



ANALYSIS OF T. COLIFORM AND E. COLI BACTERIAL CONTAMINATION IN REFILLABLE DRINKING WATER DEPOTS IN NORTH SUMATRA PROVINCE

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Abstract

Contamination of refill drinking water in Indonesia remains a serious public health issue. One of the main causes is weak sanitation supervision and poor hygiene practices during the water treatment process at Refill Drinking Water Depots (DAMIU). This study aims to analyze the contamination of Coliform and Escherichia coli bacteria in DAMIU across North Sumatra Province and to assess their compliance with the quality standards set by the Ministry of Health Regulation (Permenkes) No. 02 of 2023 concerning Environmental Health Quality Standards (SBMKL). The research employed a descriptive observational method with a secondary data analysis approach using microbiological laboratory test results from the Public Health Laboratory Center on 55 water samples collected from 11 districts/cities in North Sumatra Province. The results showed that most refill water samples did not meet microbiological standards, as they contained T. Coliform and E. coli exceeding the maximum limit of 0 CFU/100 ml. The highest contamination levels were found in Medan Sunggal District, Medan Selayang District, and Mandailing Natal Regency, while Toba Regency and parts of Pematang siantar City showed compliant results. The findings indicate that the majority of DAMIU in North Sumatra Province have not met microbiological quality standards, with approximately 70% of samples testing positive for T. coliform and more than 40% containing E. coli. The presence of T. coliform and E. coli in refill drinking water poses a potential risk of waterborne diseases such as diarrhea, cholera, hepatitis A, and dysentery. Therefore, regular supervision and strict implementation of hygiene and sanitation

Keywords: Refill Drinking Water, Coliform, Escherichia Coli, Water Quality, Waterborne Diseases

Introduction

Water is a natural resource that is essential for human survival. In everyday life, humans need clean water to support household needs such as washing, cooking, and drinking. Refillable drinking water depots (DAMIU) are one solution to meeting the drinking water needs of Indonesians in an affordable and practical way. The affordability of refillable drinking water is a key reason why people choose it for consumption [1].

It is known that 70% of the human body is made up of fluids, so humans cannot survive more than 4 days without drinking water. Every day, humans need 1 to 2.5 liters of water, or the equivalent of 6-8 glasses, to meet their daily drinking water needs. DAMIU has become the choice of the lower-middle class as a means of meeting their drinking water needs [2].

The WHO estimates that in developed countries, each individual requires 60-120 liters of water per day, while in developing countries such as Indonesia, people generally need 30-60 liters of water per day. Data compiled by the Indonesian Ministry of Health in 2019 shows that 33.4 million people

throughout Indonesia are in a state of clean water shortage and 99.7 million Indonesians still have difficulty obtaining clean water [3].

Ministry of Health Regulation No. 02 of 2023 concerning Environmental Health Quality Standards states that every producer/provider/operator of drinking water or ready-to-eat processed food must ensure that the drinking water or ready-to-eat processed food produced meets the Environmental Health Quality Standards (SBMKL) and Health Requirements. This includes proper water treatment (such as filtration, disinfection with chlorination, and maintenance of the distribution pipe network) and the maximum permissible levels for total coliform and *E. coli* parameters in clean water and water used for hygiene and sanitation purposes is 0 CFU/100 ml.

This means that the presence of even a single colony of these bacteria indicates that the water does not meet the requirements (TMS) and is unfit for consumption or hygiene purposes [4].

Drinking water must meet several requirements, including physical, chemical, and microbiological requirements. Drinking water should be odorless, tasteless, and free of turbidity. Additionally, it must not contain any hazardous chemical compounds. Based on microbiological parameters, the maximum limit for the total number of *T. coliform* and *E. coli* bacteria required for drinking water and sanitation hygiene is 0 CFU/100 ml [5].

DAMIU is a business entity that manages drinking water to meet the needs of the community. The water is produced through a purification process using technologies such as ultraviolet (UV) light, ozonation, or a combination of both, as well as a filtration process to obtain clean water that is safe for consumption. However, the safety of drinking water from DAMIU is not always guaranteed because many depots do not meet the hygiene and sanitation standards as stipulated in Minister of Health Regulation No. 17 of 2024 concerning Risk-Based Licensing Standards for Businesses in the Health Sector. Poor hygiene and sanitation practices, improper handling of gallons, and lack of maintenance of sterilization equipment are the main causes of microbiological contamination such as *T. Coliform* and *E. coli*. In addition, weak supervision of DAMIU also causes the quality of drinking water produced to be inconsistent between depots. Several studies indicate that most DAMIUs do not comply with regulations on facility cleanliness, equipment, and hygienic practices, thereby increasing health risks for communities consuming water from these depots [6].

E. coli and *T. Coliform* bacteria are gram-negative rod-shaped bacteria that do not form spores and are part of the normal intestinal flora in humans and animals. These bacteria can be found in contaminated water from suboptimal drinking water treatment through filtration and disinfection, as well as during the packaging and rinsing processes of reused water containers [7].

Areas with low contamination levels generally have strong commitment from local governments in allocating budgets for sanitation infrastructure, sustainable community education programs, and functioning water quality monitoring systems [8].

