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Exposure of Pregnant Women by E-Coli Bacteria Due to Ground Water Pollution

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Abstract. At present there has been pollution of groundwater in Yogyakarta city by E-Coli bacteria due to domestic waste pollution of human feces. It was indicated that 90% of pregnant women were sick with urinary tract infections due to E-Coli bacteria. This research would like to find a relationship between pregnant women who get urinary tract infections and groundwater pollution. The method in this research was observational analytic with Cohort approach and laboratory analysis. The results of this research indicated the initial potential for exposure of pregnant women by E-Coli bacteria is when using well water. From 92 samples of well water, 51 well water of pregnant women were contaminated with E-Coli bacteria. Thus it can be concluded while that there has been exposure of pregnant women by E-Coli bacteria as a result of the use of well water. From this condition, it is possible for the danger of the effects of the risk factors that the pregnant woman suffers from a urinary tract infection.

INTRODUCTION

Groundwater is an important natural resource for human because it's easy to find and has good quality. Therefore, people often collect groundwater from wells for their daily needs (Suprihanto, 2005).

Well water is a part of the groundwater system. Groundwater is a hydrological system which serves as one of the chain links which acts as reservoir, which then is slowly released to river or lake, so that the continuity of the flow is maintained. Meanwhile, the water source flows into aquifer in a groundwater basin. Here, groundwater also receives addition from rainwater (recharge), aquifer (media where water is present), groundwater flow, and seepage and/or additional water input (from river, gutter, dam, river) from the environment (domestic and non-domestic wastewater). Inputs from rainwater, aquifer, seepage, and additional water input from the environment determine the quality of groundwater. Water quality covers 3 characteristics, i.e. physical, chemical, and biological. Physical characteristics which affect water quality were overall solids, whether floating or dissolved, turbidity, color, scent, and water temperature. The chemical characteristics of water include pH, alkalinity, cation and dissolved anion and hardness. The biological characteristics of water were based on the types of organisms living in the water, including macroscopic, microscopic, and bacteria (Suripin, 2004).

Ground as a place where water is present in soil (aquifer) is also a media of wastewater disposal, including domestic wastewater. The main domestic wastewater is from lavatory, i.e. human feces which is directly absorbed or goes through septic tank. Water movement (domestic waste) in the ground (percolation) from the effluent of septic tank can pollute people's well water. Pollutants which enter well water depend on the contaminant/pollutant (in this case, human feces in septic tank). Ground and groundwater naturally contain microorganisms. However, microorganisms which endanger human should receive attention. In domestic wastewater, the amount of bacteria is

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approximately 1-38 x 106 / m2. Among bacteria from domestic waste in the form of human feces, there is Escherichia Coli or E-Coli (Suprihanto, 2005).

Groundwater qualities in different areas may be different. Groundwater quality varies due to inputs from domestic and non-domestic wastewaters. The present study focuses on the effects of domestic wastewater. The main sources of domestic wastewater are residential area, commercial area, offices, and recreation areas (Setyono, 2008).

Yogyakarta is a major city with a population of 413,936 and population density of 12,736 people/km2 in 2014. The groundwater system in Yogyakarta is Yogyakarta groundwater basin (CAT), which covers the administrative areas of Sleman Regency, Yogyakarta City, and Bantul Regency.

The quantity of groundwater discharge of well water in Yogyakarta can fulfill domestic needs, but not all well waters qualify as clean water. Based on the data of the Department of Health of Yogyakarta in 2014 and 2015, over 40% of well water didn't quality as clean water because the total coliform content exceeded the required quality standard (consistent with the Regulation of the Minister of Health of RI No. 416 of 1990 and Regulation of the Minister of Health No. 32 of 2017).

Well water contains total coliform microorganisms, including fecal coli and in fecal coli, there are E-coli which can cause sickness in human. This study focuses on the impacts of well water contaminated by E-Coli on the health of pregnant women. Pregnant women were selected due to physiological vulnerability which makes it easy for them to get sick.

In this case, pregnant women used well water contaminated by E-Coli to clean their genitals. Because of this, pregnant women may be infected by E-Coli in the well water through their genitals. E-Coli in their genitals colonize, then moves into urinary tracts and infect them. It may cause urinary tract infection (ISK) among pregnant women.

Jannah's study in 2011 states that many pregnant women have ISK ad 15% of women will have ISK in their lives. Due to anatomical structure and hormonal changes, pregnant women have a greater risk of ISK. ISK may be caused by E-Coli. E-Coli is the most commonly found microorganism in the urine culture of pregnant women, causing 80% to 90% of urinary tract infections. According to Dwiana's study in, the prevalence of pregnant women with urinary tract infection (ISK) is 10%.

Generally, ISK can be caused by virus, fungi, or bacterium. A bacterium which commonly causes ISK is E-Coli. This study aims to find pregnant women with ISK caused by E.Coli due to using well water contaminated by E-Coli.

The formulations of the problems of this study were: Whether there was E-Coli contamination in the well water of pregnant women. And the purposes of this study were: Finding E-Coli contamination in the well water of pregnant women.

LITERATURE REVIEW

This literature review contains theories and previous research results which are related to the research problems. The research problems were related with groundwater, pollutant source, pollutant source bacterium, E-Coli test on contaminated water source, E-Coli in ISK in pregnant women, and the process of ISK in pregnant women.

Groundwater and E-Coli i Well Water

Water, with chemical formula H2O, is an important substance or material for all lives on earth. With water, the earth is the only planet in the solar system which has lived. Human and all living organisms require water. Water could be liquid, solid (ice) and gas (Kodoatie, 2012).

