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# Impact of rapid diagnostic testing on school closures

## Rapid systematic review

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## Third-Party Materials

Not applicable.

## General Disclaimer

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## Abbreviations and Definitions

### Abbreviations

RDT = rapid diagnostic testing

### Key Definitions:

Rapid diagnostic testing – refers to point of care testing. More fully, as defined by the US Food and Drug Administration: “Rapid, point-of-care diagnostic tests use a mucus sample from the nose or throat but can be analyzed at the doctor’s office or clinic where the sample is collected and results may be available in minutes. These may be molecular or antigen tests.”<sup>1</sup> For the purpose of this review, pooled testing (i.e., where samples are analyzed as a batch, and if a batch tests positive, then individuals in that pool are retested) is excluded from the definition unless explicitly defined as rapid in nature.

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<sup>1</sup> US FDA. Coronavirus Disease Testing Basics. Nov 8, 2021. <https://www.fda.gov/media/140161/download>.

## EXECUTIVE SUMMARY

### Introduction

The purpose of this study was to provide evidence on the impact of rapid diagnostic testing (RDT) for COVID-19 [i.e., SARS-CoV-2] on school closures (K-12).

### Research question

What evidence exists on rapid diagnostic testing (RDT) for COVID as a tool to limit school closures?

### Design

A rapid systematic review was conducted.

### Methods

MEDLINE, EMBASE, Web of Science and the WHO COVID-19 Global Literature on Coronavirus Disease were searched. We performed all searches between Nov 6-8, 2021. Both empirical and modeling studies were included from 2020-2021. No language restrictions were applied. Two team members carried out the initial title and abstract screen following a calibration exercise (single reviewer screening) and then one team member undertook the full study data extraction. In addition, grey literature was searched through McMaster Health Forum, Google and the CADTH COVID-19 Evidence platform. Five public members responded to a short questionnaire and two public members provided comments on the draft report.

### Summary of key findings

#### WHAT EVIDENCE EXISTS ON RDT FOR COVID AS A TOOL TO LIMIT SCHOOL CLOSURES?

- RDT may be a useful tool for limiting transmission of Covid-19 in schools and more limited interventions such as Test-to-Stay may be particularly worth further study with respect to impact on school closures.
- School RDT as reported in the literature tends to take place on site, using trained staff members rather than health care professionals, which adds burden to those in schools and thus in practice may pose feasibility challenges.
- Access to RDT for at home testing may be a practical approach but this shifts burden to families; there have been no studies on the cost-effectiveness or social impacts of this approach and there may also be equity implications.

### Conclusion



RDT is being used by some schools, across a number of jurisdictions, as an additional strategy within a multi-faceted suite of policy instruments to prevent Covid-19 transmission and limit loss of instructional days or school closures. While some studies claim that RDT produces positive results, it has not been evaluated independently of the other measures in place. Given the variability of school settings, socio-economic conditions and local Covid-19 contexts, it seems that tailored approaches to screening would be best developed in conjunction with meaningful local stakeholder engagement.

## Introduction

It is important to consider emerging evidence on how rapid diagnostic testing (RDT) policies for COVID-19 might be applied in different settings. Other recent reviews have examined the effectiveness of point-of-care testing and RDT and considered social and economic impacts more generally.<sup>2,3</sup> The intention here was not to duplicate these efforts but rather to look specifically at RDT in the context of schools (K-12). The objective was to uncover evidence on whether RDT can limit school closures.

### Research question:

What evidence exists on rapid diagnostic testing (RDT) for COVID as a tool to limit school closures?

## Methods

### Search strategy and screening

An experienced medical information specialist developed and tested the search strategies through an iterative process in consultation with the review team. We searched Medline, EMBASE, Web of Science and WHO COVID-19 Global Literature on Coronavirus Disease. We performed all searches between Nov 6-8, 2021. The full searches are found in Appendix A. No language restrictions were applied but results were limited to the publication years 2020 to the present. Results were downloaded and deduplicated and then uploaded to Excel.

Two team members carried out the initial title and abstract screen following a calibration exercise (single reviewer screening) and then one team member undertook the full study data extraction using an existing data extraction form (Mitton et al, 2021) modified for this study.

In addition, grey literature was searched through McMaster Health Forum, Google and the CADTH COVID-19 Evidence platform using a combination of the following keywords: Rapid diagnostic test, COVID-19, and schools. Relevant reports and website were reviewed and included in the overall synthesis.

### Population/ problem:

We included studies on empirical findings or modeling results, or other evidence, about **rapid diagnostic testing in schools K-12**.

### Interpretation:

- empirical designs can be either qualitative or quantitative

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<sup>2</sup> Kelly S, Wells G. Rapid and point-of-care diagnostic tests for SARS-CoV-2 (COVID-19). SPOR Evidence Alliance, June 2021.

<sup>3</sup> Mitton C, Smith N, Lakzadeh P, Kim D. Rapid Diagnostic Testing for COVID-19 in a fully vaccinated population. SPOR Evidence Alliance, June 2021.

- include ethical or policy analyses
- exclude opinion pieces, commentary or editorials

We excluded papers or reports that focused solely on the effectiveness of RDT. No limit was made on vaccinated vs. unvaccinated populations.

