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EVIDENCE BRIEF

(ARCHIVED) Asymptomatic Screen Testing of Students who are Vaccine-Ineligible by Age for the 2021-22 Academic Year

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Key Messages

- The number of Coronavirus Disease 2019 (COVID-19) cases and outbreaks in schools reflects the community incidence. The single most important strategy for reducing the burden of COVID-19 in schools are community public health measures and maintaining low incidence in the community.
- One-time asymptomatic screen testing (using antigen or PCR) is associated with a low yield and high resource utilization.
- Repeat screen testing programs (using antigen or PCR) may lead to increased case detection in schools. However, there is limited evidence around the impact on transmission / school outbreaks / closures. Modelling studies suggest that rapid antigen screen testing would need to be completed at least twice a week to be of benefit for early case detection to reduce transmission.
- There are significant logistical, feasibility and operational considerations associated with asymptomatic screen testing programs, which vary depending on whether antigen or PCR testing is used. This response focuses on rapid antigen screen testing given that PCR is not currently being considered for the purposes of widespread repeat screen testing.
- Antigen screen testing has a high specificity for detecting infection and provides a rapid result, but confirmatory PCR testing of positive results is currently required.[1] Current available antigen tests are validated using nasal swabs only. On-site testing prior to school entry is unlikely to be feasible based on the experience with long-term care homes with staff testing. At–home rapid antigen screen testing is more feasible and likely acceptable alternative to on-site testing; education and training resources for parents and students would be required, especially to ensure that antigen testing is not used for diagnostic purposes.

- The incremental benefit of repeat antigen testing in addition to the current broad health and safety measures in schools remains uncertain. The sensitivity of currently available antigen tests is estimated at 50% in asymptomatic individuals (based on a one-time test), with lower sensitivity anticipated in children and with home-based testing.[2-6] However, individuals with high viral loads are more likely to be detected, and with repeat screening the sensitivity is improved. Regardless, repeat antigen testing alone will not prevent transmission and outbreaks; other health and safety measures should continue.

- Repeat antigen test screening, especially when community incidence is low, increases the risk of false positive results. With a presumptive test specificity ranging from 99.5% to 99.9%, if 500,000 students are screened a day, there will be between 500 and 2,500 false positive results.[6] Positive screen results will result in school exclusion and currently require PCR confirmation, which would impact diagnostic testing capacity and have further implications for household and school cohort management. The impact of these false positive results needs to be weighed against the positive impacts of case detection, the number of which will depend on community infection rates.

- For antigen screen testing programs, the impact on early case detection depends on uptake and continued adherence to screen testing protocols. Given that test uptake and adherence have been low in most reported studies of voluntary programs in schools, it would be important to ensure that community supports are in place to communicate program goals and manage positive results. Few jurisdictions have reported home-based antigen screening programs that have been successfully implemented and sustained beyond a brief period of high community transmission.

- The Ontario-specific modelling study by Moghadas et al. (2021) that assumed a 76% vaccination rate in eligible individuals and the context of Delta, did not define a specific threshold, but assessed the impact of frequency of testing when the annual attack rate was 3.2% (equating to approximately 63,000 infections in those < 12 years over a one year period).[7] In this scenario, identifying 20% of silent infections in those <12 years within 2 days reduced the attack rate in this age group from ~3.2% to ~0.5%. Identifying 20% of silent infections within 5 days reduced the attack rate in this age group from ~3.2% to ~2.5%.

- An absolute threshold to initiate asymptomatic screen testing is difficult to define. Models on silent transmission fall short of defining a threshold above which asymptomatic screen testing has additional value in reducing in-school transmission. As there is an element of risk tolerance, further modeling is recommended to examine the opportunity costs of various thresholds above which asymptomatic screen testing will be introduced in schools. Important considerations include factors such as days of in-person attendance lost/gained, healthcare utilization (particularly, pediatric critical care capacity and persistent staffing shortages in urban and rural settings), access to remote learning especially in marginalized, rural and remote Northern communities, and wrap-around supports to students and families with positive test result.

- Initiation of an antigen screen testing program may be most effective in situations where students and families are motivated to complete the testing, for example, in situations of high community transmission or when multiple cases are detected in the school to support ongoing school attendance.

