



Epidemic of acute Gastroenteritis in the Municipality of Deçan caused by contamination of drinking water - Challenges in the research and management of the epidemic

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Abstract

Introduction: This study presents a comprehensive analysis of the management of an acute gastroenteritis epidemic in the municipality of Deçan in Kosovo, with a specific focus on its epidemiological and environmental aspects. Originating in July 2021 the epidemic significantly affected residents in the municipality of Deçan and nearby areas.

Research Methodology: Descriptive epidemiological research methods and a case-control study model were employed, integrating mixed methods (qualitative, quantitative, and laboratory). Clinical samples from affected patients and water samples from the water supply system and private wells were analyzed. The testing was carried out at the Regional Center of Public Health in Pejë and at the National Public Health Institution in Pristina in the Department of Human Ecology / CTL (Center of Testing Laboratories and the Laboratory of Microbiology, as well as some more specific testing in the external laboratories of our country.

The results and conclusions of this study are significant for understanding the epidemiology and the impact of water contamination on the spread of acute gastroenteritis in this area. They also provide recommendations for future prevention and treatment measures for this disease in the local community.

Keywords: Acute gastroenteritis, epidemic, waterborne illnesses, contamination, Deçan.

1. Introduction

Acute gastroenteritis, also known as infectious diarrhea, is an inflammation of the gastrointestinal tract - stomach and intestines. Symptoms may include diarrhea, vomiting, abdominal pain, fever and malaise, typically appearing 12–72 hours after contact with the infectious agent with the mucosa of the gastrointestinal tract. Gastroenteritis is usually caused by viral, bacterial or parasitic infections.



Mass water intoxications impose burden on the health system and unpredictable complications for the public health of the population in general, such as the epidemic of acute gastroenteritis in the municipality of Deçan, which is the focus of this master's thesis.

The legislation of the Republic of Kosovo with the Law on Health, the Law on Public Health, the Law on the Prevention and Combating of Communicable Diseases, the Law on Food and the Law on the Sanitary Inspectorate of Kosovo foresee certain actions regarding epidemics of this nature. Effective inter-institutional coordination has proven crucial in managing public health crises like the acute gastroenteritis epidemic in Deçan, July 2021.

The Law on Health in its article 9, paragraph 1.11. accurately defines the aspect of water quality control and public health protection as follows: Supervision of water and food quality control for the purpose of consumer protection, in cooperation with the relevant ministries, in accordance with the Law (No. 04/ L-125).

Furthermore, the Law on Public Health in the first article, paragraph a), regarding this matter specifies the functions of public health:

Public health: an independent discipline that deals with the identification and solution of all community problems from all health points of view, disease prevention, research etiology of diseases, health promotion, rehabilitation and re-adaptation of the handicapped, health education and social issues.

It also clarifies the definition of an epidemic as, the occurrence of two or more cases of a contagious disease, closely related in time and certain territory or the enormous increase in the number of cases of a contagious disease (Law No. 02/L-78). Moreover, these laws regulate various aspects concerning their management and eradication, aligning closely with the scope of our research.

The Law on the Prevention and Combating of Communicable Diseases, in Article 1, precisely defines communicable diseases as well as regulates the activities for timely detection, evidence of occurrence, prevention, stopping the spread and their treatment, (Law No. 02/ L- 109), which corresponds exactly to the activity undertaken by the relevant institutions in managing and dealing with epidemics of this nature.

The Law on Food, regarding the consumption of water, in article three, in several of its paragraphs, specifies the following:



In paragraph: 2. The notion of "food" includes water as well, as:

- 2.1. Water utilized for public supply as drinking water;
- 2.2. Water utilized or forming a part of food during production, preparation, and processing;
- 2.3. Packaged water such as drinking water, mineral water and spring water (Law No. 03/L-016).

The law also consists of the actions and the connection with the relevant mechanisms for water quality control and public health protection of citizens.

