Community-Acquired Antimicrobial Resistant Enterobacteriaceae

Subjects: Others

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Antimicrobial resistance (AMR) is an issue of increasing importance worldwide. Community-acquired antimicrobial resistant Enterobacteriaceae (CA-ARE) are of particular concern because of the risks they pose to human health and the variety of drivers that promote their spread. Community-acquired refers to the mechanism of AMR spread, which is in the community rather than clinical settings. Enterobacteriaceae are a family of Gram-negative bacteria. Antimicrobial misuse in clinical settings and food animal production is amplified by environmental contamination and persistence in the community, resulting in the spread of CA-ARE. Because the factors contributing to the proliferation of CA-ARE are multifaceted and interconnected, it is critical to use a One Health framework, which focuses on the interfaces between humans, animals, and the environment, to address this issue. This approach will help future collaborations between stakeholders in the animal, environmental, and human health sectors incorporate multidisciplinary aims to be more successful in mitigating the spread of CA-ARE and antimicrobial resistance in general.

antimicrobial resistance | Enterobacteriaceae | One Health | Central America

1. Introduction

Antimicrobial resistant Gram-negative bacteria belonging to the Enterobacteriaceae family pose a significant risk to human health, and are categorized through identification of priority groups as "critical", "high" and "medium" by the World Health Organization (WHO) [1]. The spread of community-acquired antimicrobial resistant Enterobacteriaceae (CA-ARE) is an increasing problem worldwide and is particularly problematic in low- and middle-income countries (LMICs) with fewer surveillance and regulation mechanisms [2]. As CA-ARE are detected in a broader geographic landscape with increasing prevalence, it has become clear that coordinated research and antimicrobial resistance (AMR) mitigation efforts should include spread in communities outside of clinical settings [3]. Understanding the mechanisms and risk factors driving CA-ARE proliferation is fundamental to prevention and control efforts.

CA-ARE are attributed to many drivers, including antimicrobial misuse in humans and animals that create selective pressure for drug resistance, as well as poor water and sanitation systems that allow for the organisms to spread. In human health, the improper use of antimicrobials leads to a selection of CA-ARE [4]. Outside of clinical settings, there is evidence that antimicrobials are misused in food animal production, where they are administered to both commercial [5]and small-scale food animals to promote growth, prevent disease and improve feed conversion efficiency [6]. Persistence and spread of CA-ARE contribute to the global problem and numerous studies have

identified that travel to LMICs is a risk factor for CA-ARE [7]. CA-ARE are also likely to be spread from human and agricultural waste which are often disposed of in the environment and subsequently contaminate waterways, soil, edible crops and wildlife. Furthermore, waste from pharmaceutical manufacturing, hospitals, and a variety of industries contribute to the spread of CA-ARE [8]. The combined capability for CA-ARE to be spread outside of healthcare facilities, as well as the intra- and inter-species transfer of resistance, and the already serious state of antimicrobial resistance in Enterobacteriaceae make this family of bacteria a critical target for research [9].

Given the interconnecting factors contributing to increasing CA-ARE, understanding and responding to this issue necessitates the use of a One Health framework, which focuses on issues that occur at human, animal, and environmental interfaces [10][11]. Upholding this principle, the WHO Plan to address global AMR uses a One Health approach and asks members to follow by example when creating country-specific action plans [12].

This review of CA-ARE focuses on Central America, a region composed of seven countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama, which are in varying stages of development in terms of demographics, health and economics (Table S1). There is evidence that the most widely available antibiotics in the Central American region are amoxicillin and tetracycline often sold without a prescription in corner stores [13]. Self-medication practice in the region also reflects the prevalent community use of amoxicillin and tetracycline to treat the common cold, or flu like symptoms [14]. In clinical medicine, however, phenotypic resistance profiles do not reflect these community antibiotic use practices where high rates of resistance to broad spectrum antibiotics have been shown in Guatemala [15]. In this context, there are likely to be other drivers of antimicrobial resistance related to hygiene and sanitation that play an important role in propagating bacterial resistance to broad spectrum antibiotics in the region [16].

2. Future Directions

Investment in local capacity will be essential for developing a One Health AMR framework in Central America. This review has shown that there are enormous knowledge gaps in the region that hinder global and regional efforts to reduce AMR spread, and international efforts, like GLASS and ReLAVRA, do not fully characterize the current AMR situation in Central America. The only country in the region with a national AMR action plan, Costa Rica, was also the country best described by existing literature on CA-ARE. It is clear that international and regional investment in understanding AMR is critical, while also improving systems that help mitigate the impact of AMR, such as healthcare access and services, patient and clinician education, expanded laboratory capacity, and regulation of antimicrobial use in all settings (clinical and agricultural).

Major improvements to One Health surveillance of AMR are greatly needed in Central America, and there is a significant need to apply this approach with multiple sectors involved at the early stages of development. Dedicated resources for the One Health approach will likely strengthen regional capacity to prevent and control the spread of AMR by building new knowledge and understanding of the drivers for AMR locally [17]. However, to have access to more funds, to meet clear research and surveillance objectives that respond to the needs of each country and the region, it is necessary to prioritize the problem, structure strategic plans, and define specific lines of research.

Stakeholders working in the animal, environmental and human health sectors have often found it difficult to understand each other's objectives, and this has led to a lack of mutual understanding of the shared benefits of collaboration. Development and implementation of One Health frameworks that incorporate multidisciplinary goals and outcomes could augment this effort. Focusing on AMR that is clinically relevant (i.e., causing the greatest morbidity and mortality in hospitalized patients regionally and globally), will likely be an important start for One Health AMR surveillance programs at the early stage of development. In this review, we highlight the limited scope of information about community-acquired AMR in Central America, particularly for last-line antimicrobials like carbapenems and colistin. This review draws attention to the gaps related to the lack of studies and surveillance with the One Health approach, especially in Enterobacteriaceae [18][19][20].

The 2016 WHO global containment plan includes, among its five pillars, the improvement of knowledge of AMR through communication and education, as well as the strengthening of the scientific base through surveillance and research. Outlining the state of knowledge about AMR, especially community-acquired AMR, in Central American countries is a starting point for regional plans. This review contributes to the knowledge of this state and to the consideration of the One Health approach as a way of addressing the problem. Effective design and implementation of strategies to decrease AMR will require the consideration of risk factors encompassing interactions between humans, animals and the environment. Further, greater transparency and uniformity in data collection strategies and dissemination of results will improve cohesion and comparability of findings across the region. These efforts will require greater coordination of efforts across sectors, and among countries.

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