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Living Rapid Review Update 17: What is the specific role of daycares and schools in COVID-19 transmission?

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Date: August 12, 2021

Suggested Citation:

National Collaborating Centre for Methods and Tools. (2021, August 12). *Living Rapid Review Update 17: What is the specific role of daycares and schools in COVID-19 transmission?* https://res.nccmt.ca/res-schools-daycares-EN

Please Note: An update of this review may be available. Access the most current version of this review by visiting the National Collaborating Centre for Methods and Tools COVID-19 Rapid Evidence Service at the above link.

The National Collaborating Centre for Methods and Tools (NCCMT) is hosted by McMaster University and funded by the Public Health Agency of Canada. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada. This review was supported by funding from nib Health. The funder had no role in collection or interpretation of data.

The authors declare they have no conflicts of interest to report.

Executive Summary

Background

As jurisdictions continue to implement and lift restrictions to slow the spread of coronavirus disease 2019 (COVID-19), they face major decisions about how and when to re-open and operate schools and daycares. While children are known to be effective vectors for other viruses, such as influenza, their role in the transmission of COVID-19 is much less clear.

This living rapid review was produced to support public health decision makers' response to the COVID-19 pandemic. This review seeks to identify, appraise, and summarize emerging research evidence to support evidence-informed decision making.

This review is based on the most recent research evidence available at the time of release. A previous version was completed on June 14, 2021. This updated version includes evidence available up to July 22, 2021.

In this living rapid review, we answer the question: **What is the specific role of daycares and schools in COVID-19 transmission?**

What Has Changed in This Version?

- In this version, new eligibility criteria have been added to focus on the most relevant studies to the current context. In this version, only studies which include data collected on or after January 1st, 2021, are included. While major regional variations exist, this represents the time where vaccinations were beginning to be available, and variants of concern (VoC) were becoming more common in many regions around the world. This resulted in 67 previously included studies being removed from this version. An archived version of Update 16 is available here, and a list of previously included but now excluded studies is available in Appendix 2.
- Four new syntheses were identified, two of which include meta-analysis to estimate prevalence of infection through RT-PCR and seroprevalence, secondary attack rates (SAR) from index cases, and factors associated with presence of cases, and SAR in school settings. Estimated SARs were 2.54 cases per index case, 95% CI=0.76, 5.31 and 0.5% of close contacts positive (95% CI=0.1, 1.6) from child index cases only. Lower age was consistently associated with decreased risk of transmission, with findings mixed in daycare settings. Higher community incidence was consistently associated with higher cases in school settings. Mixed findings were found for mask wearing in primary school, with lower risk of transmission associated with mask wearing in secondary schools. A variety of physical distancing measures were pooled in the meta-analysis and are associated with reduced risk of transmission (OR: 0.26, 95% CI=0.18, 0.37). Increased class size (no definition or number of students provided) was associated with higher risk of transmission in the meta-analysis (OR: 1.26, 95% CI=1.21, 1.30), contradicting findings from included single studies. It is important to note that these reviews include studies from early in the pandemic, and there is little overlap between studies included in the included syntheses.
- Updated reports from ongoing longitudinal studies are available from Germany, England and Switzerland; widespread transmission within school settings continues to occur rarely, although the percentage of students and staff who test seropositive (ever infected) continues to rise.

- A case series of outbreaks of the B.1.1.7 VoC in Germany reported high secondary attack rates, however few IPAC measures were in place. The authors suggest that this VoC may result in children being more susceptible and infectious, however no formal comparisons to other outbreaks were conducted.
- One new study explored associations between ICU admissions and case numbers and school reopening following school break in Italy; school reopening was associated with an increase in ICU cases however authors note other community mitigation measures were changed at the same time, so the role of school reopening is unclear.

