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WATERBORNE INFECTIOUS DISEASES: A PERSISTENT CHALLENGE TO PUBLIC HEALTH

Abstract. Introduction: Waterborne diseases remain a significant public health issue, particularly in regions with poor sanitation and limited access to clean water. In Tajikistan, these diseases, especially among children, are a major concern. Water scarcity and pollution, exacerbated by climate change, contribute to the problem.
Methods: This study is based on epidemiological data from Tajikistan's Ministry of Health and international organizations. It analyzes data on waterborne diseases from 1997 to 2024.
Results: and DiscussionWaterborne diseases, including hepatitis A, typhoid, and cholera, are common in Tajikistan. Poor infrastructure and sanitation contribute to the spread of these diseases, especially in rural areas, which are most vulnerable.
Government: ResponseTajikistan plays an active role in global water diplomacy and supports initiatives aimed at improving water and sanitation. However, the issue of access to clean water remains critical.
Conclusion: Addressing waterborne diseases requires improvements in water infrastructure, sanitation, vaccination, and public education. International collaboration is essential for reducing the spread of these diseases.
Key words: water-dependent infections, cholera, typhoid fever, leptospirosis, viral hepatitis A and E, rotavirus infection.

Introduction

Waterborne infectious diseases remain one of the most significant public health challenges, especially in countries with low levels of sanitation and limited access to clean drinking water. These diseases can lead to large-scale outbreaks, high morbidity rates, and even mortality, particularly among children.

Despite its simple molecular composition, water remains a substance whose full nature continues to puzzle scientists. It is vital for human life, yet at the same time, it presents numerous challenges. Around one-third of the global population lives in regions suffering from acute water scarcity, and every fifth person lacks access to safe drinking water.

Antoine de Saint-Exupéry wrote about the value of water in his 1930s book Wind, Sand and Stars, describing how, in the desert, children do not beg for money–but for water. Today, according to the 2021 UNESCO World Water Development Report, global freshwater usage has increased sixfold over the last century and continues to rise by about 1% annual- ly. This increase in consumption has led to growing pollution from industry, agriculture, and urban waste, which threatens water sources and poses risks to human health and sustainable development.

WHO's 1991 strategy "Health for All" and Tajikistan's national health strategy both emphasize that everyone should have access to safe drinking water, and that pollution of surface and groundwater must not endanger public health. However, modern challenges–such as climate change and environmental degradation–complicate these goals.

Methods and materials

This article is based on epidemiological surveillance data on waterborne infections in the Republic of Tajikistan, including reports from the Ministry of Health, sanitary-epidemiological services, and international organizations such as WHO, UNICEF, and the World Bank.

The analysis covers official statistical data on the incidence of waterborne diseases from 1997 to 2024, including recorded outbreaks of typhoid fever, hepatitis A, and other cases.

Qualitative analytical methods were applied, including content analysis of publications and regulatory documents, as well as a comparative review of sanitary and hygienic conditions and access to safe water across different regions of the country.

The study also considers Tajikistan's international initiatives in the field of water diplomacy and sustainable development, such as the Decade of Action "Water for Sustainable Development" (2018–2028), along with national programs like WASH and immunization efforts.

The practical component of the research draws upon data on local epidemic foci, drinking water quality, sanitary interventions, and educational campaigns implemented in cooperation with national and international partners.

Results and discussion

Currently, special attention is paid to sanitation and anti-epidemic measures, which makes the book particularly relevant for analyzing approaches to waterborne infections. In particular, the foundational manual is devoted to the study of cholera, specifically its El-Tor variant [1].

According to Dustov A., regarding the prevalence and transmission mechanisms of hepatitis E in Tajikistan, there is a high vulnerability of the population under conditions of limited access to water [2]. The importance of epidemiological surveillance and diagnostics in endemic areas is emphasized.

Significant attention is also given to leptospirosis as an infection often associated with aquatic environments. The transmission routes, including contact with contaminated water, are described in detail, along with modern approaches to diagnosing and treating the disease in children [3].

When considering seasonality, transmission routes (including the waterborne pathway), and prevalence among preschool-aged children, viral diarrheas–particularly rotavirus and norovirus infections–come to the forefront. In such cases, prevention and vaccination play a crucial role [4].

