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Analysis of the Correlation between Infection Incidents Caused by E. Coli Contamination in Water and Community Behavior in RT 02/RW 11, Mata Air Village

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A B S T R A C T

Poor sanitation quality in the environment can be a source of various diseases because unclean water can cause health problems. There are various environmental health problems in Mata Air Village in Padang Selatan sub-district, Padang City, especially in RT 2/RW 1, these problems include people's latrine waste going directly into the river, not having a septic tank, and also many people still throw rubbish into the river. The method used to analyze the incidence of infection by Escherichia coli bacteria was through a problem identification process, Healthy Home Sanitation Inspection for 34 houses, water quality measurements for 10 houses. Based on the results of activities carried out in RT 02/RW 11, Mata Air Village, the average houses in RT 02 RW 11 are categorized as unhealthy. Conclusion: The problem is that almost all houses do not have septic tanks, so people's feces and waste water are channeled directly into the river, and on average people manage their waste by burning it at night. The water quality of 9 out of 10 houses that were sampled had a high risk of infection by Escherichia coli bacteria.

Keywords: Environmental quality, Sanitation, Escherichia coli.

Introduction

According to UU Number 32 of 2009, the living environment is a combination of all spaces and their contents such as objects, conditions, power, and all forms of living creatures, including humans and their actions, which influence the life and welfare of humans and other living creatures. Health conditions in the physical environment are greatly influenced by the level of sanitation in human residences. Poor sanitation quality in the environment can be a source of various diseases because unclean water can cause health problems. The availability of clean water in an area greatly influences health because water is a basic need for humans involved in daily activities. Sanitation includes providing good household water, sufficient quality and quantity, regulating the use of family latrines, garbage disposal, waste water disposal, building healthy homes, and eradicating disease-spreading animals such as flies, mosquitoes, fleas, and other diseases. Poor sanitation will cause various problems due to the emergence of bacteria and viruses which will affect health. One of the bacteria that arises from poor sanitation is Escherichia coli. In general, Escherichia coli is known to occur normally in the digestive tract of humans and animals. Its presence outside the human body is an indicator of the sanitation of food and drink whether it has been contaminated by human waste or not. The presence of Escherichia coli in water or food is also considered to have a high correlation with the discovery of disease germs (pathogens) in food. (Rahwan Ahmad, 2017)

In the United States, bacterial foodborne illnesses cause morbidity from 6.5 to 33 million cases and 9,000 deaths each year. Escherichia coli infection is the most commonly reported infection. In 2010 there were 8,256 cases of infection (17.6 illnesses per 100,000 people) and had the largest number of hospitalizations with 2,290 cases and 29 deaths. The incidence of Escherichia coli infections in 2010 was not significantly different than during 1996-1998 but was significantly higher than in 2006 – 2008. (Rahwan Ahmad, 2017)

Health problems are complex issues, interrelated with various problems outside the health sector itself. Likewise, efforts to resolve public health problems are not only related to health aspects alone, but also involve factors that influence these health problems from various angles. The factors that most influence health problems in humans are the environment and behavior. Health behavior is a response (organism) to stimuli or objects related to illness and disease, the health service system, food and drink, and the environment. Bad public behavior can have a direct impact on health. As happened in RT 02/ RW 11, Mata Air Village.

Mata Air Village is one of the sub-districts in South Padang sub-district, Padang City, West Sumatra. The health of the residential environment is still a problem in various RT/RW in this sub-district, especially in RT 2/RW 11. Various problems include people's toilet waste going directly into the river, not having a septic tank, and also many people still throwing rubbish into the river. Based on the explanation above, researchers will carry out an analysis regarding the probability of infection from the level of water pollution by Eschericia coli bacteria on the behavior of the community in RT 02/ RW 11, Mata Air Village.

Methodology

The first activity carried out to analyze the relationship between the incidence of infection from the level of water pollution by Escherichia coli bacteria and community behavior is the problem identification process. Identification was carried out through brainstorming with the Head of Mata Air Subdistrict, Head of Community Health Center and Environmental Health staff at Rawang Community Health Center. Secondly, a Residential Sanitation Inspection was carried out using the Healthy Home Sanitation Inspection questionnaire, which was given to 34 houses in RT 02/RW 11, Mata Air Village. The three water quality measurements were carried out on 10 houses that had undergone healthy house sanitation inspections, with 5 clean water samples, 5 refill drinking water samples and 5 boiled drinking water samples. Next, E. coli and coliform testing was carried out at the Andalas University Environmental Engineering Laboratory. The final stage, namely conducting outreach using material lecture methods, interactive discussions, and showing interesting educational videos in the middle of the event. Before and after counseling, a pre-test and post-test were carried out.

