UDK: 616.34–002.1:579.61-092.9

THE ROLE OF BACTERIOLOGICAL METHODS IN DETERMINING THE ETIOLOGY OF INFECTIOUS ACUTE DIARRHEA

Islambek A. Kudiyarov – independent researcher
Nodira T. Yodgorova – C.M.Sc., associate professor
Tashkent Medical Academy (Tashkent, Uzbekistan)
Amet Madreimov – D.M.Sc., professor
Karakalpakstan Medical Institute (Nukus, Uzbekistan)
madreimovamet07@gmail.com

Abstract: *Acute intestinal infections (AII) represent a significant global public health challenge, particularly among children under five, contributing to high morbidity and mortality. Diarrheal diseases are caused by diverse bacterial and viral pathogens, affecting millions of children annually and substantially impacting DALY indicators. African countries bear the highest epidemiological burden, whereas nations such as Uzbekistan, Turkmenistan, and Equatorial Guinea have observed reductions in disease burden due to social and sanitary interventions. Conventional bacteriological methods are limited by long processing times, low sensitivity, and the inability to detect viable but non-culturable (VBNC) bacteria. Moreover, disk diffusion methods for assessing antibiotic resistance often fail to provide timely clinical guidance. Modern molecular-genetic approaches offer higher efficiency in identifying the etiology of AII, differentiating viral from bacterial infections, and improving prevention and treatment strategies.*

Keywords: *acute intestinal infections, diarrhea, child health, bacterial and viral pathogens, conventional bacteriological methods, antibiotic resistance, molecular-genetic methods, DALY, epidemiology, prevention*

Introduction.

Acute intestinal infections (AII) are among the major problems in global infectious pathology. Every year, more than half a million cases of this disease are recorded in children; however, in more than half of these cases, the exact etiology of the disease remains undetermined. This situation creates certain difficulties in selecting effective treatment methods, implementing preventive measures, and carrying out anti-epidemic activities (Almatov B.I., 2018) [3].

Diarrhea-related diseases remain a major global public health problem today. These diseases are caused by various bacterial and viral pathogens and are responsible for more than one million deaths worldwide each year. Notably, among children under five years of age, diarrheal infections are one of the leading causes of death, ranking as the third most common infectious disease after lower respiratory tract infections and complications associated with preterm birth. This situation is particularly evident in low- and middle-income countries, highlighting the urgent need to implement effective measures for the epidemiological control and prevention of diarrheal diseases [8,10, 11,13,23].

According to data from the Global Burden of Disease (GBD) project, between 2010 and 2021, the global incidence of diarrhea-related illnesses decreased by an average of 47.0% (39.9–52.9%). Although child mortality among those under five years of age has significantly declined in many countries, the reduction in diarrheal cases has been relatively modest. This disease still ranks fourth among causes of disability-adjusted life years (DALYs) lost in this age group [9].

In 2021, an analysis of ASDR (Age-Standardized Death Rate) and DALY (Disability-Adjusted Life Years) indicators for childhood diarrhea revealed the country's most severely affected by these diseases. The analysis showed that Chad, South Sudan, the Central African Republic, Lesotho, Somalia, Nigeria, and Niger ranked highest for both indicators, forming the top seven. Chad ranked first for both measures, with an ASDR of 233.98 per 100,000 population (95% CI: 157.22–393.9) and a DALY rate of 20,966.29 per 100,000 population (95% CI: 14,221.09–35,113.4). All these countries are in Africa, indicating that the highest epidemiological burden of childhood diarrhea is concentrated in this region.

Regional analysis results also confirmed this trend, showing that the mortality and DALY indicators associated with childhood diarrhea are the highest globally in the Western, Central, and Sub-Saharan African regions. The consistency between country-level and regional data once again underscores the severity of the public health challenges posed by this disease in African nations.

At the same time, Uzbekistan (EAPC −13.09; 95% CI: −13.92 to −12.25), Equatorial Guinea (EAPC −13.0; 95% CI: −13.55 to −12.45), and Turkmenistan (EAPC −12.55; 95% CI: −13.16 to −11.94) were among the countries that recorded a significant decline in DALY indicators associated with childhood diarrhea. It is assumed that social and sanitary reforms, along with preventive measures implemented in these countries, have contributed to reducing the health burden from diarrheal diseases.

According to the analysis results, Qatar recorded a 216% increase in childhood diarrhea cases — the highest growth rate worldwide. In contrast, the United States showed the greatest decline, with the number of cases decreasing by approximately 94%. A similar trend was observed in incidence rates: in Qatar, the rate increased by 223%, while in the United States, it decreased by 95%.

An analysis of mortality indicators showed that childhood diarrhea-related deaths increased by 171% in Canada, while in Qatar, the number of deaths remained unchanged between 1990 and 2021. In some countries, including the U.S. Virgin Islands, no deaths from this disease were recorded in 2021. Finally, the DALY indicator associated with childhood diarrhea increased by 71% in the Netherlands, whereas Armenia showed the most significant decline, 99% [23].

Therefore, an in-depth analysis of diarrhea-related morbidity, prevalence, and mortality indicators is of great importance for shaping health policies, ensuring the efficient allocation of resources, and improving prevention, treatment programs, and laboratory diagnostic methods [10,23].

