RESEARCH ARTICLE **(Open Access)**

Mapping Antimicrobial Resistance evidence in Albania: One Health context

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Abstract

Antimicrobial resistance (AMR) is now a growing public health threat that request can coordinated surveillance across veterinary, human and environmental sectors. In Balkan region, several countries contribute to have some data to international network, yet Albania remains largely absent, creating a significant gap in regional AMR monitoring. This narrative review and situational analysis synthesize available evidence on antimicrobial use and resistance in Albania within a One Health framework. Evidences from hospital indicates high empirical antibiotic use, substantial prevalence of extended-spectrum ß-lactamase (ESBL) producing Enterobacterales, and reliance on broad spectrum "Watch" antibiotics. Studies widespread self-medication and non-prescription access to antibiotics. In veterinary, commonly used antimicrobials and residue detection in food reflect continuous antimicrobial pressure, yet resistance monitoring in food producing remains limited. Available poultry data demonstrate very high multidrug resistance rates. At other side environmental evidence from Shkumbini River reveals widespread ESBL- producing and multidrug resistant Escherichia coli, highlighting aquatic ecosystem as active reservoirs of resistance. Even that is developed a National Action Plan on AMR, surveillance activities across sectors remain fragmented and poorly integrated with no systematic ESBL monitoring, limited linkage between antimicrobial consumption and resistance data. Collectively all evidences indicate that Albania is experiencing significant antimicrobial pressure and established resistance across multiple compartments. Strengthening coordination surveillance is essential to inform policy, support stewardship efforts and prevent further silent dissemination of resistance.

Keywords: ESBL; antimicrobial resistance; β-lactamase genes; genotyping; surface water; phylogenetic groups

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(Accepted for publication 15.09.2026)
ISSN: 2218-2020, © *Agricultural University of Tirana*

1. Introduction

Antibiotic resistance is recognized as a major threat to public health. Bacteria utilize a range of mechanisms to evade the effect of antibiotics leading to challenges in clinical infection treatments. These range from nonspecific processes including increasing efflux pump activity or down regulation of porin channels, to the production of enzymes that specifically target and inactivate antimicrobial agents (1). Of particular concern is the spread of Extended Spectrum ß Lactamases (ESBL) producing bacteria in both clinical and environmental settings. Assessing the public health risk associated with these organisms requires an understanding of the proportion of commensal strains and potentially pathogenic variants capable of causing disease (2). Furthermore, as bacteria continue to adapt the presence of antibiotics through the acquisition of antibiotic resistance genes (ARGs) via mobile genetic elements (MGEs), has significantly reduced the effectiveness of available antibiotics. Due to the growing limitations of treatment support, older antibiotics such as colistin, despite its known toxicity and risk of adverse effects, are being employed to treat infections caused by bacteria that are resistant to last resort antibiotics (3).

In recent years, countries across the Balkan region have strengthened their effort to monitor and address antimicrobial resistance (AMR) by actively contributing data to the central Asian and eastern European surveillance of Antimicrobial Resistance (CAESAR) network (4). Their reports highlight not only a growing regional commitment to AMR surveillance but also marked variability in resistance patterns among commonly isolated pathogens. Data from Montenegro shows that Escherichia coli remained fully susceptible to carbapenems and amikacin (0 % resistance), while the resistance to amoxicillin and ampicillin reached 89%, with multidrug resistance (MDR) observed in 5 % of isolated. Serbia reported *E. coli* resistance ranging from 1% to imipenem and meropenem up to 63% for Amoxicillin and ampicillin with an MDR rate of 21%. In the Republic of North Macedonia *E. coli* resistance ranged from 0% about imipenem and meropenem up to 83 % for amoxicillin and ampicillin, with MRD in 39% of isolates. Meanwhile in Kosovo resistance varied from 0% for imipenem, meropenem and amikacin to 79% for medicament as amoxicillin and ampicillin with multidrug resistance detected in 26% of isolates. In contrast Albania did not report any data on AMR for this period of time (4). Despite the lack of comprehensive AMR data, Albania has made notable progress in strengthening national antimicrobial resistance (AMR) framework. Achievements include the appointment of a WHO AMR focal point within the Ministry of Health, the development of a national AMR action plan and active participation in regional external quality assessment (EQA) scheme (5).

