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SYNOPSIS

Review of "Simulated Identification of Silent COVID-19 Infections among Children and Estimated Future Infection Rates with Vaccination"

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One-minute summary

- This study used a disease transmission model with data from the United States (US) from December 12, 2020 to February 26, 2021 to estimate the benefits of identifying silent (i.e., presymptomatic or asymptomatic) Coronavirus Disease 2019 (COVID-19) infections among children.
- With an effective reproduction number (R_e) of 1.2, 40% vaccination coverage of adults (>18 years) and no vaccination coverage of children (≤18 years), a targeted approach that identifies 11% of silent infections (E.g., via contact tracing and/or screening) among children within 2 days, and 14% within 3 days, after infection would bring one-year attack rates to less than 5%.
- If silent infections among children are undetected, achieving the same low attack rates would require a high vaccination coverage of greater than 80% of children, in addition to 40% vaccination coverage of adults.
- The authors' suggest that in the absence of vaccine availability for children, a targeted approach to rapidly identify silent COVID-19 infections in children was estimated to significantly mitigate disease burden. Without measures to interrupt transmission from silent infections, vaccination of adults is unlikely to contain the outbreak in the near term.

Additional information

- The study used an age-structured disease transmission model, using census data and estimates from the published literature, to simulate the estimated effect of interventions in reducing attack rates during the course of one year among a synthetic population representative of the

US demographic composition. The population included six age groups of 0 to 4, 5 to 10, 11 to 18, 19 to 49, 50 to 64, and 65 years or older.

- Model parameterization considered the following: asymptomatic rates of infection; relative transmissibility during different stages of infection; contact rates between and within age groups; time required from infection to identification of symptomatic and asymptomatic cases; vaccine coverage rates by age group (E.g., 80% of individuals 50 years and older and 22% of adults aged 18 to 49 years would be vaccinated); the R_e (1.2); pre-existing immunity in the population (10%); and vaccine efficacy (95%).

Results: Identification of Silent Infections in the Population

- In the absence of vaccination and with an R_e of 1.2, an overall attack rate of 10.8% (95% credible interval (CrI), 10.5%-11.2%) would be expected when no silent infections in the population are detected.

- If silent infections are identified within 2 or 3 days after infection, a rapid decline in the attack rate can be achieved with isolation of a relatively small (<16%) proportion of silent infections.

    - With 10% of silent infections identified in the population and isolated within 2 days of infection, the attack rate can be reduced to 3.4% (95% CrI, 3.2%-3.5%). To achieve the same 3.4% mean attack rate with delays, the following detection rates would be required: for a delay of 3 days, a detection rate of 13% for silent infections would be required; for a delay of 4 days, a detection rate of 42%; and for a delay of 5 days, a detection rate of 98%.

Results: Targeted Identification of Silent Infections among Children

- With vaccines distributed only to adults and assuming 40% coverage, estimated attack rates would be reduced to 12.5% (95% CrI, 11.9%-13.2%) among children and 8.2% (95% CrI, 7.8%-8.9%) among the overall population without identification of silent infections.

- The effect of a targeted strategy for identification of silent infections only among children on reducing attack rates was simulated.

    - Identification of at least 11% of silent infections within 2 days, and 14% within 3 days, would suppress the overall attack rate to less than 5%. With a delay of 4 days, an identification rate of 41% compared with a two day delay is needed to bring attack rates to less than 5%. With a delay of 5 days, an identification rate of 97% is needed to bring attack rates to less than 5%.

    - If silent infections among children are undetected, a high vaccination coverage of greater than 80% of this age group, in addition to 40% vaccination coverage of adults, must be achieved within one year to suppress attack rates to less than 5%. The authors indicate that even when vaccines become available for children, rapid identification of their silent infections will still be needed to mitigate disease burden in the population.

Other model simulations were performed which demonstrated that:

- When the vaccination coverage in adults was expanded from 40% to 60%, the minimum levels of identification of silent infection in children dropped from 11% to 5% with a delay of 2 days, and from 14% to 6% with a delay of 3 days.
- If susceptibility among children younger than 10 years was reduced by half and adults were vaccinated, then less contact tracing was necessary to control COVID-19. For example, 5% identification of silent infections within 2 days after infection, 6% within 3 days, 19% within 4 days, or 47% within 5 days would suppress the overall attack rate to less than 5%. Alternatively, vaccination coverage among children would need to reach 73% within one year.
    - The identification of silent infections had a greater estimated effect on reducing attack rates as the R_e increased (e.g., $R_e = 1.5$ versus 0.9).
- The authors noted the limitation that the models did not explicitly include the effects of non-pharmaceutical interventions, but instead calibrated the models to current estimates of the R_e that implicitly accounts for these effects.

PHO reviewer's comments

- Disease transmission models can be useful for decision-making with regards to disease mitigation measures. Rapid identification of silent infections in children may be important given the high rates of asymptomatic and pauci-symptomatic illness. However, the degree to which they contribute to transmission when other non-pharmaceutical interventions are in place is unclear. Asymptomatic high risk-contacts of cases are recommended to be tested according to current public health management guidance in Ontario. If a screening program is introduced, there are several logistical considerations warranted in order to support an effective program. One consideration would be the use of less invasive tests to improve uptake among children.
- The modelling for this study was performed for the period from December 12, 2020 to February 26, 2021 using US data. At this time, the COVID-19 epidemiology in the US differed from Canada. Further, this time period was prior to the incidence of several viral variants of concern that are considered to have increased transmissibility. Subsequent to the study time period, the rate of vaccination in the US and Canada differed. The study assumed vaccine efficacy of 95%. To date (April 26, 2021) in Ontario, the second dose interval has been delayed resulting in vaccine efficacy less than with two doses. The study also assumed the identification and isolation of symptomatic cases within 24 hours, which is not likely the case in Ontario, but may improve as the incidence of cases decreases. These factors should be taken into account when considering the generalizability of the model findings.

Citation

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