China's response to antimicrobial resistance governance practices, 2017-2024: a systematic gap analysis based on artificial intelligence

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Abstract

Background

Antimicrobial resistance (AMR) is a major global public health threat. Yet, existing studies lack a systematic review of cross-sectoral AMR governance. This study aims to comprehensively assess China's sectoral responses to AMR from 2017-2024, analyze sectoral and regional governance differences, and quantify correlations between response levels and AMR indicators.

Methods

We used AI (e.g., the collaborative Scrapy web crawling technique) to collect text data on how Chinese government departments at all levels have responded to AMR from 2017 to 2024, including policy papers, news, official WeChat posts, and other public data. A Large Language Model standardized the data for sectoral and regional comparison. Finally, we used a distribution-lag model to evaluate the correlations between provincial response levels and AMR.

Results

A total of 11,291 datapoints mapped China's sectoral AMR governance, with human (54.5%), animal (39.5%), environmental (4.2%), and "One Health" (1.6%) sectors contributing. From 2017 to 2024, the number of relevant texts included increased steadily, peaking in 2020 before declining. The main content types of the included texts were administrative management and policy guidance, at 42.6% and 18.7%, respectively, while basic support (8.7%), industrial innovation (7.3%), academic exchange (5.6%), and international cooperation (0.5%) accounted for relatively low proportions. Shandong, Sichuan, and Guangdong provinces ranked highest in AMR governance responsiveness, while Ningxia Hui Autonomous Region, Qinghai Province, and Tibet had the lowest. Higher governance responsiveness significantly correlates with lower detection rate of CtxCroR-kpn (β=-0.03%, p=0.035), CR-pae (β=-0.02%, p=0.030), and QnR-eco (β=-0.05%, p=0.020).

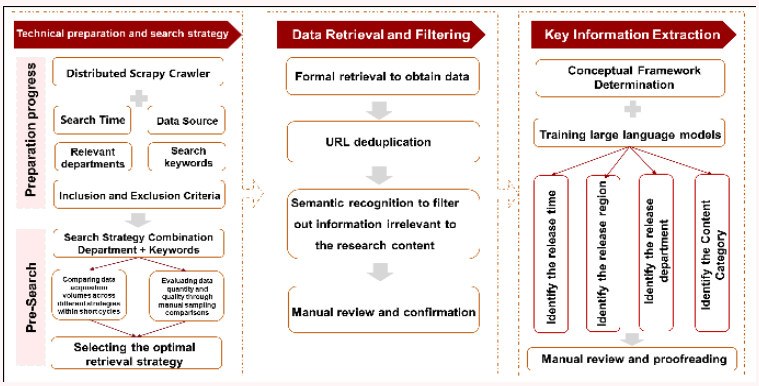
Conclusions

Different sectors vary greatly in timing and scope of AMR governance response; human sector's sole active response is inadequate. Industrial innovation, academic exchange, and international cooperation need

Introduction

- Antimicrobial resistance (AMR) is a major global public health threat, seriously hindering sustainable development goals due to its severe impacts on human health and socioeconomics.
- Modern society sees frequent, intense human interventions in health, agriculture, and the environment. Irrational activities like antibiotic abuse (in both humans and animals), improper wastewater treatment, etc. have sped up new bacterial resistance gene emergence and spread, challenging AMR control.
- The "One Health" approach promotes interdisciplinary, multisectoral collaboration in AMR governance. However, translating NAP goals into practice sustainably is tough due to diverse sectors with varying priorities. This reveals a big theory-practice gap. There's an urgent need for a more systematic, in-depth analysis of cross-sector AMR governance practices, not just policy text analysis, to offer practical advice for putting "One Health" approach into practice.
- Traditional methods struggled to screen and integrate large text databases on AMR governance. AI technologies have empowered this study, producing numerous valuable insights.
- China, a major producer and consumer of antibiotics, faces severe issues of antibiotic misuse and AMR.
- This study collects and integrates large-scale data on AMR governance practices in China to establish a database, demonstrating the significant progress and practical experiences achieved in AMR governance across sectors.