### Synthesis approach

Studies included upon abstract screening were summarized in a table with a decision for final inclusion. Results from full data extraction were discussed by the research team and were summarized in text. Information from the grey literature searches were also synthesized and integrated in summary form with the full text reviews.

### Public member input

Five public members in BC provided input on this work through responding to a short questionnaire (see Appendix B). Of the five, one is a school principal and one is an elementary school teacher, both of which have school-aged children. Of the remaining three, two are mothers with school aged children and one is a child in grade 8 (13 years old). Two different public members were asked to provide feedback on the draft report. Their comments were incorporated into the final report.

## Results

### Study selection

The number of studies by source found through our search are outlined in Table 1. These studies include 3 modeling papers included as background, and 11 empirical studies from which data was abstracted and which are discussed fully in the Summary of Findings section.

**Table 1:** studies by source from abstract screening to full paper review

Search	Total Title/Abstract screened (after duplicates removed)	Initially screened as, Yes	Yes -retained after full text review	Initially screened as, Maybe	Maybe - retained after full text review	Total retained
Medline M2	789	3	2	3	2	4
Embase E3	184	0	--	1	0	0
Web of Science	280	0	--	0	--	0
WHO	315	0	--	1	0	0

Carried over from previous study on RDT*						4
Review of reference lists of relevant studies						3
Identified through expert opinion						3
<b>TOTAL</b>						<b>14</b>

\*Mitton C, Smith N, Donaldson M, Kim D, Apantaku G. Rapid Diagnostic Testing for COVID-19: social and economic impacts. Report prepared for the SPOR Evidence Alliance and COVID-END, Nov 2021.

### Summary of findings

In broad terms, rapid diagnostic testing regimes within school settings take one of three forms. The first is tests given to symptomatic student or staff members; this is for the purpose of immediately removing those who appear to be ill and to prevent imminent infection of others. This kind of testing is not addressed by our review.

The remaining two RDT regimes concentrate upon asymptomatic persons (Bilinski et al, 2021). ‘Test-to-Stay’ involves testing of the close contacts of individuals with a confirmed or strongly suspected Covid-19 diagnosis. This provides an alternative to requiring self-isolation of those contacts—they can remain in school attendance so long as they return negative tests. In addition to limiting in-school transmission, this is meant to minimize disruption (e.g., classes cancelled due to lack of teachers) and lost school-days, the latter a measure commonly used in the evaluation of such programs. A review by Public Health Ontario (Oct 8, 2021) finds Test-to-Stay strategies being used in at least seven jurisdictions (5 US states, as well as France and Denmark); however, only 2 peer-reviewed publications were available (Lanier et al, 2021; Young et al, 2021). We independently identified and included both of those studies in this review.

The final approach, surveillance or screening testing, involves testing all of a school’s student and staff population, or some (random) sample thereof, on a regular basis. This is meant largely to preemptively track for the emergence of disease clusters, so that additional preventive measures might be implemented as needed to strengthen school health and safety.

This review identified three studies, one American and two Canadian, which modelled the possible effects of different approaches to school RDT for Covid-19. Based on the parameters and assumptions used, these studies conclude that school screening can be an effective and affordable strategy, though it is not clear if this is so under every set of circumstances.



Tupper and Colijn (2021), using Canadian data in their model, conclude that “interventions based on acting after symptomatic students receive a positive test, as is standard practice in many jurisdictions, are ineffective at preventing most infections” (p. 2) After investigating a number of scenarios, they contend frequent universal screening of entire classes –pooled or otherwise -- was the only strategy able to limit the predicted growth of Covid clusters within schools. Preventing such spread, they suggest, is key to being able to keep schools open.

Campbell et al (2020) conduct an economic analysis of RDT in at-risk populations, one of which is schools. Their model uses cross-Canada data, which suggests that if approximately 143,000 students and staff were tested daily, the entire relevant population could be screened over 42 days. Assuming 100% uptake, they conclude that school screening would require “46 368 added personnel [mobile teams of health professionals] and cost \$816.0 million” (p. E1146); in the context of government spending to Covid-19 already announced, these authors believe that “a strategy of actively testing large population groups who are at increased risk of acquiring SARS-CoV-2 is feasible and affordable in Canada” (p. E1153).

Bilinski et al, in a 2021 pre-print paper, provide an epidemiological and economic model for two simulated schools: an “elementary school (638 students in grades K-5 and 60 staff) and middle school (460 students in grades 6-8 and 51 staff)”. They assume a highly vaccinated population. They model the Test-to-Stay, random sample surveillance, and full screening approaches to RDT. They conclude that “test to stay” policies would lead to a similar extent of Covid-19 transmission as self-isolation, but would be less costly overall. Weekly universal screening, by contrast, supposedly would prevent approximately one-half of in-school Covid transmissions.

Consequently, Bilinski et al (2021) conclude,

“the value of screening varies substantially across different levels of community transmission, between elementary and middle schools, and by school attack rate... screening capacity may be useful as an “insurance policy” to maintain in-person instructional time if cases remain high ... and would be most efficiently targeted toward older students, areas with low vaccination coverage, and settings where adherence to mitigation precautions is low or unknown”.