Generally, total water volume on earth is 1,385,984,610 Km3. The water consists of seawater (96.54%), freshwater (2.53%), saltwater outside of seawater (0.93%), and others (freshwater + saltwater) (3.46%). Some of the freshwater is groundwater (Kodoatie, 2012). According to Desapta (2015), groundwater is defined as water below the ground level in water saturated zone, bordered below by waterproof layer and above by groundwater surface. The main source of groundwater is rainwater which seeps into the ground in a hydrological cycle. Hydrological cycle is the journey of water from sea to air, river, lake, seeps into the ground, and back to the sea through various processes, stages, and transformations. The important stages of the hydrological cycle are evaporation, precipitation, run off, and infiltration. Rainwater which seeps into the ground will be groundwater (Setyawan, 2010).

There are regions with high groundwater potential, but there are also regions with low groundwater potential. The groundwater potential of a region depends on rainfall, vegetation coverage, degree of porosity and rock permeability. Groundwater is found in various geological formations, especially aquifer (Setyawan, 2010).

A study by Huyen et al. (2007) states that the materials of the aquifer system in Yogyakarta are in the sedimentation of Merapi volcano with medium quartz sand type. The rock type forms porous aquifer which has great potential for storing groundwater. Groundwater flows following earth gravity. Because the northern area is higher than the southern area, generally, the groundwater flows from north to south. The contaminant also tends to follow the direction of groundwater flow (Huyen, 2007).

Groundwater flows in general in Yogyakarta – Sleman CAT follows the topography of the slope of Mt Merapi, from Sleman Regency which is north of Yogyakarta (highest), then Yogyakarta (middle), and the lowest in Bantul Regency south of Yogyakarta or the shore of southern sea. The slope or groundwater surface elevation gets lower further to the south (Heru, 2011).

According to Heru Hendrayana (2011), Yogyakarta is in Yogyakarta-Sleman Groundwater Basin (CAT) which covers the slope of Mt Merapi which includes Sleman Regency in the north, Yogyakarta in the middle, and Bantul Regency in the south. Grounwater basin is a region bordered by hydrological borders were all hydrological events, such as affixation, drainage, release of groundwater, take place.

The configuration of the aquifer system in Yogyakarta-Sleman CAT can be differentiated into 2 (two), i.e.: unconfined aquifer (upper) and semi-unconfined/semi-confined aquifer (lower). The thickness of unconfined aquifer in Yogyakarta is 15-40 meters. Unconfined aquifer is often used by people through shallow wells or dug wells. Meanwhile, the thickness of semi-confined aquifer is 40-120 meters and it's often used through deep wells or bore wells (Heru, 2011).

Groundwater utilization in Yogyakarta is predominantly for households. The volume of utilization is 20,129,560,200 liters annually. A small amount is used for non-household needs with a volume of 1,891,628, 016 liters annually. The level of groundwater utilization in Yogyakarta is still low, i.e. the dynamic comparison between groundwater utilization and reserve is less than 10% (Heru, 2011).

Shallow groundwater is collected by most people through shallow wells or dug wells. The well water isn't entirely qualified as clean water. The criterion for clean water according to the Regulation of the Minister of Health of RI No. 416 of 1990, specifically related with microbiological parameter, is maximum allowed total coliform for non-pipe water source is 50 MPN/100 ml. The parameter of total coliform could consist of various types of bacteria, including E-Coli. The bacteria can come from organic waste, animal feces, domestic waste, and human feces. The main source of E-Coli is human feces. So, shallow well water may contain E-Coli due to domestic waste pollution.

Groundwater Pollution

Although it's renewable natural resources, the production of groundwater takes a long time, up to decades. If the quality and quantity of groundwater are damage, the recovery takes a long time, high cost, and complicated technology (Kodoatie, 2010).

Contaminant can be categorized into 4, i.e.: organic, inorganic, radioactive, and microorganism contaminants. The discussion in the present study focuses on microorganism pollutant, especially E-Coli from human feces and from septic tanks which are imperfect and close to dug wells and/or other sources.

Ground and groundwater naturally contain microorganisms. However, microorganisms which can endanger human should receive close attention. In domestic waste water, there are approximately 1-38 x 106/m2 of bacteria. Among bacteria from human feces, there is E-Coli (Suprihanto, 2005). In Yogyakarta, the well water is indicated to contain E-Coli higher than the normal threshold. To be consumed, the well water must be boiled first so that it's safe for human health (Hastari, 2000).

According to the Regulation of the Minister of Health of RI No. 416 of 1990, public well water is categorized as clean water if the maximum total coliform microorganism content is 50 MPN/100 ml. Fecal Coli microorganism is a part of total coliform. Therefore, if the total coliform content of well water exceeds 50 MPN/100 ml, then it's polluted.

Urinary Tract Infection (UTI) on Pregnant Women.

A disease occurs due to the interaction of several factors from agent, host, or environment. This opinion has been depicted in the recently well-known terms, which is multiple causations of disease. It is described in epidemiologic triangle consisting of agent factor (as a cause of disease), host (human), and environment (physical, biological, and social environments). Based on epidemiological model, it can be concluded that the environmental factor has an important role in determining the occurrence of disease. Environmental factors can be in the form of the causality of well water contaminated with E-Coli bacteria (Notoatmodjo, 2011).

Urinary Tract Infection (UTI) is a common term to describe microbial colonization in the urine and urinary tract from the urethra to the kidney. UTI is commonly found in neonatal to geriatric ages. Clinical steps of UTI syndrome is various, started from the step without symptoms/asymptomatic to the occurrence of symptoms/symptomatic (Tjokoprawiro, 2015).

