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Current Challenges of Antibiotic Resistance in the Middle East: A Concise Review

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1. Abstract

Antimicrobial resistance (AMR) represents one of the most pressing global health challenges, with the Middle East emerging as a region of particular concern due to escalating resistance rates across multiple pathogen classes. This mini review synthesizes current evidence on the epidemiology, contributing factors, and intervention strategies related to antibiotic resistance in Middle Eastern countries. A comprehensive analysis of literature published between 2020 and 2025 reveals alarmingly high prevalence rates of multidrug-resistant organisms, including carbapenem-resistant Enterobacteriaceae (CRE), methicillin-resistant Staphylococcus aureus (MRSA), and extended-spectrum β-lactamase (ESBL)-producing bacteria across the region. Key drivers identified include unrestricted over-the-counter antibiotic availability, inadequate antimicrobial stewardship programs, insufficient infection prevention measures, and limited surveillance infrastructure. The COVID-19 pandemic has further exacerbated resistance patterns through increased empirical antibiotic prescribing. Regional variations exist, with Gulf Cooperation Council countries demonstrating more advanced surveillance capabilities compared to conflict-affected nations. This review highlights the urgent need for coordinated regional action, strengthened antimicrobial stewardship implementation, enhanced laboratory capacity, and policy reforms to address this escalating public health crisis. Evidence-based strategies tailored to regional socioeconomic and healthcare contexts are essential for mitigating the AMR burden in the Middle East.

2. Keywords: Antimicrobial resistance, Middle East, multidrug-resistant organisms, antimicrobial stewardship, ESKAPE pathogens, surveillance

3. Introduction

Antimicrobial resistance (AMR) has emerged as one of the most significant threats to global public health, with the World Health Organization (WHO) identifying it among the top ten global health challenges [1]. The discovery and widespread use of antibiotics revolutionized medicine in the twentieth century; however, the subsequent overuse and misuse of these agents have accelerated the evolution and dissemination of resistant microorganisms. Current projections suggest that by 2050, AMR could cause approximately 10 million deaths annually worldwide if effective interventions are not implemented [2].

The Middle East represents a geographic region of particular concern regarding AMR, characterized by unique socioeconomic, cultural, and healthcare system factors that contribute to elevated resistance rates. Countries within this region, spanning from the Gulf Cooperation Council (GCC) states to the Levant and extending to North African territories, exhibit considerable heterogeneity in healthcare infrastructure, antibiotic regulation policies, and surveillance capabilities [3]. Despite this diversity, common challenges including liberal antibiotic dispensing practices, limited antimicrobial stewardship programs (ASPs), and inadequate infection prevention and control (IPC) measures unite the region in its struggle against resistant pathogens.

The epidemiological landscape of AMR in the Middle East has been further complicated by recent events, including armed conflicts resulting in population displacement, healthcare system disruptions, and the COVID-19 pandemic, which triggered substantial increases in empirical antibiotic prescribing [4]. These factors, combined with high rates of healthcare-associated infections and the movement of patients across borders for medical care, create conditions conducive to the emergence and spread of multidrug-resistant organisms (MDROs).

This mini review aims to provide a concise synthesis of current evidence regarding antibiotic resistance patterns, contributing factors, and mitigation strategies in Middle Eastern countries, focusing on literature published within the past five years. Understanding the regional AMR landscape is essential for developing targeted interventions and informing policy decisions to combat this escalating threat.

4. Epidemiology Of Antibiotic Resistance In The Middle East

4.1. ESKAPE Pathogens and Resistance Patterns

The ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species) represent the leading causes of healthcare-associated infections globally and

demonstrate particularly concerning resistance patterns in Middle Eastern healthcare settings [5].

4.1.1. Carbapenem-Resistant Enterobacteriaceae (CRE): The prevalence of CRE in the Middle East has reached critical levels, with studies reporting rates ranging from 15% to over 50% in certain healthcare facilities. A multicenter surveillance study across six Middle Eastern countries conducted between 2021 and 2023 identified carbapenem resistance in 38.2% of Klebsiella pneumoniae isolates, with the blaNDM and blaOXA-48 genes representing the predominant carbapenemase types [6]. Saudi Arabia, the United Arab Emirates, and Egypt have reported particularly high CRE burdens, with intensive care units (ICUs) serving as primary reservoirs for these resistant organisms.

4.1.2. Methicillin-Resistant Staphylococcus aureus (MRSA): MRSA remains endemic throughout Middle Eastern healthcare facilities, with prevalence rates varying considerably by country and setting. Recent data indicate MRSA rates of 35-55% among S. aureus isolates in tertiary care hospitals across the region [7]. Notably, community-acquired MRSA (CA-MRSA) has emerged as an increasing concern, particularly in the Gulf states, where the USA300 and ST80 clones have been identified with increasing frequency.

4.1.3. Acinetobacter baumannii: Carbapenem-resistant A. baumannii (CRAB) represents perhaps the most challenging pathogen in Middle Eastern ICUs, with resistance rates exceeding 80% in several countries [8]. The organism's remarkable ability to survive on environmental surfaces and acquire resistance determinants has facilitated its widespread dissemination. A 2022 systematic review identified the Middle East as having among the highest global CRAB prevalence rates, with particularly elevated rates in Lebanon, Iraq, and Egypt.

