

Bacteriological quality of drinking water and public health inspection of refill depots: finding workable strategies to control the quality

Ishak Nurlang^{1*}, Titik Nuryastuti², Mubasysyir Hasanbasri³

Abstract

Submitted:
September 6th, 2018

Published:
January 25th, 2020

¹ Public Health Program,
Universitas Mega Buana,
Palopo

² Microbiology Department,
Faculty of Medicine, Public
Health, and Nursing,
Universitas Gadjah Mada

³ Department of Biostatistics,
Epidemiology and Population
Health, Faculty of Medicine,
Public Health, and Nursing,
Universitas Gadjah Mada

*Corresponding author:
ishaknurlang90@gmail.com

Purpose: Water refill depots have increased in all areas of Indonesia. Many studies have reported concerns about the bacteriological quality of drinking water at refill depots. However, limited studies have focused on ensuring the safety and quality of drinking water in refill depot, particularly for small scale depots. This paper examines water microbiological quality at the refill depots and their depot production inspections from the local public health authority. **Method:** This survey used 60% of depots (47 out of 77 depots in the district) from April 4th to May 31st, 2016, in the North Luwu District of Central Sulawesi. Water samples were taken for E. coli and coliform examination. In-depth interviews were conducted with environmental health officers at the local health authority, depot owners, and workers. **Results:** Almost half of the total depots (49%) failed to meet the hygiene standard. Site observation found that depots were with poor sanitation and poor water handling. Depot owners found the cost of two times a year of the bacteriological examination was too expensive, including the transportation cost of water samples to the available closest laboratory in the provincial capital. **Conclusion:** Depots with non-standard bacteriological quality were still high. Supervision of the depot by the district health office was very loose. Efforts to advocate the district health office to take a more assertive position are critical. Community organizations and refill water depot associations should be involved so that public health interests get attention from the local government.

Keywords: drinking water depot; sanitation hygiene; quality of bacteriology; supervision; refilled-bottled water kiosks; refill drinking water depot

INTRODUCTION

Refill water gallon is a source of drinking water considered safer than well water people traditionally use, including in remote areas in various Indonesia regions [1]. Following safety standards, government responsibility ensures safety still receives little attention. This investigation focused on the operational production of the refill depots.

Important reasons are low water quality and behavior to prevent disease [2]. Residents who used

refill water feel more secure than from natural resources they can access [3]. However, refill water quality depends on the production process at the refilling site [4]. Indonesian literature that cares about many water depots is many [5–10]. A study on refill kiosks reported about how the government is managing the refill kiosks [11].

Contaminated drinking water is a significant contributor to the problem of diarrheal diseases in children throughout the world. Diarrhea has caused 1.7 million deaths, almost all in children in developing countries [12] [13]. In 2012, 2.5 million deaths per year

worldwide were due to diarrheas, for which water quality was tested based on the presence of *Escherichia Coli*, *Enterococci*, and *Somatic Coliphage* to detect and control infectious diseases due to drinking water. Only bacteria *Escherichia Coli*, which is suitable as an indicator of drinking water [14].

A high bacterial content occurs because of (1) contamination during processing (filtration and disinfection), (2) post-treatment pollution, (3) non-sterile gallon rinsing, and (4) operators' ignorance of hygiene and cleanliness [2]. Residents who have access to quality drinking water in South Sulawesi are 66.99%, and the percentage of quality of drinking water that meets the requirements is 76 out of 90 or 84.44% of water samples that meet the requirements [15].

METHOD

Based on the 2015 Luwu District Health Office inventory of Drinking Water Depot (DAM), out of 94 refill depots, 55% of them did meet the production criteria. Many depot owners in North Luwu have not reported results or laboratory tests of water produced. Of the 94 gallons of DAM (Drinking Water Depot) entrepreneurs registered, only two depots were active in regular reporting. Data for this analysis came from all the 47 countries with permits and got operational recommendations from the North Luwu District Health Office, collected from April 4th, 2016 to May 31st, 2016. Drinking water meets the requirements if there are no *Coliform* and *Escherichia coli* in the 100 ml water sample equal to 0 [16]. Information about the water depot includes sanitation hygiene, site quality, equipment quality, handler attitude, and the raw material, following the health department's guidance [17]. This study used one sanitarian from the local health authority to collect data through a checklist, took water samples, and packed them to send to laboratory bacteriological examination.

