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Emerging and Re-emerging Infectious Diseases in Iran: A Narrative Review of Causes, Challenges, and Policy Recommendations

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Abstract

Background: Emerging and re-emerging infectious diseases have increasingly challenged public health in Iran, threatening both population health and economic stability. This review aims to identify the main causes and challenges associated with these diseases and propose strategies to improve health policy and national preparedness.

Materials and Methods: In this review, a comprehensive literature search was conducted across multiple databases, including PubMed, Web of Science, Scopus, Cochrane Library, SID, and CIVILICA, up to March 2025. Relevant keywords in both English and Persian were used to identify research articles, reviews, and epidemiological reports focused on Iran. Two independent researchers screened and selected the studies, with any disagreements resolved through discussion to ensure consensus.

Results: Emerging and re-emerging infectious diseases in Iran result from a complex interplay of environmental, social, and structural factors. Key causes include zoonotic origins, climate and geographic changes, rapid urbanization, increased mobility, behavioral shifts, declining vaccination coverage, weak health infrastructure, antimicrobial resistance, and regional political instability. These factors have led to challenges such as the spread of vector-borne and zoonotic diseases, emergence of novel viruses like COVID-19, and rising antimicrobial resistance, complicating disease control efforts. The health and economic impacts include escalating healthcare costs, strained health systems, increased mortality and disability, reduced productivity, and widened health inequalities. These findings highlight the urgent need to strengthen regional cooperation and border health security to mitigate these threats effectively.

Conclusion: Emerging infectious diseases pose significant threats to Iran's health and economy. An effective response requires enhanced surveillance, rapid intervention, regional and international collaboration, increased public awareness, and the implementation of the "One Health" approach. Sustainable investment in health infrastructure, research, and education is essential to mitigate impacts and strengthen resilience against future outbreaks.

Key Words: Challenges, Emerging infectious diseases, Iran, Re-emerging infectious diseases.

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1- INTRODUCTION

Emerging and re-emerging infectious diseases (EIDs and RIDs) have become major public health concerns globally and in Iran over recent decades (1, 2). Emerging infectious diseases are those that appear in human populations for the first time, such as HIV/AIDS and Severe Acute Respiratory Syndrome (SARS), while re-emerging infectious diseases are infections that reappear after a period of decline, such as drug-resistant tuberculosis and measles (3–5). The increasing incidence and spread of these diseases are driven by a complex interplay of factors, including climate change, rapid urbanization, increased population movement, changes in land use, antimicrobial resistance, and globalization (2, 6, 7). A significant proportion of these diseases are zoonotic, underscoring the importance of the human-animal-environment interface and the necessity for integrated "One Health" approaches (1, 8).

Iran faces unique challenges due to its diverse climate and geography, rapid urbanization, extensive human-animal interactions, and proximity to countries with unstable health situations (4, 9, 10).

Vector-borne diseases such as leishmaniasis, malaria, and Crimean-Congo hemorrhagic fever are of particular concern, with their distribution influenced by environmental and climatic factors (2, 4). Additionally, the resurgence of previously controlled diseases—often exacerbated by antimicrobial resistance, declining vaccination coverage, and shifting public health priorities—further complicates disease control efforts (5, 11). Although various measures have been implemented for the prevention and control of these diseases in Iran, fundamental challenges remain in early detection, rapid response, and epidemic management, necessitating comprehensive strategies and multisectoral collaboration (6, 8, 11).

This review aims to examine the causes and challenges associated with emerging and re-emerging infectious diseases in Iran, and to propose strategies to enhance health policy and national preparedness.

2- MATERIALS AND METHODS

This study was conducted as a narrative review to examine the causes and challenges of emerging and re-emerging infectious diseases in Iran.

2-1. Search Strategy:

A comprehensive literature search was performed in both English and Persian up to March 2025. The following databases were searched: PubMed, Web of Science, Scopus, Cochrane Library, SID, and CIVILICA. The search strategy combined keywords and their Persian equivalents, including “emerging infectious diseases,” “re-emerging infectious diseases,” “Iran,” “epidemiology,” “public health challenges,” “risk factors,” and “disease control.” Boolean operators (AND, OR) were applied to optimize search results.

2-2. Inclusion Criteria:

- Original research articles, review articles, and epidemiological reports related to emerging and re-emerging infectious diseases
- Articles published in English or Persian
- Studies focusing on Iran or providing comparative data relevant to the Iranian context
- Articles with accessible abstracts and full texts.

2-3. Exclusion Criteria:

- Articles not related to the main topic
- Animal or laboratory studies without direct relevance to human populations
- Articles without accessible full texts
- Short reports, letters to the editor, news articles, or non-structured reviews.