Our review includes 11 empirical studies related to RDT in schools: ten implement or assess actual programs and one qualitative study obtained stakeholder perspectives about the concept of RDT. These come from six different countries (USA=6; one each from Canada, Italy, Germany, Switzerland and the UK). Seven studies were conducted as school-specific research projects, two used data from RDT applied under a national or state-wide mandate, and two involved additional testing protocols layered on top of a jurisdiction-wide mandate. Two studies described Test-to-Stay models, three described surveillance programs (time-limited testing or partial coverage), and five studies reported programs that were designed to screen all school attendees on an on-going basis. There were seven observational studies (review of test results), two qualitative studies, one program description narrative, and one cluster randomized controlled trial (RCT). Some studies were conducted in primary school(s),

some in secondary school(s) and some in schools that combined both types of student. Schools were a mix of public and private; most are day-schools but some studies included residential/boarding schools as well. Where data were provided, 6 studies reported the area prevalence of Covid-19 at the time of study to be high or rising, while 3 reported it to be low or moderate; definitions of what constitutes low or high, however, may not be consistent with one another or with the levels established by the US CDC (see: <https://covid.cdc.gov/covid-data-tracker/#county-view>).

As shown in Table 2 below, there is considerable variability in the design of RDT programs. While this indicates that some effects can be achieved in settings with different levels of resources and intensity of effort, the heterogeneity of program elements makes direct synthesis of findings a challenge.

**Table 2:** Summary of studies included in review

First Author	Voluntary or mandatory testing?	Proportion of population included	Frequency of testing	Type of Test	Test administration
Berke	required for in-person attendance	universal	weekly for staff and youngest students; twice weekly for older students when at school (classes being delivered on a one week in person, one week by distance schedule)	PCR/NAAT	on-site (could test outside at own expense) -self-administered by staff and older students; administered to younger students by trained staff
Blanchard	Consent had to be given	25% random per week	weekly	antigen (compared against PCR)	on-site -self collected; analyzed on site by a research assistant
Kriemler	voluntary	classroom level sampling	two tests only, 1 week apart	antigen and PCR	on site by the research team
Lanier	voluntary by schools. Parental consent.	Test to Play: yes for all athletes. Test to Stay: yes once triggered.	Test to Play: every 14 days. Test to Stay: a one-time event usually over 2-day period	antigen	on site (or alternatively in community) -administered by trained staff members
Pescatore	voluntary (2 dozen uptake by 1 Feb 2021)	not specified	not specified	antigen (PCR were initially available to staff)	varies by school
Smith-Norowitz	mandatory	universal	monthly	PCR	on-site -no additional details provided
Unger	not specified	not specified	not specified. Teachers support "frequent testing". Parents support daily testing, or at least several times a week. Students say they could put up with daily testing.	not specified	not specified, but seems to imply on-site
Vilani	informed consent given by almost all	aims to be universal it seems	at three points in time (about monthly)	PCR	on-site -no additional details provided
Volpp	mandatory (including signing a contract vowing full participation)	universal	twice weekly	PCR (plus antigen if symptomatic)	on-site -staff tests self-administered; student

					tests collected under clinical supervision
Wachinger	voluntary, then mandatory	by volunteers, then universal-- "A majority of school staff decided to participate in the voluntary screening (n=21 out of 34, 62%), as well as a majority of pupils and their parents (n=109 out of 186; 59%)" (p. 4).	3 times per week (2 times per week under national rules)	Ag (antigen)	at home -staff members and parents trained to administer tests
Young	voluntary at both site and individual level, with consent given	only contacts of confirmed cases [i.e., Test to Stay]	daily for 7 days	antigen (PCR confirmed)	on-site -self-administered

Authors of the peer reviewed literature were generally positive on the prospects of screening. For instance, Unger et al concluded, "If they can overcome the financial and logistical barriers, schools should consider adding frequent COVID-19 testing to their protocols" (2021, p. 12). Young et al conclude, "Daily contact testing should be considered for implementation as a safe alternative to home isolation following school-based exposures" (2021, p. 1217). "School-based COVID-19 testing should be considered as part of a comprehensive prevention strategy to help identify SARS-CoV-2 infections in schools and sustain in-person instruction and extracurricular activities" (Lanier et al, 2021, p. 789). In some studies, few or even no positive tests (e.g., Kriemler et al, 2021; Wachinger et al, 2021) were observed during the study period, which makes it hard to comment as to whether or not RDT was effective.

Two main outcomes on which authors' base their conclusions and recommendations are (a) in-school transmission; (2) avoided school days lost. These are not reported in all. See Table 3 for the data presented and conclusions drawn.

**Table 3:** Type of data presented in the studies included in the review

First Author	School transmission outcomes	School days lost outcomes
Berke		"Pooling-in-a-pod testing corresponded to a 62.2% decrease in remote learning for students in grades 6-12 ( $P < .001$ ) and a 92.4% decrease in remote learning for students in preschool to grade 5 after initiation of the program" (p. 668).
Blanshard	"The number of outbreaks was not different in the 2 participating schools compared to other high schools in the same area" (p. 2).	"A safe, accelerated return to school could have possibly saved an estimated 350,070 days or ~959 years of cumulative isolation [projected across all Montreal schools over a 4-1/2 month period]" (p. 11).
Lanier	"By identifying 1,886 cases among students, Utah's testing programs likely helped reduce SARS-CoV-2 transmission in schools" (p. 789).	Prevented the loss of an estimated 109,752 student-days of in-person instruction
Volpp	only two identified cases were plausibly caused by secondary transmission on campus. "A comprehensive mitigation strategy ... was effective in preventing in-school transmission of SARS-CoV-2 at a campus with substantial daily on- and off-campus interactions" (p. 380).	