Result

The activities were carried out in RT 02 RW 11 Mata Air Subdistrict with a total of 34 houses and 38 heads of families. The location selection was carried out based on brainstorming with the Head of Mata Air Subdistrict, Head of Rawang Community Health Center, Head of RW 11, and Head of RT 02. The activities carried out were:

Residential Sanitation Inspection

Residential sanitation inspection, which is based on the technical guidelines for healthy home assessment of the Ministry of Health of the Republic of Indonesia. The house components assessed are ceilings, walls, floors, bedroom windows, living room windows, ventilation, kitchen smoke holes, lighting, clean water facilities, drinking water, latrines, waste water disposal facilities, rubbish disposal facilities, as well as community behavior such as opening bedroom windows, opening family windows, cleaning the house and yard, throwing baby and toddler feces into the latrine, and throwing rubbish in the trash. The method we use for the assessment results is the value multiplied by the weight then for the criteria for a healthy house, namely with a value of more than 1143 and an unhealthy house less than 1443. Based on the results of the inspection that has been carried out, the average house in the RT 02 RW 11 community is in the unhealthy category. healthy because the assessment criteria are below the value 1143.

Water Quality Measurement

Regulation of the Minister of Health of the Republic of Indonesia Number 907/MENKES/SK/VII/2002 concerning Requirements and Supervision of Drinking Water Quality stipulates that the level of E. coli in water is 0 per 100 milliliters (ml) of water and must be met. In the 10 houses that were inspected, 15 water samples were taken consisting of 5 refill drinking water samples, 5 clean water samples and 5 boiled drinking water samples. After the samples were checked, the refill drinking water contained total E. coli (range 0-460 with an average of 124.6) and Coliforms (range 28-1,100 with an average of 514.2), clean water contained total E. coli (range 0-1,100 with an average of 668.6) and Coliform (range 0-1,100 with an average of 880), boiled drinking water contained total E. coli (range 0-1,100 with an average of 223.76) and Coliform (range 0-1,100 with an average of 452.4). It is known that 9 out of 10 houses whose water samples have been taken are contaminated by E. coli and Coliform bacteria.

Table 1 - Results of Quantitative Microbial Risk Assessment (QMRA) Analysis

Water Sources	Consumption Vol (L)	Average Number of E. Coli	Probability of Infection	Risk Category
Boiled Drinking Water	2	223,76	9.25219×10^{-7}	High
Refill Drinking Water	2	124,6	5.15206×10^{-7}	High
Clean Water	60	668,6	8.29147×10^{-5}	Low

From existing data, in general the average consumption of drinking water for household members is 2 liters per day and 60 liters per day for clean water. From the table above, it is known that household members of the RT02/RW11 Mata Air Village community consume an average of 348.36 million E. coli bacteria per person every day through water. The probability of infection from E. coli contamination was measured using the beta-Poisson model by combining the average dose value that causes infection and the average E. coli bacteria into a dose-response analysis formula. The results obtained show that the possibility of E. coli infection in boiled drinking water and refilled drinking water is much higher than in clean water. Apart from that, in the risk category that has been measured using the DALY (Disability Adjusted Life Year) provisions contained in the WHO guidelines, values that have a result of > 10-6 are declared to be at high risk, such as the results of measuring boiled drinking water and refill drinking water, as well as values that those with a result < 10-6 are declared to be at low risk, such as the results of measuring the clean water of the RT02/RW11 community in Mata Air Village.

