Scientific Evidence on Surveillance of COVID-19 in a Vaccinated Population: A Rapid Literature Review

June 25, 2021

Research Objectives

To summarize the available evidence on:

- the scientific evidence on surveillance approaches to monitor the presence of the virus in a fully vaccinated population*.

- emerging technologies to identify infection caused by variants of concern in a fully vaccinated population.

This rapid review was conducted between June 13 2021 and June 25 2021.

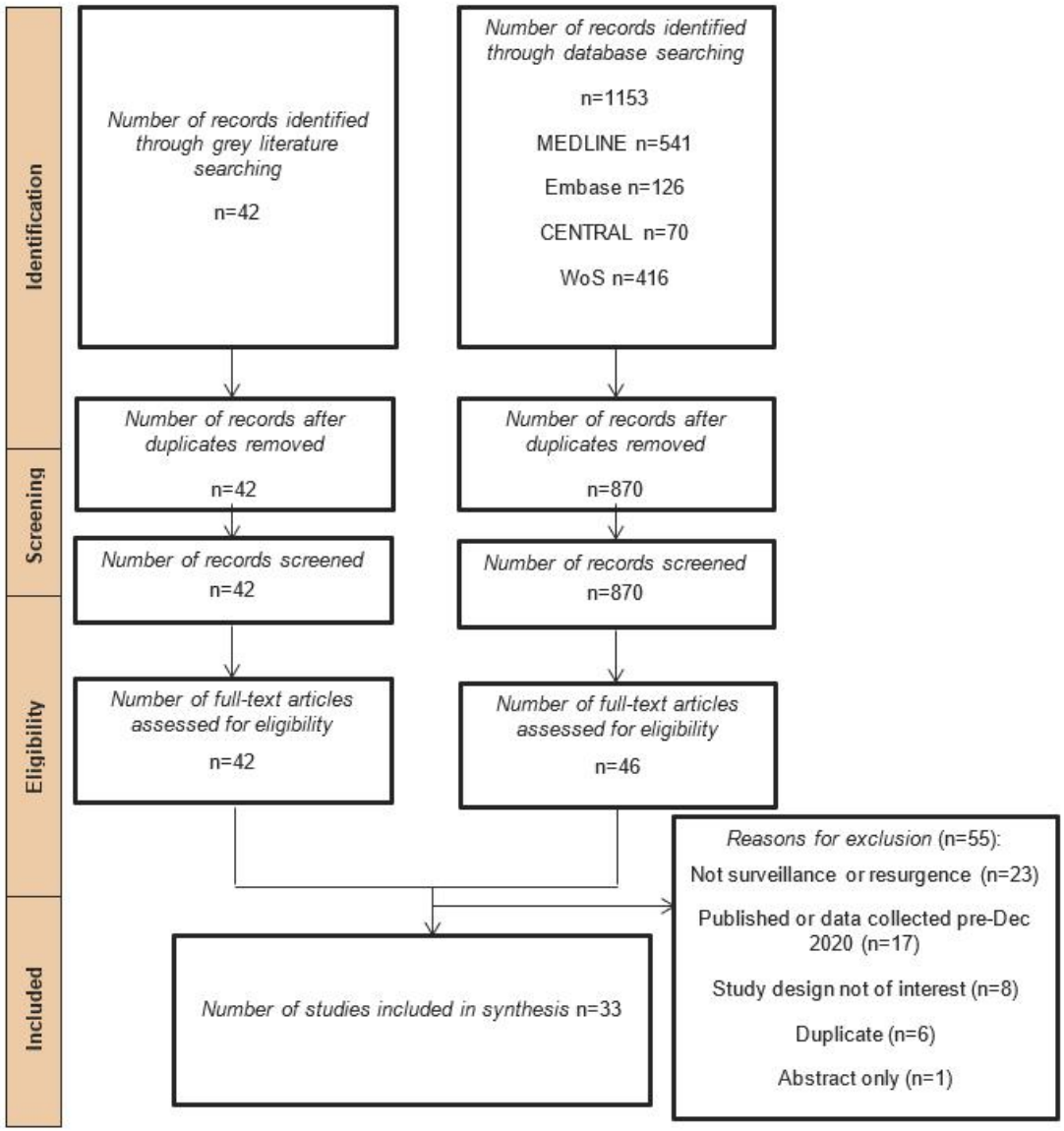
***Fully vaccinated** refers to individuals who have received complete dosage of a given vaccine

