MONITORING THE POTABLE WATER QUALITY IN ALBANIA

Shkelqime POGA
Department of Assessment and Treatment of Risks in Public Health, Institute of Public Health Tirana, Albania

Erjon MAMOÇI
Department of Food Science and Biotechnology, Faculty of Biotechnology and Food, Agricultural University of Tirana, Albania

Lindita MOLLA, Edjona BICI, Anilda KOKALI and Genci ZHURKA
Department of Assessment and Treatment of Risks in Public Health, Institute of Public Health Tirana, Albania

Corresponding author Shkëlqime Poga Tobli
e-mail address: shkelqimetobli@gmail.com

ABSTRACT

Monitoring plays a critical role in systematically recording water characteristics to assess quality and ensure public health by supporting the continuous improvement of water supply standards. This process is essential for identifying potential risks and implementing preventive measures. Most waterborne infections are transmitted via the fecal-oral route, often resulting from contamination of drinking water pipelines by sewage. A thorough understanding of the water source, treatment processes, and safety for consumption is fundamental to preventing such diseases. This study reviews the monitoring processes currently implemented in Albania for assessing drinking water quality and presents national-level data. The analysis employs WatSan, an integrated, pathogen-specific approach recommended by the World Health Organization (WHO). It includes results from microbiological and physicochemical laboratory analyses of drinking water samples collected from both urban and rural water supply systems. The findings revealed contamination levels as follows: WatSan – 2.43%, *Escherichia coli* – 1.74%, and *Enterococcus intestinalis* – 0.28%. When contamination is detected, public health authorities initiate immediate responses, including notification, epidemiological investigation, and, when necessary, the imposition of restrictions or temporary bans on water usage.

Keywords: public health, drinking water quality, water sampling, pathogens, water contamination, waterborne infections

1. INTRODUCTION

Ensuring access to safe drinking water is a cornerstone of public health and sustainable development. Globally, unsafe water significantly contributes to the burden of disease, particularly in low- and middle-income countries. The World Health Organization (WHO) and the European Union (EU) have established comprehensive frameworks for water quality monitoring, including the WHO Guidelines for Drinking-Water Quality and the EU Council Directive 98/83/EC on the quality of water intended for human consumption (EU 1998; WHO 2019a). Effective surveillance of water quality enables the identification of potential contamination sources, supports improved treatment strategies, and helps prevent waterborne diseases. In Albania, the need for robust water monitoring systems has increased due to growing urbanization, climate variability, and aging infrastructure. Contamination may occur both at the source—such as in surface water or groundwater—and along the distribution network, due to factors such as pipeline leaks, cross-contamination with sewage, or inadequate disinfection (WHO 2019b; CDC 2025). Major contributors to contamination include heavy rainfall, damaged infrastructure, poor sanitation, and agricultural runoff. The health consequences of unsafe water are substantial and include gastrointestinal infections, often caused by Escherichia coli and Enterococcus, both transmitted via the faecal-oral route (CDC 2024a, b). Although Albanian institutions have implemented monitoring systems aligned with international standards, previous reports have not provided a comprehensive national overview using current surveillance indicators. This study aims to address that gap by evaluating Albania's national system for monitoring potable water quality. It focuses on both microbiological and physicochemical indicators using the WHO-endorsed WatSan approach and presents a national synthesis of data collected and analysed by the Institute of Public Health. The findings enhance understanding of seasonal patterns, regional vulnerabilities, and current institutional capacities in water quality surveillance.