Country	Ampicillin/ Amoxicillin Resistance (%)	Carbapenem Resistance (%)	Multidrug Resistance (MDR) Rate (%)
Montenegro (4)	89	0	5
Serbia (4)	63	1	21
North Macedonia (4)	83	0	39
Kosovo (4)	79	0	26
Albania (5)	No data reported	No data reported	No data reported

Table 1 Regional Comparison of E. coli Resistance Profiles (CAESAR Data)

2. Materials and Methods

2.1 Review design

This is a narrative review and situational analysis methodology to synthesize available clinical, environmental and veterinary research in Albania.

2.2 Literature search

The PubMed, Scopus, Web of Science and Google scolar databases were searched for articles published between march 2022 and September 2026. All by using combinations of terms like: Albania, antimicrobial resistance, antibiotic resistance, antibiotic consumption, antibiotic use, ESBL, poultry, One Health, surface water, veterinary.

2.3 Grey literature and registries

Official sources were consulted for national policy and product data: the national Action Plan on AMR the register of human medicines of the National Agency of Medicine and Medical Devices (AKBPM), the list of registered veterinary medicinal products of the Ministry of Agriculture and Rural Development, and WHO and ECDC surveillance reports. The registered were accessed form march 2022 till September 2026.

2.4 Eligibility criteria and synthesis

We have included publications reporting data collected in Albania during different timing on antimicrobial use, residues and resistance in animals, humans, environment and food, published in Albanian or English. Because of the heterogeneity of this study designs, methods and populations, findings were synthesized narratively by One Health approach, without formal quality appraisal or meta-analysis.

3. The One Health Landscape in Albania

The Albanian NAP-AMR formally adopts a "One Health" approach, acknowledging that effective resistance management requires one collaboration between different sectors. Responsibilities are divided among the Ministry of Agriculture and Rural Development, Ministry of Health and Social Protection and the Ministry of Tourism and Environment. However, translating this policy framework into active, integrated surveillance across these different sectors remains a significant challenge.

4. The agricultural and veterinary compartment

The administration of veterinary medicinal products (PMV) in food- producing animals for treatment, prophylaxis or meta phylaxis drives strong selective pressure. In Albania, there are registered 930 veterinary medicinal products (PMV), key classes highly critical to human medicine dominate livestock use (6):

- Tetracyclines: 5.5% of authorized products
- Penicillin's: 3.7% of authorized products
- Amoxicillin: 3.4% of authorized products
- Trimethoprim: 1.7% of authorized products

This extensive usage correlates with the presence of drug residues in the food supply. Analytical monitoring has frequently detected amoxicillin and penicillin residues in commercial cow's milk, and penicillin residues in honey (7).

Compounding the residue risk, active resistance in food producing animals is exceptionally high. In a pilot survey evaluating 172 poultry samples across six Albanian farms, 91 Enterobacteriaceae isolates (mostly E. coli and Salmonella spp.) displayed alarming resistance patterns (8). At same time, multidrug resistance was confirmed in 95% of the isolates of E. coli and 82% of isolates with Salmonella, indicating highly established resistance reservoirs in agricultural sector (8).

5. The Human Medicine compartment

5.1. Retail Availability of critical Antimicrobials

An evaluation of National Registry of Human Medicines in Albania (as of late 2026) reveals 4.822 registered pharmaceutical products, of which is substantial portion consists of antibiotics critical to AMR surveillance (9).

Antibiotic Class / Agent	**Number of Registered Products**	**Percentage of National Registry (%)**	**WHO Aware Classification**
Ceftriaxone	46	0.95%	Watch
Amoxicillin	43	0.89%	Access
Ciprofloxacin	42	0.87%	Watch
Ceftazidime	13	0.27%	Watch
Tetracycline	11	0.23%	Access

Cefotaxime	8	0.17%	Watch
Cephalexin	4	0.08%	Access

Table 2 Registered Antibiotic Formulations in Albania

The high presence and availability of third -generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime) and fluoroquinolones (ciprofloxacin) correlates with clinical selection for ESBL producing pathogens (9).

5.2. Community and self-medication behaviors

Even that there are efforts to raise public awareness, the way how people behave in Albania heavily lean toward unauthorized, liberal use (10). Is indicated in the survey that 53.4% of 519 surveyed have admitted to self-medicate with antibiotics without a prescription of a doctor. The most frequently self-administered were amoxicillin and azithromycin, commonly used to treat some viral condition like sore throats, influence and acute bronchitis.

This issue is compounded by inconsistent pharmacological counseling at retail level and the absence of rapid diagnostic point care testing in primary clinics (11) (12). Dental practices mirror this trend, a survey of 477 dental patients revealed extensive self-reported history of antibiotic use (mostly amoxicillin with clavulanic acid), alongside with high self-reported penicillin allergies and perceived treatment failures (13).