Young	“Daily contact testing of school-based contacts was non-inferior to self-isolation for control of COVID-19 transmission, with similar rates of symptomatic infections among students and staff with both approaches” (p. 1217).	“Among students and staff, there were 59 422 (1·62%) COVID-19-related absences during 3 659 017 person-school-days in the control group and 51 541 (1·34%) during 3 845 208 person-school-days in the intervention group (intention-to-treat aIRR 0·80 [95% CI 0·54–1·19]; p=0·27; CACE aIRR 0·61 [0·30–1·23])” (p. 1217).
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Blanchard et al’s conclusions run counter to the more positive perspectives; they conclude based on their work that “deploying rapid tests randomly is not worth the time, energy and investment required” (Health Canada, 2021, p. 9; see also Blanchard et al, 2021 pre-print). This is also the position of Kriemler et al (2021): “Given the very low point prevalence even in a setting of high incidence of SARS-CoV-2, the usefulness of a surveillance system for entire schools on an individual, regional or national level is questionable and currently not needed, especially with a well-functioning targeted TTIQ [Test, Track, Isolate, Quarantine] strategy in place for symptomatic children and school personnel” (p. 4). Note that Young et al (2021), reporting a similar lack of difference, choose the framing of “non-inferiority” for the RDT approach which may account for why their conclusion is expressed more optimistically.

Qualitative findings from the included studies tend to the conclusions that RDT is acceptable and leads to increased perceptions of school safety. According to Unger et al (2021), in data from nine Los Angeles school districts, teachers supported “frequent” testing. Parents supported daily testing, or at least several times a week. Students said they could put up with daily testing. In Berke et al, “Parents, students, and staff members reported increased comfort with in-person learning (82%, 76%, and 65%, respectively)” (2021, p. 668) --though survey response rates were deemed to be low. In supplemental information to Young et al’s RCT, a qualitative study of 63 staff, students and parents found “Participants recognized that daily testing may allow students to remain in school, which was viewed as necessary for both education and social needs. Whilst some felt safer as a result of daily testing, others raised concerns about safety” (Denford et al, 2021 pre-print, p. 2). The authors conclude that testing is feasible and acceptable.

In Wachinger et al (2021), pupils, parents and school staff perceive home-based RDT screening as feasible and less disruptive than other protective measures (e.g., mask mandates). It should be noted that such trade-offs among protective measures were not being offered or promised, however, and would likely be inconsistent with the general advice that multiple protective measures together are the most effective. Concerns were expressed regarding the fidelity of home-based test performance in cases where pupils or parents are hesitant, even when testing is compulsory. Some reported that conversations among those supporting the testing study and those not in favour of it could become tense or fraught (Wachinger et al, 2021).

These articles offer relatively little information about participant demographics, thus limiting any consideration of differential impacts related to testing. Unger et al’s schools are described as largely Hispanic, and schools in Berke et al’s study are described as having many students with English as a second language. Blanchard indicates that of the two Montreal schools in their study, one was private and affluent, the other public, multi-ethnic and first-generation immigrant. Volpp et al (2021) and Smith-



Norowitz et al (2021) conducted studies only in single private schools, the latter being girls-only. Young et al stratify data analysis and reporting on income (proportion of schools eligible for free school meals). Most schools appear to be urban; Wachinger et al (2021) note that they particularly studied a “peri-urban” setting due to limited data for this context. Some studies included schools on a state-wide or nation-wide basis, but results were not reported along demographic or geographic lines. None of the papers stated whether or not school populations included Indigenous persons.

### Public Sector Recommendations and Policies

Two grey literature documents identified and included in this review were prepared by expert review panels for pan-European organizations. WHO-Europe’s Technical Advisory Committee on Schools states that, “Screening (systematic serial testing) of children and staff for the early detection [of] infectious cases without symptoms (pre-/asymptomatic) may be considered, but the cost–effectiveness of this approach in low-prevalence settings is unclear” (2021, p. 4). Likewise non-committal is a European CDC Technical Report on COVID-19 in children and schools: “Testing should be part of active surveillance aimed at early detection of all symptomatic cases, and potentially infectious asymptomatic individuals. A strategy for testing should be developed, and adapted through an ongoing assessment of the local epidemiological situation and laboratory capacity” (June 2021, p. 17). This report emphasizes symptomatic testing and isolation of cases and their close contacts; larger scale screening is suggested to potentially be of value in high prevalence areas.

A third grey literature document is a report to Health Canada by the COVID-19 Testing and Screening Expert Advisory Panel (March 2021). The report has brief descriptions of several testing programs, including symptomatic screening and surveillance testing. It concludes that “a robust body of evidence is not currently available” (p. i) but that RDT programs in schools may have value, especially where community prevalence of Covid-19 is high.

