Antimicrobial resistance and food safety in South Africa

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Outline…

- Background
- AMR in Food-Producing animals
  - African context
- Antimicrobial resistance
  - Poultry, Cattle, Pigs, wildlife
- Summary
- Thoughts for the future

Background

- Cattle, poultry, and pigs remain a source of food and income.
- Increased human population has resulted in an increase in demand for livestock products.
  - As a consequence, productions have become intensive,
    - Excessive/overuse/ misuse of antimicrobials -associated antimicrobial resistance

"A lack of effective antibiotics is as serious a security threat to disease outbreaks"

Background: Foodborne diseases

- Food-producing animals are the predominant source of foodborne diseases,
  - Non-Typh *Salmonella, Campylobacter, E. coli*
    - Antimicrobial resistance has been reported among these isolates.
- The use of antimicrobials in these animals,
  - Selection of resistant bacteria and
  - or transfer of antimicrobial-resistant bacteria from food-producing animals to humans via food.

Complexity managing AMR in Africa

- Despite evidence suggesting that the impact will be severe for developing countries (Complex Structures)
  - Highest burden of diseases, the increased financial burden (loss)
  - Lack or limited stringent policies on antibiotic use
    - Over-the-counter access to antimicrobials
  - Lack of surveillance systems,
  - Resources, financial and human capacity
  - Political


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THE NEW FACE OF SOUTH AFRICAN AGRICULTURE

NEWS CHANGEMAKERS LIFESTYLE FARMER'S INSIDE TRACK FOOD FOR THOUGHT

Farmer access to antibiotics 'revised' in South Africa

Antibiotics resistance is regarded by some as the next big pandemic of our time. In the fight against the crisis, farmer access to antibiotics needs to be limited, experts say. Those added to feed and water as growth promoters will be first to go

by Nicole Ludolph — 1st March 2022 in News Reading Time: 8 mins read

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"In Africa, livestock suffer from acute and highly fatal tick-borne diseases such as heartwater and anaplasmosis. Farmers should always have access to at least one or two injectable antibiotics for emergency treatment, especially in the deep rural areas where veterinarians often cannot attend to such outbreaks in time.“ Van Vuuren

Impact: Appropriate Antimicrobial use and improved patient outcomes

Antimicrobial resistance Governance

National Ministerial Advisory Committee on AMR; One Health approach, Provincial AMS committees.
Health establishment and district AMS committees and teams

Strategic Objectives

Diagnostic stewardship	Enhance Surveillance	Prevention including IPC and vaccination	Antimicrobial Stewardship
Correct use of diagnostic investigations to identify pathogens Strong quality assured laboratory systems Strengthen laboratories for food safety and disease diagnostics in animal health	National surveillance system for: • Resistant bacteria • Quantities of antimicrobials used and appropriateness of prescribed antimicrobials • Residues in meat and products of animal origin	IPC activities in health facilities Immunisation against preventable infections in humans and animals Water, sanitation and hygiene in communities Biosecurity and hygiene from farm to fork	Policies & Protocols National prescribing guidelines and Essential Medicines List Formulary restrictions Pre-authorisation Antimicrobial prescription forms Access and availability of antimicrobials under control of a veterinarian Stewardship at point-of-care Diagnosis of infection Appropriate antibiotic choice Dose optimization, duration, therapeutic drug monitoring, de-escalation and discontinuation

Strategic enablers

Legislative and policy reform for health systems strengthening
Single legislation to control all antimicrobials
Control of access, use and prescribing of antimicrobials in animal husbandry
Minimum standards and norms for AMS and IPC in health (National Core Standards)
Minimum standards for biosecurity, hygiene and use of alternatives for antimicrobials in animals

Education
Incorporate AMR strategies into medical, veterinary, para-medical, para-veterinary , agriculture and environmental health curricula
CPD programmes for human and animal health care professions
Sustained school health and public health campaigns

Communication
Patient and consumer advocacy
Partnership with media, industry and other relevant stakeholders

AMR in poultry

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Available at www.veterinaryworld.org/Vol.14/October-2021/12.pdf
RESEARCH ARTICLE
Open Access