To conduct a diagnosis on UTI, it is necessary to have data consisting of signs and clinical symptoms and supporting examination in the form of laboratory and radiology examination (radiology examination does not really have an initial role for most of UTI patients). Sign and clinical symptoms are obtained from physical examination and questions. Meanwhile, laboratory examination is conducted through urine culture (Tjokoprawiro, 2015).

It can be said that diagnosis of UTI is conducted by proving that there is microorganism inside the urinary tract. Signs and symptoms of UTI are not complete, or even do not exist. If the symptoms do not exist, but the bacteria are there, it can be called as bacteria without symptoms/asymptomatic (Sidabutar, 1988).

Women are more risky to suffer from UTI because they have shorter urethra which is anatomically located near vagina and anus. The number of women suffering from UTI is 50 times more than the number of men. Furthermore, one out of five women suffers from UTI (Suharyanto, 2008).

Signs and symptoms of UTI are various. Half of the clients who are infected by bacteria in their urine do not show any symptoms, or it can be called as asymptomatic. Moreover, it is necessary to conduct urine culture to find out the infection criteria (Suharyanto, 2008).

To conduct the diagnosis of UTI, it needs to find bacteria with significant amount in the urine through culture. The significant level of the number of bacteria in the urine is higher than 100,000 MPN/100 ml or urine. In UTI patients with symptoms or called symptomatic, the amount of bacteria is said to be significant if it is more than 1000 MPN.100 ml of urine. The infectious agent commonly found (about 85%) is E-Coli (Israr, 2009).

In the genitals of pregnant women (vagina), there is lactobacillus species, which is dominant, and other bacteria in lower amount, in normal condition. If the level of pH of vagina in normal condition is <4.5, then in certain condition, the level of pH becomes >4.5, meaning that the acidic condition of the vagina is not normal, and it is possible that other bacteria grow inside (Sulliva, 2009).

During pregnancy, personal hygiene of the mother must be paid attention due to her changing body system. The increasing size of the uterus (womb) presses bladder, which makes the mother want to urinate more often. Due to the increasing frequency of urinating, the mother will be more susceptible to get infected. The infectious disease comes from the wrong way of washing vagina using water, or the water has been contaminated by bacteria (E-Coli).

The correlation between E-Coli Bacteria in Well Water and Urinary Tract Infection (UTI) on Pregnant Women

Well water contaminated with E-Coli bacteria will cause disease if it is consumed directly. Pregnant women (who is more easily infected) who use well water which has been contaminated by E-Coli bacteria to wash their vagina may be easily got infected by E-Coli bacteria that goes into and lives inside the vagina. After that, the E-Coli bacteria in the vagina can go up or ascend and infect the urinary tract of the pregnant women (Samuel, 2006).

RESEARCH METHOD

The research was performed in Yogyakarta, Special Region of Yogyakarta. Special Region of Yogyakarta is a province-level special region with Yogyakarta as the capital city. The target research location or research subjects

was pregnant women who joined antenatal program in public health centers of Yogyakarta and well water used by pregnant women who were sampled.

The present study was design to prove environmental pollution, in this case well water, which was polluted by domestic waste of human waste, especially E-Coli, and had the negative effect of UTI among pregnant women.

The research design was observational analytic with cohort approach and laboratory analysis. In cohort approach, qualified sample was determined and selected to be research target. Sample was determined by selecting those that met inclusion and exclusion criteria and making sure that the samples (in this case pregnant women) was healthy or didn't have UTI. Once the pregnant women samples were found, well water samples were collected. Well water samples were well water contaminated by E-Coli (risk factor) and well water not contaminated by E-Coli. After a certain period, another examination was performed to see the effect of the risk factor on pregnant women to know whether any of them had UTI. Then, the relation between well water contaminated by E-Coli and UTI of pregnant women due to E-Coli was analyzed (Dahlan, 2012).

Population: Target population in the present study was all pregnant women who joined antenatal program in public health centers of Yogyakarta. The **accessible population** was all pregnant women who joined antenatal program in public health centers of Yogyakarta in a certain period (October 2018-April 2019) who met the inclusion and exclusion criteria.

Inclusion Criteria:

1. Pregnant woman who joined and/or had health insurance card (BPJS/JAMKESMAS/JAMKESDA).
2. Pregnant woman who checked her pregnancy in antenatal care program in public health centers of Yogyakarta during all trimesters, except the third trimester where the estimated date of birth (HPL) is less than a month.
3. Using well water at home for cleaning body and genital without first processing the water, and or without boiling it first.
4. Pregnant woman who cleaned her genital by hand correctly from front to back.
5. Pregnant woman who used natural well water and didn't use treatment using any equipment or chemical.
6. Pregnant woman who most of her time (at least 16 hours a day) cleaning her genital by hand using well water at her home.
7. Wiling to participate and be respondent/participant in the present study.

Exclusion Criteria

2.4.1 Pregnant woman who was being hospitalized and/or using catheter.
2.4.2 Cleaning genital by hand inappropriate from back to front.
2.4.3 Pregnant woman who in the past week had and/or was undergoing drug therapy due to UTI.
2.4.4 Not willing to participate and be respondent/participant in the present study.

Data Collection Instrument

The research instruments were a set of urine sampling tools for pregnant women in public health centers, a set of well water sampling tools, well water quality analysis tool and urine analysis tool in accredited Health Laboratory Center of DIY, and public health center laboratory, as well as inclusion and exclusion criteria form, well water sampling form for pregnant women.

