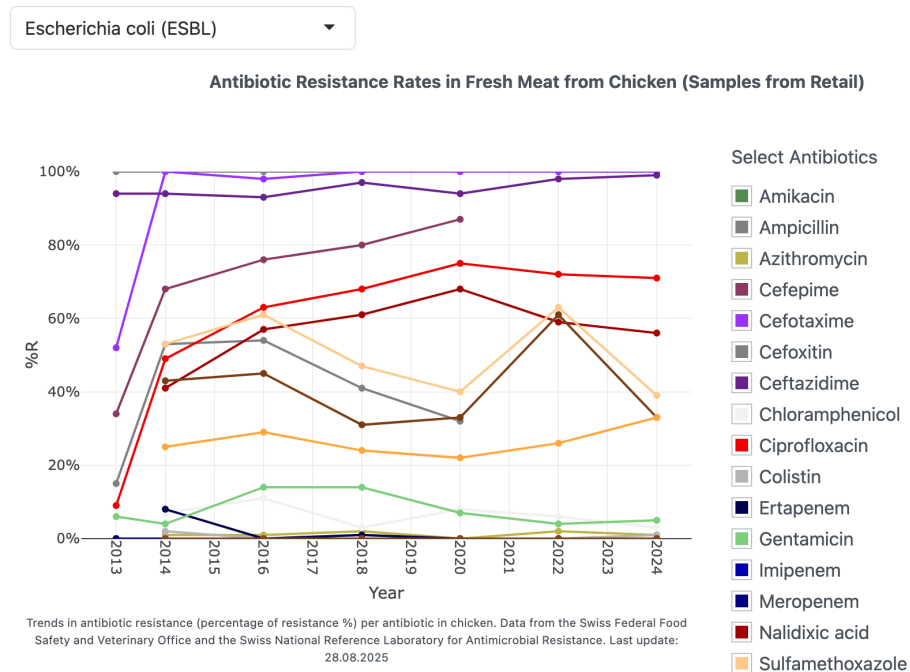


Why ?

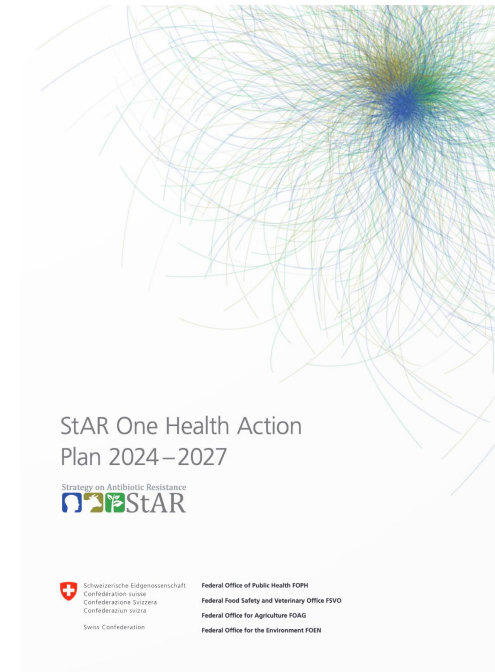
Switzerland: Antimicrobial Resistance (AMU)



We have a systematic surveillance system

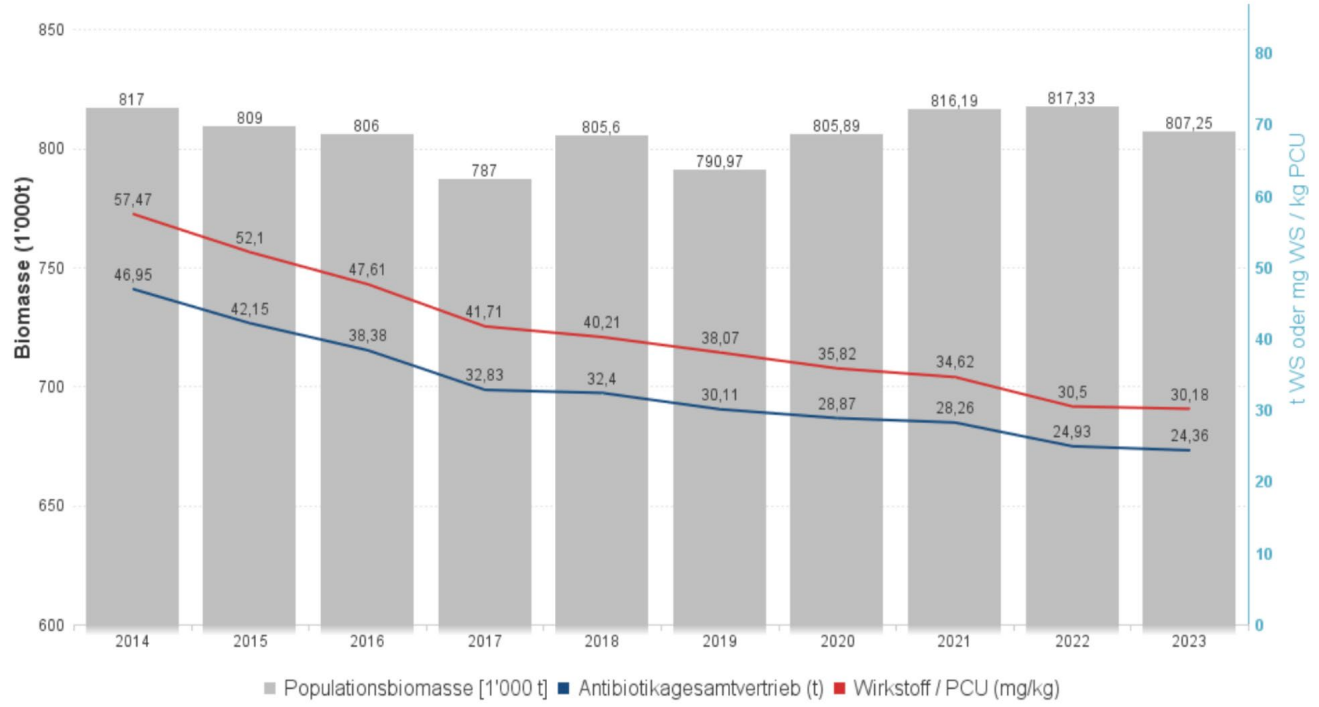
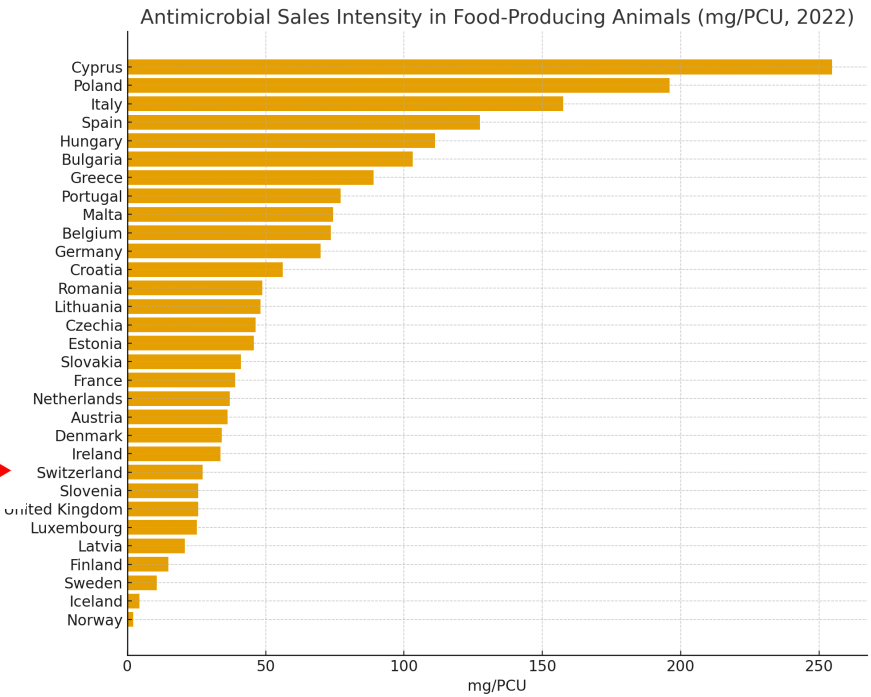