Issue and Research Question

The importance of in-person schooling for the overall health, development, and wellbeing of children and youth has been increasingly recognized during the COVID-19 pandemic.[8-12] In Ontario and other international jurisdictions, elementary and secondary school SARS-CoV-2 case rates generally reflected community incidence during the 2020-21 school year.[13-16]

Identifying SARS-CoV-2 cases to allow for appropriate and early case and contact management is an important health and safety measure in schools. There are two options for case identification: diagnostic testing and screen testing.

- Diagnostic SARS-CoV-2 testing refers to testing individuals who either have signs and symptoms of SARS-CoV-2 or have a known exposure to an individual with SARS-CoV-2. In these situations, there is a higher pre-test probability of a positive result and high-sensitivity tests (i.e., PCR) are generally recommended.

- Approximately one-third of children with SARS-CoV-2 infection are asymptomatic or have mild symptoms.[17,18] Therefore, symptom- and exposure-based testing approaches will under-detect asymptomatic, and paucisymptomatic cases who do not have a known exposure/link to an outbreak.

- Asymptomatic screen testing (i.e. testing in the absence of an exposure) is a strategy that seeks to identify and exclude infected individuals who are asymptomatic or pre-symptomatic, thereby potentially reducing in-school exposures.

- For the purposes of this review, “one-time screen testing” refers to targeted testing of asymptomatic in-person school attendees at a single point in time, typically applied in response to high community incidence or other local context. “Repeat screen testing” refers to serial testing of the same asymptomatic in-person school attendees as an ongoing screening program for low-risk individuals as part of a suite of prevention measures.

The objective of this document is to summarize evidence on the role of these asymptomatic screen testing strategies as a risk mitigation measure to prevent school transmission, outbreaks and closures. Evidence of use of asymptomatic screen testing in high school age (unvaccinated) students as well as for extra-curricular (non-school-based) attendance was also included for the purpose of understanding effectiveness of programs, but the results may not be generalizable to younger populations.

Evidence on asymptomatic screen testing using PCR was included for the purposes of understanding implementation considerations, but is not summarized in the key findings or implications given PCR is not currently being considered for the purposes of widespread repeat screen testing in order to preserve diagnostic capacity.

This Evidence Brief consists of literature and evidence identified by the Testing Strategy Expert Panel, subject matter experts at Public Health Ontario (PHO), and Ontario’s Evidence Synthesis Network to address two key questions:

- What is the evidence surrounding asymptomatic screen testing as a risk mitigation strategy to detect cases in schools?

- What are considerations for implementation of asymptomatic screen testing in the school environment?

- The following topics are beyond the scope of this review: the role of antigen or PCR testing for diagnosis (e.g. case and contact management) and the role that asymptomatic screen testing may play in school outbreak management and broader public health surveillance.

Methods

The methods for this document consist of the comprehensive rapid review of published and grey literature on the effectiveness of asymptomatic SARS-CoV-2 screen testing of in-person school attendees, as well as a jurisdictional scan of asymptomatic testing approaches.

On April 1, 2021, Ontario's Evidence Synthesis Network conducted a comprehensive rapid review of the published and grey literature for evidence on the effectiveness of asymptomatic SARS-CoV-2 screen testing of in-person school attendees. Published, peer-reviewed articles and review articles were identified through PubMed, COVID-19 Evidence Network to support Decision-making (COVID-END), and Google Scholar. Grey literature was identified through Google and relevant government websites. The search was limited to English sources and therefore may not capture the full extent of initiatives in non-English speaking countries. Full-text results extracted were limited to those available through Open Access or studies made available by project partners.

In April 2021, a jurisdictional scan of school-based asymptomatic screen testing practices was conducted. In June 2021, this scan was supplemented through email inquiries to infectious disease specialists and public health physicians across Canada and in the United States. In August 2021, targeted searches of government websites was conducted to ensure this jurisdictional information was up to date.

Evidence on Asymptomatic Testing in School-age Children

Evidence on Asymptomatic Screen Testing Programs

REPEAT SCREEN TESTING PROGRAMS

- SARS-CoV-2 screening programs have offered repeat testing of students and/or education staff through opt-in and opt-out programs at school. There have been several observational cohort studies from North America and Europe that evaluated the use of serial PCR or rapid antigen testing in asymptomatic students and/or staff to identify SARS-CoV-2 cases.[19-26]

- The majority of these studies have evaluated asymptomatic screen testing in a small number of targeted schools and/or targeted populations. These studies were also conducted prior to the widespread availability of vaccination, which is now approved and available for those 12 and older in Ontario.