2. MATERIALS AND METHODS

Ensuring access to safe drinking water is a public health priority, as it supports essential daily activities such as consumption, food preparation, and personal hygiene, while playing a critical role in preventing waterborne diseases. Water quality monitoring is vital for systematically recording water characteristics and assessing their quality, thereby contributing to the continuous improvement of water supply standards and the protection of public health (WHO 1999). This study examines the processes implemented in Albania for monitoring potable water quality and presents national-level data. Water samples were collected in 2022 from both urban and rural water supply networks across all districts of Albania, following ISO 5667-5:2006 sampling guidelines (IOS 2006). Samples were transported to accredited laboratories under controlled conditions for microbiological and physicochemical analyses. The primary focus was the identification of pathogenic contaminants that pose a risk for waterborne epidemics, along with the measurement of residual chlorine levels, which indicate the adequacy of disinfection processes. Physicochemical parameters monitored included ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), pH, turbidity, conductivity, temperature, odour, taste, and colour (Fawell & Waite 2012; CM 2016). Laboratory procedures adhered to WHO and national standards for potable water analysis (WHO 1985; WHO 2022). Microbiological analyses involved the use of membrane filtration and the multiple-tube fermentation technique for the detection of *Escherichia coli*, coliforms, and *Enterococcus intestinalis*. Residual chlorine was measured using the DPD (N,N-diethyl-p-phenylenediamine) colorimetric method. Concentrations of ammonium, nitrate, and nitrite were determined via spectrophotometric analysis. All reagents used were of analytical grade and approved for water quality testing. Sample transport and preservation conformed to ISO 5667-5:2006 and WHO water sampling protocols. Water quality control in Albania is conducted by multiple entities, including local Water Supply Authorities, Health Care Units, and the Institute of Public Health. The Institute of Public Health plays a central role by providing technical expertise, conducting monitoring and assessments, and supporting emergency response and research activities.

3. RESULTS AND DISCUSSIONS

Based on national data, the bacteriological parameters assessed using the WatSan indicator revealed the following results: the integrated WatSan indicator showed a contamination rate of 2.43%, *Escherichia coli* contamination was recorded at 1.74%, and *Enterococcus intestinalis* at 0.28%. Seasonal variations were evident in the data. The highest contamination with coliform bacteria was observed in November (0.28%), while peak *E. coli* contamination occurred in December (0.54%). The highest level of *Enterococcus intestinalis* contamination was recorded in January (0.06%).

Table 1. Monthly Distribution of Bacteriological Contamination in Drinking Water Samples

Month	E. coli-Positive Samples (n)	% of Total Annual E. coli-Positive Samples	Enterococci-Positive Samples (n)	% of Total Annual Enterococci-Positive Samples
January	90	5%	22	28%
February	50	3%	0	0%
March	91	5%	12	15%
April	106	6%	10	13%
May	114	6%	10	13%
June	83	5%	3	4%
July	145	8%	6	8%
August	165	9%	1	1%
September	97	6%	1	1%
October	121	7%	1	1%
November	154	9%	8	10%
December	557	31%	5	6%

The table presents the monthly distribution of *Escherichia coli* and *Enterococcus*-positive water samples collected throughout 2022. A total of 1,773 samples tested positive for *E. coli*, while 79 samples were positive for *Enterococci*. The data reveal a pronounced peak in *E. coli* contamination in December (31%), indicating a strong seasonal trend, potentially linked to increased rainfall or compromised infrastructure. In contrast, lower detection rates were observed in February (3%) and June (5%). *Enterococci*-positive samples were most prevalent in January (28%) but were nearly absent in several months—ranging from 0% to 1%—including February, August, September, and October. These results suggest that *E. coli* is a more consistent and dominant indicator of fecal contamination across seasons. The findings underscore the need for sustained and targeted water safety interventions throughout the year to mitigate public health risks associated with microbial contamination.

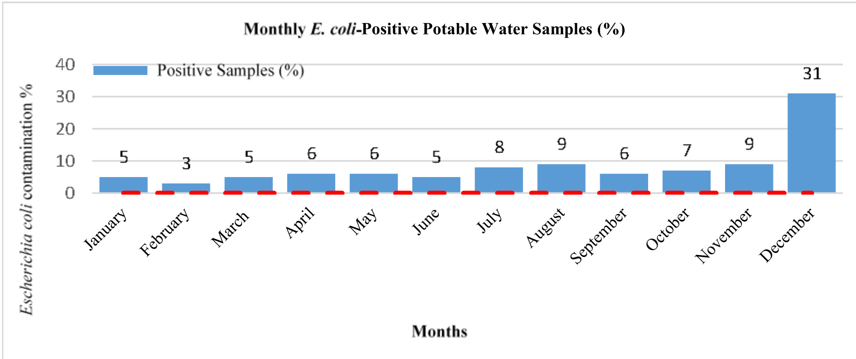

Fig 1. Monthly Variation in the Percentage of Potable Water Samples Failing Bacteriological Standards in 2022, in Escherichia coli contamination (Dataset)

Chart 1 illustrates the proportional distribution of *Escherichia coli*-positive water samples by month, with the highest incidence recorded in December, followed by November and August. The red dashed line indicates the international standard threshold for bacteriological non-compliance in potable water (0%), as defined by WHO guidelines and EU Council Directive 98/83/EC. The chart also displays data across various regions of Albania, providing both temporal and geographic insights into the distribution of contamination.