We know our problems, and successes by tracking changes in AMr prevalence in animals

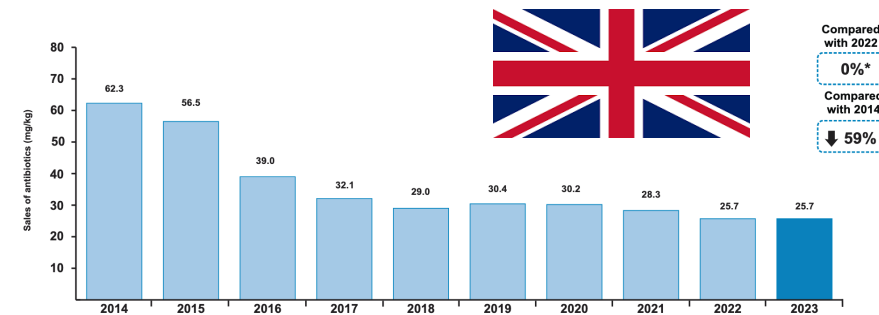
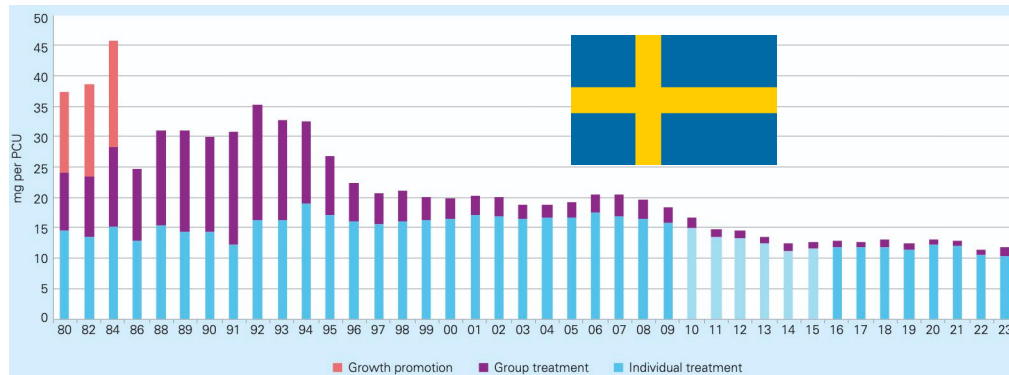
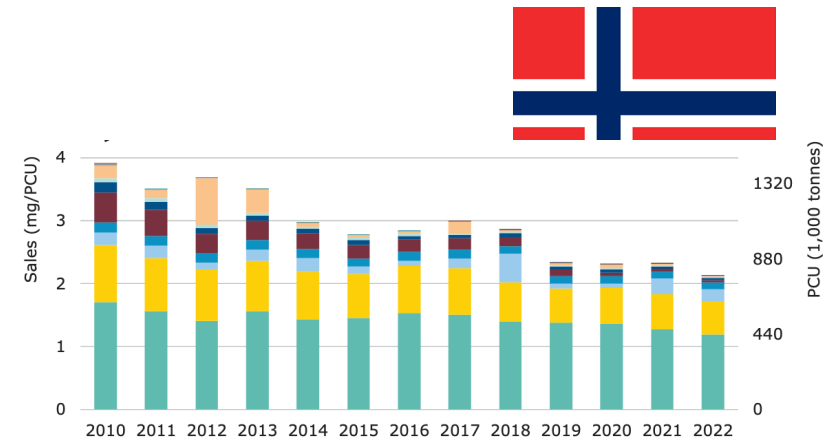
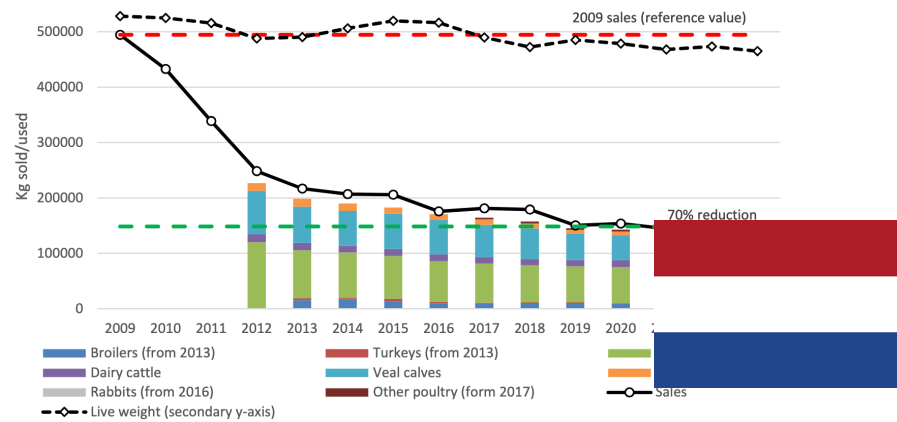


