Imperial College London

Natural Environment Research Council

2024_75_SPH_KG: Implications of climate variability on norovirus burden and control

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Norovirus is one of the most common causes of gastroenteritis in humans with approximately 1 in 5 cases of acute gastroenteritis attributable to norovirus. It is highly infectious with a 49% probability of infection from just one viral particle. Furthermore, there is a high global burden, approximately 200,000 deaths per annum, and a high global cost of illness, approximately $60 billion. However, these values are likely to be underestimated due to underreporting and non-specific symptom spectrum.

Transmission of norovirus occurs mainly through the faecal-oral route but can occur through food preparation or through contaminated surfaces, which is particularly problematic in healthcare settings. The occurrence is also highly seasonal with over half of reported cases occurring in Winter months; though this timing may have been disrupted by non-pharmaceutical interventions (NPIs) implemented through the COVID-19 pandemic. This means seasonal peaks occur simultaneously with increased burden from respiratory pathogens such as COVID-19 and influenza, further exacerbating the strain on healthcare. Yet, the drivers for the seasonality of norovirus occurrence are uncertain, encompassing both population and climatic conditions; and as a result, the mechanisms are not well described. There has also been little exploration to date on how the occurrence of norovirus may be affected by changes in climate variability in future.

Through this project we will develop mathematical models of norovirus transmission and burden whilst accounting for the mechanisms of seasonality and environmental influence. These models will allow us to examine key factors in the timing of seasonal peaks of norovirus; how to mitigate the resulting healthcare burden, and how these seasonal patterns may be affected by future disruptions both human-mediated such as NPIs, and through climate variability.

Our modelling approach will incorporate measures of seasonality by age group and geography to account for differential reporting by subpopulation whilst accounting for the environmental conditions. We will propagate uncertainty from existing epidemiological and environmental data sources into our projections as well as using sensitivity analyses to explore unobserved mechanisms for climate-mediated changes in transmission. Through examining historical data on norovirus occurrence, we can quantify trends in seasonality and disentangle the effects of NPIs instigated because of the COVID-19 pandemic. Finally, we will explore how future climate conditions may affect norovirus seasonality and occurrence in order to quantify future healthcare system burden and mitigation approaches.