Antimicrobial resistance and *mcr-1* gene in *Escherichia coli* isolated from poultry samples submitted to a bacteriology laboratory in South Africa

Ibrahim Z. Hassan[1], Buks Wandrag[2], Johan J. Gouws[3], Daniel N. Qekwana[4] and Vinny Naidoo[1]

Results: Sixty-eight percent of the strains were resistant to at least one antimicrobial; 44% were multiple drug-resistant (MDR). Most *E. coli* isolates were resistant to doxycycline (44%), trimethoprim-sulfamethoxazole (38%), ampicillin (32%), and enrofloxacin (32%). None of the *E. coli* strains was resistant to colistin sulfate (MIC_{90} of 2 μg/mL). Only one *E. coli* isolate held the *mcr-1* gene; none carried the *mcr-2* gene.

Research Article

Molecular Epidemiology of *Salmonella enterica* in Poultry in South Africa Using the Farm-to-Fork Approach

Melissa A. Ramtahal,[1] Anou M. Somboro,[1,2] Daniel G. Amoako,[1,3] Akebe L. K. Abia,[1] Keith Perrett,[4] Linda A. Bester,[2] and Sabiha Y. Essack[1]

abattoir (0.6%), and during house decontamination (0.6%). A total of 210 isolates contained the *invA* and *iroB* genes. Litter, faeces, and carcass rinsate isolates were classified as resistant to cefuroxime (45.2%), cefoxitin (1.9%), chloramphenicol (1.9%), nitrofurantoin (0.4%), pefloxacin (11.4%), and azithromycin (11%). Multidrug resistance (MDR) was observed among 3.8% of the

AMR in Cattle-Extensive

Antimicrobial use practices and resistance in indicator bacteria in communal cattle in the Mnisi community, Mpumalanga, South Africa

Charlotte Ropafadzo Mupfunya[1] | Daniel Nenene Qekwana[2] | Vinny Naidoo[2]

TABLE 5 Phenotypic antimicrobial resistance patterns of *E. coli* isolates ($n = 79$) from healthy cattle

Resistance pattern	Number of isolates	Percentage of isolates
Amoxycillin	1	1%
Enrofloxacin	1	1%
Chlortetracycline	1	1%
Colistin	11	14%
Chlortetracycline–colistin	1	1%
Chlortetracycline–amoxycillin	4	5%
Enrofloxacin–colistin	1	1%

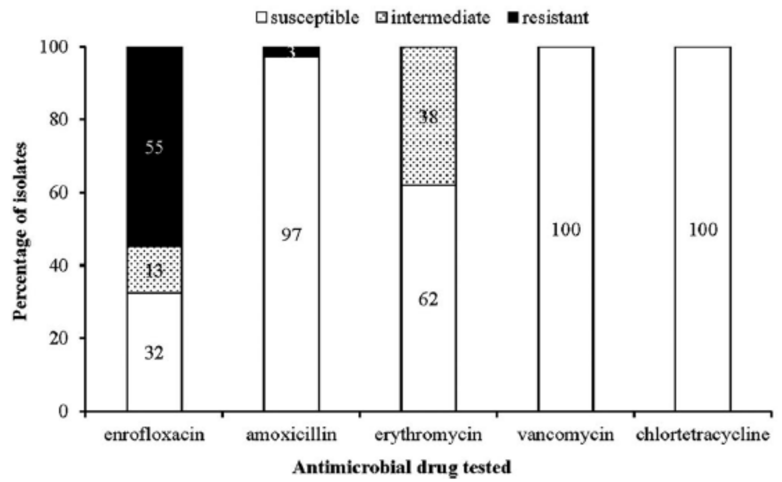


FIGURE 1 Antimicrobial susceptibility profile to five antimicrobials of *Enterococcus* isolates ($n = 71$) from healthy cattle

