Diarrhea, Stop Killing Toddlers!

Did you know that diarrhea threatens the lives of thousands of children worldwide? Every one of us has experienced diarrhea at least once in our life, and most of us think that it is not a serious situation since usually, we recover within one or two days. Although diarrhea is a treatable and preventable disease, it is the leading killer of toddlers worldwide. UNICEF has recorded that every day, around 15,000 children in the world die before the age of 5 due to diarrhea.

Diarrhea, which is characterized by frequent and watery defecation, is often caused by an infection of *E. coli* bacteria. Contamination of this bacteria in water, in soil, and on surfaces that have been touched by non-hygienic hands are some factors that increase the risk of diarrhea. The concern about the huge number of toddler deaths due to diarrhea has led the United Nations (UN) to promote the so-called WASH (water, sanitation, and hygiene) campaign in order to decrease the global number of diarrhea-related toddler fatalities.

Diarrhea is common in low- and middle-income countries, and Indonesia is among the 15 countries that contribute the most to child deaths due to diarrhea worldwide. Indonesia is an archipelago tropical country in South East Asia with 34 provinces. West Java Province is the one with the highest diarrhea occurrence in Indonesia, and Bandung City, which is the capital of this province, is among the top 5 cities with the most diarrhea cases within this area. Hence, toddlers from Bandung have a high mortality risk due to diarrhea. As the city has a high prevalence of diarrhea, the Bandung Department of Health also implements the WASH campaign.

In our study, we investigated the effect of the WASH campaign (represented by relevant factors) on the percentage of toddler diarrhea occurrence using a statistical model called GWQR (Geographically Weighted Quantile Regression). This method tries to resemble the diversity in reality, in which the effectiveness of the WASH factors on diarrhea might differ between different locations. One factor might have a significant effect in location A but a modest effect in location B, while another factor might have an opposite effect. GWQR can address this by estimating the effect of every factor in every district. Furthermore, GWQR can find the locations with high diarrhea risk and identifies the factors that have a large impact on this risk, taking into account the infectious effect from the neighboring districts. This infectious effect is from the nature that diarrhea could spread from one district to the neighboring districts and could affect the effectiveness of the WASH Campaign in those areas as well. GWQR helps us to work effectively and efficiently as we can put more attention on the most important factors in the riskiest location. In our study, the factors considered as relevant representatives of WASH were:

1) the percentage of households that used clean water in every district,
2) the percentage of households that owned toilets which satisfied the criteria of healthy toilet by Indonesian Department of Health, and
3) the percentage of households that applied the habit of washing hands in every district.

Our analysis using data from 2015 showed that among 30 districts in Bandung, Panyileukan District, located at the eastern part of the city, was the district with the highest toddlers' diarrhea risk. In this district, 75 out of 100 children under 5 were predicted to have a 32% probability of having diarrhea, which was a very high risk since the average diarrhea rate in Bandung was 22%. This information is valuable as it helps the government in Bandung to focus on the district that requires more controls and aids. Further, the three factors investigated in the study were proven to affect the percentage of diarrhea cases in Panyileukan District. Among these three factors, the most important factor in decreasing diarrhea rates in Panyileukan was the percentage of households with handwashing habit. In this district, increasing the percentage of households with handwashing habit by 10% would decrease the diarrhea percentage by 5%. This knowledge is helpful since it allows the decision-makers to have guidance in determining the percentage of households with handwashing habit, in order to attain a targeted percentage decrease of diarrhea cases for a specific location.

In conclusion, the GWQR model allows policy makers to work efficiently and effectively as it can detect the locations that are at a high risk of diarrhea and which factors are related to this risk. At an expanded level, GWQR can be used to investigate the effect of various intervention strategies, and effectively allocate the limited available resources according to which locations are most important. Therefore, we can ensure that the interventions for dealing with diarrhea issues are right on target. This can also be applied to other cities in Indonesia and other high burden countries to reduce the world diarrhea number, and a large number of toddlers' lives would be saved.