In article 3, paragraph 2.1. of the Law on the Sanitary Inspectorate of Kosovo, as regards the use of water in general, specifies: the implementation of general measures for the prevention and fight against contagious diseases (health insurance of the right food, ensuring the health regularity of items for general use, ensuring the regularity of health and drinking water, baths, beaches, pool water, fountain water and other waters of public-health interest, ensuring sanitary-technical conditions (Law No. 08/L-050), which shows precisely the great competences and the role of the Sanitary Inspectorate of Kosovo in the prevention of pathologies of this type and the protection of the public health of the population in general.

Despite advanced systems for water purification and distribution, as well as legislative frameworks for safe water (Zacheus O, Miettinen IT, 2011), microbial contamination of drinking water and waterborne infections continue to occur even in developed countries (i.e. Yang Z et al., 2011; Craun. G et al., 2011). Large numbers of people can be affected if public water systems become contaminated. Contamination of public water systems can affect large populations, stemming from deficiencies in the water supply system, inadequate water treatment, or contamination within the drinking water supply system.

Gastroenteritis predominantly has a viral cause, and typically lasts one to two days, causing symptoms of short episodes such as vomiting and diarrhea. However, gastroenteritis can cause dehydration, which can be life-threatening if not treated and fluids replaced. In children, Rotavirus is the most common cause of the illness, while in adults 50-70% of gastroenteritis is caused by Norovirus, Campylobacter, E. coli and Proteus.

Common routes of transmission:

- Consumption of unsafe or improperly prepared food;
- Ingestion of contaminated water;



- Close contact with infected individuals;
- Inadequate handwashing and personal hygiene practices (especially after toileting or diaper changing).

Preventive measures entail handwashing with soap, consumption of clean water, consumption of safe foods, breastfeeding infants instead of formula feeding, and proper disposal of solid and human waste.

1.1. The epidemic of July 2021 in Deçan, Kosovo

In July 2021, in the city of Deçan, a large number of patients sought medical assistance at the Main Center of Family Medicine presenting with symptoms of poisoning. Official suspicions regarding the cause of poisoning center around a branch of the KRU "Hidrodrini" water supply, as well as other sources and wells supplying drinking water to approximately ten villages. Patients from these villages exhibited similar symptoms suggestive of acute gastroenteritis.

The supply area (HD04) within the service area of KRU- "Hidrodrini", includes the municipality of Deçan and the villages of Prilep, Prekolluk, Irzniq, Glllogjan, Shaptej, Baballoq, Jasiq, Gramaqel, Rastavicë and Ratishë with 1285 registered consumer families. This area is served by a separate water supply system drawing from two sources: Kurvalla Spring and Hasanaga Spring, located at an elevation of 1770m lmd. The system comprises a main HDPE 250 Ø pipe, constructed in 2011-2012, spanning 18 km and passing through 12 pressure relief chambers to the Drenoc village reservoir, with a capacity of approximately 60m³ at an elevation of 590 m lmd.

Initially, the disinfection/chlorination system employed point-by-point chlorination using Na-hypochlorite (Zavell dissolution), later replaced by an injection system with Na-hypochlorite preparation containing 10-16% active chlorine, positioned in the main pipe approximately 1 km above the reservoir.

The average daily water intake into the system is approximately 1300 m³, serving a population of around 6500 inhabitants. Concerns over increased gastroenteritis cases prompted teams from the National Institute of Public Health of Kosovo and the Regional Center of Public Health - Pejë to collect field samples beginning on 11.07.2021.

Following reports of 200 individuals seeking medical assistance at the Main Center of Family Medicine in Deçan on the evening of 10.07.2021, an immediate field research and



epidemiological investigation commenced. The Ministry of Health was promptly informed, and necessary actions were initiated on Sunday morning.

Subsequent days witnessed a rise in diagnosed cases of infectious gastroenteritis and bacterial food poisoning, necessitating medical attention at the Main Center of Family Medicine in Deçan and the Regional Hospital in Peja. All patients received treatment and were discharged in improved condition.