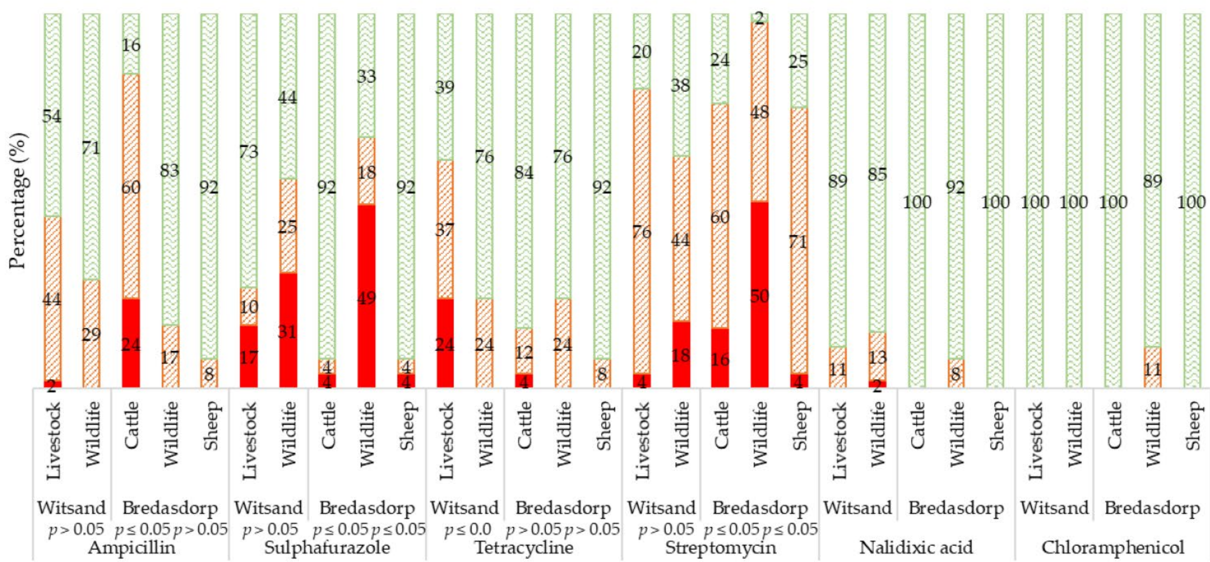
antibiotics

MDPI

Article

Escherichia coli Antibiotic Resistance Patterns from Co-Grazing and Non-Co-Grazing Livestock and Wildlife Species from Two Farms in the Western Cape, South Africa

Michaela Sannettha van den Honert [1,2], Pieter Andries Gouws [1,*] and Louwrens Christiaan Hoffman [2,3]



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AMR in Cattle-Feedlot

Research Article

Detection of Virulence Genes in Multidrug Resistant Enterococci Isolated from Feedlots Dairy and Beef Cattle: Implications for Human Health and Food Safety

Frank Eric Tatsing Foka and Collins Njie Ateba

Department of Microbiology, School of Biological Sciences, Faculty of Natural and Agricultural Sci
Mafikeng, Private Bag X2046, Mmabatho, South Africa

E. hirae was isolated in this survey. 176 confirmed enterococcal isolates possessed vancomycin resistance genes. Precisely, *vanA*, *vanB*, and *vanC* resistance genes were detected in 110, 31, and 38 isolates, respectively (Figure 1), out of which 12,

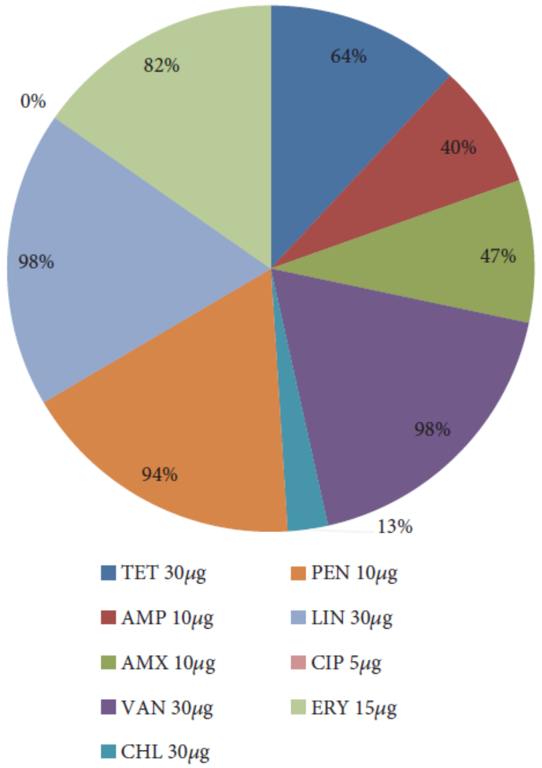


Figure 5: Proportions of antibiotic resistant VRE isolates.