The purpose of this study was to analyze *T. coliform* and *E. coli* bacterial contamination in several DAMIUs in 11 districts of North Sumatra Province through the Surveillance Program for Potential Health Risk Factors Related to Drinking Water Depots in North Sumatra Province, which was carried out by the Public Health Laboratory Center based on the activities under the responsibility and function of the Public Health Laboratory Center as regulated by Permeskes No. 25 of 2023 concerning the Organization and Work Procedures of Technical Implementation Units in the Field of Public Health Laboratories, with the content of its duties and functions being that the Medan Public Health Laboratory Center is responsible for the management of public health laboratories. The Public Health Laboratory Center in Medan conducts laboratory-based health surveillance and analyzes public health/environmental issues. Based on the results of the presentation, the researchers were interested in conducting research on *T. coliform* and *E. coli* bacterial contamination in Refillable Drinking Water Depots (DAMIU) in North Sumatra Province.

Method

This survey uses a descriptive observational method with a primary data analysis approach. The data used are the results of biological laboratory tests at the Medan Public Health Laboratory, which uses a membrane filter bacteriological testing device. Samples are examined using CCA (Chromogenic Coliform Agar) media, and then 100 ml of water samples are filtered. The results are based on the number of confirmed colonies counted on the membrane filter for *E. coli* and coliform bacteria in 100 ml of water samples. The results are based on the number of confirmed colonies counted on the membrane filter for coliform bacteria, which is the number of pink to red oxidase-negative colonies plus all dark blue to purple colonies and *E. coli* bacteria, which are dark blue to purple in color.

This survey was conducted in 11 districts in North Sumatra Province, with a total of 55 samples collected from 5 refillable drinking water depots at each location.

Results

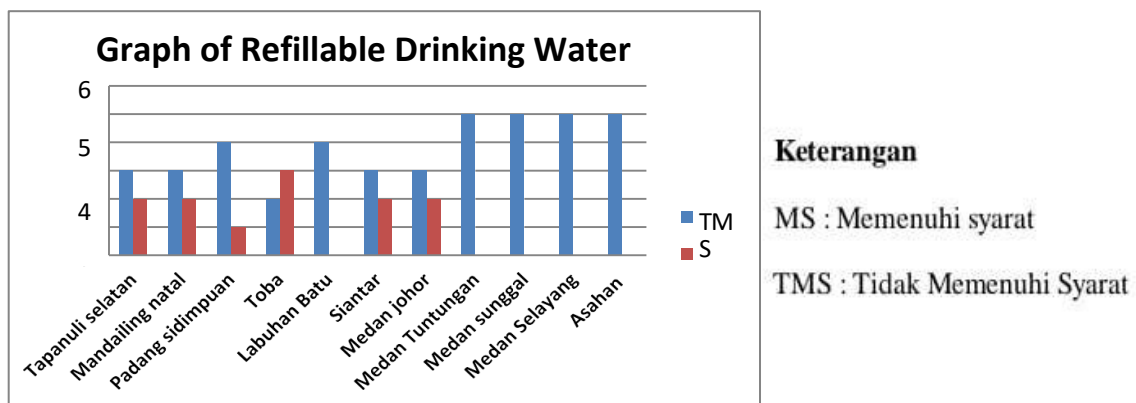


Figure 1. Graph of Analysis Results of Refillable Drinking Water Depot Samples in North Sumatra Province

Source: BLKM Medan Test Results Sheet

Based on laboratory analysis of 55 water samples from 11 districts/cities in North Sumatra Province, it was found that most refillable drinking water depots (DAMIU) did not meet the microbiological quality standards set by Minister of Health Regulation No. 17 of 2024, namely 0 CFU/100 ml for *T.coliform* and *Escherichia coli* parameters. Of all the samples tested, only a small portion met the requirements (MS), while the majority showed results that did not meet the requirements (TMS) due to high levels of coliform and *E. coli*.

The areas with the highest contamination levels included Medan Sunggal District, Medan Selayang District, and Mandailing Natal Regency, with *T.coliform* values reaching up to 180 CFU/100 ml and *E. coli* up to 50 CFU/100 ml. These conditions indicate strong evidence of fecal contamination, which is likely caused by unhygienic water treatment processes, poor hygiene of gallon containers, and poor sanitation quality in the vicinity of the depots. Meanwhile, areas such as Toba Regency, Labuhan Batu Regency, and parts of P.Siantar City showed test results that met the requirements with *T.coliform* and *E. coli* levels of 0 CFU/100 ml, indicating that the water management and sanitation systems in these areas are relatively better.

In general, of the 55 samples tested, approximately 70% showed contamination with *T. coliform*, and more than 40% were also detected to contain *E. coli*. The average *T. coliform* value in samples that did not meet the requirements was in the range of 30–120 CFU/100 ml, while *E. coli* was found in the

range of 1–50 CFU/100 ml. These data indicate that bacterial contamination is still quite high in most refillable drinking water depots in the North Sumatra region.