2-4. Selection Process:

Two independent reviewers screened the titles and abstracts of the retrieved articles, followed by full-text assessments to determine eligibility. Any disagreements were resolved through discussion until consensus was reached.

2-5. Ethical Considerations:

This narrative review utilized data exclusively from previously published studies and publicly available sources. As such, it did not involve any direct interaction with human participants or animals and did not require formal ethical approval. The review process adhered to ethical standards by ensuring accurate representation of original research and respecting intellectual property rights.

3- RESULTS

Emerging and re-emerging infectious diseases in Iran are driven by environmental, social, and infrastructural factors. These diseases pose serious health and economic challenges, requiring urgent attention to control and prevention efforts. The following sections outline the main causes, challenges, and impacts of these infections in Iran.

3-1. Main Causes of Emerging and Re-emerging Infectious Diseases in Iran

a. Ecological and environmental factors

- **Zoonotic Origins:** Approximately 60% of emerging infectious diseases in Iran originate from animal sources. Increased human-animal interactions—particularly due to land use changes and agricultural expansion—play a key role in the emergence of these diseases (1).
- **Climate Change:** Changes in climate, including rising temperatures and altered rainfall patterns, have shifted the distribution of vectors and pathogens. This has led to the expansion of vector-borne diseases such as malaria, leishmaniasis, and dengue into new regions of Iran (2, 4).
- **Geographical and Environmental Features:** Soil type, vegetation cover, and proximity to water sources significantly influence vector habitats and the occurrence of zoonotic diseases (10, 12).

b. Demographic and behavioral factors

- **Urbanization and Population Growth:** Rapid urban expansion and increased population density have created favorable conditions for accelerated transmission of infectious diseases (6).
- **Increased Travel and Trade:** Higher rates of international and domestic travel, as well as population mobility, have facilitated the rapid introduction and spread of infectious agents (13, 14).
- **Behavioral Patterns:** Changes in lifestyle, decreased vaccination coverage, and high-risk behaviors have contributed to the resurgence of diseases such as measles and cholera (5).

c. Infrastructural challenges and antimicrobial resistance

- **Weak Health and Surveillance Systems:** Limitations in surveillance, laboratory capacity, and rapid response mechanisms have hindered timely detection and control of outbreaks (11).
- **Antibiotic Resistance:** The emergence of drug-resistant pathogens has complicated treatment and control of re-emerging diseases such as tuberculosis and cholera (4).

d. Regional instability and cross-border exchanges

- **Regional Political Instability:** Proximity to countries with weak health systems and increased cross-border movement have facilitated the

introduction and spread of infectious diseases in Iran (4, 14).

3-2. Key Challenges of Emerging and Re-emerging Infectious Diseases in Iran

a. Economic and Social Burden

Emerging and re-emerging infectious diseases impose significant costs on Iran's health system and economy, resulting in reduced productivity and increased mortality rates (6).

b. Threat of vector-borne and zoonotic diseases

- **Fascioliasis***:* Despite a decline in animal cases in some regions, the incidence remains high in northern provinces such as Guilan (9).
- **Crimean-Congo Hemorrhagic Fever, Leishmaniasis, Malaria***:* These diseases show high prevalence and variable distribution across the country, with vector expansion driven by climate change and urbanization (2, 4).
- **Tick-borne Diseases***:* Infections like anaplasmosis and coxiellosis are widespread among humans and animals but remain underreported (15).

c. Emerging viral and drug-resistant diseases

- **COVID-19***:* The rapid spread of SARS-CoV-2 in Iran exposed vulnerabilities in the health system to novel infectious threats (14).
- **Drug-resistant Infections***:* The rising prevalence of multidrug-resistant tuberculosis and hospital-acquired infections presents a serious public health challenge (4).

d. Regional and international collaboration

Political instability and weak health infrastructures in neighboring countries have facilitated cross-border transmission of infectious diseases, underscoring the urgent need for strengthened regional cooperation and border health security (4, 14).

3-3. Health and Economic Consequences of Emerging and Re-emerging Infectious Diseases in Iran

a. Increased economic burden

The emergence and resurgence of infectious diseases impose substantial financial strain on Iran's healthcare system and the broader economy. These diseases lead to higher direct medical costs, increased demand for healthcare infrastructure, and reduced workforce productivity. Studies indicate that outbreaks of infectious diseases, especially in middle-income countries like Iran, can significantly slow economic growth and place considerable financial pressure on both families and government budgets (2, 4, 6).

b. Rising mortality and disability

The spread of emerging and re-emerging infectious diseases is associated with increased mortality, particularly among vulnerable groups such as the elderly, children, individuals with chronic conditions, and those with compromised immune systems. In addition to deaths, these diseases contribute to a rise in disability-adjusted life years (DALYs) and long-term disabilities within the community. Epidemics such as COVID-19 and outbreaks of diseases like leishmaniasis and malaria have exemplified these impacts in Iran (2, 5, 14).

c. Pressure on the health system

A surge in infectious disease cases challenges the capacity of hospitals and healthcare centers, potentially leading to shortages of medical staff and equipment. This strain can also compromise the quality of care for other patients (11).

d. Widening health inequalities

Emerging and re-emerging infectious diseases often disproportionately affect underserved and low-resource communities, exacerbating existing health and social disparities (6).