We have a plan for the future

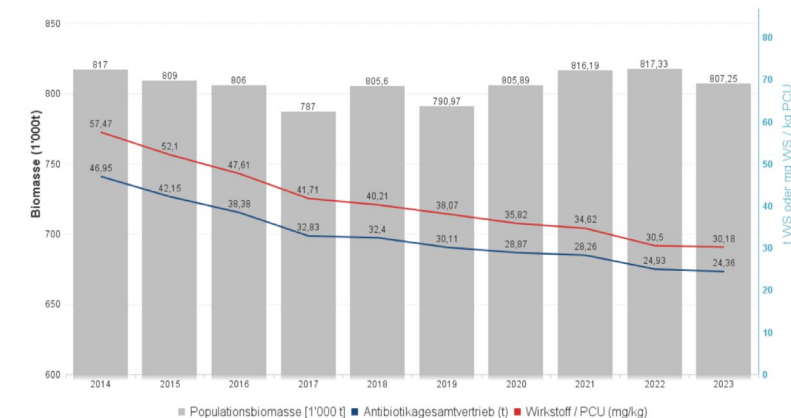
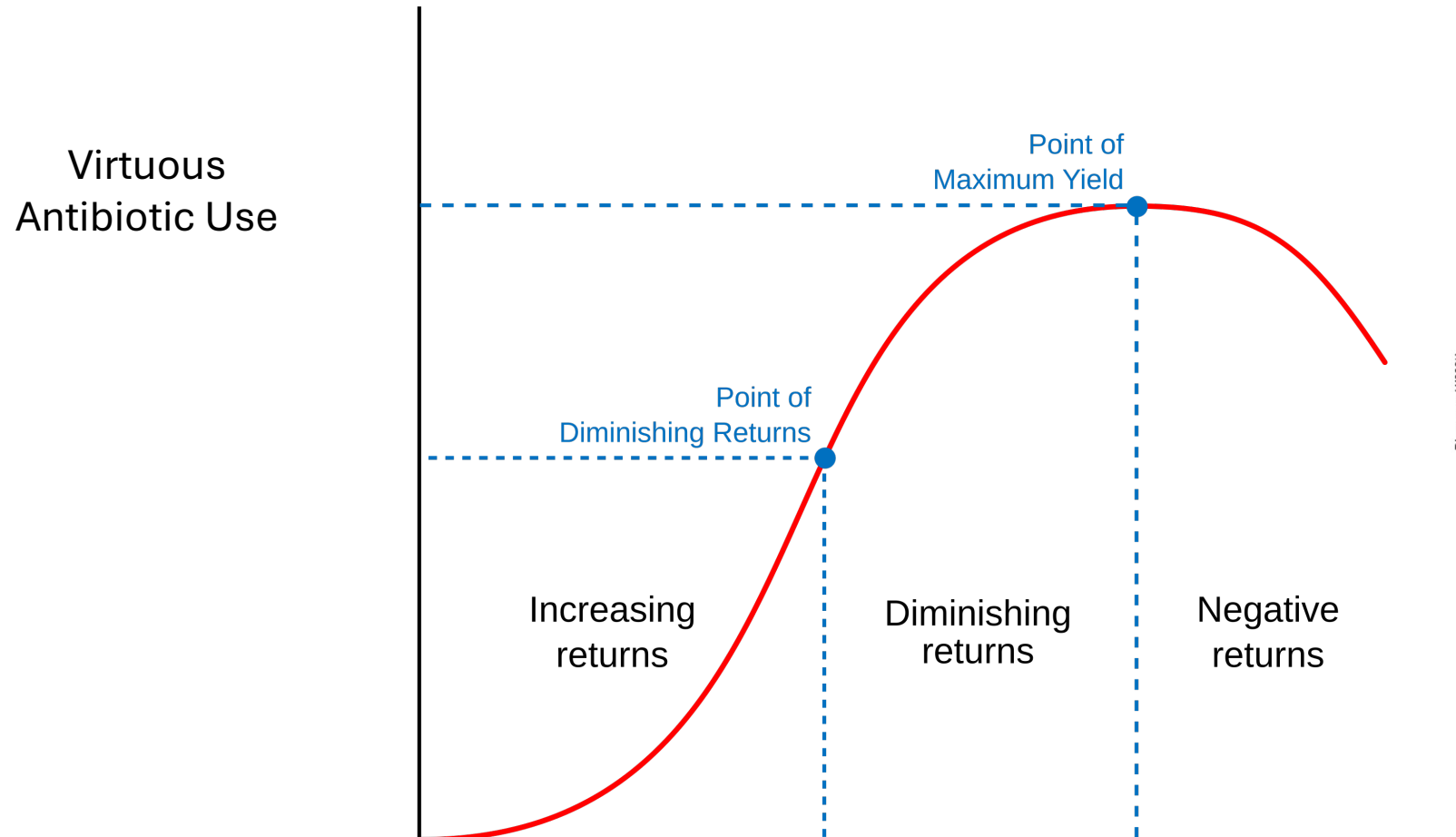
Switzerland: Antimicrobial Use (AMU)



Reduction in veterinary antibiotic use in high-income countries.



Are we getting to a point of diminishing returns?



Biosecurity, labor, reduced animals densities, increased surveillance, IT investments, diagnostics, etc...



Monitoring system for
antibiotic use in pigs

CLEAN

CLEAN

CLEAN

Visiting a chicken farm
in India



Visiting a chicken farm
in India



One Pig farm in China

vs

One Pig farm in China



Source: The New York Times

One Pig farm in China

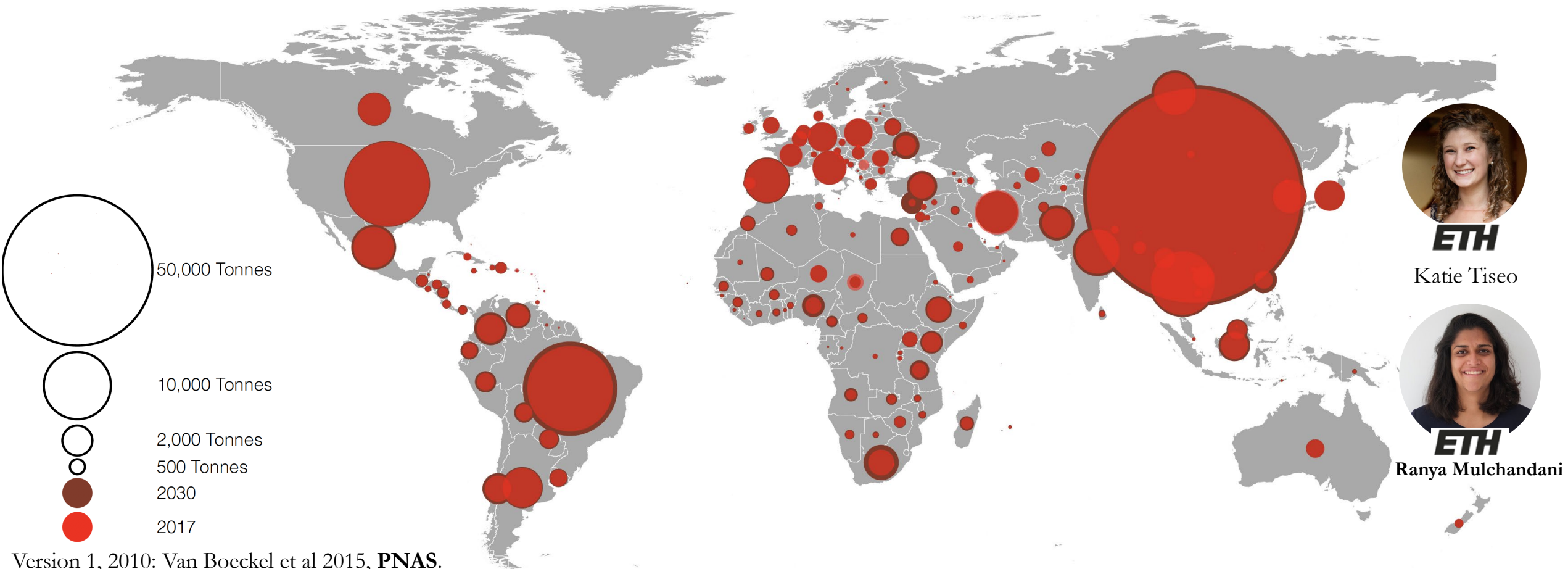
vs

One Pig farm in China



Source: The New York Times

Antimicrobial Use in Animals – Global Trends



Katie Tiseo



Ranya Mulchandani

Version 1, 2010: Van Boeckel et al 2015, **PNAS**.
Version 2, 2013: Van Boeckel et al 2017, **Science**.
Version 3, 2017: Tiseo et al 2020, **Antibiotics**.
Version 4, 2020: Mulchandani et al 2023, **PloS Global Public Health**.

Why care ?

Why care ? Travelers can import resistance

30–70% of travelers to high-risk regions return colonized with ESBL-producing Enterobacterales, especially *E. coli*.