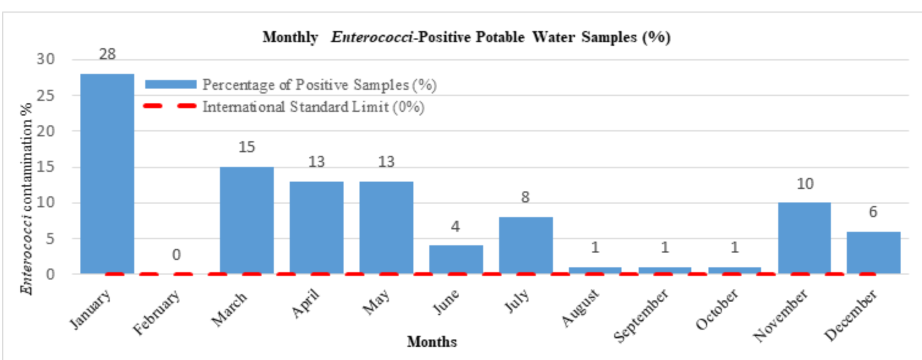

Fig. 2: Monthly distribution of Enterococci-positive potable water samples

The Chart 2 illustrates the national occurrence of Enterococci in drinking water samples during the year. Here, the red dashed line represents the international standard limit for bacteriological non-compliance in potable water (0%), based on WHO and Directive 98/83/EC standards. Monthly variation in the percentage of drinking water samples not meeting bacteriological standards in 2022, for enterococcal contamination (Dataset). The highest percentages of water samples positive for enterococci were recorded in January (28%). These findings highlight the importance of continuous monitoring throughout the year to promptly identify and address potential public health risks.

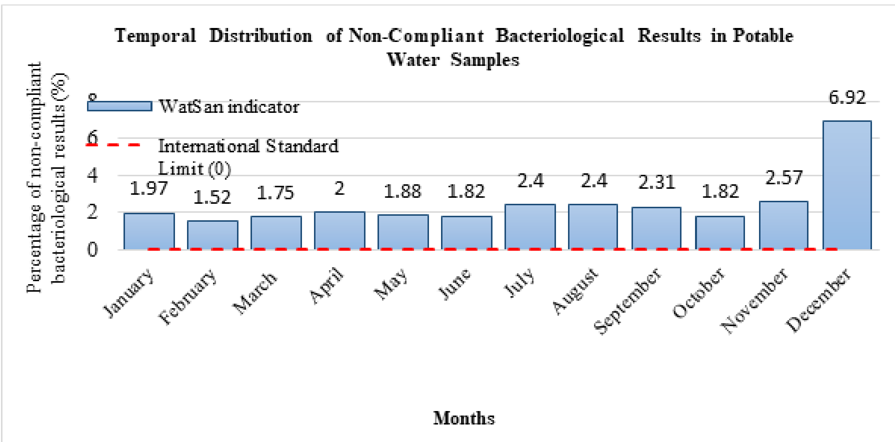

Fig. 3. Monthly variation of the WatSan S2 indicator in 2022. The red dashed line represents the international standard limit for bacteriological non-compliance in potable water (0%), based on WHO and Directive 98/83/EC standards.

Chart 3 presents the percentage of potable water samples that did not comply with bacteriological standards for each month of 2022. While values remained relatively stable throughout the year, a pronounced peak of 6.92% was observed in December, indicating an elevated risk of contamination. This highest rate of non-compliance suggests a potential seasonal influence on water quality during the winter months.