European country government agencies have adopted different approach to mass-testing strategies. The Public Health Agency of Sweden, for instance, currently recommends against it:

“the risks and uncertainties surrounding the use of regular screening among pupils outweigh the possible benefits. This is particularly true of the screening of younger pupils. There is still a lack of knowledge regarding whether screening schoolchildren can be an important tool in preventing the spread of infection and reducing sickness absences at school” (<https://www.folkhalsomyndigheten.se/the-public-health-agency-of-sweden/communicable-disease-control/covid-19/covid-19-testing/screening-at-workplaces-and-schools/>).

As described by Bird (2021), the UK government brought in screening requirements for the initial re-opening of secondary schools in Spring 2021: this involved three initial school-administered tests over a two-week period, followed by the provision of home testing kits to be used twice weekly. Young et al (2021) used this existing infrastructure in order to build their RCT for Test to Stay.

### Public Input



Five members of the public (including school staff and parents) provided input on the research question based on their own personal experiences. Participants were asked their views of the possible role of RDT in K-12 schools, whether they thought it should be made widely available and who should pay, and to note any other social or economic aspects of the issue which they deemed relevant. Overall, their comments reflect the findings of the existing literature. Respondents suggested that school testing could limit lost instructional days, and perhaps allow resumption of some sporting or musical events. However, concerns were noted about the accuracy of tests, whether or not widespread testing would breed complacency and reduce motivation to comply with other protective measures, or on the other hand, generate anxiety and fear. One wondered how parents would react to receiving positive test results from school staff rather than a health care professional. Most felt that testing should be limited to particular circumstances, for instance in high outbreak areas, in schools or class with children who are medically or otherwise vulnerable, or in advance of field trips or other activities which might bring students in possible close contact with unknown others.

It was observed that wide-spread testing could be potentially costly, and none suggested it should be offloaded as a responsibility to schools without provincial funding. Home testing was deemed by most to be feasible and probably preferable to in-school administration, though recognizing that this would be easier for parents in better financial circumstances and the equity implications needed to be considered. It is also recognized that reporting back to schools could be challenging in some circumstances and may open the door to various issues including enforcement on action, timeliness of decisions and consistency in reporting.

### Limitations

Due to time and resource limitations, no quality assessment of included studies was conducted. It should be noted that 2 of the 11 empirical studies (18%), and 1 of 3 modelling studies (33%) were pre-prints which have not yet been peer-reviewed. The literature search included multiple databases in the health field. No education-focused databases were used, so given that the research question relates to school policy, some articles which might have met the inclusion criteria might not have been identified. Title/abstract screening and full text review were conducted by single researchers, making results more dependent upon individual judgement. These methodological choices however are consistent with those made by some other rapid reviewers, as described in the literature (Ganaan, Ciliska and Thomas, 2010; Tricco et al, 2015).

### **Discussion**

Academic researchers doing modelling work or assessing empirical examples of RDT in schools, in the set of papers reviewed here, were generally positive about the benefits of such programs. However, we note that some authors go beyond the evidence they present when they endorse such programs (e.g., Johnson et al, 2021; Cho et al, 2021 [not included in review]); such conclusions must be carefully considered (and is the reason why synthesis and systematic review is a higher form of evidence than the individual study). In contrast, policy makers appear more cautious about moving ahead – expert

reviews for governments and public health organizations made at best conditional recommendations, noting the overall paucity of solid evidence.

Most testing programs identified in this review were school-based rather than dictated across schools by policy, and jurisdictions often leave implementation a choice of schools or education authorities (Pescatore et al, 2021). As a Canadian example, the province of Quebec has now made testing supplies available to elementary schools, primarily for rapid identification in symptomatic students or staff. In higher prevalence regions (Montreal and Chaudière-Appalaches), schools will be required to test entire classrooms whenever a positive test has been reported; this could be a form of Test-to-Stay, though the website does not make that explicit (<https://www.quebec.ca/en/education/guidelines-education-covid/rapid-screening-tests>). An additional Canadian example is the recent decision by the province of Ontario to expand access to rapid antigen tests during the Winter break for publicly funded schools. Ontario will be distributing 11 million rapid antigen tests to students between late November and mid-December to “support asymptomatic screening as an additional layer of protection over the holiday period and following the winter break”. Each student will receive 5 rapid antigen screening tests and are asked to use the screening tests every 3-4 days over the holiday break, beginning December 23, 2021 (<https://www.cbc.ca/news/canada/toronto/covid-19-ontario-nov-18-2021-enhancing-testing-strategy-1.6253662>). Evaluation of these approaches will obviously be warranted.

In the absence of screening, self-isolation of individuals who test positive as well as their close contacts is the usual response (ECDC 2021; Cho et al, 2021). All the various approaches to testing are attempting to reduce school days lost and keep schools open, which clearly are important social and economic considerations, and the costs of school closures to educational and other child and family outcomes have been fairly well described (for instance, Dove et al, 2020; Hammerstein et al, 2021; Zeirer, 2021). One challenge is that there is no firm answer to the question of what threshold of Covid transmission should trigger school closures. For instance, in a modeling study, Johnson et al (2021) set “a cumulative incidence of detected cases exceeding 1% of the student body” as the threshold (p. 4). Lanier et al (2021) describe an actual threshold value set for Utah schools, which evolved both during and after their study, from a figure of 15 cases per school, to a value for larger schools of 1%, later 2%, of the school population. All other US jurisdictions using Test-to-Stay do not identify any threshold level for closure (Public Health Ontario, 2021, p. 8). Smith-Norowitz et al (2021) note that New York City schools were closed in fall 2020 at a test positivity rate of 3%. In Switzerland under formal policy, individual classes would be sent into isolation if 2 or more positive cases were confirmed (Kriemer et al, 2021); by contrast, Vilani et al (2021) report that one classroom in their study produced two positive tests yet they give no indication that class-wide quarantine ensued. Decisions about when to close schools then, perhaps by necessity, are being made in the absence of definitive evidence.