Articles

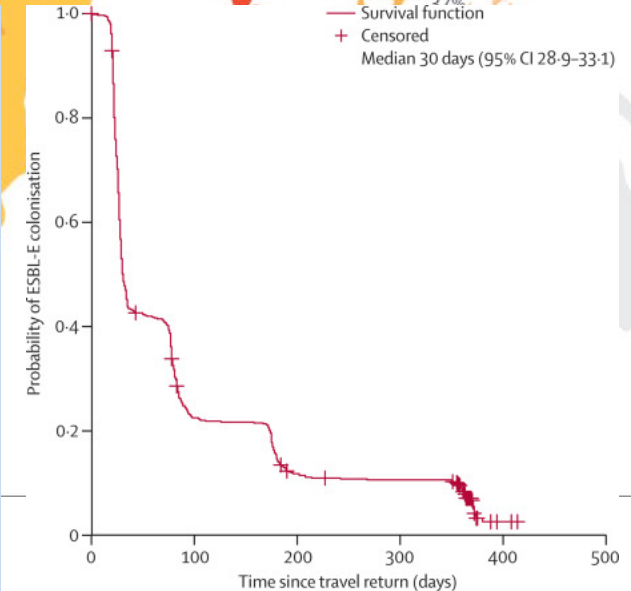
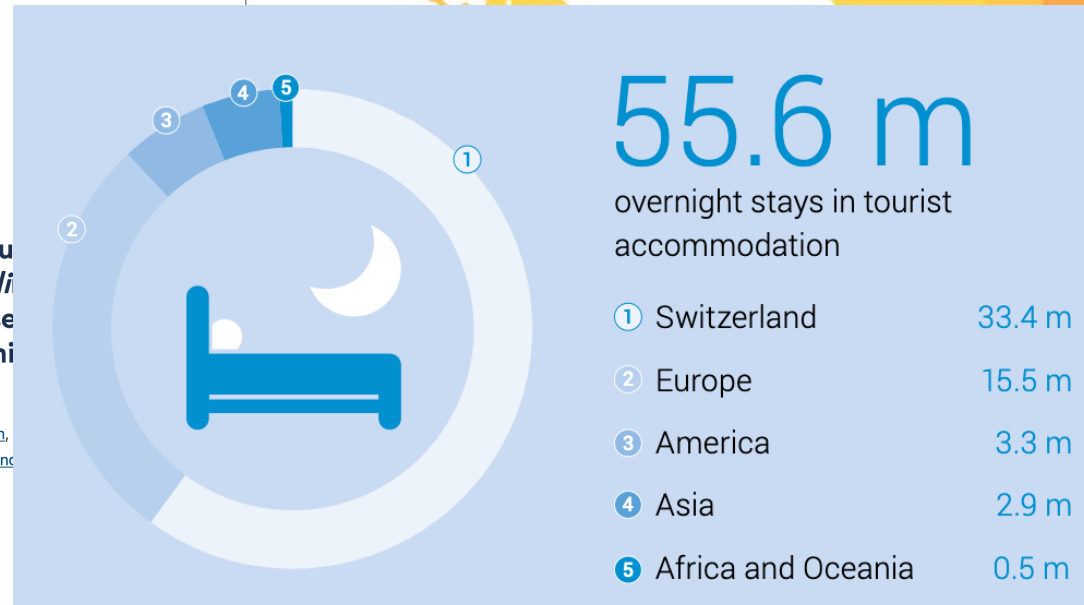
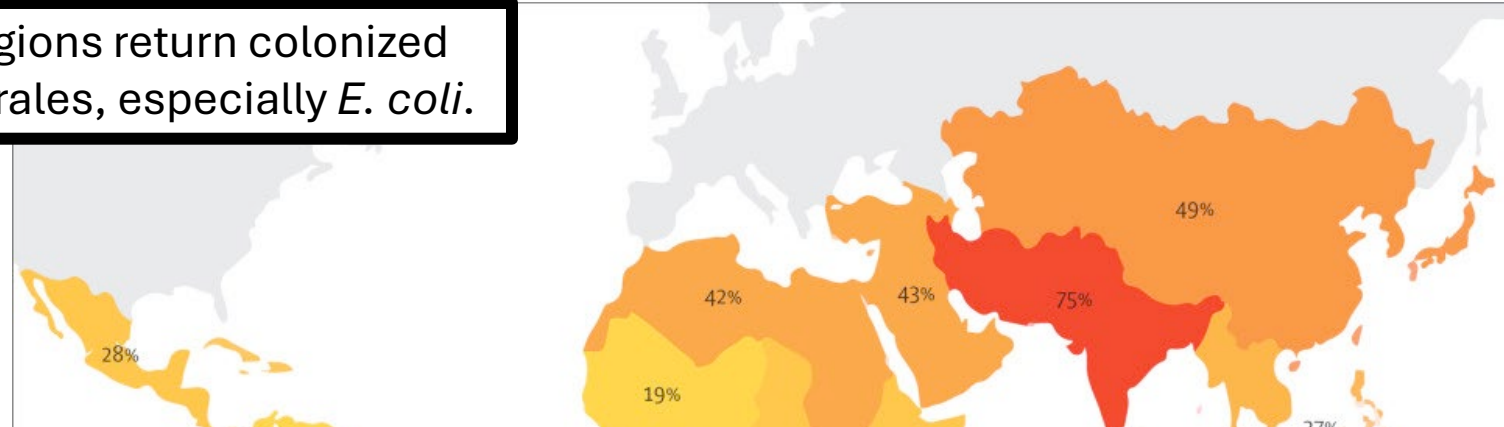
Import and spread of extended-spectrum β -lactamase-producing Enterobacteriaceae by international travellers (COMBAT study): a prospective, multicentre cohort study

Maris S Arcilla MD ^{a,†}, Jarne M van Hattem MD ^{b,†}, Manon R Haverkate PhD ^c, Martin C J Bootsma PhD ^{c,§}, Perry JJ van Genderen PhD ^a, Abraham Goorhuis PhD ^f, Prof Martin P Grobusch PhD ^f, Astrid M Oude Lashof PhD ^g, Nicky Malhoek MSc ^g, Constance Schultsz PhD ^h, Ellen E Stobberingh PhD ^g, Prof Henri A Verbrugh PhD ^g, Prof Menno D de Jong PhD ^b, Damian C Melles PhD ^a, Dr John Penders PhD ^{g,h}  

Research article | [Open access](#) | Published: 01 October 2014

High colonization rates of extended-spectrum β -lactamase (ESBL)-producing *Escherichia coli* Travellers to South Asia– a prospective observational multicentre cohort study looking at epidemiology and risk factors

