From Sip to Sick: Cholera Transmission and Its Impact on Children

By: Ali Alvi

ALERT: Five cholera cases on route. One child.

ALERT: One individual passed away on route.

Returning to the village.

ALERT: Ambulance dispatched.

An ambulance screeches to a halt in front of a Médecins Sans Frontières (MSF) hospital in Sudan as a team of doctors brace themselves for a race against time in the glare of the flashing lights. Four patients infected with the *Vibrio cholerae* (cholera) bacteria are unloaded, all of whom are shocked and dehydrated with only a few minutes to be saved. Among the four patients is a frail child, whom the disease is severely affecting due to their weakened immune system caused by malnutrition. The staff move around swiftly in their efforts to save these patients, each one playing a vital role in reaching the climax of events. Within 5 minutes, patients were resuscitated and provided IV infusions, ending with a grande finale of stabilized patients and doctors "covered… in sweat and mud" gasping with relief.[1]

What was just described was not an episode of *Grey's Anatomy* but rather one of the *fortunate* moments amidst the cholera outbreak in Sudan. These were the events of September 1, 2024, as described by Angela Giacomazzi, a human resources coordinator

working for MSF. She states that “Malnourished kids always look so fragile and cholera can really push their lives to the extreme… When you see [patients] in those conditions you find a strength in yourself that you didn’t know you had.”[1]

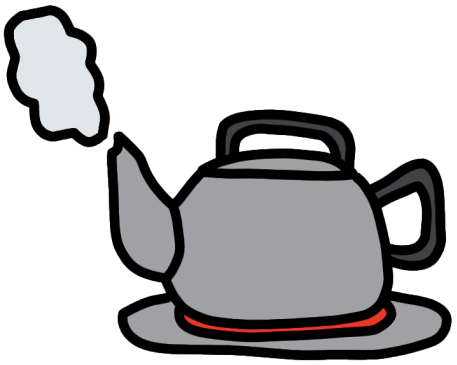
On August 12, 2024, the Federal Ministry of Health in Sudan declared a cholera outbreak. With its rapid transmission, there were close to 28,000 cases reported between July 22 and October 28, with 836 deaths across eleven Sudanese states.[2,3] Within these few months, cholera has wreaked havoc across the nation, with 500,000 children below the age of five at high risk of contracting this disease.[3] While this is indeed cause for global concern, you may wonder why this has not gained attention in other parts of the world. Should we be concerned about another pandemic coming our way that puts children at risk? To understand the factors that make children particularly susceptible to cholera, let us examine this pathogen through the lens of the child who was saved on September 1st.

Sanitation Saves Lives

The first thing all kids were told during the COVID-19 pandemic was simple (and should be implemented even without a pandemic): wash your hands! Of course, personal hygiene is essential in preventing the spread of diseases, including cholera.[4] Now, could this child have contracted cholera due to a lack of proper hygiene? It is possible. Being a disease that is transmitted from feces, contamination of food often occurs due to a lack of sanitation in its handling and preparation.[5] Although we did just establish that it is possible that this child was simply exposed to the virus

due to poor hygiene, it is highly unlikely to be the case in this situation, especially considering that this was a large outbreak; rather, the main methods through which cholera outbreaks occur are a little more sinister than poor sanitation, that being the water sources that people's livelihoods depend on.[6]

The Center for Disease Control states that, if cholera is a concern, water should be boiled or even treated with household bleach.[7] Can you imagine how annoying it would be to go through such an ordeal every time you got thirsty? Moreover, imagine taking a shower and being scared that water might get in your mouth! These are the unfortunate realities of many people living in countries that have poor water sanitation. However, even worse is the reality we see in cases of cholera outbreaks, where a vicious cycle occurs; due to the cholera infection, people experience intense diarrhea, nausea, and vomiting, resulting in the individual becoming dehydrated and incredibly thirsty. This can additionally lead people to drink more and more of the cholera-infected water, increasing the infection's potency and eventually causing death from intense dehydration and loss of electrolytes.[8-10]



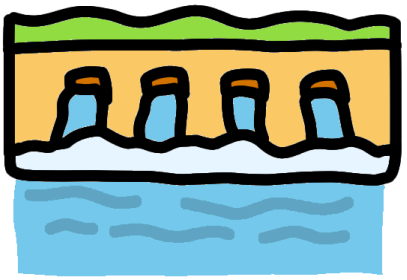
Now, consider all of this through the perspective of that same young child. How many children can you think of that are able to, let alone be patient enough, to go through all of these steps just to get a sip of water? When we think about how active children are and how much they sweat as they play (especially in a hot country like Sudan), is it fair to expect them to take these drastic precautions every time they need water? Moreover, once they contract cholera and start experiencing intense thirst due to the dehydration that the pathogen causes, would you expect them to not drink more of the already contaminated water? Such an

assumption would be entirely unrealistic and unfair, as we would not expect such precautions to be taken by a child in North America who drinks out of a public water fountain after playing in the sun.