Instruments: Clean Water Quality Standard (Regulation of the Minister of Health No. 416 of 1990 and Regulation of the Minister of Health No. 32 of 2017). The SNI of well water sampling was SNI 6989.58:2008 – section 58: groundwater sampling method.

Urine samples of pregnant women was collected and treated based on clinical bacteriological examination procedure of the Ministry of Health of the Republic of Indonesia of 2014.

Data Measurement and Collection Methods

The initial step of sampling prospective research participants was visiting public health centers which held antenatal care program, then performing inclusion and exclusion section on pregnant women. Pregnant women who

met the inclusion and exclusion criteria could be prospective participants. To ensure that a pregnant woman could be a participant in the present cohort research, she must be asked to willingly participate and went through selection again to make sure she didn't have UTI by testing her urine using regular test at local public health center. After every criterion was met, she could be a research participant. The next step was collecting well water samples from the homes of the pregnant women who became participants. Urine and well water samples sampling and measurement methods were consistent with the procedure in SNI and guideline from the Ministry of Health of the Republic of Indonesia.

Data Analysis

The regular urine samples of pregnant women were analyzed at the laboratories of local public health centers to look for UTI indication. Meanwhile, the well water samples were analyzed at the laboratory in the Health Laboratory Center (BLK) of DIY. The analysis of the well water samples was performed to determine E-Coli content.

In cohort approach, after finding research subjects, i.e. pregnant women who used well water, they were followed for a certain period to be reexamined/have their data taken again to determine the relation between the variables, i.e. risk factor (well water contaminated by E-Coli) and effect (pregnant woman with UTI).

The preliminary study only analyzed data of pregnant women who met the inclusion and exclusion criteria and regular urine test in the laboratories of local public health centers and analysis of E-Coli content in the well water of the pregnant women (used for cleaning body and genital).

RESULT

From October 2018 to April 2019, 162 pregnant women who joined antenatal care program in public health centers in Yogyakarta underwent selection process. From 162 pregnant women, 110 were qualified to be participants. 52 pregnant women weren't qualified because they had UTI. From 110 pregnant women, 92 well water samples were collected. The laboratory analysis result of the E-Coli content of 92 well water samples was: 41 had negative result and 51 positively contained E-Coli. Of 51 samples which had E-Coli, 36 had 1 to 50 MPN of content value and 15 samples had over 50 MPN of content value.

TABLE 1. Pregnant Women Who Can Be Categorize As A Participant

Description	Number
Number of pregnant women who had been observed	162
Number of pregnant women which was not contaminated by UTI (Urinary Tract Infection)/ as a participant	110
Number of pregnant women who contaminated by UTI (Urinary Tract Infection) / not as a participant	52

TABLE 2. Pregnant Women Who Exposured by Bacteria E-Coli

Description	Number
Number of pregnant women as a participant	110
Number of well water sample of pregnant women as a participant	92
Number of well water which contaminated by E-Coli	51
Number of well water which was not contaminated by E-Coli	41

The research result showed that 51 pregnant women used well water contaminated by E-Coli. 41 pregnant women used well water which wasn't contaminated by E-Coli.

CONCLUSION AND SUGGESTION

From the research result, it's concluded that the well water used by pregnant women to clean their bodies and genitals were contaminated. Pregnant women had been exposed to E-Coli in the well water. Exposure to E-Coli, could cause UTI, so future study is suggested to observe the effect on pregnant women and determine the relation between the risk factor and its effect.

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INTRODUCTION

Groundwater is an important natural resource for human because it's easy to find and has good quality. Therefore, people often collect groundwater from wells for their daily needs (Suprihanto, 2005).

Well water is a part of the groundwater system. Groundwater is a hydrological system which serves as one of the chain links which acts as reservoir, which then is slowly released to river or lake, so that the continuity of the flow is maintained. Meanwhile, the water source flows into aquifer in a groundwater basin. Here, groundwater also receives addition from rainwater (recharge), aquifer (media where water is present), groundwater flow, and seepage and/or additional water input (from river, gutter, dam, river) from the environment (domestic and non-domestic wastewater). Inputs from rainwater, aquifer, seepage, and additional water input from the environment determine the quality of groundwater. Water quality covers 3 characteristics, i.e. physical, chemical, and biological. Physical characteristics which affect water quality were overall solids, whether floating or dissolved, turbidity, color, scent, and water temperature. The chemical characteristics of water include pH, alkalinity, cation and dissolved anion and hardness. The biological characteristics of water were based on the types of organisms living in the water, including macroscopic, microscopic, and bacteria (Suripin, 2004).

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approximately 1-38 x 106 / m2. Among bacteria from domestic waste in the form of human feces, there is Escherichia Coli or E-Coli (Suprihanto, 2005).

Groundwater qualities in different areas may be different. Groundwater quality varies due to inputs from domestic and non-domestic wastewaters. The present study focuses on the effects of domestic wastewater. The main sources of domestic wastewater are residential area, commercial area, offices, and recreation areas (Setyono, 2008).

Yogyakarta is a major city with a population of 413,936 and population density of 12,736 people/km2 in 2014. The groundwater system in Yogyakarta is Yogyakarta groundwater basin (CAT), which covers the administrative areas of Sleman Regency, Yogyakarta City, and Bantul Regency.

The quantity of groundwater discharge of well water in Yogyakarta can fulfill domestic needs, but not all well waters qualify as clean water. Based on the data of the Department of Health of Yogyakarta in 2014 and 2015, over 40% of well water didn't qualify as clean water because the total coliform content exceeded the required quality standard (consistent with the Regulation of the Minister of Health of RI No. 416 of 1990 and Regulation of the Minister of Health No. 32 of 2017).