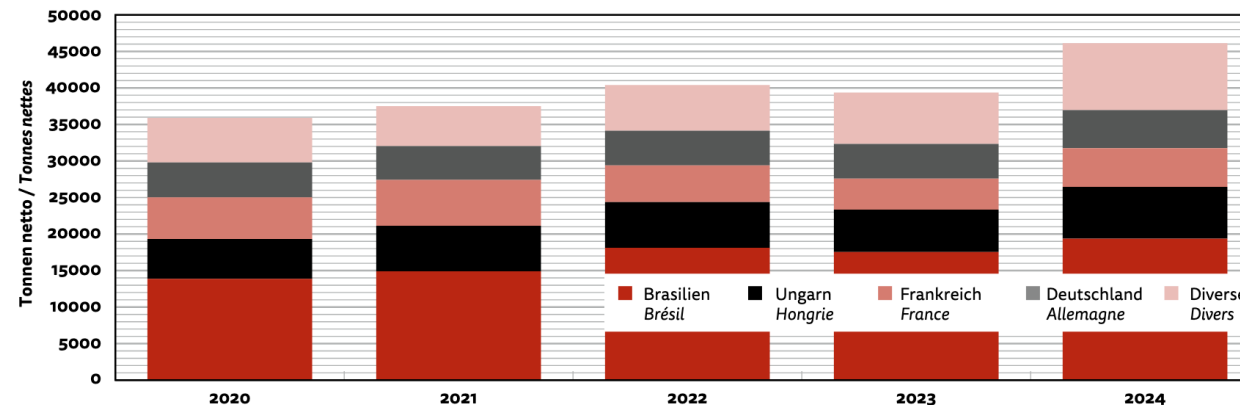
[Esther Kuenzli](#) , [Veronika K Jaeger](#), [Reno Frei](#), [Andreas Neumayr](#), [Susan DeCrom](#), [Johannes Blum](#), [Andreas F Widmer](#), [Hansjakob Furrer](#), [Manuel Battegay](#), [Andrea Enck](#), [Hatz](#)



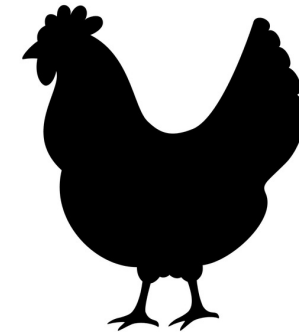
Why care ? Food Safety

Abbildung 46: Herkunft der Geflügelfleischimporte (Fleisch und geniessbare Schlachtnebenprodukte)

Illustration 46: Provenance des importations de viande de volaille (viande et abats comestibles)



Quelle: EZV/Source: AFD



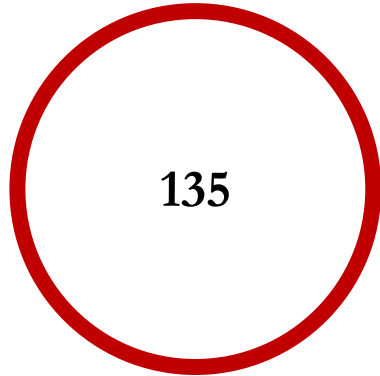
Extended-spectrum β -lactamase (ESBL)- and Carbapenemase-producing Enterobacterales Isolated from Fresh Herbs and Salads at Retail Level in Switzerland

Silvan Tresch¹, Michael Biggel¹, Manuela Schnyder², Magdalena Nüesch-Inderbinen¹, Roger Stephan¹  

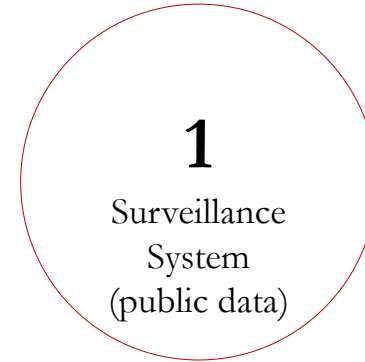
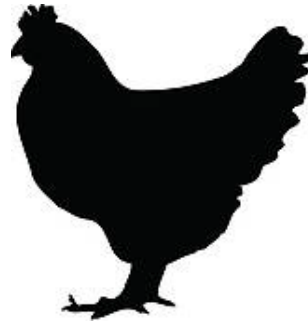
Extended-Spectrum- β -Lactamase-Producing *Enterobacteriaceae* Isolated from Vegetables Imported from the Dominican Republic, India, Thailand, and Vietnam

Authors: [Katrin Zurfluh](#), [Magdalena Nüesch-Inderbinen](#), [Marina Morach](#), [Annina Zihler Berner](#), [Herbert Hächler](#), [Roger Stephan](#) | [AUTHORS](#)

Antimicrobial Resistance in Animals in Low- and Middle-Income Countries



Low- and middle-income countries
(LMICs)



Colombia

In the short term, we need an alternative data source...



Point Prevalence Surveys (n=901)



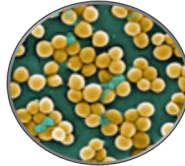
Reshma Silvester

Bacteria

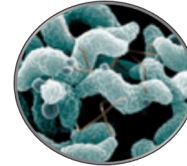
E. coli



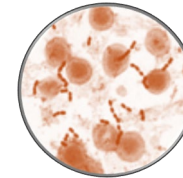
S. aureus



Campylobacter



Salmonella



Host

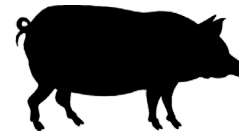
Chicken



Cattle



Pigs



Cheng Zhao



Julia Song

Drugs



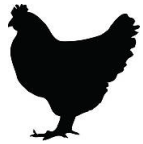
Drug/Pathogens recommended by AGISAR
WHO Advisory Group on Integrated
Surveillance of Antimicrobial Resistance



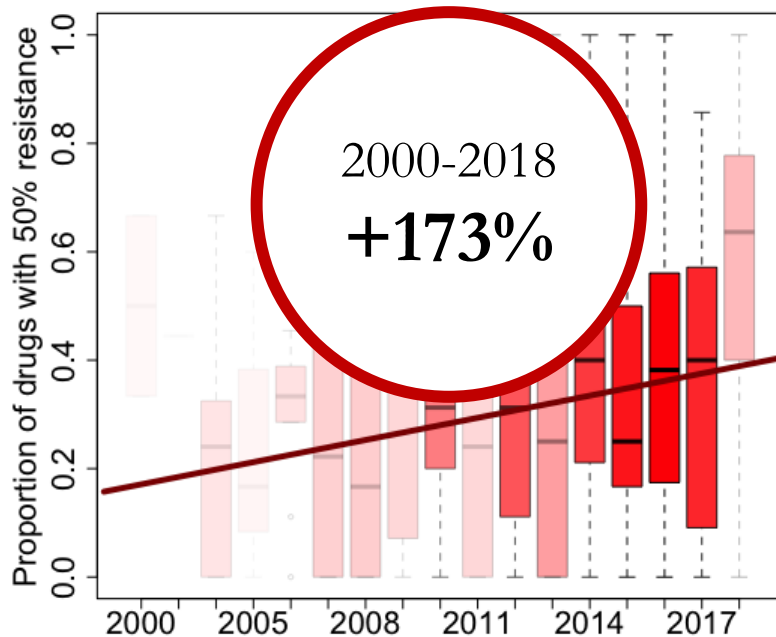
Joao Pires₈

Global trends in AMR in using point prevalence surveys

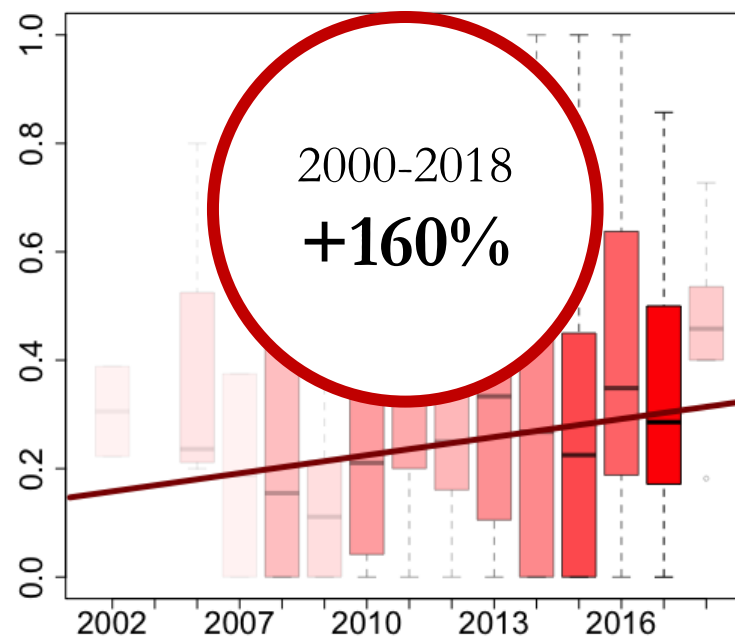
P50: proportion of antimicrobials tested in a survey with resistance prevalence higher than 50%