- With respect to regions that have implemented asymptomatic screen testing more broadly in schools (see jurisdictional scan), both the United States (US) and European testing recommendations have moved away from mandatory asymptomatic screen testing in younger age groups, given the challenges with compliance associated with repeat testing.[27,28]

- In Nebraska, during a 5-week period during which SARS-CoV-2 was at its highest prevalence in the community, voluntary weekly saliva PCR testing detected 22 additional cases among 315 asymptomatic students (12% participation) from marginalized communities (nearly 90% were eligible for financial assistance) and 24 additional cases among 455 asymptomatic school-based staff (96% participation).[20]

- Utah's Test-to-Play program mandated rapid antigen testing every 14 days for students to participate in extra-curricular activities, including indoor clubs and sports. Through this program, approximately 95% of extra-curricular activities were able to continue through the winter period of high community prevalence.[21]

- In Canada, rapid antigen testing using nasal swabs was deployed in two Montreal-area high schools prior to vaccine eligibility among staff and students, with 25% consenting to being randomly tested once a week by research staff, and paired with laboratory-based PCR test on self-collected gargle specimens. Over a 12-week period, PCR-based testing detected 14 cases among 3,618 asymptomatic students (0.39%) and zero cases among 617 asymptomatic staff (5 PCR-positive student samples were also positive by rapid antigen test) in the context of high prevalence of SARS-CoV-2 in the community (Dr. C. Quach, personal communication).

- In Ontario, numerous testing models emerged following direction from the Ministry of Education in January 2021 for school boards to undertake asymptomatic testing in 5% of schools and to target 2% of the student population per week, with a priority on schools in areas of high transmission, with high case numbers, and those where access to current testing programs may be challenging.

- In East Toronto, thirteen schools were identified in communities with high incidence of SARS-CoV-2, and weekly asymptomatic testing with wrap-around supports was offered to 20% of randomly selected students from JK to Grade 12 classes over the five weeks before schools were closed to in-person learning. The testing was conducted on-site in the high school setting, and through take-home, oral-nasal PCR-based testing kits for K-8 schools. Testing was conducted while community rates were steadily increasing and an increasing number of asymptomatic cases were detected. Prior to school closures in April 2021, this testing strategy identified 10 cases among 335 asymptomatic, non-exposed students, with test positivity ranging from 0.4% in week 1 to a peak of 3% in week 4, and 62% overall uptake (peak 68% in week 1, 56% in week 3) when community test positivity rate was 7% (Dr. J. McCready, personal communication). Other related cases were found linked to the asymptomatic contacts in household members.

ONE-TIME SCREEN TESTING PROGRAMS

- There are limited studies on the utility of voluntary one-time screen testing as a risk mitigation strategy. Experience to date suggests that these initiatives are low yield, especially when community incidence is low.

- The DETECT Schools Study in Western Australia involved random "spot-testing" in 40 schools, with 150 students and staff at each school per month for 3–6 months. The study was undertaken at a time of sporadic SARS-CoV-2 cases and no community transmission. More than 4,500 participants had combined oropharyngeal and anterior nasal swabs sent for PCR testing; all 13,988 swabs tested negative for SARS-CoV-2.[29,30]

- In Utah, a Test-to-Stay program was instituted when a school crossed a specified threshold of cases in the school. Thirteen schools offered a one-time rapid antigen test (BinaxNOW) to all unvaccinated students and staff who had neither symptoms nor high-risk exposure to cases; 0.7% had a positive result and were excluded from school. The rest continued in-person instruction, leading to an estimated 109,752 in-person instruction student-days saved in the context of high community prevalence.[21]

- Under Ontario's targeted asymptomatic testing strategy launched in February 2021, students and staff from 3,071 schools were invited for asymptomatic screen testing in school-based mobile clinics using either lab-based PCR or rapid antigen tests.[31] As of June 19, 2021, 64,876 tests were completed, yielding 481 confirmed cases (0.74% positivity). Only about 2-3% of students who were invited for testing were actually tested, and included students with high-risk exposures.[32]

