Multivariate Analysis of Antimicrobial Resistance in the animal-food-human chain and their correlation with level of development of National action plans in European Countries.

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Introduction

In the era of big data, turning data into useful knowledge and insight is a critical challenging to understand AMR (antimicrobial resistance).

Multivariate analysis contributes to this insight by studying how different and multiples variables (features) interfere among them and how they work in combination to allow afterwards, building appropriate mechanistic predictive models.

Methodology

We apply multivariate analysis methods to a dataset gathering AMR information in the animal-food-human chain for each country of the EU with three groups of variables:

- Human AMR quantitative **variables.** ECDC 2018 [1] percentage of resistant in humans of
  - **Fluo_ecoli:** *E. coli* to fluoroquinolones
  - **Metic_stap:** *S. aureus* to beta-lactam antibiotics
  - **Aminop_face:** *E. faecium* to Aminopenicillins
  - **Carbap_aeru**: *P. aeruginosa* to Carbapenem
- Food-related AMR quantitative **variables.** EFSA 2018 [2] resistance percentage in animals and food
  - **BroilerCIP:** ESBL to ciprofloxacin in broilers
  - **mBroilerCIP:** ESBL to ciprofloxacin in broilers meat
- Socioeconomic-political AMR qualitative **variables** in 2017 TrACSS [3]
  - **AMR_plan:** degree of development of national plans against AMR (A,B,C,D,E) with A no plan and E the most developed plan

Further Information

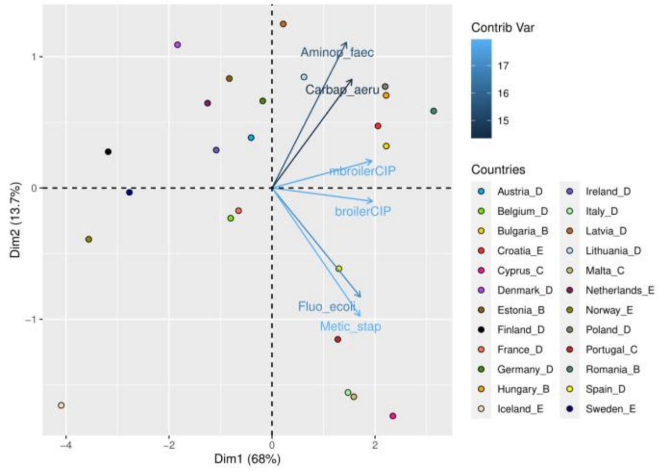
- The complete report with different multivariate analysis can be download from

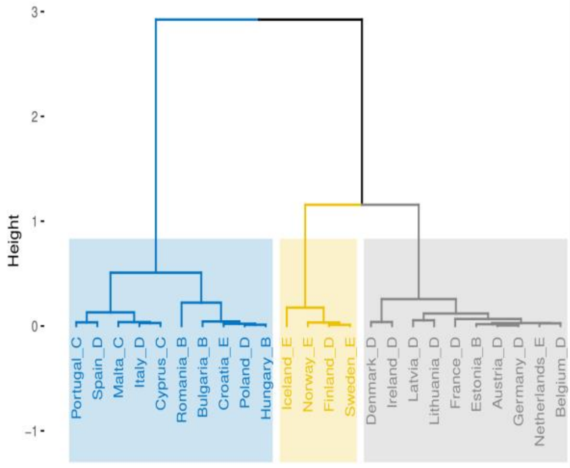
  http://resistance.iim.csic.es/pdfs/2111_OneHealth.pdf
- @Miriam_R_Garcia

Results

Using only the quantitative variables (HUMAN & FOOD)

- Principal Component captures 82% of the information just with 2 dimensions with the maximum variability between countries observed in Food variables
- The Cluster Dendrogram classifies the countries into:
  1. Northern countries
  2. East and south countries and
  3. Centre countries

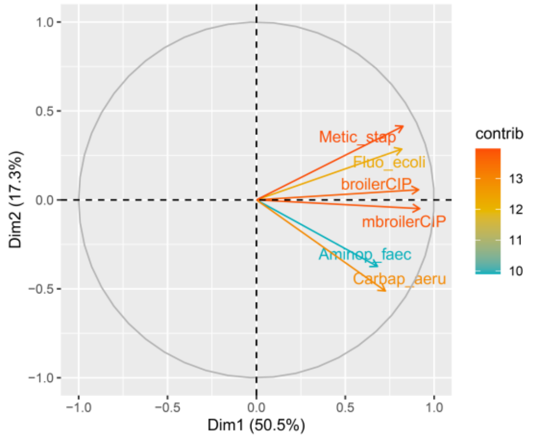


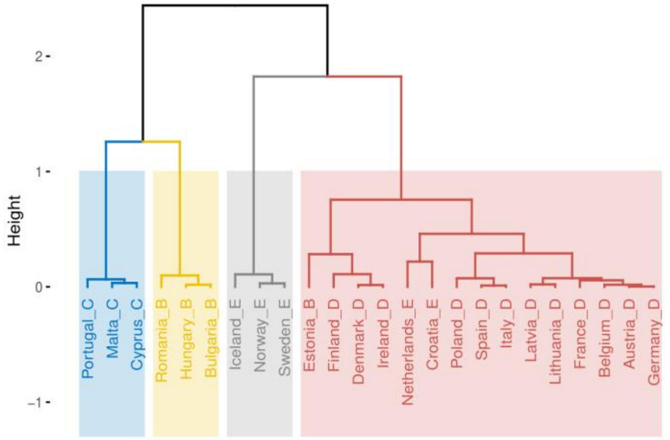


Using all variables (HUMAN, FOOD & SOCIOECONOMIC-POLITICAL)

Principal Component captures 68% with 2 dimensions

- The Cluster Dendrogram classifies the countries into groups with:
  1. National AMR plans (NP) under development (B)
  2. NP already developed (C)
  3. NP developed with monitoring (D), plus with a B-country and two E-countries
  4. NP developed, with resources, relevant sectors involved and monitoring and evaluation (E)





Conclusions

Multivariate analysis show that, when percentage of resistance is considered for each country, food-related variables are responsible for the greater variability among countries that can be clustered attending to their location (north, south/east or center EU country), but not clearly by their AMR development plan. Further analysis should be conducted to demonstrate if the AMR plans effectiveness highly depends on the country location (and implicitly culture) and to include more environmental and economical variables that could affect AMR prevalence.

Literature cited and aknowledgments

[1] Surveillance Atlas of Infectious Diseases from ECDC (https://atlas.ecdc.europa.eu/public/index.aspx)
[2] EFSA repository in Zenodo (https://zenodo.org/record/3628719#.YVH2TppBxPY)
[3] Global Database for the Tripartite Antimicrobial Resistance Country Self-assessment Survey (TrACSS) (https://amrcountryprogress.org/)

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