Initial patient reports indicated that on 09.07.2021, following rainfall, water from the Hidrodrin-Reservoir in Drenoc, supplying drinking water to several villages (Prilep, Prekolluk, Irzniq, Gillogjan, Shaptej, Dubrava, Baballoq, Gramaqel, Rastavicë, Jasiq, lower Ratish and upper Ratish), exhibited unusual discoloration and odorous properties (a brown colour, and after a white color). In response to the increasing cases of gastroenteritis, the Hidrodrini Regional Water Company suspended water supply from this source from Sunday, 11.07.2021, until Wednesday, 14.07.2021.

Although initial cases were concentrated in villages supplied by this source, subsequent cases emerged in areas unaffected by this supply. Some patients had visited or been in contact with individuals from the affected villages. Clinical manifestations included pain, vomiting, watery stomach, abdominal pain, and in some rare cases, elevated temperature, dizziness, fatigue, headache, lethargy.

A total of 42,505 residents were exposed, of which 1,371 had clinical symptoms, while 7 patients were hospitalized in the Regional Hospital of Peja, with 0 cases of death. Until 21.07.2021, 1,371 cases were reported with an incidence of 3,225.5 per 100,000 inhabitants.

2. Research Questions

1. What are the causes, sources of infection, and extent of involvement in the acute gastroenteritis epidemic in the municipality of Deçan in July 2021?
2. What measures and activities were undertaken by the institutions responsible for managing the epidemic?
3. What deficiencies were identified during the management of the epidemic?

2.1. Hypotheses

Acute gastroenteritis can stem from various etiologies, sources, and modes of transmission, with epidemics potentially reaching significant proportions requiring efficient and multisectoral management. Therefore, we hypothesize:



Based on the previously mentioned research questions, the following hypothesis were tested:

1. Water was the source of infection in the acute gastroenteritis epidemic in Deçan in July 2021.
2. Deficiencies existed in the management of the acute gastroenteritis epidemic in Deçan in July 2021.

3. Theoretical Background

Acute gastroenteritis characterized by symptoms such as nausea, vomiting, diarrhea and abdominal pain, is a prevalent infectious disease syndrome (Graves, 2013). It typically occurs when food or water contaminated with pathogenic microorganisms (such as *Clostridium perfringens*, *Vibrio cholera*, *E. coli*) or their toxins is consumed (Panesar & Bali, 2016). The illness appears in different ways but also in different countries, regardless of the level of development of those countries and possible preventive measures. Gastroenteritis causes significant mortality in developing countries and a significant economic burden on developed countries (Chung at al. 2010).

3.1. Prevalence and consequences of acute gastroenteritis

Diarrheal disease due to acute gastroenteritis remains the second leading cause of death and hospitalization worldwide (Abdel-Rahman at al. 2021). According to estimates from the World Health Organization, about 1.7 billion cases of diarrhea are reported each year among children under five; about a third of them die due to the severity of the disease (WHO, 2017). Even in countries with developed health systems, this disease presents a serious challenge for its prevention, management and treatment. Acute gastroenteritis (Acute Gastroenteritis AGE), characterized by diarrhea, vomiting, fever and abdominal pain, causes 1.3 million deaths globally each year (Cardemil at al. 2022). In the United States, AGE causes 179 million cases and 1 million hospitalizations each year (Scallan at al. 2011). This pathology and its causes that provoke epidemics with significant consequences are also confirmed by the relevant statistics of the World Health Organization (WHO): Every year, diarrhea kills about 525,000 children under the age of five.

A significant proportion of diarrheal diseases can be prevented through safe drinking water and adequate sanitation and hygiene. Globally, there are approximately 1.7 billion cases of childhood diarrheal disease each year. Water contaminated with human feces, for example from sewage, septic tanks and toilets, is a particular concern. Animal feces also contain microorganisms that can cause diarrhea (WHO, 2017).



Several cases of epidemics of acute gastroenteritis, especially with water intoxication, have been recorded in different countries of the world (those in conflict situations and countries with a wave of refugees), that greatly affects children and other age groups. Acute gastroenteritis (AGE) is a major cause of pediatric morbidity and mortality worldwide. After the crisis of Syrian refugees and the insufficient clean water in that region, studies estimate a mass intoxication of thousands of people (Salami et al., 2019).