4- DISCUSSION

The emergence and re-emergence of infectious diseases (EIDs and RIDs) in Iran result from a complex interplay of ecological, demographic, and socio-political factors, reflecting global patterns. These diseases pose significant threats to public health and place considerable economic and structural burdens on Iran's healthcare system. This discussion synthesizes the primary causes, key challenges, and the health and economic impacts of EIDs and RIDs in Iran, contextualized within recent evidence.

4-1. Main Causes of Emerging and Re-emerging Infectious Diseases in Iran

Ecological and environmental factors play a significant role in the emergence and re-emergence of infectious diseases in Iran. Climate change has altered the distribution and seasonality of disease vectors such as mosquitoes and sandflies, facilitating the spread of vector-borne diseases like malaria, leishmaniasis, and dengue fever into new regions (2, 10). Additionally, changes in land use, agricultural expansion, and intensified livestock farming have increased human-animal interactions, thereby heightening the risk of zoonotic diseases including brucellosis, Q fever, and fascioliasis (9, 16). These ecological shifts align with global data indicating that over 60% of emerging infectious diseases originate from zoonotic sources (17).

Demographic changes and socio-political factors further exacerbate the situation. Rapid urbanization and population growth have resulted in densely populated urban centers that are highly vulnerable to infectious disease outbreaks (6). Internal and cross-border migration, often driven by regional instability, complicates disease surveillance and control efforts, as demonstrated during the COVID-19 pandemic and recent cholera outbreaks (5, 14). Moreover, political instability in neighboring countries and ongoing regional conflicts facilitate cross-border transmission of diseases, placing additional strain on Iran's health infrastructure (4). Weaknesses in healthcare systems, particularly in rural and underserved areas, delay outbreak detection and response, while the growing challenge of antimicrobial resistance (AMR) further complicates treatment and containment efforts (3, 11).

4-2. Key Challenges in Managing Emerging and Re-emerging Infectious Diseases

Effectively addressing the key challenges in managing emerging and re-emerging infectious diseases requires focused attention on the following interconnected areas:

a. Surveillance and reporting limitations

Fragmented health information systems, limited laboratory capacity, and poor coordination among multiple surveillance platforms significantly delay outbreak detection and containment, particularly in low-resource settings. Many developing countries face shortages of trained personnel and material resources, as well as weak integration of laboratories into public health systems. Strengthening integrated disease surveillance programs, enhancing laboratory networks, and utilizing modern technologies such as geographic information systems (GIS) and rapid data sharing are essential to improving early warning and response systems (18–20).

b. Antimicrobial resistance

The rising prevalence of drug-resistant pathogens, including multidrug-resistant tuberculosis, complicates treatment efforts and threatens global health security. Addressing this challenge requires enhanced surveillance to monitor resistance patterns, the development of new therapeutics, and robust antimicrobial stewardship programs to contain and manage resistance effectively (14, 21).

c. Economic and resource constraints

Financial limitations and restricted international collaboration hinder access to advanced diagnostics, therapeutics, and vaccines. Many countries lack sufficient infrastructure and trained personnel, impeding their ability to scale up interventions and adopt new technologies. Building sustainable funding mechanisms and fostering global partnerships are critical to overcoming these barriers and ensuring equitable access to essential health tools (22).

d. Low public awareness and community engagement

Insufficient health education and lack of sustained community involvement reduce the effectiveness of preventive measures and vaccination campaigns. Promoting community engagement through participatory approaches, transparent communication, and health education empowers local populations, fosters behavior change, and builds trust. This strategy is especially effective in resource-limited settings where health systems are under strain (20, 23).

In summary, overcoming the challenges of emerging and re-emerging infectious diseases requires a multifaceted, integrated approach. This approach must strengthen surveillance and laboratory capacity, proactively address antimicrobial resistance, secure adequate resources through international collaboration, and prioritize community engagement to build resilient health systems capable of responding swiftly and effectively to infectious disease threats worldwide (3, 11, 17, 18).