RESULTS

Table 1 shows that the water handling process for the refill depot is still poor. Loose inspection and regulation commitment to refill depots by the district health office can be seen in Table 2 (at the end of the paper). Depot owners did not do regular drinking water quality tests (at least six months), and no employees had the sanitation food handler and hygiene training course (Minister of Health Regulation No. 43 of 2014)

Table 1. Depot characteristic (n=47)

Variable	%
Bacteriological quality of water	
Qualified	51,06
Not qualified	48,94
Supervision management	
Qualified	27,66
Not qualified	72,34
Sanitary hygiene	
Qualified	65,96
Not qualified	34,04
Quality of place	
Qualified	46,81
Not qualified	53,19
Equipment quality	
Qualified	80,85
Not qualified	19,15
Workers criteria	
Qualified	40,43
Not qualified	59,57
Type of water source	
Boreholes wells ("sumur bor")	44,68
Piped water	36,17
Dug well ("sumur gali")	14,89
Water springs	4,26

Government inspection practice of a home-based small scale water filling depots

The Health Office has implemented two types of supervision: a) routine supervision, carried out by sanitarian personnel, b) periodic supervision, carried out by the health department. In 2013 the North Luwu health office and the DAMIU manager worked together to form a depot association. The initial goal of the owners' association was to conduct internal supervision at each depot. However, since depot association members had not carried out their duties, supervision did not occur as expected. Also, the absence of a Regional Regulation that regulates DAM supervision has resulted in the Health Office and the Licensing Service throwing responsibility towards licensing/closing DAM. The lack of effective implementation of supervisory management in drinking water depots impacts the bacteriological quality that is not good or affected bacteriological quality. Due to the lack of regulations on depot inspection, the absence of health laboratories and facilities for bacteriological testing in the district. Owners must send water samples to the Provincial Health Office Laboratory, not yet Special sanitarians trained to conduct DAM supervision, and there is no specific budget allocated for DAM supervision [4].

Table 3 shows that of the total 47 drinking water depots studied, it showed that sanitation of refill drinking water depots with eligible categories amounted to 31 depots or (65.96%) with qualified bacteriological qualities of 20 depots or (42.55%).) and 11 depots or (23.41%) were not qualified. While 34% (16 depots) were unqualified, four depots had

bacteriological standards, and 12 depots failed. Chi-square statistical test results have P-values of 0.010 are less than 0.05. There is a relationship between hygiene depots and the bacteriological quality of refill drinking water. Sanitation Hygiene is an effort to control the risk factors for contamination originating from places, equipment, and handlers to drinking water, so it is safe for consumption to ensure that the drinking water produced meets quality standards or quality requirements for drinking water [6].

Depot owners cannot meet some sanitary and hygiene standards. The Ministry of Health defines depots with a score of similar or above 70% as qualified or meeting the standard. Rosyani (2016) found a positive relationship between sanitation hygiene and *Escherichia coli* due to the lack of equipment cleanliness and depot owners' commitment to cleanliness [18].

Table 2. Bacteriological quality of refill water (n=47)

Variable	% Bacteriological qualified
Supervision management	
Qualified	21,27
Not qualified	29,79
Sanitary Hygiene	
Qualified	42,55
Not qualified	8,51
Quality of place	
Qualified	31,91
Not qualified	19,15
Equipment quality	
Qualified	48,93
Not qualified	2,13
Workers criteria	
Qualified	31,92
Not qualified	19,14
Type of water source	
Boreholes wells (sumur bor)	14,89
Piped water	27,66
Dug well ("sumur gali")	6,38
Water springs	2,13

From 47 depots, the raw water source for refill drinking water using PDAM was 19 depots or (40.43%) with qualified bacteriological quality seven depots or (14.89%) and ten depots or (21.28%) were not qualified, bore wells amounted to 21 depots or (44.68%) which 13 depots or (27.66%) were qualified and eight depots or (17.02 %) were not qualified. Among dug wells, seven depots or (8.51%) were qualified of 3 depots or (6.38%) and not meeting the requirements of 4 depots or (8.51%) and springs totaling two depots or (2.13%) with bacteriological quality fulfilling the health requirements of 1 depot or (2.13%) and not fulfilling the requirements as much as one depot or (2.13%).