This does, however, raise the question of why the standard between the regions is so vastly different; what does Sudan have that is causing such large outbreaks while North America generally does not have to worry about cholera? Cholera itself is described as 'endemic' in around 50 countries, particularly in South Asia and Africa.[10] What this means is that there have been confirmed cases within 3 years that are attributed to local transmission in the area, but cholera outbreaks can occur in any country when conditions cause surges in cases.[11] The reason for the outbreak in Sudan specifically is multifaceted.[12] The on-going war in Sudan has led to a crisis on multiple fronts: thousands of people are displaced, and UNICEF has described "significant declines in vaccination rates and the destruction of health, water, sanitation, and hygiene infrastructure."[3,12] Compounding this is the heavy rainfall and flooding that has contaminated water across the region, exacerbating the outbreak.[3]

Prevention is Power

To counteract these changes, governments should work while considering the environmental factors that their specific countries experience that influence the spread of this pathogen.[13] For example, flood gates and



channels would be helpful in addressing the flooding that causes river overflow, which results in the contamination of drinking water sources.[14] Other preventative measures would include improving sewage systems and regular disinfection of water sources.[15] Also available are oral vaccines that have shown to be helpful in preventing outbreaks, although they only provide partial immunity for a few years and must be distributed to rural regions.[16] However, addressing these problems can be complex, as the improvements that need to be made to the infrastructure and water filtration plants would be very expensive and difficult to achieve in less economically stable countries.

Aside from their aforementioned inherent vulnerability to this disease, the reason why it is important to consider cholera in the context of a child is that they are an essential demographic in regard to preventing future outbreaks. If this child and their parents were more educated regarding the symptoms and causes of cholera, they might not have been rushed to the hospital in such a dire state.[17] This is why it is crucial to work towards implementing educational programs on the topics of hygiene and water safety in areas that commonly experience outbreaks; one study actually found that education regarding cholera is more effective than water chlorination efforts.[18] Perhaps if the child was taught in school about how important it is to wash their hands before eating or about the potential dangerous pathogens in their region's drinking water that require it to be boiled, they would have been less vulnerable to contracting this disease.[19]

Even if the child did get cholera, had the family been better educated regarding its symptoms, they would have been able to more effectively self-diagnose and seek treatment before reaching such a critical stage. It is even possible that they would not have had to be taken to the hospital in general, as most children infected with cholera can simply be treated using oral rehydration solution (ORS) sachets, which are small sachets of salt and sugar distributed in countries where cholera outbreaks are common.[9]

Thus, governments and non-profit organizations should also provide educational campaigns to increase knowledge regarding this disease in high-risk communities. Especially in areas with limited health care availability and poor infrastructure, such efforts could prove effective in preventing this pathogen's spread.

Regional Realities

Let us now take a look at how living in a cholera-endemic country influenced this particular child's illness. The first thing that comes to mind, and something we have already touched upon, is the increased risk this child faced of contracting cholera.[20] Living in an endemic country means that the inherent likelihood of a potential outbreak is much higher since cholera is persistent in the region through environmental reservoirs, such as rivers and lakes.[21] This current inability to permanently remove the pathogen entirely from the region causes more frequent outbreaks that promote the spread of the disease.[22]

Comparatively, cholera cases in non-endemic countries do not occur through outbreaks but are rather caused by transmission stemming from endemic regions, such as through travel.[23] These cases rarely cause major outbreaks since there are more

environmental constraints, like greater sanitation infrastructure, that prevent it from establishing a reservoir, inhibiting rapid transmission and mass outbreaks.[24,25] There also tends to be significantly more established healthcare availability in non-endemic countries, with cases being identified and treated more quickly and effectively.[20]

However, one sense in which living in an endemic country might have benefited this child is the immunity factors that aid in combating against cholera. When a particular region is afflicted by the same pathogen for generations, certain genetic traits that benefit immunity to the pathogen become more pronounced through natural selection; some scientists speculate this to be true for cholera in endemic regions, with the inhabitants possessing genetic changes that increase their overall immunity.[26,27] Although this innate immune response is found to be the body's initial method of combating this pathogen, research has also indicated that innate immunity is ineffective at protecting against more severe cases.[28]

This is why we see that outbreaks and deaths caused by cholera still occur in regions that have developed genetic traits that benefit survival. Despite this grim reality, also worth mentioning is the role of the adaptive immune system in fighting this infection. Whereas the innate immune system's effectiveness is limited, it is well understood that individuals who survive cholera infections, particularly young children, develop antibodies that provide much

higher levels of immunity that last for years. Thus, the immune systems of those who have survived cholera adapt in a way that keeps them safe from the pathogen in the future.[29] For example, the child who survived after being taken to the hospital has likely gained substantial immunity now that they have recovered.

Ending the Outbreak

It becomes clear to us how unique the impact of cholera is on the youth of epidemic countries. Although efforts are always made to treat outbreaks, it seems as though we are not working as hard as the immune systems of these children when it comes to keeping them safe from the disease in the first place. It is evident that more efforts need to be put into teaching people (particularly children) about the dangers of cholera and developing the infrastructure that we find in non-endemic countries in order to prevent future outbreaks. This way, we could effectively work to end both the major outbreaks we see in endemic countries and the transmitted cases noticed in non-endemic countries. Only through efforts that address this issue from both a medical and societal standpoint can we start winning the fight against cholera.

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