In terms of epidemiology, official data and new studies see this pathology as a permanent risk even in the developed world and contemporary trends in the development of medical sciences and modern technologies. Acute gastroenteritis is the leading cause of infant mortality worldwide. By the age of three, almost all children are infected with the most common agents. Rotavirus causes two million hospitalizations and 600,000-875,000 deaths per year (Revelas, 2015), therefore these data are an additional reason for raising the necessary capacities in the prevention, protection and strict control of drinking water sources and supplies.

In Europe, efforts have been made to address acute gastroenteritis outbreaks through multidimensional research and inter-institutional coordination. The European Center for Disease Prevention and Control (ECDC) has studied community preparedness for such outbreaks, analyzing collaborative efforts between affected communities and relevant institutions (ECDC, 2019). The European Center for Disease Prevention and Control (ECDC) has published a report on the findings of two case studies on community preparedness for acute gastroenteritis outbreaks, based in Iceland and Ireland. It is part of a wider ECDC case study project to investigate the synergies between communities affected by serious public health threats and institutions (both health and non-health) that are mandated to prepare and answer them. Specifically, the studies aim to: identify which practices and models of cooperation between affected communities and institutions mandated to address health threats have worked well and which have not; identify and analyze cross-sectoral collaboration as well as community-institution synergies, and provide examples of collaborative efforts between health and non-health sectors (ECDC, 2019).

3.2. Causes and treatment of acute gastroenteritis

Gastroenteritis is most often caused by viruses and can last one to two days. In children, rotavirus is the most common cause of illness while in adults 50-70% of gastroenteritis is caused by Norovirus and Campylobacter, E. coli and Proteus.



The main symptoms are watery diarrhea and vomiting. They can also cause stomach pain, cramps, fever, nausea and headache. Due to diarrhea and vomiting, dehydration can also occur (WebMed, 2021). Gastroenteritis, on the other hand, attacks the intestines, the gastrointestinal tract, causing signs and symptoms such as: Watery diarrhea, usually without blood, then nausea, vomiting or both, stomach cramps and pain, occasional muscle aches or headaches, low-grade fever, etc. Depending on the cause, symptoms of viral gastroenteritis can appear within 1-3 days of infection and can range from mild to severe. Symptoms usually last only a day or two, but occasionally they can last up to 14 days (Mayo Clinic, 2022). The diagnosis of acute gastroenteritis is made with a careful anamnesis by the doctor, depending on the causes and symptomatology.

Symptoms are telltale signs of viral gastroenteritis in adults and older children. The doctor should ask questions about the symptoms, about recent travel and the duration of the symptoms. The patient should be asked if they have recently been in the hospital or used antibiotics. Stool testing is done in certain circumstances when the doctor suspects something other than viral gastroenteritis, such as food or water poisoning. For food poisoning, it is important to identify the potential cause so that others do not become ill from the same contaminated food or water (MedBroadcast, 2023). The differential diagnosis of acute bacterial gastroenteritis includes other causes of gastroenteritis such as viral and parasitic gastroenteritis. Common foodborne or waterborne diseases should also be considered in the differential (Sattar & Singh, 2022).

The treatment of acute gastroenteritis depends on the cause, the patient's condition and other elements which are subject to certain clinical treatment protocols. In cases of drinking water intoxications and associated symptomatology with diarrhea, stool testing is usually performed guided by clinical findings and suspected organisms based on the patient's history and epidemiologic factors (eg, immunosuppression, exposure to a known outbreak, recent travel, recent use of antibiotics), (Gotfried, 2023). Moreover, it is also worth consulting (applying) the 2016 clinical guideline of the American College of Gastroenterology for the diagnosis, treatment and prevention of acute diarrheal infections in adults (Riddle et al, 2016).