5.3. Hospital consumption and clinical resistance

During secondary and tertiary care antibiotic pressure remain too intense. A point prevalence survey (PPS)) done at one of major hospital center in Tirana showed that 65.7% of all hospitalized patients were actively received antibiotic therapy. The major of these prescriptions (67.1%) was allocated for medical prophylaxis rather than targeted treatment, peaking at 81.0% usage rate in intensive care units (ICUs). Cephalosporins represented the dominant class prescribed with 53.1%, followed my metronidazole with 16.2% and fluoroquinolones at 14.7% (14).

A rectal swab PPS of 104 hospitalized patients recovered Enterobacteriaceae in 31.7% of cases, with a striking 41.3% pf those isolates confirm as ESBL producers (ESBL producing *E. coli* and *klebsiella pneumoniae*, alongside AmpC beta lactamase phenotypes) (15).

In a study of 271 positive urinary tract infections cultures in community and outpatient settings, E. coli was identified as the primary pathogen. There were observed high resistant's rate against tetracycline, trimethoprim-sulfamethoxazole with notable ESBL production rate (16).

During the years 2017 to year 2019, overall antibiotic consumption declined from 27.4 to 18.8 defined daily doses per 1000 inhabitants per day (DID). However, the quality of prescribing deteriorated: the proportion of "watch" group antibiotic rose from 10% to 70%. Following the COVID-19 pandemic, total consumption rebounded to 25.2 DIDs in 2021, with" watch" agents compromising an alarming 82% of the most utilized therapies used (17).

6. Environment compartment

Environmental represent often the final overlook pillar of the One Health triad. In Albania municipal wastewater and agricultural runoff frequently enter surface waters with minimal treatment.

The first molecular characterization of ESBL-producing *E. coli* in Albanian surface waters, focusing on the Shkumbini river established that these aquatic systems are highly active resistance reservoirs (18):

- ESBL- producing E. coli was detected in 80% of sampling locations along the river.
- 94.2% of environmental isolates were classified as multidrug resistant. Exhibiting high resistance to ampicillin with 98.1% and third generation cephalosporin cefotaxime with 86.5%.
- 55.8% of isolates demonstrated active biofilm-forming capacities. Biofilm information significantly enhances bacterial survival against environmental stressors, ensuring the persistence and potential transfer of ESBL resistance genes to human and animal populations utilizing the river basin.

7. One health priorities, surveillance gaps

Current Albania's AMR profile is characterized by fragmented data and a lack of systemic coordination. Transition from passive observation to active mitigation, Albania must prioritize the following strategic actions.:

1- Strictly regulate the sale of over-the counter veterinary and human antibiotics to curb self - medication practices and informal retail channels.

2- Roll out rapid diagnostic testing in primary care and hospitals to transition from high-volume, empirical 'watch' category prescribing to targeted narrow-spectrum treatment.
3- Developing standardized laboratory protocols, to monitor systematically ESB-producing E. coli and other pathogens across veterinary sector, hospitals and aquatic environments.
4- Improving agricultural, veterinary and municipal wastewater treatment to prevent the environmental recycling of resistant clinical strains.

8. Limitations

This is a narrative review without a systematic search protocol or formal quality appraisal, so relevant studies may have been missed and selection bias cannot be excluded. The available studies are heterogeneous in design, period and method. Several data sources are more than ten years old. Registry counts describe availability rather than use. The environmental evidence rests on a single study by some present authors, which may introduce self-citation bias.

9. Conclusion

Evidences from veterinary, human and environmental compartments demonstrates that antimicrobial resistance is deeply established in Albania under intense selective pressure. The current lack of an integrated, cross-sectoral surveillance database conceals the true transmission dynamics and clinical impact of these resistance strains. Executing a well-coordinated One Health surveillance framework that links real-tome antibiotics consumption with phenotypic and genotypic resistance data is vital to protect the efficacity of existing therapeutics.

10. Author Contributions:

Conceptualization, E.L, F.P. and I.K.; methodology, F.P, E.L.; formal analysis and F.P.; investigation, L.R. and F.P.; resources, F.P. and I.K.; data curation, FP and S.S..; writing—original draft preparation, F.P and I.K; writing—review and editing, I.K, and F:P.; visualization, L.R and S:S.; supervision, I.K.; project administration, E.L. All authors have read and agreed to the published version of the manuscript.

11. Conflicts of Interest

The authors declare that they have no conflicts of interest.

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