Grid monitoring of SARS-CoV-2 in sewage for early warning of community outbreaks: abridged secondary publication

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KEY MESSAGE

Sewage surveillance for SARS-CoV-2 may offer a cost-effective approach to measuring infections at the population level. It can uncover hidden transmission chains and serve as a supplementary tool to clinical testing to support public health actions.

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Introduction

Sewage surveillance for SARS-CoV-2 may serve as an early-warning, cost-effective, community-level measure to guide public health interventions for the control of COVID-19.[1] Infected individuals shed the virus in faeces, with reported positivity rates ranging from 15.3% to 100%, regardless of symptom presentation.[2] The presence of SARS-CoV-2 RNA in sewage was first reported in the sewersheds of Amersfoort, Netherlands, in April 2020.[3] Subsequent studies revealed similar findings.[4-6] Viral signals in sewage are strongly correlated with the number of clinical cases and may provide early warning of SARS-CoV-2 circulation at the population level, with an estimated lead time of 6 to 8 days or 4 to 10 days ahead of clinical testing results.[7,8] Sewage surveillance for SARS-CoV-2 has been adopted in over 50 countries.[9]

Methods

In Hong Kong, sewage surveillance was first implemented at residential care homes during the fourth wave in October 2020. It was subsequently extended to ad hoc sites at residential buildings and city blocks with infection clusters in December 2020, and later to fixed monitoring sites for early warning after the fourth wave subsided in March 2021. The number of sampling points exceeded 1500.

Virus concentration and extraction and quantification of viral RNA were performed using reverse transcription quantitative polymerase chain reaction; samples were then classified as negative or positive based on the results for two primers. A primer was classified as 'having a signal' if a cycle threshold value ≤40 was observed in at least one reaction, as negative if no signal was detected for both primers or only one showed a signal, or as positive if both primers showed a signal.

Results

Sewage testing results were largely consistent with clinical testing results. To monitor the re-emergence of SARS-CoV-2 circulation within communities, sewage samples were collected from 26 sites across Hong Kong. Sewage surveillance successfully detected the upward trend in clinical cases during the fourth wave, beginning in mid-November 2020. From December 2020 to February 2021, routine sewage testing at the 26 sites was temporarily redirected to estates with identified infection clusters. The results served as the basis for public health actions including compulsory testing operations at selected buildings and locations, leading to the identification of over 50 confirmed cases and the likely interruption of hidden transmission chains. As the fourth wave subsided in February 2021, routine monitoring at the 26 sites resumed and revealed a downward trend.

Discussion

The identification of 10 COVID-19 cases at Choi Wan (II) Estate between December 2020 and January 2021 was the first instance in Hong Kong, in which community cases were uncovered through compulsory testing operations prompted by sewage test results. Between December 2020 and March 2021, the government conducted compulsory testing at over 110 buildings with positive sewage results, uncovering >50 hidden cases. These findings provided a basis for statutory public health actions to identify infected individuals and enable timely

interventions such as isolation and treatment at the community level.

Given the limitations of sewage surveillance (the random nature of sampling, temporal variation in viral excretion, and the variable faecal positivity rates among patients), it is difficult to determine the precise number of infected individuals in a given sewershed. Nonetheless, sewage surveillance demonstrated predictive value and practical utility in guiding public health actions for early identification and isolation of infected individuals and their close contacts. The findings of this study led to the adoption of sewage surveillance strategies in other countries under various epidemiological conditions.

Conclusions

In Hong Kong, sewage surveillance for SARS-CoV-2 has provided early warning of COVID-19 outbreaks, tracked community transmission trends, and supported monitoring efforts at estates with infection clusters.

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Disclosure

The results of this research have been previously published in:

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