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Investigating the role of water in the Diffusion of Cholera using Agent-Based simulation

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Traditionally, cholera was considered to be a waterborne disease. Currently we know that many other factors can contribute to the spread of this disease including human mobility and human behavior. However, the hydrological component in cholera diffusion is significant. The interplay between cholera and water includes bacteria (V. cholera) that survive in the aquatic environment, the possibility that run-off water from dumpsites carries the bacteria to surface water (rivers and lakes), and when the bacteria reach streams they can be carried downstream to infect new locations.

Modelling is a very important tool to build theory on the interplay between different types of transmission mechanisms that together are responsible for the spread of Cholera. Agent-based simulation models are very suitable to incorporate behavior at individual level and to reproduce emergence. However, it is more difficult to incorporate the hydrological components in this type of model.

In this research we present the hydrological component of an Agent-Based Cholera model developed to study a Cholera epidemic in Kumasi (Ghana) in 2005. The model was calibrated on the relative contribution of each community to the distributed pattern of cholera rather than the absolute number of incidences. Analysis of the results shows that water plays an important role in the diffusion of cholera: 75% of the cholera cases were infected via river water that was contaminated by runoff from the dumpsites. To initiate infections upstream, the probability of environment-to-human transmission seemed to be overestimated compared to what may be expected from literature. Scenario analyses show that there is a strong relation between the epidemic curve and the rainfall. Removing dumpsites that are situated close to the river resulted in a strong decrease in the number of cholera cases. Results are sensitive to the scheduling of the daily activities and the survival time of the cholera bacteria.