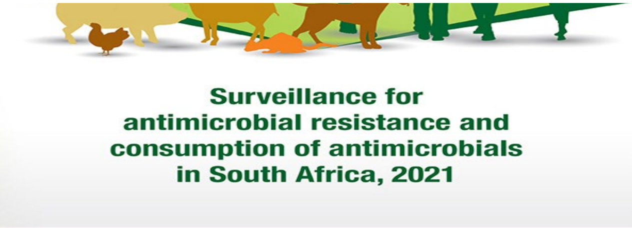
ANTIMICROBIAL RESISTANCE IN BACTERIA OF CLINICAL ORIGIN FROM SOUTH AFRICAN FEEDLOT CATTLE DURING 2002-2016.

Table 4.1: Resistance (%) per antimicrobial drug class from 2002 to 2016, and the cumulative resistance over the same period.

Antimicrobial Class	Year										Total
	2002	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2014*	*2015*	*2016*	
Macrolides	0.0	42.9	45.4	42.1	67.9	25.0	23.4	33.7	36.5	33.3	***37.0***
Sulphonamides	0.0	14.9	9.0	5.1	7.1	25.0	4.2	11.6	7.1	28.0	***9.1***
Aminoglycosides	40.0	58.7	59.7	43.6	78.6	50.0	43.3	21.7	20.2	-	***45.6***
Penicillins	18.2	14.8	10.3	4.2	2.4	7.7	3.1	6.2	5.7	4.6	***6.9***
Tetracyclines	20.0	37.0	28.4	15.4	14.3	0.0	29.8	18.8	13.1	32.4	***22.8***
Fluoroquinolones	30.0	39.5	42.3	33.2	39.3	29.2	27.9	40.2	40.7	57.0	***37.8***
Lincosamides	-	15.6	6.7	11.5	3.6	0.0	3.0	4.4	5.5	0.0	***6.7***
Cephalosporins	0.0	17.0	23.7	29.6	28.9	20.0	12.7	26.2	14.8	12.6	***20.1***
Polymixins	10.0	6.7	3.6	2.3	0.0	0.0	0.0	0.0	-	-	***2.6***
Phenicol	-	-	-	25.0	0.0	0.0	42.5	2.4	6.1	0.0	***15.4***
Total											**22.5**

Table 1. Surveillance of AMR in cattle feedlots

	Mannheimia haemolytica	***Pasteurella multocida***	***Histophilus somni***	***Salmonella phimurium***
Penicillin	1/20(5%)		1/21(5%)	2/2
Ampicillin	1/20(5%)		1/21(5%)	
Amoxycillin				
Amoxycillin/ Clavulanic acid				
Cephalosporin 1st gen				2/2
Cephalosporin 2nd gen				2/2
Cephalosporin 3rd gen				
Tetracycline	2/20(10%)	18/32(56%)	7/21(33%)	
Fluoroquinolones				
Erythromycin	6/20(30%)	17/32(53%)	3/21(14%)	2/2
Clindamycin/ lincomycin	20/20(100%)	32/32(100%)	14/21(67%)	2/2
Gentamicin		4/32(13%)	2/21(10%)	2/2
Amikacin	3/20(15%)	12/32(38%)	7/21(33%)	2/2
Kanamycin	3/20(15%)	5/32(16%)	13/21(62%)	2/2
Florfenicol	1/20(5%)	1/32(3%)		
Sulfamethoxazole/ trimethoprim	2/20(10%)	2/32(6%)	3/21(14%)	
Tilmicosin	1/20(5%)	13/32(41%)	2/21(10%)	
Tildipirosin		12/32(38%)	2/21(10%)	
Gamithromycin		12/32(38%)	1/21(5%)	
Ceftiofur				
Cefquinome				