- In Ottawa from January to March, 2021, school-based clinics offered rapid antigen testing from mid-nasal swabs as one-time screening to students, staff and their families in neighbourhoods that had seen increasing rates of SARS-CoV-2 infections in recent weeks. Individuals who presented with a history of high-risk exposure or symptoms, or who had a positive rapid test, also had a nasopharyngeal swab to detect SARS-CoV-2 by PCR.[33] Over eight weekends between January and March 2021, 16 students tested positive by rapid antigen testing out of 3,315 total students tested (0.48%, confirmed by PCR) with no false positive rapid tests; only 5 antigen test-positive students tested (0.15% of total students tested) were asymptomatic without high-risk exposures.[33]

- Higher community incidence of SARS-CoV-2 increases the pre-test probability, or likelihood of cases detected in schools.[15] In the Toronto East region, one-time PCR testing was offered in the fall of 2020 in communities that had been disproportionately impacted by the pandemic due to associated risk factors for SARS-CoV-2 transmission, including low-income and high-density racialized neighbourhoods with multigenerational homes. Many participating schools had multiple cases detected and outbreaks declared. One-time asymptomatic screen testing was conducted during a period of high community prevalence in late-Fall 2020 at six schools. With strong community engagement and test uptake, 1%, 2%, 4.5%, 5.6%, 6% and 11% of students without a history of symptoms or high-risk exposures, respectively, were found to test positive for SARS-CoV-2. This was in the context of overwhelmed contact tracing capacity, high test uptake among exposed cohorts, and efforts to identify chains of transmission in the community through easily accessible local 'pop-up' testing centres located within walking distance of these schools.

Jurisdictional Experiences with Asymptomatic Screen Testing of School-age Children

Asymptomatic screen testing strategies (both repeat and one-time screening) have been implemented in various jurisdictions, including Ontario, as a strategy to identify SARS-CoV-2 cases, primarily among students, within the school environment. The section below summarizes the asymptomatic testing programs implemented in select jurisdictions, and any available outcomes from these programs.

Summary of select Asymptomatic screen Testing programs and reported outcomes

Select studies have examined the outcomes of these testing programs in the pre-vaccine period; for more details see **Table 1**. In addition to these studies, the points below summarize the components of select jurisdictions' asymptomatic testing programs as well as whether jurisdictional approaches to asymptomatic testing are still included in the guidance for the 2021-22 school year.

UNITED KINGDOM

- The Department of Education maintains guidance on asymptomatic screen testing using rapid antigen tests (lateral flow devices). Schools would only provide tests for twice weekly asymptomatic testing for students over the summer period if they were attending school settings. However, testing was still widely available over the summer and kits could be collected either from the local pharmacy or ordered online.[34]

- School settings may commence asymptomatic testing from three working days before the start of term and can stagger return of pupils across the first week to manage this. Students should then continue to test twice weekly at home until the end of September 2021, when this will be reviewed [34]

- Secondary schools should also retain a small asymptomatic testing site until further notice so they can offer testing to students who are unable to test themselves at home; note that mRNA vaccines have not been approved in otherwise healthy 12-15 year-olds in the UK, and only recently approved for 16-17 year-old youth.[34,35]

- Students with a positive test result should self-isolate in line with the stay at home guidance. They will also need to get a free PCR test to check if they have COVID-19, and must continue to self-isolate while awaiting these results.[34]

UTAH

- On March 24, 2021, the "Test to Stay" testing strategy was incorporated into Utah Senate Bill 107 on the prioritization of in-person instruction.[36] The bill indicates that "Test to Stay" is required in K-12 schools. Testing events, with rapid antigen test kits provided by the Utah Department of Health (UDOH), should be done in coordination with the local health department and are required to take place when a certain number of students test positive for COVID-19 at one point in time in a 14-day window. Schools can request assistance from the UDOH for "Test to Stay" events.[37]

- Under "Test to Stay", which began January 4, 2021, the threshold of cases in schools during the previous 14 days (defined as the "outbreak threshold") was recommended by the UDOH as 1% of the school population for schools with >1,500 students and staff members and 15 cases for schools with ≤1,500 students and staff members. The period of advised remote instruction and quarantine of the unvaccinated staff and student body after crossing the outbreak threshold was changed to 10 days.[21] Beginning March 24, 2021, per the Utah Senate Bill 107,[36] the outbreak threshold changed such that a school would be required to conduct a "Test to Stay" event if student cases during the previous 14 days reached 2% of the school's student population for schools with ≥1,500 students and 30 students for schools with <1,500 students.