Some of the pictures below provide an illustration of the situation in what the setting and operational activities of a refill depot are. For example, depot

locations were not free from pollution and disease transmission. Under such circumstances the process of bacteriological contamination of refill drinking water is very high. Floors that do not meet the requirements because there is stagnant water. Depot floors masih sederhana dan belum waterproof, flat, smooth, not slippery, not cracked, does not absorb dust, and is easy to clean, and the slope is sufficiently gentle to ease cleaning and no standing water.

District Health Monitoring of Drinking Water

The local health authority implemented a) routine supervision, carried out by the Puskesmas sanitarian, and b) periodic supervision by local health officials. In 2013 the North Luwu Health Office and the depot owners established the "depot owner association," the association was expected to conduct internal supervision at each depot. However, no inspection by the depot association did. The role of depot associations in internal supervision is to carry out sanitation hygiene checks, provide suggestions and conduct food and beverage sanitation hygiene courses. Local Health Office conducts supervision such as the depot data collection, fostering, and conducting a healthy depot.

Besides supervision, the Department of Health conducts guidance on depots to prevent violations in processing facilities such as hoses when filling gallons, replacement of small gallon filters at least three months and improving water quality not meeting the requirements. Follow-up of the violation problem results in the Health Office being able to withdraw the certificate until the depot manager makes the suggested repairs. One obstacle to the Health Office is no health laboratory available in the district to test for bacteriological quality. To bring water samples to the Center for Environmental Health and Disease Control (BTKLPP) in Makassar City cover a distance of 420 km.

Health authority tolerance towards the business

The Ministry of Health has a policy that local health authorities should check for drinking water quality in a depot every six months. However, in reality, the North Luwu Health Service tolerates periodic water quality testing carried out once a year considering the cost of an inspection is expensive., to issue a complete inspection of the quality of drinking water, depot managers must prepare a minimum of 1.1 million - 1.5 million per sample every six months with a gallon price of Rp. 4,000 per unit, depots must sell at least 275-375 gallons every six months just to cover water quality checks, and these costs do not include the cost of shipping water samples, maintenance, and replacement of tools.



Figure 1. Contaminated Depot Location: Depot locations were not free from pollution and disease transmission. Under such circumstances the process of bacteriological contamination of refill drinking water is very high.



Figure 2. Leakage in the Depot Faucet: the leakage in the depot faucet increases bacteriological contamination of drinking water, this is due to the water coming out of the mouth of the depot pipe becoming moist and allowing the growth of bacteria.



Figure 3. Floors that do not meet the requirements because there is stagnant water. Depot floors must be waterproof, flat, smooth, not slippery, not cracked, does not absorb dust, and is easy to clean, and the slope is sufficiently gentle to ease cleaning and no standing water.



Figure 4. Use of contaminated hoses (Left) and Brittle roof (Right): depots using contaminated hoses. Gallon filling chamber with fragile roof, which causes bacteriological contamination when loading gallons.



Figure 5. Contaminated Depot Places (Left) and Non-Contaminated (Right): conditions of depot sites contaminated by products such as, close to gas cylinders and gasoline. The picture to the right shows the condition of the drinking water depot that meets the sanitary hygiene requirements.



Figure 6. Condition of Gallons Not Eligible (Left) and Eligible (Right): the condition of gallons that are no longer suitable for use, the gallons have a leak which is then patched. The picture to the right shows gallons that are still worth using.



Figure 7. Depot Locations Not Eligible: building conditions are not strong and lighting is not bright enough.