Key Point

- Although the data is consistent that children can both contract and transmit COVID-19, based on published reports to date following re-opening, the risk of transmission from children to children and children to adults in primary school and daycare settings is low, when IPAC measures are in place and adhered to. The certainty of the evidence is moderate (GRADE), and findings may change as new data become available. The risk of transmission within secondary schools is more variable, with findings suggesting that adherence to IPAC measures in place in the school setting and reducing activities outside of the school settings is critical in this age group. This trend appears to be consistent in the limited data to date collected in the presence of VoCs.
- Implementation of infection control measures is critically important to reducing transmission, especially when community transmission rates are high. Across jurisdictions reviewed, there is wide variability in policies in place limiting the ability to evaluate the impact of specific IPAC measures or make best practice recommendations for daycare or school settings due to variability in the combination of measures implemented. There is emerging evidence that wearing masks, maintaining at least 3ft of distance (especially amongst staff), restricting entry to the school to others, cancelling extracurriculars, outdoor instruction, and daily symptom screening reduce the number of cases within schools; inconsistent findings have been found for associations between ventilation, and class size. Hybrid or part-time in-person learning appears to be associated with higher incidence compared to full-time in-person. The certainty of the evidence is low (GRADE) and findings may change as new data become available.
- Across studies, the number of cases amongst students and teachers mirror trends in the community. There is little high-quality evidence to suggest that re-opening schools contributes meaningfully to community transmission, particularly when community rates are low-moderate and effective IPAC measures are in place. The role of schools on the surrounding community in areas of high community transmission is less clear and not well studied. The certainty of the evidence is low (GRADE), and findings may change as new data become available.
- All identified studies related to camps was collected in summer 2020, and therefore does not meet eligibility criteria for this version. An archived version with older studies conducted in camp settings is available here.
- Data continues to emerge on the impact of VoCs related to prevalence, SAR, and associations with IPAC measure implementation in school and daycare settings, but to date is still limited. It is possible that findings may change as more information becomes available about the impact of VOCs on transmission in school and daycare settings.
- The studies included in this review do not provide evidence for the experiences of populations who live with social and structural inequities, such as Indigenous or

racialized communities. Further research is required to ensure representation of these populations for decision making.

Overview of Evidence and Knowledge Gaps

- There is limited data on the impact of either staff or student vaccinations in mitigating risk of transmission in school and daycare settings, and what IPAC measures may be relaxed or removed with high vaccination coverage in the school setting.
- Building upon earlier case reports, contact tracing and prevalence studies, there is a growing body of reports using national or regional surveillance data and comprehensive contact tracing and testing strategies to minimize the likelihood of underestimation of cases. While surveillance reports are identifying cases among staff and students and children in schools and daycares, these commonly include single cases or a small number of cases typically less than five.
- Within clusters and outbreaks, adult to adult transmission seems to be more common than child to adult or adult to child. Not all included studies separate out cases between staff and students in this way.
- A growing number of studies have randomly selected schools/classes/individuals to undergo testing for active infection (via RT-PCR) or antibodies; consistent across studies, few additional cases are detected suggesting that widespread asymptomatic transmission is not commonly occurring in these settings, particularly when strong IPAC measures are in place.
- Studies that explore the impact of school re-opening or closing on rates of community-transmission are generally limited by reliance on simple correlations, and lack of adequate control for potential confounding factors, such as coinciding timing of implementation or relaxing of other public health measures such as limits on gatherings, opening/closing of stores and restaurants, and community mask mandates.
- The use of more rigorous data collection (e.g., random testing, comprehensive contact tracing/testing) and enhanced reporting of surveillance data (e.g., index cases, secondary transmission, overall prevalence) in future studies can provide more robust data for interpretation and improve certainty of findings.
- Infection control measures were highly variable across jurisdictions scanned. It is important to note that there may be regional variations in policies in place above what are reported in national guidelines.

Methods

Research Question

What is the specific role of daycares and schools in COVID-19 transmission?

Search

The following databases and sources were searched for evidence pertaining to the role of daycares and schools in the transmission of COVID-19 up to July 22, 2021. This search builds upon the previous search conducted in the fifteenth version of this rapid review.