- Studies have reported the outcomes of Utah's "Test to Stay" and "Test to Play" strategies during the 2020-21 school year. For both programs, the UDOH provided training and rapid antigen test kits to school staff members, who performed school-based rapid antigen testing (e.g., in school gymnasiums), supported by UDOH and local health departments.[21]
- The "Test to Play" strategy was implemented in 66% (127 of 193) of Utah's public high schools during the 2020-21 school year. In order to participate in extracurricular activities such as sports, students took part in mandatory, rapid antigen testing every 14 days.[21]
- The "Test to Stay" was presented as an option when schools had outbreaks. From January 4 to March 5, 2021, out of the 28 high schools that reported outbreaks 13 elected to conduct school-wide single-day Test to Stay events. Students who tested positive were required to isolate for 10 days while students who tested negative could continue in-person learning with masking, distancing and cohorting as school-based mitigation measures. Of note, 60% school participation was required in the testing event, and the percent positivity of the testing event had to be less than 2.5%. If asymptomatic students tested positive in the screening program, and had been wearing masks when in contact with other unvaccinated individuals, then the contact would not be considered exposed and would not have to self-isolate.
- After testing events, these 13 schools continued in-person instruction, collectively saving an estimated 109,752 in-person instruction student-days.[21]
- Between November 30, 2020 and March 20, 2021, schools reported a total of 165,078 tests among high school students in Test to Play and Test to Stay. Furthermore, among the 59,552 students who received at least one test, 1,886 (3.2%) had a positive result (i.e., over a prolonged period across all participating schools and events, therefore higher than 2.5%).[21]

NEW YORK

- During the 2020-21 school year, New York State Department of Health implemented a mandatory statewide surveillance testing program that sampled staff and students in all schools in zones at higher risk for COVID-19 transmission. The state defined yellow (3% positivity rate and 10% of hospital admissions), orange (4% positivity rate and 85% hospital capacity) and red (elective procedures cancelled, 90% hospital capacity occupied) zones for which the state required 20%, 20% and 30% respectively of in-person students and staff to complete a test.[38] The state distributed rapid testing kits and testing resources primarily through local health departments, streamlined the process for local laboratories to become licensed to analyze samples, and instituted reporting requirements and a state dashboard for displaying results.[39]
- While the CDC recommends working with local public health officials to determine whether screen testing should be offered in schools, there is no asymptomatic testing program in the guidance for K-12 schools for the 2021-22 school year.[40]

Table 1. Summary of studies examining the outcome of asymptomatic testing programs in select jurisdictions

Location	Population	Study method	Modality, Frequency	Results
Utah, USA[21]	"Test to Stay": **students** at 13 high schools "Test to Play": **students** at 127 high schools	Prospective cohort – repeat screen testing	"Test to Stay": 14 events from January 4 to March 20, 2021 "Test to Play": every 14 days Modality: Abbott BinaxNOW rapid antigen nasal swab test kits	Continued in-person instruction once school crossed outbreak threshold. Among 59,552 students, 1,886 (3.2%) tested positive through these programs. Estimated 109,752 in-person instruction student-days saved.
New York City, NY[38]	Randomly selected group of **staff and students**, consisting of 10–20% of a school's population	Prospective cohort – repeat screen testing	Modality: Rapid molecular testing Frequency: on-site mandatory monthly surveillance testing (increased to weekly in December 2020)	Prior to November 19, 2020, a randomly selected group of staff and students, consisting of 10–20% of a school's population, participated in mandatory monthly surveillance testing. On December 7, 2020, test frequency increased to 20% of students and staff every week using a short nasal swab for molecular testing, with results available within 3 days.

Considerations for Implementation of Asymptomatic Screen Testing in Schools

- Screen testing strategies require close collaboration with school boards, public health units, testing and laboratory partners, funders and community support programs to ensure access and acceptability of testing among students and families.
- Repeat and one-time screen testing can be challenging for schools to implement, with respect to access to testing, implications / risks with testing itself, including possible discomfort, result disclosure, and consequences such as cohort dismissal.
- An important limitation of voluntary testing initiatives is that they may not capture populations at risk of SARS-CoV-2 exposure and infection if access to testing is not readily available and if supports are not in place should a positive test be detected (e.g., paid sick leave for caregivers) and therefore make testing less desirable.[41]

- For antigen screen testing programs, the impact on early case detection depends on uptake and continued adherence to screen testing protocols. Antigen screening program may have the highest uptake and benefit in situations where students and families are motivated to complete the testing, for example, in situations where serial antigen screen testing is instituted when there is high community transmission or when multiple cases are detected in the school (or to allow continued attendance in the context of a school outbreak) and screening is part of other response measures to support ongoing in-person school attendance. In these situations, there is also a higher pre-test probability and predictive value for testing. However, sufficient system capacity is required to rapidly deploy antigen screen testing kits in these scenarios, and that the capacity is also equitably distributed across the province.