Well water contains total coliform microorganisms, including fecal coli and in fecal coli, there are E-coli which can cause sickness in human. This study focuses on the impacts of well water contaminated by E-Coli on the health of pregnant women. Pregnant women were selected due to physiological vulnerability which makes it easy for them to get sick.

In this case, pregnant women used well water contaminated by E-Coli to clean their genitals. Because of this, pregnant women may be infected by E-Coli in the well water through their genitals. E-Coli in their genitals colonize, then moves into urinary tracts and infect them. It may cause urinary tract infection (ISK) among pregnant women.

Jannah's study in 2011 states that many pregnant women have ISK ad 15% of women will have ISK in their lives. Due to anatomical structure and hormonal changes, pregnant women have a greater risk of ISK. ISK may be caused by E-Coli. E-Coli is the most commonly found microorganism in the urine culture of pregnant women, causing 80% to 90% of urinary tract infections. According to Dwiana's study in, the prevalence of pregnant women with urinary tract infection (ISK) is 10%.

Generally, ISK can be caused by virus, fungi, or bacterium. A bacterium which commonly causes ISK is E-Coli. This study aims to find pregnant women with ISK caused by E.Coli due to using well water contaminated by E-Coli.

The formulations of the problems of this study were: Whether there was E-Coli contamination in the well water of pregnant women. And the purposes of this study were: Finding E-Coli contamination in the well water of pregnant women.

LITERATURE REVIEW

This literature review contains theories and previous research results which are related to the research problems. The research problems were related with groundwater, pollutant source, pollutant source bacterium, E-Coli test on contaminated water source, E-Coli in ISK in pregnant women, and the process of ISK in pregnant women.

Groundwater and E-Coli i Well Water

Water, with chemical formula H2O, is an important substance or material for all lives on earth. With water, the earth is the only planet in the solar system which has lived. Human and all living organisms require water. Water could be liquid, solid (ice) and gas (Kodoatie, 2012).

Generally, total water volume on earth is 1,385,984,610 Km3. The water consists of seawater (96.54%), freshwater (2.53%), saltwater outside of seawater (0.93%), and others (freshwater + saltwater) (3.46%). Some of the freshwater is groundwater (Kodoatie, 2012). According to Desapta (2015), groundwater is defined as water below the ground level in water saturated zone, bordered below by waterproof layer and above by groundwater surface. The main source of groundwater is rainwater which seeps into the ground in a hydrological cycle. Hydrological cycle is the journey of water from sea to air, river, lake, seeps into the ground, and back to the sea through various processes, stages, and transformations. The important stages of the hydrological cycle are evaporation, precipitation, run off, and infiltration. Rainwater which seeps into the ground will be groundwater (Setyawan, 2010).

There are regions with high groundwater potential, but there are also regions with low groundwater potential. The groundwater potential of a region depends on rainfall, vegetation coverage, degree of porosity and rock permeability. Groundwater is found in various geological formations, especially aquifer (Setyawan, 2010).

A study by Huyen et al. (2007) states that the materials of the aquifer system in Yogyakarta are in the sedimentation of Merapi volcano with medium quartz sand type. The rock type forms porous aquifer which has great potential for storing groundwater. Groundwater flows following earth gravity. Because the northern area is higher than the southern area, generally, the groundwater flows from north to south. The contaminant also tends to follow the direction of groundwater flow (Huyen, 2007).

Groundwater flows in general in Yogyakarta – Sleman CAT follows the topography of the slope of Mt Merapi, from Sleman Regency which is north of Yogyakarta (highest), then Yogyakarta (middle), and the lowest in Bantul Regency south of Yogyakarta or the shore of southern sea. The slope or groundwater surface elevation gets lower further to the south (Heru, 2011).

According to Heru Hendrayana (2011), Yogyakarta is in Yogyakarta-Sleman Groundwater Basin (CAT) which covers the slope of Mt Merapi which includes Sleman Regency in the north, Yogyakarta in the middle, and Bantul Regency in the south. Grounwater basin is a region bordered by hydrological borders were all hydrological events, such as affixation, drainage, release of groundwater, take place.

The configuration of the aquifer system in Yogyakarta-Sleman CAT can be differentiated into 2 (two), i.e.: unconfined aquifer (upper) and semi-unconfined/semi-confined aquifer (lower). The thickness of unconfined aquifer in Yogyakarta is 15-40 meters. Unconfined aquifer is often used by people through shallow wells or dug wells. Meanwhile, the thickness of semi-confined aquifer is 40-120 meters and it's often used through deep wells or bore wells (Heru, 2011).

Groundwater utilization in Yogyakarta is predominantly for households. The volume of utilization is 20,129,560,200 liters annually. A small amount is used for non-household needs with a volume of 1,891,628, 016 liters annually. The level of groundwater utilization in Yogyakarta is still low, i.e. the dynamic comparison between groundwater utilization and reserve is less than 10% (Heru, 2011).

Shallow groundwater is collected by most people through shallow wells or dug wells. The well water isn't entirely qualified as clean water. The criterion for clean water according to the Regulation of the Minister of Health of RI No. 416 of 1990, specifically related with microbiological parameter, is maximum allowed total coliform for non-pipe water source is 50 MPN/100 ml. The parameter of total coliform could consist of various types of bacteria, including E-Coli. The bacteria can come from organic waste, animal feces, domestic waste, and human feces. The main source of E-Coli is human feces. So, shallow well water may contain E-Coli due to domestic waste pollution.