- Pubmed's curated COVID-19 literature hub: LitCovid
- TripDatabase
- World Health Organization's Global literature on coronavirus disease
- COVID-19 Evidence Alerts from McMaster PLUS™
- COVID-19 Living Overview of the Evidence (L·OVE)
- PROSPERO International prospective registry of systematic reviews
- NCCMT COVID-19 Rapid Evidence Reviews
- medRxiv preprint server
- NCCDH Equity-informed responses to COVID-19
- NCCEH Environmental Health Resources for the COVID-19 Pandemic
- NCCHPP Public Health Ethics and COVID-19
- NCCID Disease Debrief
- NCCIH Updates on COVID-19
- Public Health Ontario
- Uncover (USHER Network for COVID-19 Evidence Reviews)
- Centers for Disease Control and Prevention's Morbidity and Mortality Weekly Report
- Government of Ontario
- Ontario COVID-19 cases in schools and child care centres
- Alberta COVID-19: Education and childcare
- Québec Situation in Québec
- COVID-19 School Response Dashboard
- Newfoundland and Labrador Centre for Applied Health Research (NLCHAR)
- National Institute for Public Health and the Environment (RIVM)
- Health Information and Quality Authority (HIQA)
- National Centre for Immunisation Research and Surveillance (NCIRS)
- Institut national de santé du Québec (INSPQ)
- Don't Forget the Bubbles

A copy of the full search strategy is available in Appendix 1.

Information on policies for daycares and educational settings were retrieved from the scientific publications and governmental public health webpages for the jurisdictions included in research articles in this review.

Study Selection Criteria

The search first included recent, high-quality syntheses. If no syntheses were found, single studies were included. English-language, peer-reviewed sources and sources published ahead of print before peer review were included.

Additional exclusion criteria were established (April 2021) to refine the focus of this review given the substantial body of evidence:

- Studies that only report absolute number of cases or overall prevalence within a school or district without calculation of SAR or discussion of likelihood of transmission within the schools were ineligible for inclusion.
- Studies which described the risk of COVID-19 or COVID-19 mortality between teachers, students or parents of children attending school vs. those not attending school, or with no description of exposure within the school were ineligible.
- Predictive modelling studies using only estimated vs. collected data were not included.

Additional exclusion criteria have been applied to this living review to refine its focus given the substantial body of evidence, and evolution of the COVID-19 pandemic. Beginning August 2021, studies were excluded if:

- Data were collected prior to January 2021 when vaccines were not available, and VoCs were not prevalent in many countries

	Inclusion Criteria	Exclusion Criteria
Population	Children and adolescents aged 1–18	Infants
Intervention	Exposure to or diagnosis of COVID-19	
Comparisons	-	
Outcomes	Confirmed or suspected case of COVID-19	
Setting	Schools, daycares, camps	Extra-curricular activities such as sports teams

Data Extraction and Synthesis

Data on study design, setting, location, population characteristics, interventions or exposure and outcomes were extracted when reported. We synthesized the results narratively due to the variation in methodology and outcomes for the included studies.

The identified syntheses relevant to this report had considerable overlap in the primary literature but varied in the data reported across reviews for the same primary studies. We chose to conduct a new synthesis rather than reporting the overlapping results of the identified syntheses to present the data most succinctly and clearly. The primary studies were used to extract study characteristics and key findings, and to appraise study quality.

Due to the large number of studies, studies are grouped into tables so similar studies can be reviewed together. These tables include 1) studies of transmission within schools and daycares; 2) case reports or case series of transmission within schools or daycares; 3) studies exploring the relationship between IPAC measures and transmission in schools and daycares; 4) studies of the impact of school in-person learning and community transmission; 5) in-progress single studies; 6) syntheses; 7) in-progress syntheses; and 8) Canadian surveillance data.

Appraisal of Evidence Quality

We evaluated the quality of included evidence using critical appraisal tools as indicated by the study design below. Quality assessment was completed by one reviewer and verified by a second reviewer. Conflicts were resolved through discussion.