Although bacteriological contamination levels in Albania remain relatively low, continuous monitoring is essential, particularly during periods of seasonal peaks. The highest frequency of *Escherichia coli* contamination was recorded in December, coinciding with increased rainfall and the potential for overflow or failure of water infrastructure. Comparable seasonal trends have been reported in other European countries, including Italy and Croatia, where flooding and aging distribution systems contribute to heightened microbial risks. It is important to emphasize that the World Health Organization (WHO) maintains a zero-tolerance policy for *E. coli* in 100 mL of drinking water (WHO 2005; 2006).

The observed contamination levels in Albania fall within regional norms; however, they underscore the need for strengthened preventive infrastructure. Enhancing laboratory capacity is critical to expanding the scope and reliability of drinking water quality monitoring systems. Adequate laboratory equipment and well-trained personnel are essential for incorporating additional microbiological and physicochemical indicators beyond those currently monitored. Such an expansion would enable a more comprehensive assessment of water safety, in alignment with WHO recommendations and EU directives. Improved laboratory infrastructure would also support the timely detection of emerging contaminants and antimicrobial-resistant pathogens, which pose growing public health threats. Investments in modern diagnostic technologies and the harmonization of analytical protocols across regions would enhance data accuracy, comparability, and the effectiveness of early warning systems within the national surveillance framework. Internationally, integrated digital platforms and remote sensing technologies are increasingly being utilized to enable real-time water safety assessments. Albania could benefit from the adoption of similar innovations, particularly in densely populated urban areas.

4. CONCLUSIONS

Water pollution, even at low levels, remains a significant public health challenge. In Albania, although the current water quality monitoring system has been effective in detecting contamination events, several challenges persist. These include the need for more consistent and comprehensive coverage nationwide, particularly in rural and remote areas where infrastructure may be aging or inadequately maintained. As demonstrated by the findings of this study, while some regions meet bacteriological standards, seasonal fluctuations in contamination levels underscore the vulnerability of the water supply to factors such as rainfall, infrastructure deficiencies, and agricultural runoff.

Comparative data from neighboring countries such as Italy and Croatia further highlight the importance of proactive measures to prevent contamination, especially during high-risk periods like the rainy season.

The results suggest that while Albania's water quality monitoring aligns with regional trends, there remains significant room for improvement in critical areas, including infrastructure enhancement and the implementation of real-time monitoring capabilities. Observed seasonal patterns and regional variations in contamination emphasize the need for targeted, localized strategies to effectively improve water safety.

Notably, contamination peaks—such as the elevated incidence of *Escherichia coli* observed in December—correlate with increased rainfall and potential infrastructure failures, including leaks or overflows. These findings highlight the urgent need for more robust preventive infrastructure to mitigate contamination risks before they escalate to critical levels. Additionally, strengthening laboratory capacity and enhancing monitoring systems remain essential for the early detection of hazards and effective risk management.

While Albania's water quality monitoring system has proven effective in detecting contamination and enabling timely responses, preventing future waterborne health risks requires targeted investments in infrastructure, digital technologies, and capacity-building initiatives. Strengthening these areas will enhance the resilience and sustainability of the national water monitoring framework, ensuring the long-term safety of drinking water and protecting public health.

5. RECOMMENDATIONS

To improve the sustainability and resilience of potable water monitoring systems in Albania, the following actions are recommended:

- **Infrastructure Improvement:** Upgrade water infrastructure, particularly in high-risk areas with aging pipe networks that are vulnerable to leaks and cross-contamination.
- **Digital Monitoring Systems:** Invest in real-time digital tools and remote sensing technologies to enable rapid detection and timely response to contamination events.
- **Standardization of Monitoring Practices:** Harmonize monitoring methodologies nationwide to ensure consistent data collection, facilitating accurate national trend analysis and informed public health decision-making.
- **Capacity Building:** Provide continuous training for public health professionals on emerging monitoring techniques, updated

analytical protocols, and comprehensive risk management strategies.

- **Public Awareness:** Enhance public education campaigns, especially during seasons with increased contamination risks, to encourage safe water practices and promote community engagement.
- **International Collaboration:** Develop partnerships with international organizations to gain technical support, methodological guidance, and facilitate the adoption of global best practices in water quality surveillance.

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