Discussion

Residential Sanitation Inspection

A healthy house is a building or place to take shelter and rest, as well as a means of fostering a family that fosters a healthy life physically, mentally and socially, so that all family members can work productively. Therefore, the existence of healthy, safe, harmonious, orderly housing is very necessary so that the function and use of the house can be fulfilled properly. If the housing environment is not paid attention to, it can facilitate the transmission and spread of disease (Fajar Wibisono and Khairul Huda, 2014).An unhealthy home is the cause of a low level of physical and mental health which makes it

easier to contract disease and reduces a person's working capacity or productive power. This unhealthy house can become a reservoir of disease for the entire environment, if unhealthy conditions are not only in one house but in a group of houses (residential environment). The emergence of health problems in residential environments is basically caused by the low level of economic capacity of the community, because houses are built based on the financial capabilities of their residents (Notoadmojo, 2010).

a) Ceiling

The ceiling must be able to withstand the flow of hot air in the roof cavity due to solar heat received on the roof covering, directly into the space below. Almost all houses in the RT 02/RW 11 Mata Air sub-district have ceilings made of planks or tarpaulin which are difficult to clean and prone to accidents. If the ceiling is made of boards or tarpaulin, if it is not cleaned regularly it can accumulate dust which can harm the health of the occupants, especially in terms of breathing.

b) Wall

The walls must be able to withstand natural disturbances such as strong winds, rain and heat, so as not to disturb the occupants' activities in the room, the walls must also be watertight, so that they do not cause the room to become damp. On average, houses in the RT 02/RW 11 Mata Air Village settlement have semi-permanent walls or half walls and boards that are not watertight. Basically, semi-permanent walls are not good for use in houses with tropical geographic conditions, because this type of semi-permanent wall is less sturdy, not soundproof and not watertight.

c) Floor

The requirements for a healthy house are floors that are not dusty in the dry season and not wet in the rainy season. A good floor is a floor that is dry and not damp (Dewanti et al., 2018). The floor material must be waterproof and easy to clean, at least it needs to be plastered and it would be better if it is covered with tiles or ceramics which are easy to clean. Almost all houses in the RT 02/RW 11 residential area, Mata Air Village, have plastered floors but do not use tiles or ceramics. The type of floor in a residential house also has a significant relationship with the incidence of diarrhea in children under five. This is seen from the type of base or base material of the bottom covering, assessed in terms of material and water resistance (Djasio Sanropie, 1989).

d) Window

The main function of windows is to let in natural light and circulate natural air when needed into the room. Almost all houses in RT 02/RW 11 Mata Air Village have windows located in the living room and bedroom. However, many people in RT 02/RW 11 Mata Air Subdistrict have dead windows or permanent windows that cannot be opened, making it difficult to exchange air inside the house. Many people also have window glass that tends to be dark, making it difficult for light to enter the house.

e) Ventilation

Home ventilation has many functions. Its main function is to maintain air flow exchange in the house so that it remains fresh and optimal. Good ventilation measures 10% to 20% of the floor area. Most houses in RT 02/RW 11 Mata Air Village have permanent ventilation holes < 10% of the floor area. Lack of ventilation in the house will cause a lack of O2 in the house, which means that toxic CO2 levels will increase.

f) Lighting

A healthy house requires sufficient lighting and not too much. Light can be classified into two, namely: natural light which comes from sunlight and artificial light which comes from lamps. Sunlight is very important because it can kill pathogenic bacteria in the house. On average, houses in RT 02/RW 11 Mata Air Subdistrict have natural lighting conditions that are not bright enough so that it is not clear enough for normal reading. Lack of light entering the house will cause the growth of several bacteria, because in this case insufficient lighting will be an excellent medium for the growth of these bacteria, especially pathogenic bacteria. And it will cause several health problems or diseases.

g) Latrine (Means of Disposal of Feces)

Faecal disposal facilities are an important part of environmental health. Requirements for waste disposal that meet health regulations are: (1) not polluting the surrounding land surface; (2) does not pollute the surrounding surface water; (3) does not pollute the water in the surrounding ground; (4) feces must not be exposed so that it can be used as a place for flies to lay their eggs or for the breeding of other disease vectors; (5) does not cause odor; (6) cheap to manufacture; (7) easy to use and maintain (Notoadmojo, 2010). All houses in the RT 02/RW 11 Mata Air Village settlement have latrines, but the latrines do not have lids and do not have septic tanks, so the waste/feces are channeled directly into the river. Disposal of feces that is not in accordance with healthy home regulations will facilitate the development of disease germs, the spread of disease, and transmission diseases through feces include diarrheal diseases.

h) Waste Water Disposal Facilities (SPAL)

Waste water is the remaining water that is disposed of from household waste. In general, they contain ingredients or substances that can endanger human health and pollute the environment. On average, houses in the RT 02/RW 11 Mata Air sub-district do not have waste water disposal facilities, usually waste water from people's houses is channeled directly into the river. The absence of waste water disposal facilities can endanger the health of residents and the environment because waste water does not seep into the ditches, thereby polluting water sources and the surrounding environment.