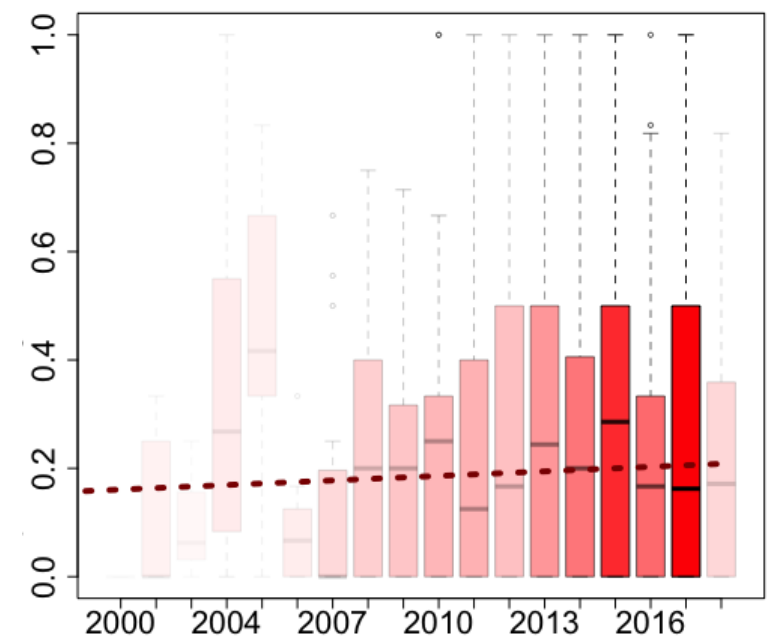
Chicken (n = 486)



Pig (n = 197)



Cattle (n = 533)



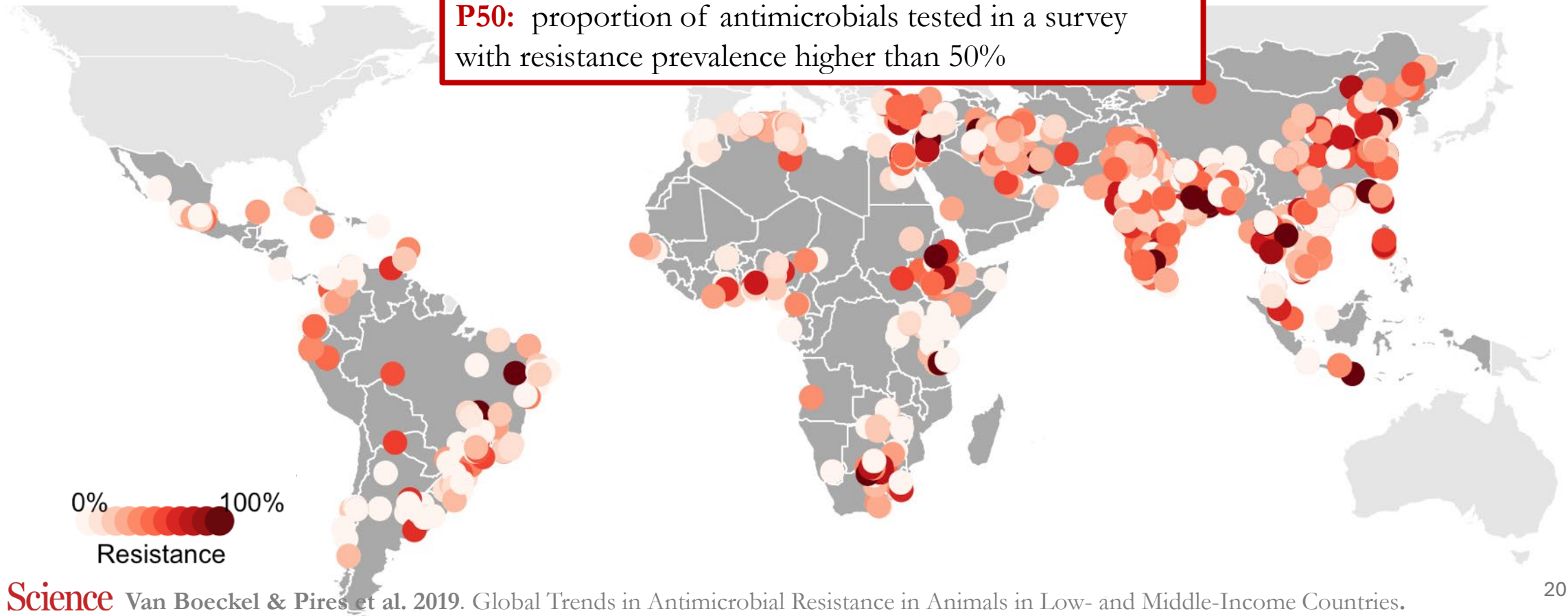
Point-Prevalence Surveys of AMR in Animals

Surveys
n = 901

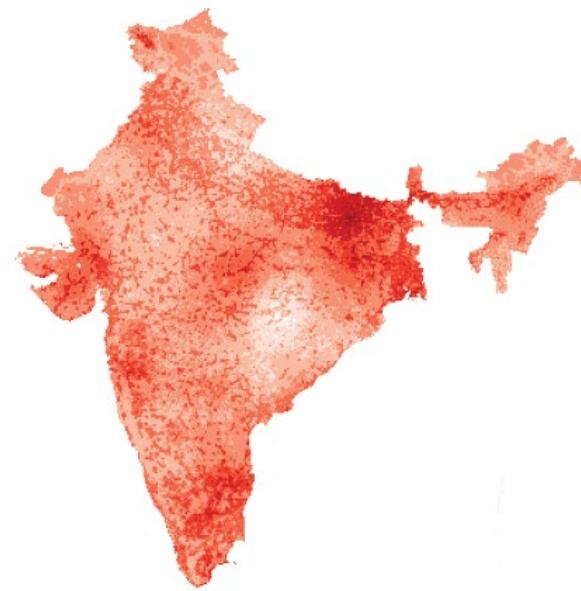
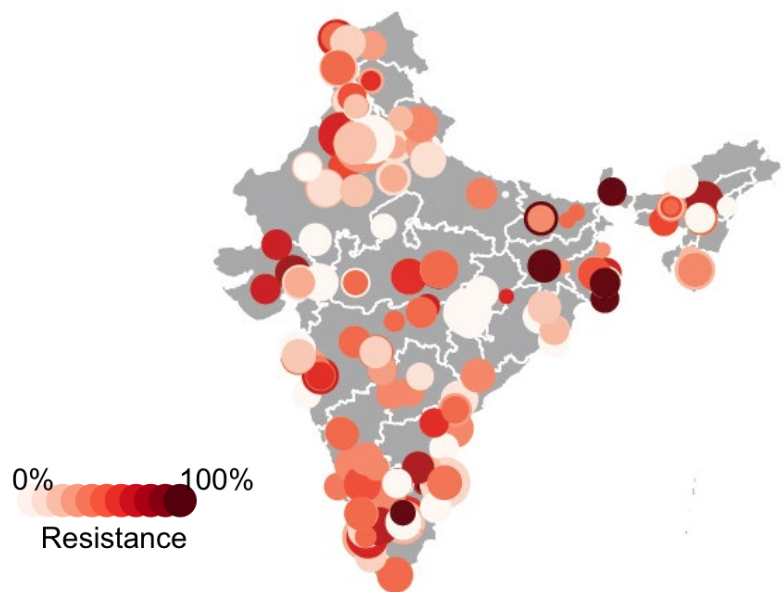
resistance rates
n = 12,933

biological
samples
n = 285,000

P50: proportion of antimicrobials tested in a survey
with resistance prevalence higher than 50%