Vaccine Status and Population Targets

- Given high vaccine efficacy, repeat asymptomatic screen testing is likely to be lower yield in a highly vaccinated population. As a result, asymptomatic screen testing strategies should take into consideration vaccine availability and uptake. In Ontario, with vaccine available for those 12 years of age and older, school screening programs are likely to be of more benefit for case detection in those who are unvaccinated, in particular, those under 12 years of age until a COVID-19 vaccine is approved for use in this age group.

- In Ontario, the most experience with asymptomatic screen testing has been in long-term care (LTC). Between June 28, 2020 and March 13, 2021 weekly repeat screen testing yielded an overall test positivity of 0.16% among staff, which decreased to <0.1% during periods of low SARS-CoV-2 community incidence.[42] Recent changes to the Ontario Ministry of Long-Term Care's asymptomatic screen testing directive discontinued screen testing for fully SARS-CoV-2 vaccinated LTC staff given this low yield and the subsequent high vaccination rates.

- Simulation models of US and French cohorts demonstrated the potential contribution of repeat screen testing to rapidly identify and contain cases among students and the impact of vaccination among adults, educators and youth.[7,43] Repeat screen testing reduced introduction of infections into schools by at least 20% when 50% of educators and youth were fully vaccinated, and test uptake among unvaccinated individuals was 50%; the impact was limited with adherence rates of 10%.[7,43]

- In an updated analysis using Ontario data, taking into consideration the highly-transmissible Delta variant, achieving a 2-dose vaccine coverage of 76% among 12-17 year olds and adults was associated with substantial reductions in attack rates among 0-11 year old children, even in the absence of other health and safety measures (including asymptomatic repeat screen testing).[7] I

    - Initially, the model examined an attack rate of 10% among children aged 0-11 years under an assumption of 25% 2-dose vaccine coverage in those aged 12 years or older. When this assumption was changed to 76% coverage, the corresponding attack rate (i.e. reduction via increased vaccination alone) in the 0-11 year olds was approximately 3.2%.[7]

- As of September 7, 2021, 2-dose coverage is estimated to be 77% of the eligible population. Assuming 76% 2-dose coverage, the authors examined the impact of serial testing in low, medium, and high attack rate scenarios, with high attack rates estimated at 3.2% (over the course of one year) of the population aged 0-11 years.

- This equates to approximately 63,000 cases in a year in children < 12 years old (~62/100,000/week). Weekly confirmed case incidence in Ontario in children 5-11 years old was > 60/100,000/week for approximately 6 weeks in wave 2 and for 10 weeks in wave 3.[44] As of August 28, 2021, case rates were ~30/100,000/week among 5-11 year olds, and on an upward trajectory.

- While estimated attack rates were lower with increased (i.e. 76%) 2-dose coverage in those ≥12 years, identifying silent infections may further reduce attack rates. In the 3.2% attack rate scenario, identifying 20% of silent infections within 2 days reduced the attack rate in this age group from ~3.2% to ~0.5%. Identifying 20% of silent infections within 5 days reduced the attack rate from ~3.2% to ~2.5%.

- The authors set an arbitrary threshold of 3% overall attack rate in the population, with the model estimating what proportion of silent infections in children need to be identified in order to keep the overall attack rate below this threshold, under varying assumptions. In the authors' previous paper, they used 5% annual attack rate as their pre-set threshold for success of screening (this threshold was based on examining the attack rates from wave 1 of the COVID-19 pandemic).[7] This threshold does **not** reflect a modelled "threshold" at which to introduce screen testing, but rather an arbitrary pre-annual attack rate.

- Additional non-pharmaceutical interventions were not incorporated into the model, therefore the reduction in attack rates reflect the impact of identifying 'silent infections' in those <12 years. The model assumed that any symptomatic cases were identified within 24 hours of symptom onset.