Prevention strategies, particularly concerning waterborne diseases like gastroenteritis, are emphasized by the World Health Organization (WHO). These include promoting national policies and investments supporting case management, enhancing access to safe drinking water and sanitation, conducting research to develop preventive strategies, capacity building for implementing preventive interventions, development of new health interventions like rotavirus



immunization, and training healthcare workers, particularly at the community level (WHO, 2017).

4. Methodology

The research methodology involved elucidating the process of epidemic management and factors contributing to the outbreak of acute gastroenteritis in the municipality of Deçan during the period from 11.07.2021 to 30.07.2021. The study utilized descriptive epidemiological methods and a case-control study model, employing mixed methods encompassing qualitative, quantitative, and laboratory approaches.

4.1. Sample

Data collection occurred at the Regional Center of Public Health in Peja and the National Institute of Public Health in Pristina, focusing on clinical samples from affected patients and water samples from suspected sources. The study encompassed 1371 reported cases, with 531 cases surveyed, and 50 water samples tested between 11.07.2021 and 22.07.2021. Out of 66 samples of feces taken from patients for analysis, 38 samples were processed in the Microbiology laboratory at IKSHPK, while 28 samples were processed in the Microbiology laboratory at QRSHP Pejë.

The epidemiological data presented were taken from the IKSHPK Report on the "Progress of the water epidemic in Deçan" dated 23.07.2021.

4.2. Research instruments

1. Epidemic research and epidemiological tracking: It was carried out on the ground by the Pejë QRSHP teams together with the teams of IKSHPK, QRSHP Prizren, Gjakovë, Mitrovica, Gjiilan. The research has continued intensively every day in order to assess the spread - the extent of the epidemic;

2. Epidemiological survey: 577 patients and 916 people of the control group were surveyed. The survey included patient demographic data such as first name, last name, year of birth, residence, phone number, and diagnosis, as well as disease data, information on symptoms, and their exposure to food and drinking water.

3. Physic-Chemical Analysis of Water: In order to assess the quality of drinking water, water samples were taken from the sources of the water supply in the affected area as well as from private wells. These samples were tested for physico-chemical and bacteriological parameters that determine water quality and the possibility of contamination.



4. Water samples were also tested for heavy metals, THM (trihalomethanes), TOC (total organic carbon) and PAH (Polynuclear Aromatic Hydrocarbons) in the laboratories of CTL and for pesticides in the laboratory of the Institute of Agriculture in Peja,

5. Microbiological analyzes of water samples: Microbiological tests of water samples were carried out to identify pathogenic microorganisms that may have caused infection in humans.

6. Laboratory Analysis of Feces Samples: Feces samples were taken from patients with symptoms of acute gastroenteritis to identify infectious agents that may be the cause of the disease.

7. Analysis of the Water Supply System: Inspection of water sources of the aqueduct and individual private wells by the Sanitary Inspectorate. Water samples were taken from the drinking water supply system to assess water quality and identify any possible contamination.

8. Communication and Cooperation with Local and Central Health Structures: Health teams have established close contacts with local and central health structures to gather important information and coordinate the measures taken for the prevention and control of the epidemic

9. Recommendations and Preventive Measures: After various analyzes and researches, recommendations have been given to the sanitary inspectorate, to the Hidrodrini Regional Water Company, to the citizens, and to all health personnel for preventive measures and for the treatment of cases of acute gastroenteritis.

4.3. Laboratory research findings:

Feces Samples:

A total of 66 feces samples collected from patients were analyzed, with 38 processed at the Microbiology Laboratory at IKSHPK and 28 at the QRSH Pejë laboratory. Results indicated that all tested samples were negative for Rotavirus, Norovirus, Adenovirus, and enter pathogenic E. coli (EPEC). Additionally, microscopic examination revealed the absence of Giardia.

Two feces samples sent for testing in laboratories outside Kosovo on July 15, 2021, tested positive for Norovirus GI/GII, enter pathogenic E. Coli (EPEC), and enter toxigenic E. Coli (ETEC).