This condition reflects the weak implementation of hygiene in the refillable drinking water treatment process, starting from the filtration stage, disinfection, to the filling and storage of gallons. These results also reinforce the finding that routine monitoring of DAMIU is still suboptimal, so that the quality of water circulating in the community is not uniform and is not always safe for consumption. CFU/100 ml, which indicates that the water management and sanitation systems in the region are relatively better.

Discussion

The quality of drinking water sold to consumers must be fit for consumption, which means it must meet the requirements for drinking water that is fit for consumption, namely that it must be clean, healthy, hygienic, and also meet the health standards set by the government. Factors that affect the quality of drinking water include the source of drinking water, storage facilities, processing methods, public knowledge, and supervision by relevant agencies [9].

However, refillable drinking water products often do not comply with or meet the established health standards. Violations of these health standards result in refillable water that is unfit for consumption and causes health problems such as diarrhea [10].

DAMIU is one of the business activities that focuses on clean water to meet the drinking water needs of the community and also to meet the current lifestyle of the community, which prioritizes practicality and convenience in meeting their daily needs. Refillable drinking water is one-third cheaper than branded bottled water, so for this reason, people prefer to buy refillable drinking water [11].

Based on the results of water quality tests from various locations such as South Tapanuli Regency, Mandailing Natal Regency, Padangsidempuan Regency, Toba Regency, Labuhan Batu Regency, Siantar City, Medan Johor District, Medan Tuntungan District, Medan Sunggal District, Medan Selayang District, and Asahan District, it was found that most samples showed microbiological contamination, particularly by total coliform bacteria and *Escherichia coli* (*E. coli*). According to Minister of Health Regulation No. 02 of 2023 concerning Environmental Health Quality Standards (SBMKL), the maximum permissible level for total coliform and *E. coli* parameters in clean water and drinking water is 0 CFU/100 ml. This means that the presence of even one colony of these bacteria indicates that the water does not meet the requirements (TMS) or is not suitable for consumption.

Data analysis shows that areas such as South Tapanuli Regency, Mandailing Natal Regency, Padang Sidempuan Regency, Medan Tuntungan District, Medan Sunggal District, and Medan Selayang District have high levels of T. coliform and *E. coli*, reaching more than 100 CFU/100 ml at several points. This condition illustrates that several DAMIUs do not implement good sanitation hygiene in accordance with the standard of Minister of Health Regulation No. 02 of 2023 concerning Environmental Health Quality Standards (SBMKL), including proper water treatment (such as filtration, disinfection with chlorination, and maintenance of distribution pipe networks). Water contaminated with *E. coli* poses a risk of causing various waterborne diseases such as diarrhea, dysentery, cholera, typhoid, and hepatitis. Long-term exposure to water with poor microbiological quality can also increase the incidence of gastrointestinal infections, especially in children and the elderly who have lower immunity.

Meanwhile, several areas such as Labuhan Batu Regency, Toba Regency, and parts of Siantar City showed results that met the requirements (MS) because the coliform and *E. coli* levels were 0 CFU/100 ml. This indicates that water source management and sanitation in these areas are relatively good, both in terms of clean water supply systems and community behavior in maintaining

environmental hygiene. This achievement aligns with the provisions in Ministry of Health Regulation No. 17 of 2023.

Meanwhile, several areas such as Labuhan Batu Regency, Toba Regency, and parts of Siantar City showed results that met the requirements (MS) because the coliform and *E. coli* levels were 0 CFU/100 ml. This indicates that water source and sanitation management in these areas is relatively good, both in terms of clean water supply systems and community behavior in maintaining environmental hygiene. This achievement is in line with the provisions of Minister of Health Regulation No. 17 of 2024 concerning risk-based licensing standards for businesses in the health sector, which emphasizes the importance of implementing periodic water quality monitoring and controlling sources of pollution around infiltration areas and clean water distribution networks.

In general, these results indicate that water quality in several districts/cities in North Sumatra still does not consistently meet environmental health standards. This problem highlights the need to strengthen the monitoring system and raise public awareness of the importance of sanitation and hygienic behavior. Local governments and health agencies must ensure the implementation of Minister of Health Regulation No. 17 of 2024 concerning risk-based licensing standards for businesses in the health sector, including proper water management (such as filtration, disinfection with chlorination, and maintenance of distribution pipe networks) to prevent further microbiological contamination. Thus, the risk of disease transmission due to contaminated water can be reduced, and the quality of public health can be improved sustainably.

Conclusion

Based on data obtained from the Public Health Laboratory, the quality of drinking water depots in several areas of North Sumatra shows that most water samples do not meet the microbiological quality standards set by Minister of Health Regulation No. 02 of 2023 concerning Environmental Health Quality Standards (SBMKL). The total coliform and *E. coli* values in 11 districts in North Sumatra Province, with a total of 55 samples, exceeded the established quality standard of 0 CFU/100 ml, indicating fecal contamination of the water source. The presence of high levels of *E. coli* and coliform indicates that the sanitation system in several areas is still not optimal, as well as the possibility of domestic waste mixing with clean water sources. This condition increases the risk of waterborne diseases such as diarrhea, dysentery, cholera, typhoid, and hepatitis A, especially among communities that use this water for daily needs without adequate treatment.

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