Methods



Conceptual framework

Anderson et al. developed and assessed a governance framework for NAPs on AMR, including nine governance areas for the purpose of categorizing subsequent text content:

- Policy Guidance
- Administrative Supervision
- Personnel Training
- Surveillance and Monitoring
- Health Education
- Infrastructure Support
- Industrial Innovation
- Academic Exchange
- International Cooperation

Examining correlates

Two-way fixed model to examine the impact of AMR governance responses on AMR across provinces.

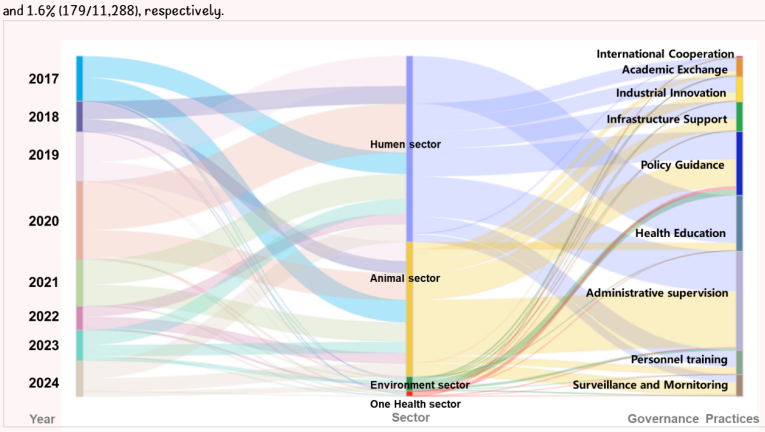
AMR governance responses were indicated by response scores (core explanatory variable).

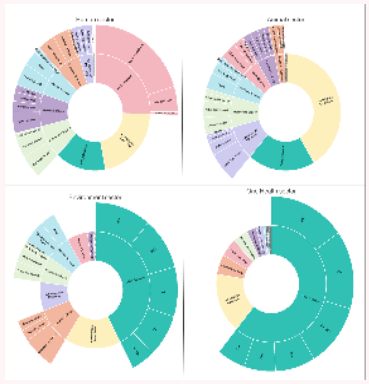
For a province, the response score was the Min-Max normalized count of AMR governance activity texts in the database linked to that region.

AMR prevalence was gauged via annual detection rates of CtxCroR-kpn, CR-pae, and QnR-eco across provinces from 2017 -2024 (explained variables). Data came from the China Antimicrobial Resistance Surveillance System.

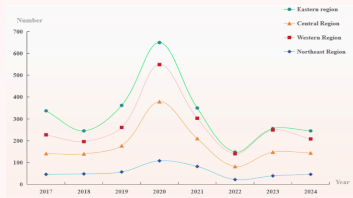
Results

A total of 11,288 data points were ultimately mapped to AMR governance practices across various sectors in China, with human, animal, environment, and "One Health" sectors accounting for 54.6% (6162/11,288), 39.6% (4470/11,288), 4.2% (477/11,288), and 1.6% (179/11,288), respectively.





Included data mainly covered administrative supervision (29.2%, 3,293/11,288) and policy guidance (18.8%, 2,117/11,288), followed by health education (16.4%, 1,851/11,288) and infrastructure support (8.7%, 984/11,288). Industrial innovation (7.3%, 825/11,288), personnel training (7.1%, 802/11,288), surveillance and monitoring (6.4%, 721/11,288), academic exchange (5.6%, 635/11,288), and international cooperation (0.5%, 60/11,288) have low proportions.



Correlation analysis between the government response and AMR

The study showed a negative correlation between AMR governance response and drug-resistant bacteria detection rate, with a notable lag effect. The optimal model revealed that governance responses with a 2-year lag still affect CR-pae and QnR-eco, with regression coefficients of -0.030 and -0.075, respectively, showing statistical significance. Governance responses with a 1-year lag continue to impact CtxCroR-kpn, with a regression coefficient of -0.001.

Discussion

The human and animal sectors have made comprehensive preparations for AMR, whereas the environmental sector is just beginning.

There are significant regional differences in AMR governance responses, with higher scores indicating lower prevalence;

Enhancing public and regional administrators' awareness of the "One Health" concept is crucial for translating theory into practice.

Cross-sectoral health education serves as an effective approach, especially for rural areas.

Greater participation and collaboration among border stakeholders, such as schools and communities, may play an unexpectedly significant role in governance.

We call for regional pilot programs to better achieve human-animal monitoring data sharing for AMR surveillance.