Drinking Water Samples:



Water samples collected from May 11, 2021, to July 22, 2021, were analyzed for physico-chemical and microbiological parameters. From six water samples collected on July 11, 2023, from various villages supplied by the water supply-Drenoc, all samples lacked residual chlorine, indicating unsafe water and a potential risk of microbiological contamination. However, other physico-chemical parameters fell within defined standards.

Bacteriological examination revealed increased levels of total live bacteria in samples from Gramaqel and Glllogjan villages, while coliform bacteria were isolated from individual well samples in Glllogjan and Irznjq villages, exceeding standards for water intended for human consumption.

Samples tested for THM, TOC, PAH, pesticides, and heavy metals met standards for human consumption. However, bacteria such as *E. Coli* and *Hafnia Alvei* were identified in a water sample from the Drenoci catchment, indicating its failure to meet safety standards.

4.4. Statistics and Data Analysis:

Data analysis was conducted using SPSS and MS Excel software, with results presented through explanatory tables. The findings from feces and water sample analyses provided crucial insights into the presence of pathogens and contamination levels, guiding subsequent actions and interventions to mitigate the epidemic of acute gastroenteritis in the municipality of Deçan.

5. Results

Out of 66 samples of feces collected from patients for analysis, 38 were processed in the Microbiology laboratory at IKSHPK, while 28 were processed in the laboratory of QRSHP Pejë. All tested samples were negative for Rotavirus, Norovirus, Adenovirus, EPEC (enteropathogenic *E. coli*). Also, by microscopic examination of the feces samples, *Giardia* was found to be negative.

Norovirus GI/GII, Enteropathogenic *E. Coli* (EPEC) and Enterotoxigenic *E. Coli* (ETEC) were detected in the two feces samples sent for testing in laboratories outside Kosovo on July 15, 2021.

Drinking water samples were tested starting from 11.05.2021 to 22.07.2021.

From the 6 water samples collected on 11.07.2023 in the villages of Prilep, Irznjq, Glllogjan, Babablloq, Gramaqel and Rastavicë, which are supplied by the water supply-Drenoc, tested/analyzed in the laboratories of QRSHP Pejë, analyzed in physico-chemical terms all water samples showed a lack of residual chlorine, which indicates unsafe water and a potential risk



of microbiological contamination. Other physic-chemical parameters result within the standards defined according to Administrative Instruction 16/2012.

With bacteriological examination, the samples taken in Gramaqel and Glllogjan resulted in increased values of the total number of live bacteria. While the other samples in terms of microbiology result within the standards defined according to Administrative Instruction 16/2012.

Colonies of coliform bacteria were isolated in the two samples of individual wells (in whose families there were cases of gastroenterocolitis) in the villages of Glllogjan and Irzniq, therefore they do not fall within the standards for water for human consumption determined according to Administrative Instruction 16/2012.

Four (4) samples of water from the water supply (water from the source - Gurra e Hasanagë, water after treatment Administrative Instruction - Carabreg village, untreated water from Prilep village and water from the water supply - Isnqi village) were also tested in THM, TOC, PAH, Pesticides and Heavy Metals and all of which result within the standards for water for human consumption determined according to Administrative Instruction 16/2012.

The water samples planted in the nutrient field in the Laboratory of Microbiology in QRSHP - Pejë have been referred to IKSHPK where the cultivation of water samples and testing with the MALDI-ToF method has continued. E. Coli and Hafnia Alvei bacteria were identified in the water sample taken from the Drenoci catchment and as such the Drenoci catchment sample does not fall within the standards for water for human consumption determined according to Administrative Instruction 16/2012.

Table 1. Water supply from supervised waterworks, from unsupervised waterworks and from wells

	Water supply method	Number of families	Number of inhabitants	Daily demand for water in emergency cases
1	Water supply from supervised water works	5616	22103	63930 liters
2	Water supply from the water	814	5070	11396 liters



	supply which is not supervised			
3	Water supply from wells	2178	13469	30492 liters
	Total:	8608	40642	105818 liters

Source: Municipality of Deçan, Directorate for Protection and Rescue & Public Services - Security and Emergency Sector (2018).