Groundwater Pollution

Although it's renewable natural resources, the production of groundwater takes a long time, up to decades. If the quality and quantity of groundwater are damage, the recovery takes a long time, high cost, and complicated technology (Kodoatie, 2010).

Contaminant can be categorized into 4, i.e.: organic, inorganic, radioactive, and microorganism contaminants. The discussion in the present study focuses on microorganism pollutant, especially E-Coli from human feces and from septic tanks which are imperfect and close to dug wells and/or other sources.

Ground and groundwater naturally contain microorganisms. However, microorganisms which can endanger human should receive close attention. In domestic waste water, there are approximately 1-38 x 106/m2 of bacteria. Among bacteria from human feces, there is E-Coli (Suprihanto, 2005). In Yogyakarta, the well water is indicated to contain E-Coli higher than the normal threshold. To be consumed, the well water must be boiled first so that it's safe for human health (Hastari, 2000).

According to the Regulation of the Minister of Health of RI No. 416 of 1990, public well water is categorized as clean water if the maximum total coliform microorganism content is 50 MPN/100 ml. Fecal Coli microorganism is a part of total coliform. Therefore, if the total coliform content of well water exceeds 50 MPN/100 ml, then it's polluted.

Urinary Tract Infection (UTI) on Pregnant Women.

A disease occurs due to the interaction of several factors from agent, host, or environment. This opinion has been depicted in the recently well-known terms, which is multiple causations of disease. It is described in epidemiologic triangle consisting of agent factor (as a cause of disease), host (human), and environment (physical, biologic and social environments). Based on epidemiological model, it can be concluded that the environmental factor has an important role in determining the occurrence of disease. Environmental factors can be in the form of the causality of well water contaminated with E-Coli bacteria (Notoatmodjo, 2011).

Urinary Tract Infection (UTI) is a common term to describe microbial colonization in the urine and urinary tract from the urethra to the kidney. UTI is commonly found in neonatal to geriatric ages. Clinical steps of UTI syndrome is various, started from the step without symptoms/asymptomatic to the occurrence of symptoms/symptomatic (Tjokoprawiro, 2015).

To conduct a diagnosis on UTI, it is necessary to have data consisting of signs and clinical symptoms and supporting examination in the form of laboratory and radiology examination (radiology examination does not really have an initial role for most of UTI patients). Sign and clinical symptoms are obtained from physical examination and questions. Meanwhile, laboratory examination is conducted through urine culture (Tjokoprawiro, 2015).

It can be said that diagnosis of UTI is conducted by proving that there is microorganism inside the urinary tract. Signs and symptoms of UTI are not complete, or even do not exist. If the symptoms do not exist, but the bacteria are there, it can be called as bacteria without symptoms/asymptomatic (Sidabutar, 1988).

Women are more risky to suffer from UTI because they have shorter urethra which is anatomically located near vagina and anus. The number of women suffering from UTI is 50 times more than the number of men. Furthermore, one out of five women suffers from UTI (Suharyanto, 2008).

Signs and symptoms of UTI are various. Half of the clients who are infected by bacteria in their urine do not show any symptoms, or it can be called as asymptomatic. Moreover, it is necessary to conduct urine culture to find out the infection criteria (Suharyanto, 2008).

To conduct the diagnosis of UTI, it needs to find bacteria with significant amount in the urine through culture. The significant level of the number of bacteria in the urine is higher than 100,000 MPN/100 ml or urine. In UTI patients with symptoms or called symptomatic, the amount of bacteria is said to be significant if it is more than 1000 MPN.100 ml of urine. The infectious agent commonly found (about 85%) is E-Coli (Israr, 2009).

In the genitals of pregnant women (vagina), there is lactobacillus species, which is dominant, and other bacteria in lower amount, in normal condition. If the level of pH of vagina in normal condition is <4.5, then in certain condition, the level of pH becomes >4.5, meaning that the acidic condition of the vagina is not normal, and it is possible that other bacteria grow inside (Sulliva, 2009).

During pregnancy, personal hygiene of the mother must be paid attention due to her changing body system. The increasing size of the uterus (womb) presses bladder, which makes the mother want to urinate more often. Due to the increasing frequency of urinating, the mother will be more susceptible to get infected. The infectious disease comes from the wrong way of washing vagina using water, or the water has been contaminated by bacteria (E-Coli).

The correlation between E-Coli Bacteria in Well Water and Urinary Tract Infection (UTI) on Pregnant Women

Well water contaminated with E-Coli bacteria will cause disease if it is consumed directly. Pregnant women (who is more easily infected) who use well water which has been contaminated by E-Coli bacteria to wash their vagina may be easily got infected by E-Coli bacteria that goes into and lives inside the vagina. After that, the E-Coli bacteria in the vagina can go up or ascend and infect the urinary tract of the pregnant women (Samuel, 2006).

RESEARCH METHOD

The research was performed in Yogyakarta, Special Region of Yogyakarta. Special Region of Yogyakarta is a province-level special region with Yogyakarta as the capital city. The target research location or research subjects

was pregnant women who joined antenatal program in public health centers of Yogyakarta and well water used by pregnant women who were sampled.

The present study was design to prove environmental pollution, in this case well water, which was polluted by domestic waste of human waste, especially E-Coli, and had the negative effect of UTI among pregnant women.