Mapping hotspots of resistance in animals

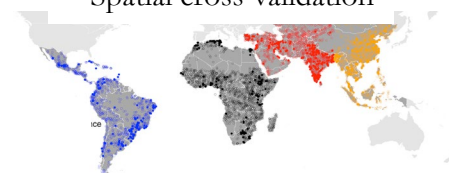


Resistance Here = **Resistance Nearby** + **Covariates (risk factors):** antimicrobial use, animal densities, temperature, travel time to cities,...

$$P_{50}(x_0, y_0) = \sum_{i=1}^n \lambda_i \cdot P_{50}(x_i, y_i) + \sum_{k=1}^P \beta_k \cdot Cov_k(x_0, y_0)$$

Step 2
Stacking with Universal Kriging

Spatial cross-validation



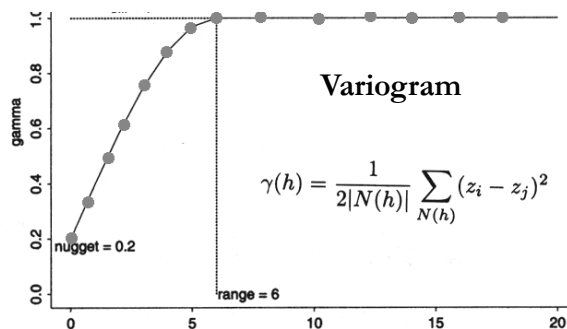
$$Cov_1 = P_{\text{Boosted Regression Trees}}$$