The heterogeneity of RDT approaches in this literature makes synthesis difficult. It does seem that reported rates of prevalence of positive tests within schools often differ from those of the surrounding community. Several papers found school incidence to be lower during the period of study, though others indicate the opposite. On this point, the main message to be drawn from the literature is that this context matters; authors tend to suggest that testing for surveillance reasons may be most appropriate



when prevalence of Covid-19 is higher (e.g., Health Canada, 2021; ECDC, 2021; Bilinski et al, 2021, Kreimler et al, 2021). This also suggests that one-size-fits-all approaches across a jurisdiction are less suitable than those which allow individual schools to implement the testing which they find appropriate (e.g., Pescatore et al, 2021 in the state of Delaware; see also state of California policy, at <https://testing.covid19.ca.gov/school-testing/>).

The modeling study by Campbell et al (2020) presumed that school testing in Canada would be done by mobile teams of health professionals, and there are examples of this, for instance in Nova Scotia (see Health Canada, 2021, p. 5). However, most of the literature reviewed here suggested that test administration and often even reading of results would be conducted or overseen by trained staff members. This can alleviate burden on health system resources (Health Canada, 2021). However, the burden is then placed upon the education system and/or individual schools. Those added demands of school personnel were of concern in many places (e.g., Lanier et al, 2021; Unger et al, 2021; Wachinger et al, 2021) and was raised in particular by the school principal who responded to our questionnaire.

Most studies in this review reported that rapid tests were administered at the school site itself. This allows monitoring and supervision, though adds to the staff burden as noted. Health Canada (2021) also states that this might be considered as an equity issue, where school-based testing would make access easier for vulnerable or at-risk groups. However, tests can also be administered at home, as reported by Wachinger et al (2021) for the German state of Baden-Württemberg where it was found to be feasible, though there were concerns among some that home administration would be less reliable (shared by members of the public we consulted). This is the approach used by the UK (Bird, 2021), as well as Austria (as reported in Health Canada, 2021). Home test kits were not available in Canada, as of March 2021 (Health Canada) though this has since changed and the notable example of Ontario sending home kits over the winter break was mentioned above.

## Conclusion

In order to prevent the spread of Covid-19, primary and secondary schools across jurisdictions have implemented a package of preventive measures, including such things as improved ventilation, physical distancing, hand-washing, masking and vaccination. RDT is being used as well by some as an additional strategy within a multi-faceted suite of policy instruments. While some studies claim that RDT produces positive results, it has not been evaluated independently of the other measures in place, at least so far as the literature identified in this review has found. As the Covid-19 pandemic evolves, research and evaluation related to RDT in schools will continue to develop.

Given the variability of school settings, and local Covid-19 contexts, it seems that permissive or tailored approaches to screening would be better advised than standardized policies applied across all schools within a jurisdiction. This is in keeping with the decentralized nature of school administration within most Canadian provinces. If RDT is seen as a means to quickly and pre-emptively identify positive cases before they can transmit disease to close school contacts, it might be something best considered in



high prevalence situations, as suggested by multiple papers reviewed here. This is supported by the limited number of public members engaged directly in this report. Implementation at a school district or individual school level seems best conducted with meaningful engagement of school personnel, parents, and students themselves, including Indigenous-led approaches in the unique circumstances in First Nations, Inuit and Métis schools (Health Canada, 2021, p. 4).

Some of the earliest research and modeling related to RDT in schools envisioned the use of mobile health care teams, but in practice it appears from the studies reviewed here that it is more common to train school staff or parents in the administration of tests. This has become easier as new technologies for antigen testing have been rolled out and made available. This lifts some burden from health care professionals who are already extremely pressed in dealing with the pandemic overall; however, it pushes that burden and costs of testing down to the education system and the schools, raising concerns about resources and supports from those institutions. Having tests self-administered at home, rather than on-site in schools, appears to be an emerging alternative; this pushes the burden of testing to the family level, and to the best of our knowledge there has been no cost-benefit analysis from the societal perspective of this shift, nor of the social impacts such as the effect upon the gendered division of household labour. As such, we cannot conclude that RDT in schools is necessarily cost-effective and, in any case, would certainly depend on the specific type of application and the given context (e.g., community prevalence).

In short, RDT may be a useful tool for limiting transmission of Covid-19 in some school contexts and more limited interventions such as Test-to-Stay may be particularly worth further study in terms of the impact on school closures. Tailored approaches to screening using RDT are likely to bear the most fruit. RDT may have a role in limiting school closures but the precise contribution amongst other public health measures is unclear at this time.