- The model does not take into account the feasibility considerations for rapidly initiating and sustaining antigen testing, or the broader implications of community case rates if rates in children are high. It also does not take into account the impact of other simultaneously implemented non-pharmaceutical interventions that would likely be necessary at high community transmission levels

Testing Methods

- SARS-CoV-2 specimen types include nasopharyngeal swabs, oral-nasal swabs, throat swabs, saline mouth rinse/gargle and saliva.[45]

- The type of test being completed may necessitate the use of a specific specimen type; rapid antigen tests are currently only approved on nasopharyngeal or nasal swab specimens versus any approved specimen can be used for diagnostic (i.e. PCR) testing.

- The specimen type used for testing is likely to influence its uptake, especially for screen testing purposes. The use of less invasive methods, such as oral-nasal swabs, gargles or saliva, may encourage increase testing uptake as they can be easily tolerated down to approximately 4 years of age.[46-48]

- Utilization of saliva necessitates the use of molecular (PCR) testing which could impact diagnostic testing capacity and result in prolonging turnaround time on both diagnostic and screen testing samples.

- Rapid antigen tests currently require nasopharyngeal or nasal swabs and have been shown to have [49-53] a sensitivity of less than 50% as a single test in an asymptomatic population, yet have increasing sensitivity when viral concentrations are higher and with repeat screening. While their sensitivity in children using nasal swabs is unknown, the serial testing approach is designed to off-set these relative losses, albeit with significant logistical considerations (see section below).

- Widespread use of rapid antigen tests in the asymptomatic population may result in false-positive events and it is recommended that positive antigen results be confirmed with PCR-based testing.

Logistics

- The uptake of school-based testing is influenced by budget, human resources and adoptability in the community. An agent-based model developed in the US projected that weekly antigen screen testing of all students and staff, alongside other mitigation measures such as masking and distancing, would reduce in-school infections by 50%. However, less frequent testing was projected to add limited value above and beyond other mitigation strategies.[54]

- The administration of asymptomatic screen testing requires consent for a sample to be collected for testing from either the parent/caregiver or the student (depending on age/capacity) and may be implied or provided on an annual or semester basis. Registration and results management need to be well-defined, with technical support and linkages between laboratory results and case and contact management databases within local public health units.

- The location of testing is an important consideration. On-site antigen screen testing programs will require qualified and trained staff to test each child prior to entry into the school in a timely way to avoid line-ups. Screen testing prior to entry proved to be infeasible in the LTC home setting in Ontario, and there were substantially fewer staff that needed to be tested prior to entry, when compared to the number of children entering school.[53]

- In Ontario, LTC staff were tested throughout the shift.[42] A similar approach testing children throughout the school day would have several logistical challenges, including significant coordination and support from public health, education and testing partners to hire technical staff and implement the program. All positive screen tests require molecular testing confirmation, and public health actions beyond testing and isolating the student theoretically should not occur before confirmation. However, this would be challenging in the school setting as rapid antigen test results that are done during the school day are likely to be known by other classmates and/or the student dismissal would be noted after testing, which could lead to concern by teachers and students in proceeding with the school day. In addition, it would be important to consider the potential for stigmatization associated with identifying positive cases at school as well as the visible identification among peers of children who do not participate, leading to significant equity issues.

- Concerns around stigmatization could be reduced by the use of pooled samples for screen testing, and dismissal of the entire cohort if positive. However, this requires PCR testing and would result in a delay in testing and identification of cases for contact tracing. In high incidence areas, when pooled testing would be frequently positive, it would likely to lead to higher resource use, in which asymptomatic screening of individuals would be more helpful. Currently, many laboratories in Ontario do not process pooled samples due to the high laboratory resources needed to do so and challenges automating the process.