$$Cov_2 = P_{\text{Neural Networks}}$$

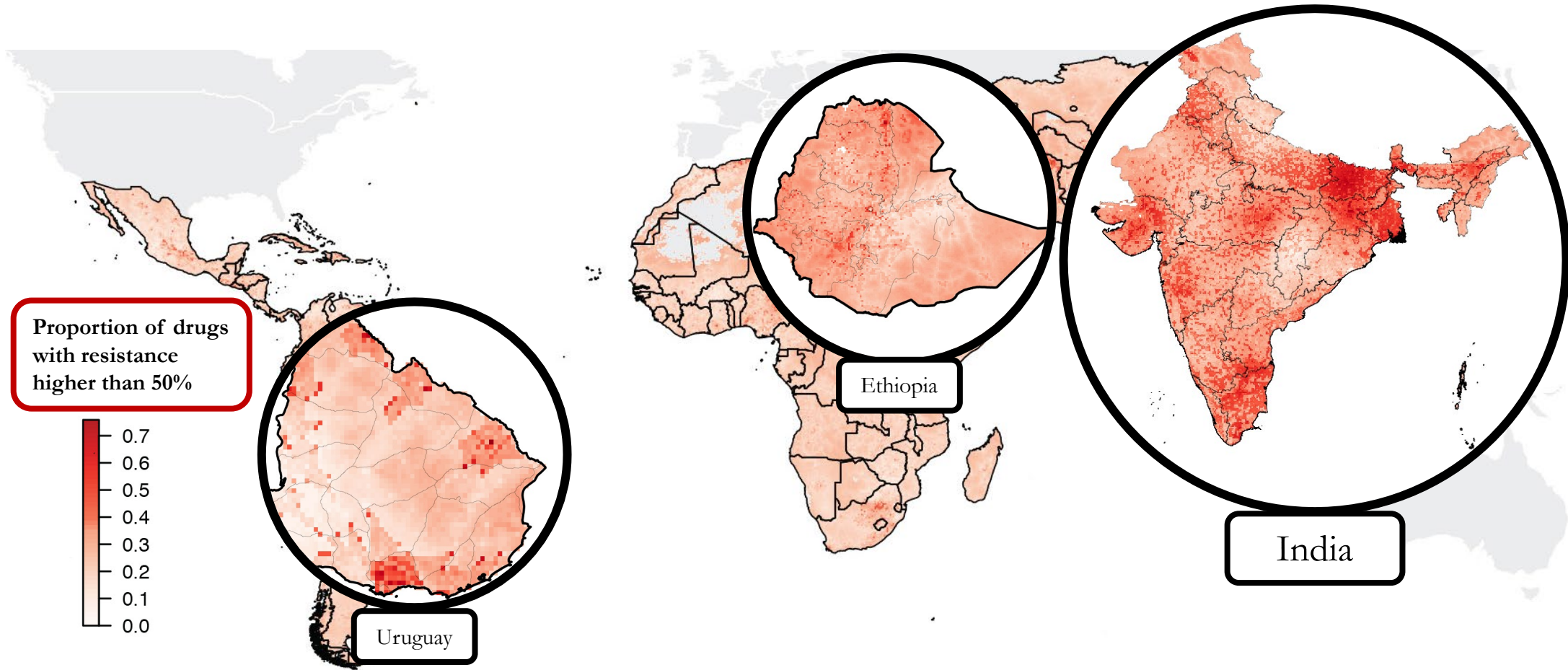
$$Cov_3 = P_{\text{LASSO Regression}}$$

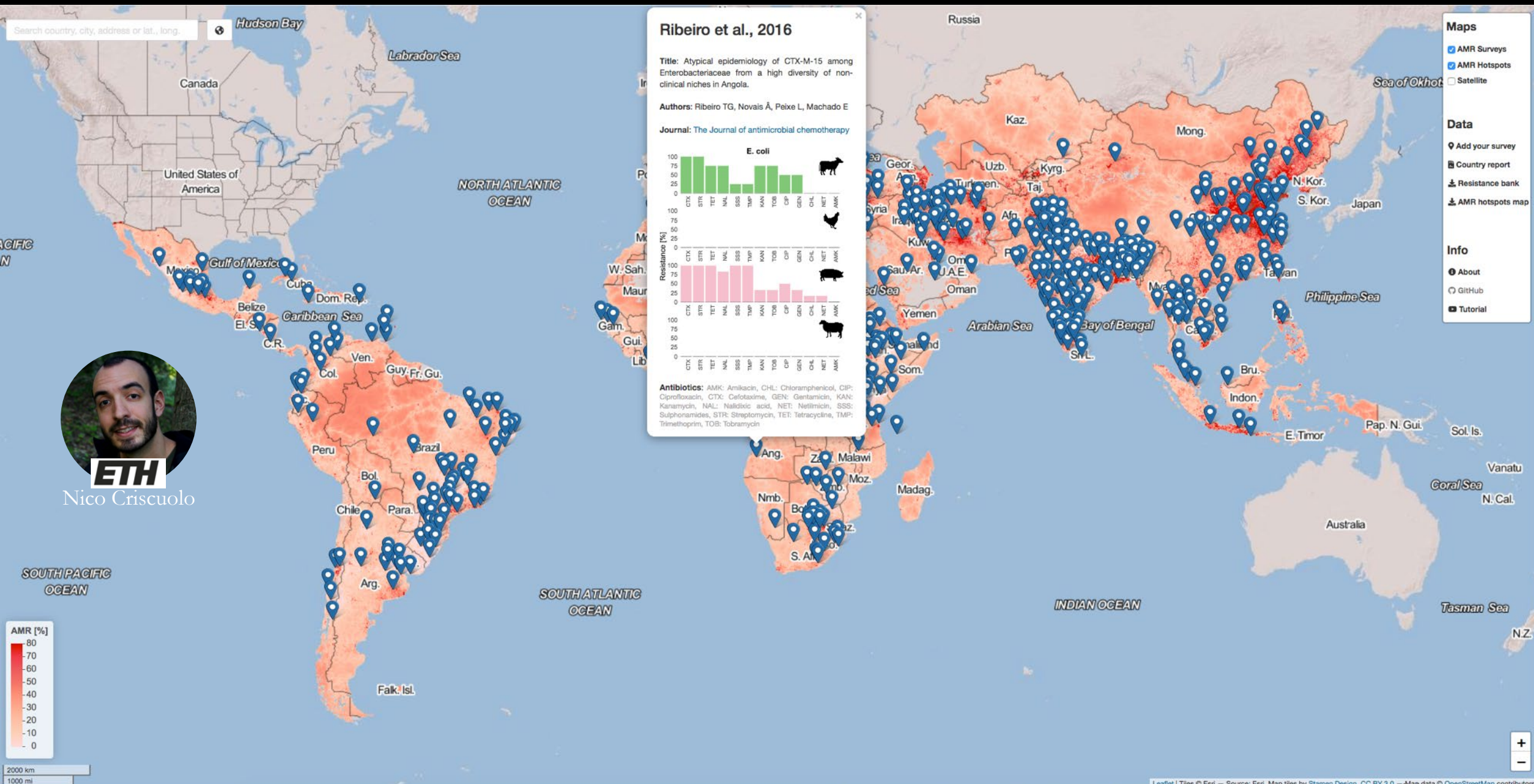
Step 1
trend models

Covariates

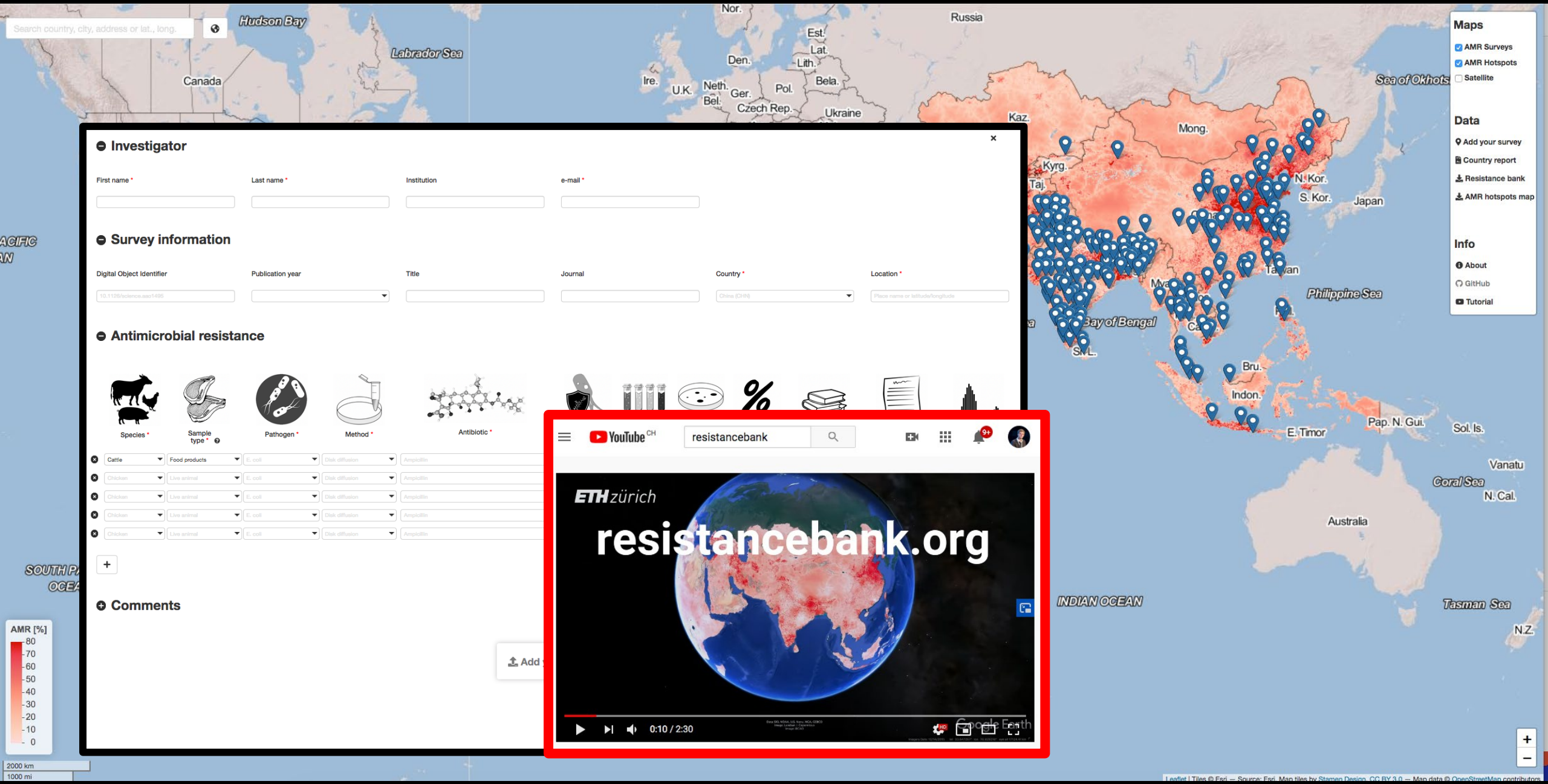


Mapping hotspots of resistance in animals





ETH
Nico Criscuolo



Maps

- ☒ AMR Surveys
- ☒ AMR Hotspots
- ☐ Satellite

Data

- Add your survey
- Country report
- Resistance bank
- AMR hotspots map

Info

- About
- GitHub
- Tutorial

Investigator

First name *

Last name *

Institution

e-mail *

Survey information

Digital Object Identifier

Publication year

Title

Journal

Country *

Location *

10.1128/science.asee1495

China (CHN)

Place name or latitude/longitude

Antimicrobial resistance

Species *

Sample type *

Pathogen *

Method *

Antibiotic *

Cattle

Food products

E. coli

Disk diffusion

Ampicillin

Chicken

Live animal

E. coli

Disk diffusion

Ampicillin

Chicken

Live animal

E. coli

Disk diffusion

Ampicillin

Chicken

Live animal

E. coli

Disk diffusion

Ampicillin

Chicken

Live animal

E. coli

Disk diffusion

Ampicillin

+

Comments

↑ Add

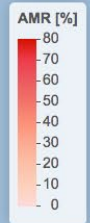
YouTube^{CH}

resistancebank

ETH zürich

resistancebank.org

0:10 / 2:30



2000 km
1000 mi



Thank You - Merci



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