Table 1 shows the water supply of settlements with water pipes that are supervised by the Hidrodrini Regional Water Company, those that are supplied with water but not supervised by the Hidrodrini Regional Water Company, as well as residences that are supplied with drinking water from wells (wells). , this topography of settlements is of great importance for the aspect of detection and etiology of the source of infection during the epidemic of acute gastroenteritis in the municipality of Deçan.

Table 2. Cases surveyed by gender and age group

	Cases surveyed	
	n=531	%
Gender		
F	325	61.2
M	206	38.6
Age groups		
0-4 years	35	6.6
5-14 years	98	18.5
15-34 years	211	39.7
35-54 years	103	19.4
55-64 years	44	8.3
over 65 years	31	5.8
Without details	9	1.7



Source: National Institute of Public Health of Kosovo, Report on the progress of the water epidemic in Deçan, 2021.

Table 2 shows the monitored cases according to age and gender. 61.2% of surveyed and monitored patients were female, while 38.8% were male.

Table 3. Cases surveyed by symptoms

Symptoms	Yes		No	
	n (total 531)	%	n (total 531)	%
Watery diarrhea	405	76.2	126	23.7
Vomit	448	84.3	83	15.6
Fevers	69	13.0	462	87.0
Abdominal pain	307	57.8	224	42.2

Source: Source: National Institute of Public Health of Kosovo, Report on the progress of the water epidemic in Deçan, Julay, 2021.

Table 3 shows the results surveyed according to symptoms. All surveyed patients complained of nausea, vomiting, watery diarrhea, abdominal pain and fever, but the most frequent symptom is vomiting in 448 patients or (84.3%).

Table 4. Surveyed cases according to the treatment method in Health Institutions

	Outpatient		Hospital Care	
	n (total 531)	%	n (total 531)	%
Treatment of the patient	524	98.7	7	1.3

Source: : National Institute of Public Health of Kosovo, Report on the progress of the water epidemic in Deçan, in Deçan, July 2021.



Table 4 shows the cases according to the way of treatment in Health Institutions. The cases were mainly treated on an outpatient basis, only 7 patients or (1.3%) were hospitalized. No deaths have been reported.

Table 5. Cases surveyed according to the way of drinking water supply and nutrition

			Yes		No	
			n (total 531)	%	n (total 531)	%
Drinking water supply:						
Water from well/pump	40	7.5	491	92.5		
The stones of Hasanaga water supply	256	48.2	275	51.7		
Other water supplies	273	51.4	258	48.6		
Bottled water	54	10.1	477	89.4		
Feeding method:						
Food prepared at home	491	92.5	40	7.5		
Eating out	42	7.9	489	92.1		

Source: : National Institute of Public Health of Kosovo, Report on the progress of the water epidemic in Deçan, in Deçan, July 2021.

Table 5 presents the surveyed cases according to the drinking and feeding water supply method. Of the surveyed patients: 256 or (48.2%) consumed drinking water from the Gurrat e Hasanaga waterworks, compared to other sources. A number of patients have consumed drinking water from at least two sources (both from the water supply and from the well, or bottled water). 491 patients or (92.5%) before the onset of symptoms consumed food prepared at home, where the whole family was fed.

Referring to the laboratory analysis data on water samples from the water supply and from individual wells, it is reflected:



- Lack of continuous disinfection/chlorination and consequently contamination/exceeding the parametric values for E. Coli parameters, coliform bacteria of fecal origin and sulfidoreducing bacteria.
- Connection of private wells (with unsafe water quality) to the water supply network, which means that well water and water in the water supply network are mixed.

6. Discussion

This study provides comprehensive insights into the water supply infrastructure, disinfection systems, water quantities, population demographics, and the characteristics of acute gastroenteritis as a disease. During field inspections, it was observed that the drinking water sources were unsupervised and suffered from technical deficiencies.