i) Waste Disposal Facilities/Trash Bins

Good waste management is by collecting it and then transporting it. Waste collection is the responsibility of each household which in this case produces waste. Next, it will be destroyed. Almost all houses in RT 02/RW 11 Mata Air Subdistrict do not have rubbish bins, people usually collect household waste in plastic bags, then collect it in the front gardens of each resident's house, and will destroy it by burning it at night. Garbage that is left to pile up all day has a high potential to become a breeding ground for various kinds of disease vectors such as mosquitoes, cockroaches, mice, and others. The method of destroying waste by burning can also endanger residents because the smoke produced can enter the house and disturb the comfort and health of the residents of the house.

Water Quality Measurement

The human body consists of 70% water, therefore in life activities humans really need water. Every human being needs water between 60 liters and 200 liters per day, depending on the daily activities they carry out. The main human activities that require water are for drinking, cooking and washing (body, clothes, kitchen utensils and eating utensils). Clean water sources can come from clean water supply companies such as PDAM, independent clean water providers managed by individuals or communities independently (PAM-BM), or from springs and/or wells. Water used daily such as drinking, cooking, bathing and other water must be clean so that we can avoid diseases caused by poor water quality. By using clean water we can avoid diseases such as diarrhea, cholera, dysentery, typhoid, worms, skin diseases and poisoning. (Kementrian Kesehatan Direktorat Promosi Kesehatan dan Pemberdayaan Masyarakat., 2020)

In the Minister of Health Regulation No. 32 of 2017, it is stated that what is meant by water is the Environmental Health Quality Standard for Water media for Sanitation Hygiene Purposes including physical, biological and chemical parameters which can be mandatory parameters and additional parameters for Water for Sanitation Hygiene Purposes. used to maintain personal hygiene such as bathing and brushing teeth, as well as for washing food, eating utensils and clothing. Apart from that, water for hygiene, sanitation purposes can be used as raw drinking water.

Water quality can be viewed from a physical, chemical and bacteriological perspective. According to the Republic of Indonesia Minister of Health Regulation No.492/Menkes/Per/IV/2010, the physical requirements are that drinking water is odorless, tasteless, colorless and not cloudy. Bacteriological requirements for drinking water must not contain bacteria, while chemically the water must not contain toxic chemical compounds and each substance dissolved in water has certain permissible limits.

The water used for daily needs should be water that meets the criteria for clean water. Clean water is water that can be used for daily needs whose quality meets health requirements and can be drunk if it has been cooked. Meanwhile, what is called drinking water is water that has gone through a processing process or stages of the processing process that meets health requirements and is immediately drunk.

- Escherichia Coli

Escherichia coli is a type of coliform bacteria belonging to the Enterobacteriaceae family. Escherichia coli is also an indicator bacteria for drinking water quality because its presence in water indicates that the water is contaminated by feces, which may also contain other pathogenic enteric microorganisms. E. coli bacteria in water are generally non-pathogenic E. coli but sometimes pathogenic strains such as enterotoxigenic and E. coli which produce shiga-toxin (Enterohemorrhagic) are also found (Rahayu et al., 2018).

According to Pelczar and Chan (1986), E. coli bacteria are the bacteria most widely used as sanitation indicators because this bacteria is a commensal bacteria in the human intestine, generally is a disease-causing pathogen and is relatively resistant to living in water so that its presence in the water can be analyzed. actually not an ideal medium for bacterial growth. E. coli can be spread through water contaminated with feces or urine of people suffering from digestive infections, so it can be transmitted to other people. E. coli comes out of the body with feces in large quantities and can last for several weeks. The survival and replication of E. coli in the environment forms coliforms. E. coli is not resistant to dry conditions or ordinary disinfectants. These bacteria will die at a temperature of 600˚C for 30 minutes.

Conclusion

Based on the results of the activities carried out in RT 02/RW 11, Mata Air Village, it can be concluded that:

- The average house inhabited by the community is included in the category of unhealthy houses. The problem that is generally found is that almost all houses do not have septic tanks so that feces are channeled directly into the river, waste water from people's houses is directly channeled into the river, and on average the community manages waste by burning it at night.
- In measuring water quality, it was discovered that 9 out of 10 houses whose water samples had been taken were contaminated by E. coli and Coliform bacteria.

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