A review of global changes in the structure of infectious diseases during the 20th century highlights the evolution of infections related to water contamination. It notes the transformation of waterborne infections in connection with urbanization and changes in sanitation conditions [5].

Nevertheless, international cooperation plays a significant role in combating epidemics, with attention given to hepatitis, typhoid, viral diarrheas, and other waterborne diseases [6]. When it comes to specialized approaches, typhoid fever in children remains a challenge despite progress in diagnostics and treatment. The authors examine the clinical features, epidemiology, and diagnostic and treatment difficulties in the context of Tajikistan. Throughout the analysis, the link between the disease and the quality of drinking water and sanitation is strongly emphasized [7].

In the Republic of Tajikistan, there are still difficulties in combating water-related infectious diseases. This is often due to insufficient access to clean drinking water and poor sanitation infrastructure in a number of regions. Nevertheless, we see signifi- cant progress that has been made in recent decades. We see this as a nationwide effort to achieve immunization, as well as to improve water and sanitation policies. But despite this, hepatitis A and typhoid fever are still major public health problems. An in-depth analysis of long-term epidemiological trends indicates a clear association between infec- tion rates and environmental conditions, including the availability of centralized water systems, sew- age networks, and public awareness of hygiene. The prevalence of seasonal spikes, especially in spring and summer, underscores the necessity of preventive hygiene education and effective early-warning mechanisms.

A critical insight revealed by the study is the disproportionate impact of socio-economic disparities on health outcomes. Populations in rural and mountainous regions, where infrastructure remains limited, are at heightened risk of outbreaks. Contributing factors such as internal migration, urban density, and climate-related strain on water resources further amplify these vulnerabilities.

Encouragingly, the Tajik government has shown ongoing dedication by participating in global water and sanitation initiatives. Programs like WASH and the UN's Decade for Water for Sustainable Development (2018–2028) have fostered intersectoral collaboration, leading to gradual improvements in water quality monitoring, public health awareness, and vaccine outreach.

Nonetheless, long-term success will depend on sustained investment in water and sanitation infrastructure, robust health surveillance systems, and deeper integration of hygiene education into local communities. Continued international cooperation is essential–not only for technical and financial support but also to align Tajikistan's efforts with international best practices in water safety.

Over the past twenty years, Tajikistan has become a significant supporter of global water diplomacy, which has initiated several major campaigns. These include the announcement of the International Year of Freshwater in 2003. The International Year of Water Cooperation was declared in 2013.Protozoal: amoebiasis, balantidiasis

Cholera outbreaks are often linked to warm, running water, which provides ideal conditions for vibrio growth. The risk of outbreaks is especially high in areas affected by war or natural disasters, where water safety measures are not enforced–such as border regions near Afghanistan. Vigilant epidemiological surveillance and long-term national health strategies are critical to prevent outbreaks.

Typhoid Fever

According to WHO, typhoid is found worldwide, with widespread outbreaks in countries with poor sanitation. In Tajikistan during the 1990s, incidence rates soared–up to 497.8 per 100,000 population. Unlike sporadic cases, waterborne outbreaks tend to involve more moderate and severe forms, rapid spread, and large-scale exposure. Eradication requires massive investments and coordinated public health responses.

Leptospirosis

This disease, common in flood-prone and rural areas, is spread by water contaminated with animal urine. Leptospires can survive up to 30 days in water and over 270 days in moist soil. In Tajikistan, outbreaks occurred in the second half of the 20th century, particularly in Baljuvon and Fayzabad districts. Prevention involves rodent control, water sanitation, and vaccination in high-risk zones.

Hepatitis A and E

Enteric hepatitis viruses are highly resistant to chlorine and can survive even in treated drinking water. As a result, outbreaks may occur even in areas with centralized water supply systems, particularly in regions with poor sanitation.

Contributing Factors to the Spread

Several key factors contribute to the transmission and persistence of waterborne diseases: Inadequate availability of safe and clean drinking water, unsatisfactory sanitation infrastructure and hygiene services, limited public awareness and education on personal hygiene practices, pollution of water sources due to untreated wastewater discharge, environmental disruptions such as floods and natural disasters that damage or disable water supply systems

Waterborne infections are particularly dangerous for children, the elderly, and individuals with weakened immune systems. Beyond physical suffering, these diseases also lead to economic losses due to high treatment costs and reduced workforce productivity. Epidemic outbreaks often necessitate quarantine measures.

