Stopping the spread of diarrheal disease through the environment

More than half a million children die every year from diarrheal diseases. Most of these diseases are caused by pathogens, or “germs”. In my paper *Environmental Transmission of Diarrheal Pathogens in Low and Middle Income Countries* published in *Environmental Science: Processes and Impacts*, I suggest we should be promoting effective environmental interventions that help stop diarrhea from spreading. I also suggest that we can look at which interventions will work the best by looking at which pathogens are spreading within a community.

When the medical and scientific community works to reduce the impacts of diarrheal disease, we tend to invest heavily in medical treatments. For example, we promote the use of oral rehydration therapy – which is water, sugar, and salt at a balanced ratio. Oral rehydration therapy – put into widespread use in the 1970s - is one of the most important inventions of the past 100 years. It has been extremely helpful in reducing deaths due to diarrheal disease. In 2000, for example, 2.5 million children were dying due to diarrhea every year, much higher than the half million today. However, treatments including oral rehydration therapy do not stop the disease from spreading. They mainly help people cope with - and survive - the disease. As a result, almost as many people get diarrhea today as they did in 2000.

I suggest that we should think about *how* diarrhea is being spread and that we can use this information to decide which environmental interventions we should invest in. Most pathogens are spread through the environment. To cause disease, diarrheal pathogens generally move from feces – where they are shed – to another person. This movement occurs through one or more of six environmental *reservoirs*. The reservoirs include food, fingers (e.g. hands), fluids (i.e. water), fomites (e.g. inanimate objects), fields (i.e. soils in household, agricultural fields), and flies.

How pathogens move through these reservoirs is influenced by characteristics of the pathogens themselves. Although there are hundreds of pathogens that can cause diarrhea, recent studies have found six that cause the worst cases of diarrhea globally. The six pathogens are *Cryptosporidium spp.,* enterotoxigenic *E. coli*, enteropathogenic *E. coli*, *Shigella spp.,* norovirus, and rotavirus. These six pathogens are very different from each other, and their differences influence how they are spread. By knowing about the pathogens, environmental reservoirs, and existing infrastructure in a community, you can better design effective environmental interventions.

For example, enterotoxigenic *E. coli* – or ETEC - is a bacterial pathogen that causes diarrhea that lasts 3-5 days. However, if you drink water with very little – but some – ETEC, you are unlikely to become sick because your body has mechanisms to prevent infection. Drinking a lot – more than a hundred thousand – of ETEC bacteria is often required to overwhelm your defense mechanisms and make you sick. Existing evidence suggests that water is rarely that contaminated. However, if very few ETEC bacteria contaminate your food, they can grow and divide rapidly: Only a few can

quickly become enough to make you sick. So if ETEC is in a community, food hygiene measures may be more important than drinking water interventions to control diarrheal disease.

But ETEC is only one example. In my paper, I discuss the characteristics of the six most important pathogens, and how those characteristics relate to the environmental reservoirs that we interact with every day. When we invest in environmental interventions to control diarrheal disease, we should consider the most important pathogens and environmental reservoirs in each community to have the most impact.

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