BIO-FI: LEVERAGING THE POWER OF BIOLOGICAL BIG DATA FOR ADVANCED ANALYTICS AND MODELING OF CHEMICAL AND BIOLOGICAL THREATS

Notional Spread Of Cholera In Haiti Following A Natural Disaster

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Cholera remains a significant public health burden for many countries, especially in endemic and underdeveloped nations that are prone to natural disasters and flooding. Cholera can have devastating effects on the local population, and like other highly communicable diseases, the severity can largely be determined by the location of an outbreak and the local conditions that drive disease spread. The purpose of this study is to demonstrate the use of epidemiological modeling to understand the dynamics of infectious disease outbreaks, and inform planning and military preparedness in areas with highly communicable diseases. Diarrheal diseases have the potential to inhibit a soldier's ability to fight and degrade their lethality for extended periods of time. Military bases located in endemic areas following natural disaster must consider the health risk posed to stationed personnel and the potential disruption to operations should a highly communicable disease outbreak occur in the local population. A cholera model (EpiGrid) initially developed by Los Alamos National Laboratories and parameterized from the 2010 cholera outbreak in Haiti was used in this notional scenario following the importation of an index case after a 2021 earthquake and tropical storm. We model the 12 week spread of cholera under three identical but geographically distinct origin scenarios starting in Jeremie (Grand'Anse), Les Cayes (Sud), and Miragoane (Nippes). For each model location, mitigated (intervention with 30% transmission reduction on week 7) and unmitigated (without intervention) spread are simulated. Unmitigated cholera spread originating in Jeremie, Grand'Anse is expected to result in 58,742 total cases, while mitigation strategies on week 7 result in 13.3% fewer cases by week 8, and 42.5% and 61.9% fewer cases by week 10 and 12, respectively. Unmitigated spread in Miragoane, Nippes resulted in the greatest number of cholera cases (79,518 cases) by week 12, spanning the largest geographical area (11,757 km2), while mitigated transmission resulted in 55.1% fewer cases totaling 35,667 cases. An unmitigated outbreak in Les Cayes, Sud resulted in 76,561 cases after 12 weeks. Mitigation strategies at week 7 result in 14.2% fewer cases by week 8; 44.4% fewer cases by week 10, and 63.1% less cases by week 12 totaling 28,225 cases. Our models show notional epidemic spread and severity differ across outbreak locations. Epidemiological models help improve our understanding of disease dynamics, identification of high risk areas and evaluation of timely mitigation strategies. Models are an important tool for assessing health risks to military personnel operating in disease endemic areas and for understanding the protective measures needed to safeguard the warfighter deploying to high risk areas and maintaining their operational readiness.