The research design was observational analytic with cohort approach and laboratory analysis. In cohort approach, qualified sample was determined and selected to be research target. Sample was determined by selecting those that met inclusion and exclusion criteria and making sure that the samples (in this case pregnant women) was healthy or didn't have UTI. Once the pregnant women samples were found, well water samples were collected. Well water samples were well water contaminated by E-Coli (risk factor) and well water not contaminated by E-Coli. After a certain period, another examination was performed to see the effect of the risk factor on pregnant women to know whether any of them had UTI. Then, the relation between well water contaminated by E-Coli and UTI of pregnant women due to E-Coli was analyzed (Dahlan, 2012).

Population: Target population in the present study was all pregnant women who joined antenatal program in public health centers of Yogyakarta. The **accessible population** was all pregnant women who joined antenatal program in public health centers of Yogyakarta in a certain period (October 2018-April 2019) who met the inclusion and exclusion criteria.

Inclusion Criteria:

1. Pregnant woman who joined and/or had health insurance card (BPJS/JAMKESMAS/JAMKESDA).
2. Pregnant woman who checked her pregnancy in antenatal care program in public health centers of Yogyakarta during all trimesters, except the third trimester where the estimated date of birth (HPL) is less than a month.
3. Using well water at home for cleaning body and genital without first processing the water, and or without boiling it first.
4. Pregnant woman who cleaned her genital by hand correctly from front to back.
5. Pregnant woman who used natural well water and didn't use treatment using any equipment or chemical.
6. Pregnant woman who most of her time (at least 16 hours a day) cleaning her genital by hand using well water at her home.
7. Wiling to participate and be respondent/participant in the present study.

Exclusion Criteria

2.4.1 Pregnant woman who was being hospitalized and/or using catheter.
2.4.2 Cleaning genital by hand inappropriate from back to front.
2.4.3 Pregnant woman who in the past week had and/or was undergoing drug therapy due to UTI.
2.4.4 Not willing to participate and be respondent/participant in the present study.

Data Collection Instrument

The research instruments were a set of urine sampling tools for pregnant women in public health centers, a set of well water sampling tools, well water quality analysis tool and urine analysis tool in accredited Health Laboratory Center of DIY, and public health center laboratory, as well as inclusion and exclusion criteria form, well water sampling form for pregnant women.

Instruments: Clean Water Quality Standard (Regulation of the Minister of Health No. 416 of 1990 and Regulation of the Minister of Health No. 32 of 2017). The SNI of well water sampling was SNI 6989.58:2008 – section 58: groundwater sampling method.

Urine samples of pregnant women was collected and treated based on clinical bacteriological examination procedure of the Ministry of Health of the Republic of Indonesia of 2014.

Data Measurement and Collection Methods

The initial step of sampling prospective research participants was visiting public health centers which held antenatal care program, then performing inclusion and exclusion section on pregnant women. Pregnant women who

met the inclusion and exclusion criteria could be prospective participants. To ensure that a pregnant woman could be a participant in the present cohort research, she must be asked to willingly participate and went through selection again to make sure she didn't have UTI by testing her urine using regular test at local public health center. After every criterion was met, she could be a research participant. The next step was collecting well water samples from the homes of the pregnant women who became participants. Urine and well water samples sampling and measurement methods were consistent with the procedure in SNI and guideline from the Ministry of Health of the Republic of Indonesia.

Data Analysis

The regular urine samples of pregnant women were analyzed at the laboratories of local public health centers to look for UTI indication. Meanwhile, the well water samples were analyzed at the laboratory in the Health Laboratory Center (BLK) of DIY. The analysis of the well water samples was performed to determine E-Coli content.

In cohort approach, after finding research subjects, i.e. pregnant women who used well water, they were followed for a certain period to be reexamined/have their data taken again to determine the relation between the variables, i.e. risk factor (well water contaminated by E-Coli) and effect (pregnant woman with UTI).

The preliminary study only analyzed data of pregnant women who met the inclusion and exclusion criteria and regular urine test in the laboratories of local public health centers and analysis of E-Coli content in the well water of the pregnant women (used for cleaning body and genital).

RESULT

From October 2018 to April 2019, 162 pregnant women who joined antenatal care program in public health centers in Yogyakarta underwent selection process. From 162 pregnant women, 110 were qualified to be participants. 52 pregnant women weren't qualified because they had UTI. From 110 pregnant women, 92 well water samples were collected. The laboratory analysis result of the E-Coli content of 92 well water samples was: 41 had negative result and 51 positively contained E-Coli. Of 51 samples which had E-Coli, 36 had 1 to 50 MPN of content value and 15 samples had over 50 MPN of content value.

TABLE 1. Pregnant Women Who Can Be Categorize As A Participant

Description	Number
Number of pregnant women who had been observed	162
Number of pregnant women which was not contaminated by UTI (Urinary Tract Infection)/ as a participant	110
Number of pregnant women who contaminated by UTI (Urinary Tract Infection) / not as a participant	52

TABLE 2. Pregnant Women Who Exposured by Bacteria E-Coli

Description	Number
Number of pregnant women as a participant	110
Number of well water sample of pregnant women as a participant	92
Number of well water which contaminated by E-Coli	51
Number of well water which was not contaminated by E-Coli	41

The research result showed that 51 pregnant women used well water contaminated by E-Coli. 41 pregnant women used well water which wasn't contaminated by E-Coli.

CONCLUSION AND SUGGESTION

From the research result, it's concluded that the well water used by pregnant women to clean their bodies and genitals were contaminated. Pregnant women had been exposed to E-Coli in the well water. Exposure to E-Coli, could cause UTI, so future study is suggested to observe the effect on pregnant women and determine the relation between the risk factor and its effect.

