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## Commentary

# Detailed analysis of enteric pathogen incidence associated with COVID-19 mitigation behaviors informs upcoming clinical and policy decision making

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There is a growing body of literature on the impact of COVID-19 nonpharmaceutical interventions (NPI) on other infectious diseases. [1-7] In their article published in *The Lancet Regional Health - Western Pacific*, Li-Ping Wang and colleagues [8] analyzed data from 134 hospitals across 27 provinces in China to evaluate the incidence of common acute diarrheal pathogens through four phases of COVID-19 NPI in 2020 compared to historical data. Their data was obtained from the Chinese Center for Disease Control and Prevention's nationwide surveillance program for acute diarrhoea, offering a lengthy (the program began in 2009) and detailed historical record of geographic and seasonal variations for comparison.

They report a marked decrease in the overall viral activity of the seven common viral pathogens tested (adenovirus, astrovirus, norovirus, sapovirus, and rotaviruses A, B, and C), and the overall bacterial activity of the thirteen common bacterial pathogens tested (*Aeromonas hydrophila*, *Campylobacter coli*, *Campylobacter jejuni*, diarrheagenic *Escherichia coli* (DEC), nontyphoidal *Salmonella* (NTS), *Plesiomonas shigelloides*, *Shigella*, *Vibrio cholera*, *Vibrio fluvialis*, *Vibrio mimicus*, *Vibrio parahaemolyticus*, *Yersinia enterocolitica*, and *Yersinia pseudotuberculosis*) after COVID-19 NPI became widely adopted.

This paper is the first large study on the population-level effects on common enteric pathogens during COVID-19 in China. The authors offer a timely, globally relevant warning to anticipate high levels of rebound infections as children return to school. Further, this work augments the few international studies exploring the impact of COVID-19 NPI on common enteric pathogens, which are limited to evaluations of norovirus [2,4] or regional data. [7] By including 20 common pathogens in their analysis, Wang

*et al.* offer detailed insights into how the infection rates of various pathogens changed during COVID-19 and how their relative commonality changes through the cycle of pandemic lockdown re-opening and return to school. They corroborate reports of decreased norovirus and *Shigella* infections during COVID-19 NPI; add rotavirus A, adenovirus, and DEC to the list of pathogens whose activity is reduced during COVID-19 NPI; and provide an interesting discussion of the paradoxical increase in NTS during lockdown periods.

Wang *et al.* present their data with visually accessible charts and graphs. These may prove particularly valuable to clinicians, scientists, and policymakers seeking to anticipate the health impact of their decisions around changing COVID-19 NPI policy. They may also be used when considering public health responses to infrequent but highly virulent enteric pathogen outbreaks, like the DEC outbreak in Germany in 2011, which infected 3 816 persons and caused 54 deaths. [9] Wang *et al.*'s data suggests that Phase IV NPI may have decreased DEC infections by 62.5%. [8]

The long-term benefit of this work is that it serves as a model for population-level epidemiology studies that enable outcomes to be compared to many of the more challenging influences of bacterial and viral parthenogenesis. For example, their data can be used to consider the impact of seasonality and geography. This consideration enables more focused comparisons to other populations, improving generalizability. Social scientists may add local and regional political decisions to future analyses and use correlations identified to give leaders greater insight into their policies' anticipated downstream health effects. Climatologists might incorporate meteorological data into future analyses; extrapolations from a large database of linked meteorological and health data may provide estimates of the impact of climate change on infectivity rates of these pathogens.

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As an observational study of surveillance data, it is not possible to determine whether there is causality to the reported correlations. Further, pandemic-related changes to health-seeking behaviours (by personal choice or by health facility mandate) act as a confounder to pre-pandemic comparisons. Notwithstanding these limitations, the sample sizes for viral (45 937) and bacterial (67 395) infections, combined with test timing and geographic location enabled spatiotemporal generalized linear modelling, which offers unique insights into the relationship between NPI, infection, and co-infection of twenty common enteric pathogens in China through its 2020 pandemic experience.

Key take-home points include:

- Like other countries, China experienced a general decrease in the incidence of common enteric pathogens causing acute diarrhoea when engaged in COVID-19 NPI precautions.
- Rebound enteric pathogen infections should be anticipated as COVID-19 NPI precautions are lifted, particularly when children return to school.
- During periods of radical behavioural change (like COVID-19 NPI lockdowns), the relative incidence of enteric pathogens may change. Hence, it behoves clinicians to anticipate changes to what is "common" and have a higher suspicion for highly pathogenic bacteria like NTS for patients presenting with acute diarrhoea during these times.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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