ONE HEALTH: PERSISTENCE OF ANTIMICROBIAL RESISTANCE (AMR) IN THE SWINE FARM ENVIRONMENT

Camila Rosana Wuaden[1], Janaína Pastore[1], Raquel Rebelatto[1], Mateus Lazzarotti[1], Rodrigo da Silveira Nicoloso[1], Franciele Siqueira Maboni[2], Jalusa Deon Kich[1*]

1 Embrapa Suínos e Aves, Concórdia, Santa Catarina, Brasil.

2 Laboratório de Bacteriologia, Faculdade de Veterinária, Universidade Federal do Rio Grande do Sul –UFRGS, Porto Alegre, Rio Grande do Sul, Brasil

*Corresponding author email: jalusa.kich@embrapa.br

Keywords: AMR persistence, Antimicrobial, Environment, One Health, Swine Farms

BACKGROUND

At the core of the "One Health" debate is the distribution of determinants of antibiotic resistance (AMR) in the environment affected by intensive animal husbandry, which requires further research. Brazilian intensive pig farming uses oral antimicrobials (ATM) prophylactically resulting in selective pressure for resistant bacterial populations in the enteric microbiota. Therefore, manure, although rich in nutrients for use as fertilizer, also contains ATM and resistance determinants
This cross-sectional study addresses the persistence of AMR in the environment of swine farms.

MATERIALS AND METHODS

An observational study was conducted on 68 pig farms distributed across three regions of Brazil, with different production systems (nursery, finishing, UPL, and full cycle) and manure management systems (stabilization ponds and biodigesters), used as soil fertilizer. Samples of feed, swine manure treatment entry and exit points and soil samples from fertilized and unfertilized areas were collected to identify AMR phenotypes of indicator enterobacteria (*Enterococcus spp.* and *Escherichia coli*).
The samples (340) were cultured on selective media; the indicator enterobacteria isolates were tested against a selection of antimicrobials[1,2,3] (25 molecules: AML-Amoxacillin, AMP-Ampicillin, AZM-Azithromycin, CAZ-Ceftazidime, CEF-Ceftiofur, CIP-Ciprofloxacin, CLO-Chloramphenicol, COL-Colistin, CTX-Cefotaxime, ERI-Erythromycin, ENR-Enrofloxacin, EST-Streptomycin, FFC-Florfenicol, GEN-Gentamicin, LZD-Linezolid, MER-Meropenen, NA-Nalidixic acid, NOR-Norfloxacin, SUL-Sulfonamides, SUT-Sulfamethoxazole/trimethoprim, TEI-Teicoplan, TET-Tetracycline, TIG-Tigeglycine, TRI- Trimethoprim, VAN - Vancomycin,) used in swine farming and/or of importance for human medicine, totaling 8,476 combinations (assays). The results were analyzed descriptively and using a Venn diagram.

RESULTS

A total of 339 isolates were obtained: 175 *Escherichia coli* and 164 *Enterococcus spp.,* from different sample types.
Phenotypic resistance was blocked in 1,649 assays (Figure 1) and the Venn diagram revealed demonstrated the distribution of phenotypic resistance markers among the different compartments of the farm. No single marker was identified in all samples. The feed presented 139 markers, 106 of which were unique and 33 shared with manure. The highest occurrence was observed in manure, both at the input (721 cases, 14 ATMs) and at the output (646 cases, 15 ATMs), of which 348 were common to both stages. Environmental persistence was evidenced by the detection of 27 markers from the manure input to the fertilized soil, in addition to three also present in the unfertilized soil. In total, the fertilized soil presented 70 manure-related markers, while 24 occurred exclusively in the unfertilized soil.