In recent years, the limitations of traditional bacteriological methods

Analysis of scientific sources indicates that the contribution of bacteriological methods in diagnosing acute intestinal infections (AII) remains relatively low. According to Jakypbekova G.Z. (2019), in recent years, bacteriological testing accounted for only about 10% of AII cases [6]. At the same time, due to the widespread use of bacteriological methods in clinical practice, determining the etiology of the disease is often carried out primarily for bacterial infections [5,22], while viral detection in AII is rarely performed.

According to a 2025 study conducted by I.A. Kudiyarov in Nukus, out of 178 patients with AII who underwent bacteriological testing, the etiology of the disease was identified in only 45 cases, while the causative agent remained unknown in the remaining patients. Additionally, based on data from Z.D. Bakhrieva (2024), among 340 patients under 18 years of age who were admitted to the Infectious Diseases Hospital in the Samarkand region with a diagnosis of diarrhea, bacteriological analysis of stool samples identified the etiological agent in only 25 cases (7.4%), with the causative agent remaining undetected in the other patients [4].

Based on these data, in recent years, we have attempted to analyze the effectiveness of bacteriological methods and their practical significance using evidence from scientific sources.

According to our analysis, scientific literature in recent years contains extensive information on the limitations of traditional bacteriological methods in diagnosing acute intestinal infections. In particular, the emergence and spread of antimicrobial resistance (AMR) in bacteria pose significant challenges to the effectiveness of classical bacteriological methods. The development of resistance due to incorrect or excessive use of antibiotics reduces the efficacy of these drugs and contributes globally to an increase in disease incidence, higher mortality rates, and rising healthcare costs [15].

Traditional bacteriological methods — namely, cultivating bacteria on specialized nutrient media and identifying their biochemical properties through various tests — have long been the primary approach for microorganism identification. Although these methods provide important information about pathogenic microorganisms, they are labor-intensive, time-consuming, and, in some cases, especially if the patient has received antibiotics, they may fail to ensure adequate sensitivity and accuracy [2,7]. One of the main challenges arises in isolating a pure (unique) colony of the pathogenic microorganism. This requires that the pathogen be present in sufficiently high concentration in the sample and that the material is collected from an anatomical site free from interference by the normal microflora [21].

Moreover, traditional approaches, while valuable in many respects, may fail to detect pathogens that do not grow under standard culture conditions (VBNC — viable but non-culturable) or slow-growing bacterial agents, which require prolonged cultivation. This limitation can lead to delayed diagnosis and inappropriate treatment [1,14,16,19].

Challenges in determining antibiotic resistance using traditional methods.

Determining antibiotic resistance using traditional methods is associated with several challenges. In particular, the disk diffusion method is often used to assess antibiotic susceptibility, but obtaining results with this method typically requires 18–24 hours or more. This creates significant difficulties in clinical practice, as it is crucial to provide timely and appropriate treatment to patients with infections [17]. In addition, this method requires a large volume of the sample, which can be challenging when working with certain clinical materials, such as blood, tissue, or cerebrospinal fluid [2].

Nowadays, many specialist microbiologists consider traditional testing methods — that is, classical approaches based on cultivating bacteria on specialized nutrient media — to be relatively outdated and not fully meeting modern requirements. The main reason is that these methods require considerable time to obtain results, and each microorganism demands its own specific optimal growth conditions for effective cultivation [12]. Nevertheless, bacteriological methods remain the gold standard for the diagnosis and monitoring of many bacterial infections, including gonococcal infections [20].

Determining whether an acute intestinal infection (AII) is viral or bacterial in nature is crucial. This has significant practical importance for the patient's recovery and for selecting the appropriate treatment approach [18].

In conclusion:

Acute intestinal infections (AII) are one of the major infectious health problems worldwide, particularly contributing to high mortality and disease burden among children under five years of age. In most cases of diarrhea, the exact etiology of the disease remains unidentified, creating challenges for effective treatment, prevention, and implementation of epidemic control measures.

Global and regional analyses show that African countries, especially in West, Central, and Sub-Saharan Africa, carry a high epidemiological burden of childhood diarrhea. At the same time, in some countries, such as Uzbekistan and Turkmenistan, social and sanitary reforms and preventive measures have produced a noticeable positive effect. Moreover, in certain countries, both the incidence and mortality rates of childhood diarrhea have shown significant increases or decreases, which have serious implications for patient outcomes and healthcare systems.

Traditional bacteriological methods — that is, cultivating bacteria on specialized nutrient media and identifying their biochemical properties — have long been the primary approach for microorganism identification. However, these methods have notable limitations: they are labor-intensive, time-consuming, unable to detect VBNC (viable but non-culturable) pathogens or slow-growing microorganisms and often cause delays in assessing antibiotic susceptibility. These factors create significant challenges in clinical practice for timely and accurate diagnosis and for determining effective treatment strategies.

Additionally, the growing antimicrobial resistance in bacteria limits the effectiveness of traditional methods and contributes globally to an increase in disease incidence, higher mortality rates, and rising healthcare costs.

In summary, determining whether AII is of viral or bacterial origin and applying modern, rapid laboratory methods is crucial for the effective implementation of health policies, preventive measures, and treatment strategies.

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