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## Appendix A: Search strategies

### 1. MEDLINE Search – Nov. 6, 2021: COVIDsch-M3

**Database:** MEDLINE (OVID)

**UBC access:** <http://resources.library.ubc.ca/139>

**OVID Account:** COVID19

**Search Name:** COVIDsch-M3

**Results:**

26      24 not 25 (1522)

1522 includes the results from the 2 MEDLINE searches - COVIDsch-M2 and COVIDsch-M3  
(789 + 709 +24) = 1522 – 24 dups = 1498

**Search was executed on:** Nov. 6, 2021

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions(R) <1946 to November 05, 2021>

Search Strategy:

- 
- 1 covid-19 testing/ or covid-19 serological testing/ or covid-19 nucleic acid testing/ (7321)
  - 2 ((COVID or COVID-19 or COVID19) adj3 (assay? or immunoassay? or immuno-assay? or detect\* or diagnos\* or screen\* or test\*)).ti,ab,kf. (12673)
  - 3 ((coronavirus\* or corona virus\*) adj3 (assay? or immunoassay? or immuno-assay? or detect\* or diagnos\* or screen\* or test\*)).ti,ab,kf. (2342)
  - 4 ((2019-nCoV or 19nCoV or 2019nCoV or nCoV or n-CoV or "CoV 2" or CoV2) adj3 (assay? or immunoassay? or immuno-assay? or detect\* or diagnos\* or screen\* or test\*)).ti,ab,kf. (8549)
  - 5 ((SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2) adj3 (assay? or



immunoassay? or immuno-assay? or detect\* or diagnos\* or screen\* or test\*).ti,ab,kf. (10254)

6 or/1-5 [COVID-19 Screening] (25062)

7 COVID-19/pc, tm [Prevention & Control, Transmission] (12732)

8 or/6-7 [COVID-19 Testing] (36267)

9 Schools/ (44726)

10 School Teachers/ (2092)

11 Students/ (68189)

12 educational setting\$1.ti,ab,kf. (1726)

13 ((school\* or campus\* or class\* or employee\* or pupil\* or staff\* or student\$1 or teacher\$1) adj3 (elementary or junior or middle\* or primary or secondary)).ti,ab,kf. (65946)

14 school\*1.ti,ab,kf. (294772)

15 classroom\*.ti,ab,kf. (19805)

16 educational personnel/ (244)

17 (in person adj3 (learn\* or teach\* or school\* or education or instruction)).ti,ab,kf. (621)

18 or/9-17 (373082)

19 8 and 18 [COVID-19 Testing & Schools] (878)

20 ((covid\* or sars\*) and (test\* or screen\* or surveillance\*) and (classroom\* or school\*)).mp. (1139)

21 (8 and 18) or 20 [COVID-19 Testing & Schools] (1629)

22 exp animals/ not humans/ (4911284)

23 21 not 22 (1628)

24 limit 23 to yr="2020 -Current" (1601)

25 comment/ or editorial/ or letter/ or news/ (2203469)

26 24 not 25 (1522)



## 2. EMBASE Search – COVIDsch E3

**Database:** EMBASE (OVID)

**UBC access:** <http://resources.library.ubc.ca/129>

**OVID Account:** COVID19

**Search Name:** COVIDsch E3

### Results:

50 48 not 49 (576)

392 Duplicates leaving 184 records for review

**Search was executed on:** Nov. 7, 2021

Database: Embase <1974 to 2021 November 05>

Search Strategy:

-----

- 1 \*coronavirus disease 2019/di [Diagnosis] (14832)
- 2 \*asymptomatic coronavirus disease 2019/di [Diagnosis] (58)
- 3 coronavirus disease 2019/ and screening test/ (942)
- 4 covid-19 testing/ or covid-19 nucleic acid testing/ or covid-19 serological testing/ (3872)
- 5 ((COVID or COVID-19 or COVID19) and (assay? or immunoassay? or immunoassay?)).ti,ab,kw. (4721)
- 6 (COVID test\* or COVID-19 test\* or COVID19 test\*).ti,ab,kw. (2004)
- 7 ((SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2) and (assay? or immunoassay? or immuno-assay?)).ti,ab,kw. (4901)
- 8 ((SARS-CoV-2 or SARS-CoV2 or SARSCoV-2 or SARSCoV2 or SARS2 or SARS-2 or severe acute respiratory syndrome coronavirus 2) adj1 (screen\* or test\*)).ti,ab,kw. (1810)

9 sars coronavirus 2 test kit/ or sars coronavirus 2 immunology test  
kit/ or sars coronavirus 2 nucleic acid test kit/ (2517)

10 or/1-9 [COVID-19 Testing] (24443)

11 (IgM adj3 test\*).mp. (3848)

12 (IgM adj3 rapid).mp. (447)

13 (antibody adj3 kit).mp. (1249)

14 (("point-of-need" or "point of care") adj3 kit\*1).mp. (133)

15 (RADT or RADTs).mp. [ rapid antigen detection tests ] (178)

16 (antigen adj3 (test\* or kit\*)).ti,ab,kw. (17857)

17 (rapid adj3 (test\* or kit\*)).ti,ab,kw. (32954)

18 antigen/ and (test\* or kit\*).ti,ab,kw. (28371)

19 (RADT or RADTs).mp. [ rapid antigen detection tests ] (178)

20 rapid test/ (6213)

21 (IgM adj3 rapid).mp. (447)

22 (test or testing or screen\*).ti,ab,kw. (3830733)

23 mass screening/ (57873)

24 or/11-23 [Testing] (3866564)

25 exp \*severe acute respiratory syndrome coronavirus 2/ (20254)