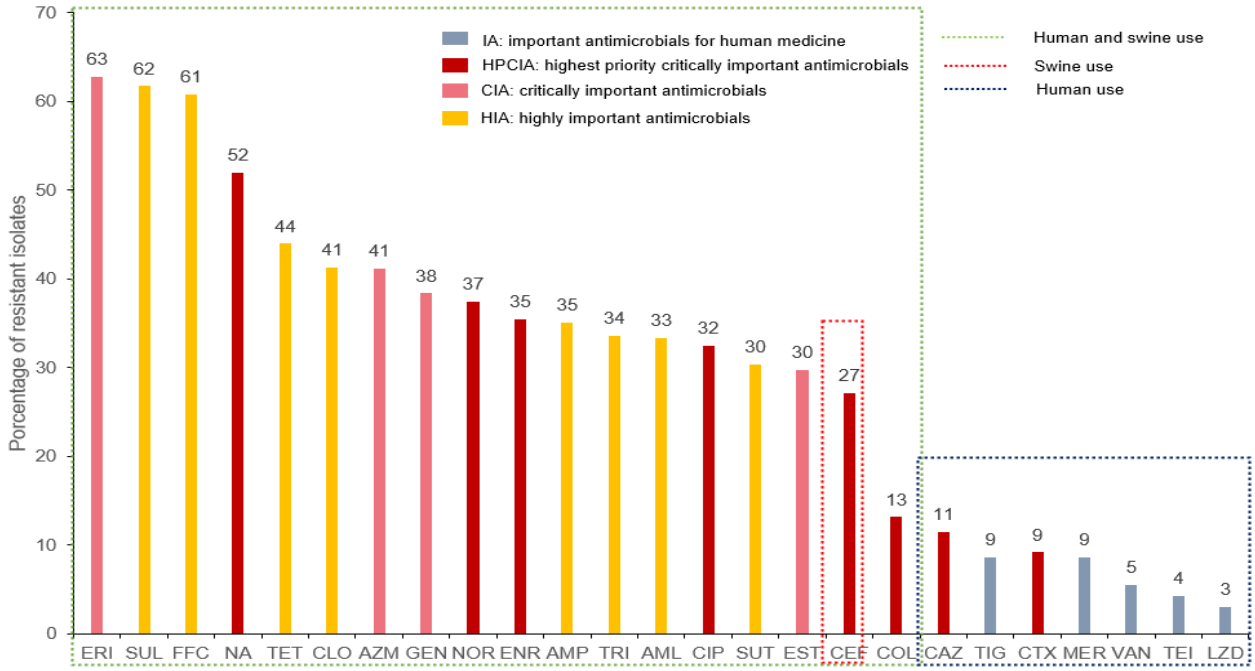

Figure 1. Frequency of resistant isolates against antimicrobials categorized by medical importance according to WHO (2024)[4]

DISCUSSION and CONCLUSION

In the swine production environment, the studied Enterobacteriaceae proved to be complementary and effective bioindicators of antimicrobial resistance. There was a wide distribution of resistant isolates and a high frequency of resistance and multidrug resistance (resistance to more than 3 classes of ATM[5]) phenotypes. The Venn diagram showed a higher occurrence of resistance in manure; with shared markers were observed feed, manure, and soil, confirming the environmental persistence of AMR.

The high rate of AMR and multidrug resistance observed and the presence of AMR phenotypes critical to human health, combined with the persistence of resistance phenotypes in the swine farm environment, emphasizes the need for prudent antimicrobial use.

ACKNOWLEDGEMENTS

To the entire team involved in the study

REFERENCES

1. BrCAST - Método de Disco-Difusão para Teste de Sensibilidade aos Antimicrobianos. Versão 9.0, janeiro de 2021 do EUCAST. Versão para o português.
2. CLSI. Clinical and Laboratory Standards Institute. Antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals. Norma aprovada 3ª ed. Wayne, PA, CLSI document M31-A3, 2008.
3. CLSI. Methods of antimicrobial dilution and disk susceptibility testing of infrequently isolated orfastidious bacteria. Approved guideline, 2nd ed. Wayne, PA, CLSI documen M45-A2, 2010.
4. List of Medically Important Antimicrobials: A risk management tool for mitigating antimicrobial resistance due to non-human use. WHO, 2024.
5. SCHWARZ S., SILLEY P., SIMJEE S., WOODFORDS N., VAN DUIJKEREN E., JOHNSON A.P. & GAASTRA W. 2010. Assessing the susceptibility of bacteria obtained from animals. J. Antimicrob. Chemother. 65:601-604.