4-3. Health and Economic Consequences

Emerging and re-emerging infectious diseases have posed significant health challenges in Iran, resulting in high rates of illness and mortality, particularly among vulnerable groups such as children, the elderly, and immunocompromised individuals. Diseases including Crimean-Congo hemorrhagic fever, leishmaniasis, and COVID-19 have severely strained healthcare facilities, leading to shortages of medical resources and disruptions in routine healthcare services. Economically, these outbreaks have imposed substantial costs through direct medical expenses, emergency response efforts, and lost productivity, thereby placing a heavy burden on Iran’s healthcare system and broader economy. Addressing these challenges requires sustained investment in health infrastructure, enhanced disease surveillance, and dedicated research to mitigate the impact of future outbreaks and strengthen national resilience (2, 5, 6, 7, 9).

4-4. Alignment with Global Perspectives and Recommendations

Iran faces challenges in managing emerging and re-emerging infectious diseases (EIDs and RIDs) that are common among countries with similar ecological and socio-economic conditions. The World Health Organization (WHO) strongly advocates the One Health approach, which emphasizes the interconnectedness of human, animal, and environmental health as an effective framework to address these complex threats. This approach is particularly relevant to Iran due to its diverse ecosystems and the associated risks of zoonotic diseases. WHO supports Iran in strengthening cross-sectoral collaboration, surveillance systems, and integrated strategies aligned with global

frameworks to improve infectious disease control and health security (1, 2, 9, 24, 25).

4-5. Key Recommended Strategies

Based on WHO guidance and recent research studies (2, 4, 25–33), the following integrated strategies are essential:

4-5-1. Strengthening disease surveillance and reporting systems: Iran has been developing integrated surveillance systems aligned with national information systems and global standards to enable timely detection and response to infectious diseases. Despite progress, challenges remain, including limited cooperation from non-academic sectors in data reporting and gaps in inter-sectoral collaboration (25–28).

4-5-2. Improving vector control and ecosystem management: Vector-borne diseases such as Crimean-Congo Hemorrhagic Fever, Dengue Fever, and West Nile Virus remain significant concerns in Iran. Targeted vector control programs and sustainable ecosystem management are vital to reducing transmission, requiring multisectoral collaboration and investment in environmental health (4, 29, 30).

4-5-3. Expanding regional and international collaboration: Given Iran's geographical position and shared borders with countries experiencing endemic infectious diseases, cross-border cooperation and information sharing are critical. WHO supports Iran in strengthening cross-sectoral and cross-border collaboration for communicable disease control, including zoonotic diseases and antimicrobial resistance, under the One Health framework (24, 25).

4-5-4. Strengthening healthcare infrastructure and workforce capacity: The COVID-19 pandemic exposed weaknesses in Iran's healthcare infrastructure, particularly in laboratory capacity and workforce training. Investments in local vaccine production, diagnostic capabilities, and workforce development have been prioritized to enhance resilience against future outbreaks (31, 32).

4-5-6. Increasing public education and community engagement: Effective outbreak response depends on risk communication and community participation. Enhancing public awareness and training programs is recommended to control infectious diseases, especially among high-risk groups (26, 33).

4-5-7. Investing in predictive modeling and risk assessment research: Supporting research on predictive analytics and risk assessment tools is necessary for anticipating outbreaks and prioritizing interventions, aligning with WHO's emphasis on strengthening country capacity in data and innovation (2, 25).

By aligning national strategies with global frameworks such as the One Health approach, strengthening surveillance systems, fostering regional and international cooperation, and investing in health infrastructure and research, Iran can enhance its capacity to manage emerging and re-emerging infectious diseases effectively and improve the resilience of its health system against future infectious disease threats (2, 4, 24–26).

5- CONCLUSION

This review highlights that the emergence and re-emergence of infectious diseases in Iran result from a complex interplay of ecological, demographic, behavioral, infrastructural, and regional factors. Key drivers include increased human-animal contact with zoonotic origins, climate change affecting the distribution of disease vectors, rapid urbanization, heightened population mobility, and weaknesses in disease surveillance and rapid response systems.

These challenges are further compounded by antimicrobial resistance and political instability in neighboring countries. The consequences are significant, including a heavy economic burden, increased mortality and disability, strain on healthcare infrastructure, and widening health inequalities, particularly among vulnerable populations.

To effectively address these threats, comprehensive and multisectoral strategies are essential. Priorities should include strengthening surveillance systems, enhancing healthcare infrastructure, promoting regional cooperation, and implementing integrated One Health approaches. Such coordinated efforts are critical to preventing and controlling both ongoing and future threats posed by emerging and re-emerging infectious diseases in Iran.

6- CONFLICT OF INTEREST: None.

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