4.1.4. Extended-Spectrum β-Lactamase (ESBL) Producers: ESBL-producing Enterobacteriaceae have become ubiquitous in both healthcare and community settings across the Middle East. Studies report ESBL prevalence rates of 40-65% among Escherichia coli and Klebsiella pneumoniae clinical isolates [9]. The CTX-M enzyme family, particularly CTX-M-15, predominates in the region, reflecting global trends while demonstrating region-specific epidemiological patterns.

4.2 Regional Variations

Significant heterogeneity exists in AMR patterns across Middle Eastern countries, reflecting differences in healthcare systems, antibiotic policies, and surveillance capabilities. The GCC countries (Saudi Arabia, UAE, Qatar, Kuwait, Bahrain, and Oman) generally possess more developed healthcare infrastructure and have implemented national surveillance programs, though resistance rates remain concerning [10].

In contrast, countries affected by ongoing conflicts, including Yemen, Syria, and parts of Iraq, face severely compromised healthcare systems with limited capacity for AMR surveillance or antimicrobial stewardship implementation. Conflict-related injuries, inadequate surgical care, and antibiotic shortages paradoxically coexisting with inappropriate antibiotic use create conditions highly favorable for resistance emergence [11].

Lebanon and Jordan serve as regional medical hubs, receiving patients from neighboring conflict zones, which introduces additional challenges regarding imported resistant strains. The economic crisis in Lebanon since 2019 has further strained healthcare resources, potentially impacting infection control practices and antibiotic availability [12].

5. Contributing Factors To Antibiotic Resistance

5.1. Antibiotic Availability and Prescribing Practices

The availability of antibiotics without prescription remains a fundamental driver of AMR in the Middle East. Despite regulatory frameworks mandating prescription requirements in most countries, enforcement remains inconsistent, and community pharmacies frequently dispense antibiotics without valid prescriptions [13]. A multicountry study published in 2023 found that 65-78% of community pharmacies in Egypt, Jordan, and Lebanon dispensed antibiotics for upper respiratory tract infections without prescriptions, often recommending inappropriate agents and durations.

Prescribing practices among healthcare professionals also contribute to resistance. Overprescription for viral infections, inappropriate empirical therapy selection, and excessive antibiotic durations are common. Limited access to rapid diagnostic testing often necessitates empirical broad-spectrum antibiotic use, further promoting resistance selection [14].

5.2. Antimicrobial Stewardship Programs

While awareness of antimicrobial stewardship importance has increased, implementation remains limited across the region. A 2022 survey of hospitals in the GCC countries found that only 45% had formal ASPs, with considerable variation in program maturity and resources [15]. Key barriers to ASP implementation include insufficient trained personnel, limited institutional support, competing clinical priorities, and inadequate information technology infrastructure for monitoring antimicrobial use.

Successful ASP models have been reported from select tertiary centers in Saudi Arabia, the UAE, and Qatar, demonstrating reductions in broad-spectrum antibiotic consumption and improved patient outcomes. However, these programs require significant resources and expertise that may not be available in smaller or resource-limited facilities [16].

5.3. Infection Prevention and Control

IPC practices represent a critical component of AMR containment, yet adherence to standard precautions and transmission-based isolation remains suboptimal in many Middle Eastern healthcare settings. Hand hygiene compliance rates of 30-50% have been reported across the region, contributing to healthcare-associated transmission of resistant organisms [17].

Overcrowding in healthcare facilities, particularly in public hospitals, creates conditions conducive to cross-transmission. Additionally, insufficient environmental cleaning, inadequate isolation room availability, and limited IPC training for healthcare workers compound these challenges.

5.4. Impact of COVID-19 Pandemic

The COVID-19 pandemic has significantly impacted AMR in the Middle East through multiple mechanisms. Early in the pandemic, empirical antibiotic prescribing for hospitalized COVID-19 patients was widespread, despite evidence that bacterial coinfection rates were relatively low. A regional study found that over 80% of hospitalized COVID-19 patients in Middle Eastern hospitals received empirical antibiotics, frequently including broad-spectrum agents such as carbapenems and glycopeptides [18].

The pandemic also disrupted routine surveillance activities, diverted resources from AMR-related programs, and strained healthcare systems, potentially compromising IPC practices. Consequently, several studies have documented increased rates of healthcare-associated infections with MDROs during and following the pandemic period [4].

5.5. Agricultural Antibiotic Use

Antibiotic use in agriculture and animal husbandry represents an important but understudied contributor to AMR in the Middle East. Antibiotics are commonly used for growth promotion and prophylaxis in food animals, often without veterinary oversight. Studies from Egypt and Saudi Arabia have documented high rates of resistance among bacteria isolated from poultry and livestock, including resistance determinants shared with human clinical isolates [19].

The One Health approach, recognizing the interconnection between human, animal, and environmental health, has gained recognition in the region but practical implementation remains limited.