Methods

- A comprehensive literature search was conducted by and information specialist on Jun 13, 2021 to retrieve studies published from December 1, 2020 until search date
- Databases searched: MEDLINE, Embase, CENTRAL, and Web of Science
- A targeted grey literature search of pre-print servers, Google, and websites of international health organizations was also conducted
  - e.g., MedRxiv, COVID-END, WHO, CDC

Results

Figure 1: Flowchart of Studies Included in the Review of Scientific Evidence



SPOR EVIDENCE ALLIANCE

Strategy for Patient-Oriented Research SPOR Putting Patients First

Surveillance Methods for COVID-19 Cases

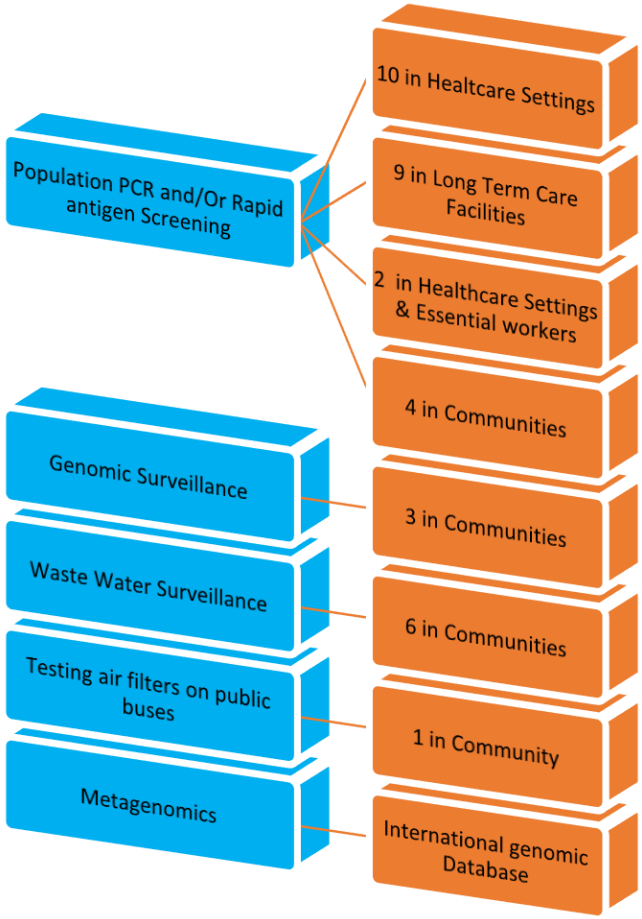


Figure 2: Summary of Scientific Evidence on Surveillance Methods

- 5 approaches to monitoring post-vaccination COVID-19 cases and emerging variants of concern:
  - Reverse transcriptase polymerase chain reaction (RT-PCR) or rapid antigen test, or a combination of the 2
  - Genomic surveillance
  - Wastewater surveillance
  - Metagenomics
  - Testing of air filters on public buses

Key messages

- Current scientific evidence suggests that population **PCR screening**, supplemented by **rapid antigen tests**, or a combination of both is the most frequently used surveillance method.
- Reverse transcriptase polymerase chain reaction (**RT-PCR**) detects the RNA genome of SARS-CoV-2 and has been the mainstay of COVID-19 diagnosis.[1]
- **Rapid antigen testing** was used to complement RT-PCR and less commonly used alone. This test detects the presence of viral proteins, is easy to perform, and can be interpreted without specialized training or equipment and widely distributed with a rapid turnaround time between sampling and results. However, they have lower sensitivities. [1-3]
  - Other approaches included: genomic surveillance [4], wastewater surveillance [5], metagenomics [6], and testing of air filters on public buses.[7]
- **Wastewater surveillance** may provide a non-invasive, anonymous, and scalable method of tracking the virus within the population, within a geographic area, at a point in time. [8]

