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SYNOPSIS

03/15/2021

Review of "The temporal association of introducing and lifting non-pharmaceutical interventions with the time-varying reproduction number (R) of SARS-CoV-2: a modelling study across 131 countries"

Article citation: Li Y, Campbell H, Kulkarni D, Harpur A, Nundy M, Wang X, et al.; Usher Network for COVID-19 Evidence Reviews (UNCOVER) group. The temporal association of introducing and lifting non-pharmaceutical interventions with the time-varying reproduction number (R) of SARS-CoV-2: a modelling study across 131 countries. Lancet Infect Dis. 2021;21(2):193-202. Available from: https://doi.org/10.1016/S1473-3099(20)30785-4

One-minute summary

- This study modelled the association between introducing and relaxing eight different non-pharmaceutical interventions (NPIs) with the level of transmission of SARS-CoV-2, based on the time-varying reproduction number (R).
- It takes some time after introducing or relaxing NPIs to observe their effect on R. Using country-level data from Jan 1 and July 20, 2020, the authors report that after introducing an NPI, it took a median of 8 days (IQR: 6–9) to reach 60% of the maximum reduction in R, and after relaxing an NPI it took 17 days (IQR: 14–20) to reach 60% of the maximum increase in R. Each of the eight NPIs required a different amount of time to reach a certain level of effect.
- The R ratio decreased over time following the introduction of school closure, workplace closure, public event bans, bans on public gatherings of more than ten people, public transport closure, requirements to stay at home and internal movement limits, with a decrease in R ratio starting around day 7, and that ranged from 3% to 24% on day 28.
    - **After introduction of NPIs, Day 7 R ratio was (95% confidence interval [CI]):**
        - **School closure: 0.89 (0.82–0.97)**
        - **Workplace closure: 0.89 (0.83–0.96)**
        - **Public events ban: 0.90 (0.82–0.99)**
        - **Ban on gatherings of more than ten people: 0.93 (0.87–0.99)**
        - Public transport closure: 0.97 (0.91–1.04)
        - **Requirements to stay at home: 0.90 (0.85–0.97)**
        - Internal movement limits: 0.97 (0.90–1.03)
        - **International travel limits: 0.89 (0.81–0.98)**

    - **After introduction of NPIs, Day 28 R ratio was (95% CI):**

        - School closure: 0.85 (0.66–1.10)
        - Workplace closure: 0.87 (0.73–1.03)
        - **Public events ban: 0.76 (0.58–1.00)**
        - Ban on gatherings of more than ten people: 0.97 (0.83–1.14)
        - Public transport closure: 0.99 (0.84–1.18)
        - Requirements to stay at home: 0.97 (0.83–1.14)
        - Internal movement limits: 0.93 (0.79–1.10)
        - International travel limits: 1.08 (0.85–1.38)
- The R ratio increased over time following relaxation of school closure, workplace closure, bans on public events, bans on public gatherings of more than ten people, public transport closure, requirements to stay at home and internal movement limits, with an increase in R ratio that ranged from 11% to 25% on day 28.
    - **After relaxing of NPIs, Day 28 R ratio was (95% CI):**
        - **School closure: 1.24 (1.00–1.52)**
        - Workplace closure: 1.01 (0.83–1.25)
        - Public events ban: 1.21 (0.97–1.50)
        - **Ban on gatherings of more than ten people: 1.25 (1.03–1.51)**
        - Public transport closure: 1.04 (0.85–1.27)
        - Requirements to stay at home: 1.11 (0.94–1.32)
        - Internal movement limits: 1.13 (0.94–1.37)
        - International travel limits: 0.98 (0.68–1.40)
- In an ad-hoc analysis to address a possible SARS-CoV-2 resurgence, the authors modelled the effect of incremental introduction of NPIs and report the following:
    - Bans on public events and public gatherings of more than ten people could reduce R, with an R ratio of 0.71 (95% CI: 0.55–0.93) on day 28, decreasing to 0.62 (95% CI: 0.47–0.82) if workplace closures were added, decreasing to 0.58 (95% CI: 0.41–0.81) if workplace closures and internal movement restrictions were added, and decreasing to 0.48 (95% CI: 0.32–0.71) if workplace closures, internal movement restrictions, and stay at home orders were added.

Additional information

- The study used the EpiForecasts project by the London School of Hygiene & Tropical Medicine for country-level estimates of R, and obtained country-level NPI policies from the Oxford COVID-19 Government Response Tracker.
- The study linked a global dataset of NPI policies from 131 countries and a global dataset of their daily R estimates, and then modelled the change in R values (R ratio) using the R value on the day before the NPI change, and the R value at various time points since the NPI change, up to 28 days. An R ratio >1 indicated an increase in transmission since the change in NPI, and an R ratio <1 indicated a decrease in transmission.
- The authors modelled the R ratio using a log-linear regression with introducing and lifting each NPI as independent variables for each day of the first 28 days after the change in the NPI. The authors used the change of NPIs between two adjacent phases and the resulting R ratio to model the effect of introducing or lifting each of the eight NPIs.

- The model framework accounted for reporting delays, right truncation of notification dates and delays between onset and infection based on empiric data. The model framework was unable to account for the change over time in eligibility for testing, method of testing or case definition in different countries.
- The authors applied their regression model to the total workplace visits and the total time spent in residential areas using Google mobility data and found similar results for immediacy of NPI effect when compared to the R ratios for changes in workplace closures and requirements to stay home.
- The most common NPIs were stay at home requirements and restrictions on internal movements, and these NPIs were often introduced and lifted simultaneously.
- School closures and bans on public events were the first NPIs to be introduced and were lifted later than most NPIs.
- Stay at home requirements and public transport closures were the last two NPIs introduced and were relaxed before most other NPIs.

PHO reviewer's comments

- The authors performed several sensitivity analyses to address some limitations of their study and these results support their primary analyses.
- The findings from this study should be interpreted with caution given the following:
    - In many countries, some NPIs are implemented simultaneously. This study used modelling to estimate the average impact of individual NPIs on R across multiple jurisdictions; therefore, there is accompanying statistical uncertainty with these estimates. Further, effects of a given intervention in a specific jurisdiction may differ from those estimated here.
    - As the authors acknowledge, the innate limitations of the R measurement are still present in their study and the results should be interpreted with these known limitations.
    - Individual behaviours and public health measures have evolved dramatically since the start of the pandemic; thus, these results, based on data from January to July 2020 (i.e., the first wave), may no longer be generalizable to the current context, particularly given the appearance of viral variants and the evolution of stringency of NPIs.

Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Review of "The temporal association of introducing and lifting non-pharmaceutical interventions with the time-varying reproduction number (R) of SARS-CoV-2: a modelling study across 131 countries". Toronto, ON: Queen's Printer for Ontario; 2021.

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