Throughout the research process, rigorous steps were taken to investigate the epidemic, including sample collection, engagement with local authorities, and collaboration between IKSHPK and QRSHP - Pejë teams. Analysis of water and feces samples revealed contamination issues in certain areas, although parasitological analyses yielded negative results. Moreover, the study offers detailed statistics on reported and surveyed cases, demographics, symptoms, treatment modalities, and hospitalization rates.

A comparative analysis with similar epidemics in neighboring regions, such as the outbreak in Ellassona, Greece, in 2012, underscores shared etiological, epidemiological, clinical, and laboratory characteristics. The delay in detecting the outbreak's cause and implementing water treatment measures prolonged the epidemic, highlighting the critical importance of timely intervention and public notification. The Ellassona outbreak is similar to the epidemic of acute gastroenteritis in the municipality of Deçan. Even in Ellassona, the first cases were reported in health institutions after the rains, in the publication of this research, about the progress of the epidemic in that part of Greece, it is said: "Descriptive epidemiological data (curve of the epidemic, geographical distribution of cases, etc.) and the results of the analytical study supported an aqueous origin of the explosion. The history of heavy rains at the beginning of the month and the reports that the water was colored, together with the results of the water samples, further support this hypothesis of the causes of the epidemic." Delays in detecting the cause, delayed implementation of drinking water treatment, and ultimately secondary transmission from one person to another caused the epidemic to last 26 days. Delayed public notification was the main limitation in epidemic research (Mellou et al, 2013).



It is important to note that the legislation of the Republic of Kosovo that covers this field is aligns with EU directives on water quality standards, emphasizing the need for compliance with stringent regulations to safeguard public health, specifically with the directive from the chemical quality standards specified in the first Annex - of the European Directive 98/83/EC - Directive on water for human consumption, (Council Directive 98/83/EC, 1998).

7. Conclusions

From the literature and research presented the following conclusions can be made: In general, polluted and unsafe water in terms of physic-chemical and microbiological aspects, presents a high potential for endangering health and disrupting the epidemiological situation for repeated outbreaks of diseases. Moreover, the size of the epidemic and the isolation of E. Coli, coliform bacteria in water samples as well as the isolation of Norovirus GI/GII, Enteropathogenic E. Coli (EPEC) and Enterotoxigenic E. Coli (ETEC) in feces samples, are an indicator for fecal contamination of drinking water with faeces originating from sewage. Furthermore, irregular disinfection and chlorination practices contribute to water pollution in certain segments of the water supply system. These processes are impeded by issues such as inadequate reservoir maintenance, illegal well connections, pressure reductions, and surface water infiltration which then exacerbate network pollution and incorrect water disinfection.

In the context of the specific Decan epidemic, it is clear that the investigation of the acute gastroenteritis epidemic in Deçani municipality did not lead to a definitive conclusion as to how the water source was contaminated and whether the fecal contamination was of human or animal origin. We can also conclude, that timely detection and reporting of waterborne epidemics are crucial for effective research and identification of etiological agents. Finally, seeing as testing and laboratory tests of causes of epidemics caused by water sources is complex (especially in developing countries like Kosovo, where no laboratory might not be sufficient in testing for the wide spectrum of pathogens that can be implicated in epidemics), close cooperation and organization between laboratories and authorities is needed for the proper management of such waterborne epidemics.

7.1. Limitations

The study has some limitations, which are linked to deficits of different aspects in the data, data collection and reporting of the tests. Firstly, the data was reported quite late from the patients' side, and was not detailed enough, with quite essential data missing. Secondly, data were reported by the Deçan HCMC in some cases only with symptoms or with different diagnoses not coinciding with gastroenteritis diagnosis (i.e. A05, A09, K29). Furthermore, despite the



given recommendations and the insistence of the doctors of the Deçan Medical Center, the number of feces samples submitted by the patients was very small and samples from the patients of the first days are missing. Finally, on 12.07.2022 and 13.07.2021 at the water supply points - Drenoc Reservoir, no water samples were taken because the supply of drinking water was interrupted, adding a crucial limitation to the data collection.

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