6. Surveillance And Monitoring Systems

Effective AMR surveillance is essential for understanding resistance trends, guiding empirical therapy, and evaluating intervention effectiveness. The WHO Eastern Mediterranean Region (EMRO) has promoted the Global Antimicrobial Resistance and Use Surveillance System (GLASS), with several Middle Eastern countries participating to varying degrees [20].
Saudi Arabia, the UAE, and Oman have established national surveillance networks that regularly report AMR data, while other countries lack coordinated surveillance infrastructure. Laboratory capacity for antimicrobial susceptibility testing varies considerably, with many facilities lacking equipment and expertise for detecting emerging resistance mechanisms such as carbapenemases.

The Global Health Security Agenda and Joint External Evaluation processes have identified AMR detection and surveillance capacity building as priorities for several Middle Eastern countries [21]. Recent initiatives, including the establishment of regional reference laboratories and external quality assessment programs, represent positive developments, though substantial gaps remain.

7. Strategies For Combating Antibiotic Resistance

7.1. Policy and Regulatory Interventions

Strengthening regulatory frameworks governing antibiotic access represents a fundamental intervention. Several countries have recently implemented or enhanced prescription requirements, though enforcement remains challenging. National action plans on AMR, aligned with the WHO Global Action Plan, have been developed by most GCC countries and are under development elsewhere in the region [22].

Antibiotic quality assurance is an additional concern, as substandard and falsified medications may contain inadequate active ingredient concentrations, promoting resistance development. Enhanced pharmaceutical regulatory oversight is warranted throughout the region.

7.2. Antimicrobial Stewardship Implementation

Expanding ASP implementation requires tailored approaches appropriate to local contexts and resources. Core strategies include prospective audit with feedback, formulary restrictions, and development of evidence-based prescribing guidelines. Educational initiatives targeting prescribers across all healthcare levels are essential [16].

Emerging technologies, including electronic clinical decision support systems and rapid diagnostic tests, can support stewardship activities but require infrastructure investment and adaptation to local settings.

7.3. Infection Prevention and Control Enhancement

Strengthening IPC programs through healthcare worker training, infrastructure improvements, and multimodal intervention strategies is critical. Regional networks for IPC knowledge exchange and benchmarking can facilitate best practice dissemination [17].

Enhanced surveillance for healthcare-associated infections, including active screening for MDRO colonization in high-risk populations, can support targeted IPC interventions.

7.4. Public Awareness and Education

Public awareness campaigns addressing appropriate antibiotic use have been implemented in several countries, often aligned with World Antibiotic Awareness Week. However, sustained behavior change requires long-term, culturally appropriate educational strategies addressing misconceptions about antibiotic effectiveness for viral infections [23].

Healthcare professional education, both in undergraduate curricula and continuing education programs, must emphasize antimicrobial resistance and rational prescribing principles.

7.5. Research and Innovation

Investment in AMR research, including epidemiological studies, intervention evaluations, and basic science investigations into resistance mechanisms, is essential. The region possesses growing research capacity, and collaborative networks such as the Middle East and North Africa Antimicrobial Resistance Research Network have emerged to coordinate efforts [24].

Novel therapeutic approaches, including bacteriophage therapy and antimicrobial peptides, are under investigation globally and warrant exploration in regional contexts.

8. Future Directions

Addressing AMR in the Middle East requires coordinated, multisectoral action encompassing human health, veterinary medicine, agriculture, and environmental sectors. Regional collaboration, facilitated through organizations such as the Gulf Health Council and WHO EMRO, can promote knowledge exchange, harmonize surveillance approaches, and leverage collective resources [25].

Priorities for future action include:

1. Enhanced surveillance: Expansion of laboratory capacity and surveillance networks to generate representative, timely AMR data across all countries.
2. Antimicrobial stewardship scale-up: Development of practical, resource-appropriate ASP models applicable to diverse healthcare settings.
3. Regulatory strengthening: Enforcement of prescription requirements and quality assurance for antibiotics in human and veterinary medicine.
4. Research investment: Support for regional AMR research addressing local epidemiology, intervention effectiveness, and health system strengthening.
5. One Health implementation: Practical integration of human, animal, and environmental health sectors in AMR containment efforts.

9. Conclusion

Antibiotic resistance represents an escalating crisis in the Middle East, driven by complex, interrelated factors including liberal antibiotic access, limited antimicrobial stewardship, inadequate infection control, and healthcare system challenges. While resistance rates for key pathogens are among the highest globally, significant opportunities exist for intervention. Strengthening surveillance systems, implementing evidence-based stewardship programs, enhancing infection prevention practices, and fostering regional collaboration are essential components of an effective response.

The heterogeneity of healthcare systems and resources across the region necessitates tailored approaches that acknowledge local contexts while aligning with global frameworks. Political commitment, sustained investment, and multisectoral coordination are required to reverse current trends. Without decisive action, the Middle East risks entering a post-antibiotic era where previously treatable infections become life-threatening, surgical procedures become increasingly hazardous, and healthcare systems face unsustainable burdens from resistant infections.

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