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Artikel ini ditulis dengan format yang sudah mengikuti guidelines dari panitia yaitu introduction, method and data analysis, result and conclusion. Isi artikel sesuai dengan judul dan materi yang dibahas

b. Ruang lingkup dan kedalaman pembahasan :
Artikel ini membahas mengenai masalah lingkungan yang dihubungkan dengan kesehatan bagi wanita yang sedang hamil, secara ekonomi tidak terdapat hubungan secara langsung, namun secara ekonomi lingkungan polusi yang menyebabkan mulidimensi problem harus diselesaikan agar tidak berpengaruh terhadap masalah ekonomi baik langsung maupun tidak langsung. Namun pembahasan dalam artikel ini sangat simple sehingga tidak memberikan keterbaruan apapun dan menjawab tujuan. Reference yang digunakan sebanyak 32 artikel namun lebih banyak digunakan dalam literature review dan tidak menambah kedalaman hasil dan pembahasan

c. Kecukupan dan pemutakhiran data/informasi dan metodologi :
Artikel ini menggunakan alat analisis yang sangat simple yaitu deskriptif analisis tanpa ada pembahasan secara mendetail

d. Kelengkapan unsur dan kualitas terbitan :
AIP merupakan salah satu proceeding artikel yang cukup berkualitas

e. Indikasi Plagiat :
Hasil turn it ini menjukkan nilai 12% yang artinya tidak terdapat indikasi plagiarisme

f. Kesesuaian bidang ilmu :
Artikel ini membahas tentang lingkungan dan kesehatan sehingga ekonomi tidak berhubungan secara langsung, namun di kedepannya apabila ada penelitian lanjutan bisa dicari hubungannya dengan ekonomi

Surakarta, 9 Desember 2020

Reviewer 1, **

Dr. Izza Mafruhah, SE, M.Si
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Pangkat,Gol Ruang : IV/b
Unit Kerja : FEB
Bidang Ilmu : Ekonomi Pembangunan

*Dinilai oleh dua Reviewer secara terpisah
**Coret yang tidak perlu

4.11

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : ***PROSIDING** **

Judul Karya Ilmiah (paper)	:	Exposure of pregnant women by E-coli bacteria due to ground water pollution		
Jumlah Penulis	:	4 Orang (Yohanes Agus Setianto, **Evi Gravitiani**, Totok Gunawan, Hartono)		
Status Pengusul	:	~~Penulis pertama~~ / penulis ke 2 / ~~penulis korespondasi~~**		
Identitas Prosiding	:	a. Nama Prosiding	:	**International Conference on Science and Applied Science (ICSAS) 2019**
		b. ISBN/ISSN	:	**978-0-7354-1953-7**
		c. Tahun Terbit,Tempat Pelaksanaan	:	**Surakarta, 19 Juli 2019**
		d. Penerbit/organiser	:	**AIP Publishing**
		e. Alamat repository PT/web prosiding	:	https://aip.scitation.org/doi/pdf/10.1063/1.5141741
		f. Terindeks di (jika ada)	:	

Kategori Publikasi Makalah (beri ˇ pada kategori yang tepat)
: ☒ Prosiding Forum Ilmiah Internasional .....
☐ Prosiding Forum Ilmiah Nasional .....

Hasil Penilaian *Peer Review* :

Komponen Yang Dinilai		Nilai Maksimal **Prosiding 15**		Nilai Akhir Yang Diperoleh
		Internasional ☒	Nasional ☐	
a.	Kelengkapan unsur isi paper (10%)	1.5		1
b.	Ruang lingkup dan kedalaman pembahasan (30%)	4.5		4
c.	Kecukupan dan kemutahiran data/informasi dan metodologi (30%)	4.5		4
d.	Kelengkapan unsur dan kualitas terbitan/prosiding (30%)	4.5		3
Total = (100%)		**15**		**12**
Nilai Pengusul = (40% x 12) /3 = 1.6 (Penulis Kedua)				

Catatan Penilaian artikel oleh Reviewer :

a. Kelengkapan dan kesesuaian unsur isi artikel: Artikel ini sudah sesuai dengan aturan standar penulisan ilmiah dalam International Conference on Science and Applied Science (ICSAS) 2019 (abstract, introduction, literature review, research method, result, discussion, and conclusion) (skor=1)

b. Ruang lingkup dan kedalaman pembahasan: Studi ini bertujuan untuk mengetahui hubungan ibu hamil yang terkena infeksi saluran kandung kemih dan polusi air tanah atau bakteri E-Coli. Hasil penelitian menunjukkan bahwa kemungkinan besar ibu-ibu hamil yang terpapar infeksi kandung kemih karena teracuni oleh bakteri E-Coli dari air sumur, (skor=4)

c. Kecukupan dan pemutakhiran data/informasi dan metodologi : Data yang dipergunakan dalam penelitian ini cukup mendalam dengan menggunakan data primer dan sekunder metode statistic cohort dan analisis laboratorium (skor =4)

d. Kelengkapan unsur dan kualitas terbitan : Konferensi yang diikuti cukup berkualitas yang dilaksanakan setiap tahun bekerjasama dengan AIP Publishing (skor=3)

e. Indikasi plagiat: Berdasarkan tes semiliritas hanya sebesar 12%, maka dapat diinyatakan tidak ada indikasi plagiat.

f. Kesesuaian bidang ilmu: Sangat sesuai bidang ekonomi terutama dalam bidang ekonomi pembangunan

Surakarta, 04 DEC 2020

Reviewer ½ **

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Bidang Ilmu : Ekonomi Pembangunan

*Dinilai oleh dua Reviewer secara terpisah
**Coret yang tidak perlu