Table 3. Percentage of 47 water refill depots that meet standards

Sections	Observation items	%
I General inspection	1. Water is tested for bacteriological quality in accordance with Kepmenkes Number: 492 / Menkes / PER / IV / 2010.	100
	2. Employers check the workers' health status at least every 6 months.	55.32
	3. Workers use work clothes equipped with business brands so that they are easily recognized and monitored.	2.13
II Human resources	1. Workers have taken food handler training	29.79
	2. Workers have training in simple laboratory testing of drinking water	29.79
	3. Workers have training in taking a water sample for lab examination	29.79
III Documentation of activities	1. Receipts of sales using the company brand	40.43
	2. Documentation of the arrival of raw water includes arrival time, the condition of raw water, and the name of the worker doing the job.	89.36
	3. Documentation of test results of drinking water and raw water	61.70
IV Availability of equipment	1. Any equipment is made from goods with food grade	100
	2. Microfilter and disinfection equipment still in use or not expired	85.11
	3. Raw water reservoirs must be covered and protected	85.11
	4. Gallon and containers should be cleaned before water filling.	100
	5. Containers filled with drinking water must be given directly to consumers and may not be stored in DAM for more than 1x24 hours.	91.49
	6. Regular backwashing when changing macro filter tubes.	100
	7. More than one microfilter (μ) with tiered size	100
	8. Sterilization equipment, in the form of ultraviolet and or ozonation and or other disinfection equipment that functions and used correctly	80.85
	9. Equipment for washing and rinsing bottles (gallons). Equipment fill water to bottle (gallons) in a closed room	97.87
	10. Clean bottle caps	80.85
V Building observation	1. The site location is free from pollution and disease transmission	55,32
	2. The building is strong, safe, easy to clean, and easy to maintain	72,34
	3. Water-resistant floor, flat surface, smooth, not slippery, no cracked, does not absorb dust, and is easy to clean, and has a reasonably gentle slope	76,60
	4. Walls are waterproof, flat surface, smooth, not slippery, not cracked, does not absorb dust, and is easy to clean, bright and bright colors	72,34
	5. Roofs and ceilings must be strong, anti-mouse, easy to clean, does not absorb dust, flat surface, and has a bright color, and has sufficient height	70,21
	6. Spatial consists of processing, storage, division/provision, and consumer waiting room	42,55
	7. Lighting is bright enough to work, not dazzling, and spread evenly	85,11
	8. Ventilation guarantees good circulation/air exchange	65,96
	9. Humidity can provide comfort in carrying out work/activities	95,75
	10. Bathroom and toilet are available	78,72
	11. Sewerage channels that run smooth and closed covered	48,94
	12. Waste bins are available	4,25
	13. Hand washing place equipped with running water and soap	65,96
	14. Free from mice, flies, and cockroaches	89,36
VI Water handler	1. Healthy and free from infectious diseases	80.85
	2. No carrier of germs	91.49
	3. Good hygiene and sanitation practices when serving consumers	76.60
	4. Always wash hands with soap and running water every time serving consumers	80.85
	5. Using clean and neat work clothes	44.68
	6. Conduct periodic health checks at least 1 (one) time in a year	72.34
	7. Operator / person in charge/owner has a certificate that has attended a drinking water depot sanitation training	2.13

Government function in water safety protection

There need to be concrete steps in implementing existing policies. There should be no tolerance, such as

irregularities in drinking water treatment facilities. Water inspections should be once a year.

Need for support from the consumer group. Consumers complained that there are larvae in drinking water, but there have never been reports to the health office. In developing countries, people tend not to report complaints because they did not want to deal with the bureaucracy. In many situations, they have to bring more detailed evidence before submitting a complaint. Also, consumers were not ready with the formal description used to submit complaints to the authorities.

Tolerance

Unlike in big cities, some of which have one door that makes law enforcement clear. Actors in more suburban areas are more tolerant and take non-existent action in getting permits. Refill water depot companies that do not get permission can run. Conversely, those trying to follow the rules experience many obstacles in implementing supervision required by the authorities. Because of limited funds in government agencies, the company has to provide a source from them to carry out supervision, which increasingly makes supervision more difficult because allowed officials can close their eyes if they get bribes.