Emerging Technologies

- The review included one new surveillance technology for COVID-19 that was studied in a real-world setting:
  - One study used filters placed in existing air filtration systems on public buses in Seattle to test for the presence of trapped SARS-CoV-2 RNA using phenol-chloroform extraction and RT-PCR (detected SARS-CoV-2 RNA in 14% of public bus filters tested). [7]

- The review also found several other new technologies that have been validated but have not yet been studied in a real-world setting. Some of these include:
  - Wearable monitoring device (BioButton) that continuously monitors skin temperature, heart rate, and respiratory rate for early detection of COVID-19 symptoms. [9]

  - Deep-learning based model to detect COVID-19 infection via CT scans and chest x-rays. [10]

Key Gaps

- Population-level tracking of the origin, distribution, and trends of COVID-19 is challenging especially considering the rapidly evolving profile of the virus.
- There is limited evidence on surveillance in fully vaccinated populations.
- Most studies examined existing surveillance programs; therefore, limited evidence was available on the economic build-out costs for implementation.
- We found very little data on the implementation of emerging surveillance technologies in real-world settings.

Considerations and Limitations

- The majority of studies were epidemiological studies of existing surveillance programs; therefore, the focus was on prespecified outcomes rather than the practicality of a surveillance program.

- Although all the studies included vaccinated populations, there were variations in the reporting of vaccination rate. While some of the hospital-based studies reported institutional vaccination rates, several large studies did not.

Acknowledgement

The SPOR Evidence Alliance is supported by the Canadian Institutes of Health Research (CIHR) under Canada's Strategy for Patient-Oriented Research (SPOR) Initiative.

This rapid review is funded by Health Canada and the SPOR Evidence Alliance.

References

1. Mercer TR, Salit M. Testing at scale during the COVID-19 pandemic. *Nature Reviews Genetics.* 2021;22(7):415-426.
2. Scohy A, Anantharajah A, Bodéus M, Kabamba-Mukadi B, Verroken A, Rodriguez-Villalobos H. Low performance of rapid antigen detection test as frontline testing for COVID-19 diagnosis. *Journal of Clinical Virology.* 2020;129:104455.
3. Perchetti GA, Huang M-L, Mills MG, Jerome KR, Greninger AL. Analytical sensitivity of the Abbott BinaxNOW COVID-19 Ag card. *Journal of Clinical Microbiology.* 2020;59(3):e02880-02820.
4. Rego N, Costábile A, Paz M, et al. Implementation of a qPCR assay coupled with genomic surveillance for real-time monitoring of SARS-CoV-2 variants of concern. *medRxiv.* 2021:2021.2005.2020.21256969.
5. Fitzgerald SF, Rossi G, Low AS, et al. COVID-19 mass testing: harnessing the power of wastewater epidemiology. *medRxiv.* 2021:2021.2005.2024.21257703.
6. Quinonez E, Vahed M, Hashemi Shahraki A, Mirsaeidi M. Structural Analysis of the Novel Variants of SARS-CoV-2 and Forecasting in North America. *Viruses.* 2021;13(5).
7. Hoffman J, Hirano M, Panpradist N, et al. Passively Sensing SARS-CoV-2 RNA in Public Transit Buses. *medRxiv.* 2021:2021.2006.2002.21258184.
8. Public Health Ontario. Focus on Wastewater surveillance of COVID-192021. https://www.publichealthontario.ca/-/media/documents/ncov/phm/2021/04/public-health-measures-wastewater-surveillance.pdf?la=en (accessed 23 June 2021).
9. Wendel SK, Zane, R., Faruki, A. BioButton COVID-19 vaccination monitoring operational pilot. 2021.
10. Saha P, Mukherjee D, Singh PK, Ahmadian A, Ferrara M, Sarkar R. GraphCovidNet: A graph neural network based model for detecting COVID-19 from CT scans and X-rays of chest. *Sci Rep.* 2021;11(1):8304.