- The availability of at-home testing options with less invasive sampling sites (e.g. saliva, nasal, or buccal-oral-nasal swabs) could overcome some of these barriers. [53]

Evaluation of Outcomes of Testing

- Objectives and metrics are important for school administrations, public health officials and school communities to keep track on the progress of school-based testing and to increase confidence in the health and safety measures among in-person school attendees. Other metrics include the number of cohort dismissals due to an asymptomatic test-positive individual, and number of days of in-person instruction at an individual and class unit level. Schools in Utah saw an increase in the number of in-person days saved through one-time screen testing once the school's case numbers crossed a pre-defined threshold, likely because the alternative was an entire school closure for 14 days as part the state department of health's outbreak response.[21] Moreover, secondary students had greater access to, and sustained participation in, indoor extra-curricular activities during periods of high community transmission through repeat screen testing, with an observed increase in mask-wearing behaviour in the school environment. In a school modeling study based on data from France, regular rapid antigen screen testing with self-collected nasal swabs was anticipated to lead to fewer class closures compared to conventional symptom-based testing.[43]

- With increasing community incidence of SARS-CoV-2, the goals of asymptomatic screen testing need to be clear, and appropriate public health and laboratory resources secured to ensure the testing, tracing and isolation of high-risk individuals. It will be important to ensure the approach is not inequitably based on race, ethnicity or income, but rather on epidemiology and that an evaluation process be in place to determine the utility of asymptomatic screen testing in situations where public health systems are delayed in confirming and tracing all asymptomatic positive tests alongside individuals with symptomatic illness or high-risk exposures.

Communication and Equity Considerations

- The ripple effects from positive results from screen testing include staffing shortages (if low vaccine uptake), lost academic days and exclusion from work for employed household members (if unvaccinated). Moreover, there are inequitable impacts of the COVID-19 pandemic within marginalized and racialized communities. The COVID-19 pandemic has disproportionately affected racialized communities in Ontario,[55] as well as communities with the highest density of essential workers and low income levels.[56] Voluntary participation in screen testing programs may not capture rates among families who are marginalized and/or cannot afford the consequences of a positive test result, underscoring the importance of paid sick days and community programs to support self-isolation, quarantine, and food security.[41]

- If testing is mandatory, it may lead to school refusal and may reduce in-school attendance. Conversely, if testing is not mandatory, there are potential equity concerns and selection bias of who is getting tested, in addition to potential stigmatization of those who do/do not get tested.[20,57,58]

- Case detection through screening will likely exacerbate inequities as cases and exposed cohorts are identified, isolated, and pivoted to remote learning; thus, community partnerships and creative learning models to support children and youth with barriers to accessing technology will be important in promoting academic achievement.[59] In addition, there may be concerns that people who test positive may not adhere to notifying contacts and isolation behaviours; however, compliance can be improved with communication and wrap-around community supports.[60]

- If introduced into the school setting, asymptomatic screen testing should be communicated as an added safety measure to provide students, families and school staff with additional confidence to return to the classrooms in those areas hardest hit by COVID-19. Enablers to enhanced test uptake include letters in multiple languages, home collection kits, child-friendly instructional video and pictures, and community wrap-around supports, including financial aid and obtaining essentials (i.e. food, medications) for families with a test-positive individual.

Implications for Practice

- The number of COVID-19 cases and outbreaks in schools reflects the community incidence. The single most important strategy for reducing the burden of COVID-19 in schools are community public health measures, including COVID-19 vaccination and appropriate ongoing non-pharmacological measures that achieve and maintain low incidence in the community.[61,62]

- The current evidence described above indicates that one-time screen testing is not helpful as an additional mitigation strategy against SARS-CoV-2 transmission in school settings.

- There is some evidence that repeat antigen screen testing will identify asymptomatic and pre-symptomatic cases in schools when community incidence is high. In addition, modeling studies support the effectiveness of repeat screen testing in addition to other public health measures (including COVID-19 vaccination), to reduce outbreaks in schools.[63] However, these models require the use of frequent testing (2 or more times per week) to be effective.

- There are important logistic, cost and equity considerations with asymptomatic screen testing programs. With any screening program, it is essential to ensure that community supports are in place to communicate program goals and manage positive results.

- For antigen screen testing programs, the impact on early case detection depends on uptake and continued adherence to screen testing protocols. Therefore, antigen screening program may be most effective in situations where students and families are motivated to complete the testing, for example, in situations of high community transmission or when multiple cases are detected in the school (or school outbreak is declared) to support ongoing school attendance

- The use of less invasive samples is also likely to improve uptake. For rapid antigen testing, which is the testing modality most commonly used for asymptomatic screening, there is currently no Health Canada-approved saliva test. Existing specimen collection methods are nasal and may be less acceptable, particularly among elementary school-aged children, but has been used in other jurisdictions and is better tolerated than the naso-pharyngeal swab.

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