26 \*coronavirus disease 2019/ (134983)

27 (sars\* or covid\*).ti,ab,kw. (200502)

28 or/25-27 [COVID-19] (207135)

29 24 and 28 [COVID-19 and testing] (34354)

30 10 or (24 and 28) [COVID-19 and testing] (48390)

31 school/ or high school/ or kindergarten/ or middle school/ or primary  
school/ (100514)

32 return to school/ (169)



33 student/ or disabled student/ or elementary student/ or high school student/ or middle school student/ (124044)

34 teacher/ or school teacher/ or teaching assistant/ (38056)

35 (school\* or classroom\*).ti,ab,kw. (388634)

36 ((school\* or campus\* or class\* or employee\* or pupil\* or staff\* or student\$1 or teacher\$1) adj3 (elementary or junior or middle\* or primary or secondary)).ti,ab,kw. (81115)

37 educational setting\$1.ti,ab,kw. (1954)

38 in person learning.ti,ab,kw. (133)

39 educational personnel.ti,ab,kw. (62)

40 or/31-39 [Schools] (525620)

41 **30** and 40 [COVID-19 & testing & Schools] (1151)

42 exp animal/ not human/ (5000048)

43 41 not 42 (1150)

44 editorial/ or letter/ or note/ (2621987)

45 43 not 44 (1110)

46 limit 45 to yr="2020 -Current" (1084)

47 limit 46 to conference abstracts (250)

48 46 not 47 (834)

49 limit 48 to medline (258)

50 48 not 49 (**576**)

### 3. Web of Science Search

**UBC Database:** Web of Science Core Collection (Clarivate Analytics)

**UBC access:** <https://resources.library.ubc.ca/page.php?details=web-of-science-core-collection&id=138>



**WOS Account:** [mimi.doyle-waters@ubc.ca](mailto:mimi.doyle-waters@ubc.ca)

**Search was executed on:** Nov. 8, 2021

**Results:** 317 Records

37 duplicates leaving **280** records for review

**TOPIC:** (("COVID19 test\*" or "COVID-19 test\*" ) OR ("SARS-CoV-2 test\*" or "SARS-CoV2 test\*" or "SARSCoV-2 test\*" or "SARSCoV2 test\*" or "SARS2 test\*" or "SARS-2 test\*" or "severe acute respiratory syndrome coronavirus 2 test\*") OR ("covid-19 serological test\*" or "COVID19 serological test\*") OR ("covid-19 nucleic acid test\*" or "covid19 nucleic acid test\*"))  
**AND TOPIC:** ((school\* or campus\* or class\* or employee\* or pupil\* or staff\* or student\* or teacher\* or "elementary school\*" or "junior schools\*" or "middle school\*" or "primary school\*" or "secondary school\*" or classroom\* or "in person learn\*" or "in person teach\*" or school\* or "in person education" or "in person instruction" or "return to school" or "school closure\*"))

**Refined by: DOCUMENT TYPES:** ( ARTICLE OR REVIEW )

**Timespan:**2020-2021. **Indexes:**SCI-EXPANDED, SSCI.

#### 4. WHO COVID-19 Global Literature on Coronavirus Disease

**Database:** COVID-19 Global Literature on Coronavirus Disease

**Access:** <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov>

**Date:** Nov. 8, 2021

**Results:**

381 Records

After 66 duplicates were removed **315** records were available for review

tw:(school closure OR school closures) AND db:("PREPRINT-MEDRXIV" OR "ProQuest Central" OR "Academic Search Complete" OR "GREY-COVIDWHO" OR "PMC" OR "LILACS") AND year\_cluster:("2021" OR "2020" OR "2022")  
**225** (Export 7)



```
tw:((tw:((covid* OR sars*))) AND (tw:((test OR testing OR screen OR screening OR surveillance)))) AND (tw:((school* OR campus* OR class* OR employee* OR pupil* OR staff* OR student* OR teacher*))) AND (tw:(("return to school" OR closure* OR "in person learning")))) AND db:("PREPRINT-MEDRXIV" OR "ProQuest Central" OR "Academic Search Complete" OR "GREY-COVIDWHO" OR "Africa Wide Information" OR "PMC" OR "LILACS") AND year_cluster:("2021" OR "2020" OR "2022") 100 (Export 6)
```

```
tw:((tw:((covid* OR sars*))) AND (tw:((test OR testing OR screen OR screening OR surveillance)))) AND (tw:((school policy OR school* polic*))) AND db:("PREPRINT-MEDRXIV" OR "ProQuest Central" OR "Academic Search Complete" OR "GREY-COVIDWHO" OR "PMC") AND year_cluster:("2021" OR "2020" OR "2022") 56 (Export 5)
```

**Total:**  
**381 Records**



## **Appendix B:** questions asked of public members

In your opinion what role might rapid diagnostic testing\* play amongst other current public health measures for COVID-19 specifically in a school (K-12) setting?

Do you think rapid testing should be widely available in schools (K-12)? If so, who should be responsible for roll-out and costs of such a program in your opinion?

What are some social and/ or economic considerations that come to mind for you in relation to rapid diagnostic testing in schools (K-12)?

\*Definition: Rapid diagnostic or point of care testing uses a mucous sample collected at a given site with results available within minutes.