Low Prevalence

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AMR in dairy animals

Onderstepoort Journal of Veterinary Research
ISSN: (Online) 2219-0635, (Print) 0030-2465
AOSIS
Page 1 of 9 Original Research

Climatic and regional antibiotic resistance patterns of *Staphylococcus aureus* in South African dairy herds

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TABLE 3: Prediction of expectation of *Staphylococcus aureus* antibiotic resistance to ampicillin, penicillin G and clindamycin for different seasons where significant differences were shown according to the analysis using the general linear mixed model.

Product	Season	Resistance (%)
Ampicillin	Spring†	39
	Summer‡	48
Penicillin G	Spring†	41
	Summer‡	53
Clindamycin	Spring†	36
	Autumn‡	43

antibiotics
MDPI

Article

Surveillance of Antibiotic Resistance of Maltose-Negative *Staphylococcus aureus* in South African Dairy Herds

Joanne Karzis [1,*], Inge-Marié Petzer [1], Edward F. Donkin [2], Vinny Naidoo [3] and Eric M.C. Etter [1,4,5]

This study indicated no significant differences (at a significance level of, $p < 0.05$) of antibiotic resistance amongst the provinces on the maltose-negative *S. aureus*, with a limited significant difference concerning seasons and SCC categories (Table 1).

AMR in Pigs

Article

Occurrence, Antimicrobial Resistance, and Molecular Characterization of *Campylobacter* spp. in Intensive Pig Production in South Africa

Viwe Sithole [1], Daniel Gyamfi Amoako [1,2,*], Akebe Luther King Abia [1,*], Keith Perrett [3], Linda A. Bester [2] and Sabiha Y. Essack [1]

were classified as "other spp". Relatively high resistance was observed in *C. coli* and *C. jejuni* to erythromycin (89% and 99%), streptomycin (87% and 93%), tetracycline (82% and 96%), ampicillin (69% and 85%), and ciprofloxacin (53% and 67%), respectively. Multidrug resistance (MDR) was noted in 330 of the 378 (87.3%) isolates. The antibiotic resistance genes observed were *tetO* (74.6%),

From Farm-to-Fork: *E. Coli* from an Intensive Pig Production System in South Africa Shows High Resistance to Critically Important Antibiotics for Human and Animal Use

Shima E. Abdalla [1,*], Akebe Luther King Abia [1], Daniel G. Amoako [1,2,3], Keith Perrett [4], Linda A. Bester [2] and Sabiha Y. Essack [1]

meropenem (0.2%), respectively. Resistance was also observed to chloramphenicol (71.4%), ampicillin (71.1%), trimethoprim-sulfamethoxazole (61.3%), amoxicillin-clavulanate (43.8%), cephalexin (34.3%), azithromycin (23.9%), nalidixic acid (22.1%), cefoxitin (21.1%), ceftriaxone (18.9%), ciprofloxacin (17.3%), cefotaxime (16.9%), gentamicin (15.5%), cefepime (13.8%), ceftazidime (9.8%), amikacin (3.4%), piperacillin-tazobactam (1.2%), tigecycline (0.9%), and imipenem (0.3%). Multidrug resistance

Conclusions

- ❑ AMR data in food-producing animals is limited in ZA
  - Progress has been made
- ❑ Phenotypic resistance has been reported among isolates
  - Poultry, cattle, poultry and wildlife
- ❑ Some isolates carry registrant genes
- ❑ The impact of AMR on
  - Food animals and human has not been quantified

Recommendations

- Regulatory Framework on antimicrobial use in food-producing animals.
  - Fertilizers, Farm Feeds, Seeds and Remedies Act 36 of 1947
  - Medicines And Related Substances Act. No. 101 Of 1965.
- Develop and improve surveillance of AMR
  - Capacity of veterinary laboratories
    - Inter-laboratory collaborations
- Educational programs for prescribers, animal owners
- On-farm biosecurity must be prioritised
- Reduce antimicrobial use and consumption at farm level

Thank you!