Effective control of water-borne infections requires an integrated approach. This approach includes ensuring access to safe drinking water, and developing sanitation and sanitation systems. An important role is played by educating the population on hygiene issues, as well as monitoring water quality and conducting epidemiological surveillance. It is already known that targeted vaccination (for example, against hepatitis A and cholera) has a good effect. Despite all these measures, infectious diseases associated with dirty water remain a serious threat to public health in Tajikistan. And this is acutely felt in rural areas with limited access to safe water and sanitation. This is relevant for Tajikistan, as sever- al outbreaks of diseases have been reported in recent years. Among them is typhoid fever, which had an outbreak in 1997. Due to the lack of full-scale chlorination of water, there was a large-scale outbreak of this disease. More than 29,000 cases were officially registered, with an incidence rate of 500 per 100,000 people. In the first six months of 2009, 338 cases were registered. And this is 2.2 times more than in the same period of 2008. All these endemic outbreaks of the disease are associated with poor water quality. In 2023, there was an outbreak of cholera in different regions of our planet. The Ministry of Health of Tajikistan reported that there was no threat of the spread of cholera in the republic, but nevertheless it was reflected in measures to strengthen border control. All these activities emphasize the importance of access to clean water and improved sanitation. Hepatitis A remains one of the most common waterborne diseases worldwide and in the country. Schoolchildren and children attending kindergartens are especially vulnerable. Despite the measures taken, outbreaks of the disease occur approximately every three years, on average, about 200,000 children under the age of 14 are at risk.In 2022, the Ministry of Health report- ed cases among children aged 3 to 14, particularly in schools and kindergartens. While a full epidemic was avoided, vaccination was administered based on epidemic indicators. Hepatitis A vaccination is not included in the national immunization schedule and is only used during outbreaks.

Government Response and Preventive Measures

Typhoid fever remains a major issue in areas with poor water supply and sanitation. The 1997 outbreak is historically significant, and although water quality has improved since then, the risk remains.

No major cholera outbreaks have been recorded in recent years, but the proximity to epidemic zones such as Afghanistan remains a concern. n 2024, Tajikistan’s Ministry of Health strengthened surveil-

lance of water quality along the Panj River in an effort to mitigate the potential cross-border transmission of infectious diseases. The national government continues to place strong emphasis on improving water, sanitation, and hygiene (WASH), with particular focus on healthcare institutions and local communities. However, access to centralized water services remains limited–only 41% of the population benefits from such systems, and in rural areas, this number falls to just 22%. The reliance on surface water sources in many communities significantly heightens the risk of contamination.

One of the critical obstacles in curbing hepatitis A is the absence of a routine vaccination program; immunization is administered only reactively, during outbreaks, as it is not part of the national immunization schedule.

In response to these challenges, a range of initiatives is being implemented. In partnership with international organizations such as WHO, UNICEF, and the World Bank, Tajikistan is working to upgrade its water infrastructure–especially in remote and mountainous regions. This includes the construction of new wells and the installation of advanced filtration and water purification systems.

Local sanitary-epidemiological authorities regularly disinfect water sources and conduct water sampling to test for pathogens including typhoid, dysentery, and hepatitis A.

In the event of outbreaks, local quarantines, sanitation measures, and distribution of personal protective equipment are enforced. Border areas undergo enhanced water quality inspections, especially along the Panj River due to cholera risks from neighboring regions.

Awareness campaigns play a vital role. Public education programs promote hygiene and safe wa- ter use. The national "WASH" program is being implemented in schools, hospitals, and public institutions to raise hygiene standards. Visual types of propaganda should be used for sanitary and educational work. Such as posters, brochures. Working with religious and community groups plays an important role. Targeted hepatitis A vaccination is usually carried out in outbreak zones. Sectoral cooperation involving the Ministry of Health, the Ministry of Energy and Water Resources, the Ministry of Education and local authorities plays an important role.

Conclusion

Waterborne infectious diseases continue to pose a serious public health concern in Tajikistan. Addressing them effectively requires a comprehensive strategy that encompasses improvements in water supply infrastructure, sanitation services, immunization efforts, and public education. Meaningful progress can only be achieved through coordinated action across the health, environmental, and education sectors, enabling a reduction in disease transmission and the protection of human lives.

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