DISCUSSION

Efforts to advocate the district health office to take a more assertive position are critical. Community organizations and refill water depot associations should be involved in promoting public health. This paper uses the perspective of public health regulation for residents with low public health awareness. Assuming that drinking water security is a human right, how does public health authority have the principle of strengthening their capacity to uphold security as a common interest in public health. Public health activists must continue to remind the public health authority to assume the role of public protection from potential health hazards with a measurable step-by-step strategy. Local governments should decide when depot owners make their preparation before they are ready to implement a rule.

As in developing countries, it will take everything for granted unless there is a big problem. We also see hazardous events as only in a local accident. We treat them as merely unexpected incidents; therefore no need to worry. Public health and prevention awareness is not a priority.

Evidence from this study shows weaknesses in surveillance systems efforts in small-scale industries. The percentage of refill depots with low bacteriological quality is still high, and the depots continue to operate even though supervisory officials find irregularities in the production process. The findings in poor practices

in production management without asking for direct repairs are insufficient. Depot owners pay little attention to risks people face. The supervisory body is considered only administrative. We should not take the situation lightly. District heads in the regions must be brave enough to work with the provincial government so that the availability of laboratories for supervision, such as water quality testing, can be more specific. If there is certainty about costs, certainty in terms of the length of the inspection process, certainty about security in sending samples, and actions for irregularities, then employers have a confident attitude to guarantee public security from their businesses. Uncertainty regarding government regulations in various businesses involving public interests must change. Employers would be likely to comply with the rule if the system is transparent.

Besides the safety of refill water considered by the population as a standard requirement, improving households' quality water sources remains essential. Local governments must take firm action against residents who dispose of household waste, which contaminates groundwater and pollutes drinking water sources. Law enforcers must take the right position. Depot owners can be tolerated for a certain period, but will receive strict sanctions if they do not follow after the tolerance period.

First, it is essential to emphasize that the phenomenon of bottled water or from this refill shows that clean water services by the government and sources of clean water near residents' dwellings are not workable [1]. Residents do not believe that the water supply around them meets the requirements, including drinking water provided manually in food stalls or restaurants. Especially if they live in slums where sanitation facilities are inferior [19,20], we should use a more holistic approach to building a clean water service system by the government [21][22]. The management model is still important to learn: it can be technological, but it might be a requirement in Indonesia [23]. As in developing countries, clean water management and its distribution have many weaknesses [24]. Also, in terms of water management for the public in many places in Indonesia [25].

Second, while awaiting strengthening institutions that manage public clean water, the government must regulate all residents' drinking water supplies to meet security requirements. Even though we often forgive us if we are loose on supervision, it must be even more of a concern for us that such practices institutionalize the omission of problems that bring the interests of many people's lives. Weak public health regulatory institutions are reflected in officers who feel unimportant, not supported by political commitment,

and public health support groups. This weakness occurs because of limited funds for institutions working in this sector [26] [27]. Apart from that, effective strategies in water supply surveillance need to be sought [26,28]. We must not focus only on the places of water taken for refilling but supervise other sources used by the public. We must pay attention to water sources for filling commercial drinking water, which people have to pay to get it.

Third, local health authorities should have regular training where employees who work in the refill water depots could take. Aside from this, the local government should enforce clean and sanitary practices. The officers should stop the operational permit if they violate safety and hygiene standards. Hand washing before carrying out work, checking health status every six months, use of formal work clothes were included in food handler courses. The building and the depot processing equipment's sanitation conditions were acceptable, but what needs to worry is the availability of handwashing facilities and equipment, where all depots did not provide them [27]. This finding is in line with a positive relationship between depot operator hygiene and the amount of coliform refilled water [28].

Fourth, on improving regulation and refill water supervision, the government should consider a flexible place for bacteriological water tests that reduce owners' costs for packing and expediting water samples. The health office and regional environmental health agency should find strategies to allow depot owners to be concerned about public health safety. If this is not the case, the company will easily dodge because it is incapable and therefore allow public safety not to oversee.

CONCLUSION

This paper points out that refill workers' practice did not meet the expected standard. The public health inspectors gave no sanctions on owners and workers' inability to meet the expected standards. The lack of effective control over the refill depots' quality and environmental health practices should be a primary concern of public health stakeholders, particularly the authoritative government agencies.

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