Study Design	**Critical Appraisal Tool**
Synthesis	Assessing the Methodological Quality of Systematic Reviews (AMSTAR) AMSTAR 1 Tool
Case Control	Joanna Briggs Institute (JBI) Checklist for Case Control Studies
Case Report	Joanna Briggs Institute (JBI) Checklist for Case Reports
Case Series	Joanna Briggs Institute (JBI) Checklist for Case Series
Cohort	Joanna Briggs Institute (JBI) Checklist for Cohort Studies
Cross-sectional	Joanna Briggs Institute (JBI) Checklist for Analytical Cross Sectional Studies
Prevalence	Joanna Briggs Institute (JBI) Checklist for Prevalence Studies
Quasi-experimental	Joanna Briggs Institute (JBI) Checklist for Quasi-Experimental Studies
Randomized Controlled Trial	Joanna Briggs Institute (JBI) Checklist for Randomized Controlled Trials

Completed quality assessments for each included study are available on request.

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach was used to assess the certainty in the findings based on eight key domains.

In the GRADE approach to quality of evidence, **observational studies,** as included in this review, provide **low quality** evidence, and this assessment can be further reduced based on other domains:

- High risk of bias
- Inconsistency in effects
- Indirectness of interventions/outcomes
- Imprecision in effect estimate
- Publication bias

and can be upgraded based on:

- Large effect
- Dose-response relationship
- Accounting for confounding.

The overall certainty of the evidence for each outcome was determined taking in to account the characteristics of the available evidence (observational studies, some not peer-reviewed, unaccounted-for potential confounding factors, different tests and testing protocols, lack of valid comparison groups). A judgement of 'overall certainty is very low', means that the findings are very likely to change as more evidence accumulates.

Findings

Summary of the Certainty of Evidence

In this update, nine new single studies, four new syntheses, two new in-progress single studies, two new in-progress syntheses, and five updates to single studies were identified. 67 **previously included** studies were excluded based on new eligibility criteria, for a total of 49 publications addressing the research question.

A full list of studies that were previously included that are now excluded is available in Appendix 2.

What is the role of schools and daycares on COVID-19 transmission?

Outcome	Studies included		Overall certainty in evidence (GRADE)
	Study design	n	
COVID-19 transmission within schools/daycares (including number of cases, cases per population, and secondary attack rates)	Syntheses	4	⊕⊕⊕◯ Moderate[1]
	Observational	13	
Impact of IPAC measures on COVID-19 transmission within schools/daycares (including number of cases, cases per population, and secondary attack rates)	Syntheses	3	⊕⊕◯◯ Low[2]
	Randomized controlled trial	1	
	Observational	5	
COVID-19 transmission in the community (change in number of cases, and cases per 100,000 before/after school re-opening)	Syntheses	1	⊕⊕◯◯ Low[3]
	Quasi-experimental	3	
COVID-19 transmission within camps (including number of cases, cases per population, and secondary attack rates)	-	0	N/A

[1]In the GRADE approach to quality of evidence, **observational studies,** as included in this review, provide **low quality** evidence, and this assessment was upgraded to **moderate** based on the large effect observed.
[2]In the GRADE approach to quality of evidence, **observational studies,** as included in this review, provide **low quality** evidence. No additional up or downgrades were made.
[3]In the GRADE approach to quality of evidence, this assessment was downgraded due to high risk of bias, and imprecision of effect estimates.

Warning

Given the need to make emerging COVID-19 evidence quickly available, many emerging studies have not been peer reviewed. As such, we advise caution when using and interpreting the evidence included in this rapid review. We have provided a summary of overall certainty of the evidence to support the process of decision making. Where possible, make decisions using the highest quality evidence available.

Table 1: Single Studies, Within School Transmission

Reference	Date Released	Study Design	Setting, Location	IPAC measures	Summary of Findings	Quality Rating:
New evidence reported on August 12, 2021						
Ulyte, A., Radtke, T., Abela, I.A., Haile, S.R., Ammann, P., Berger, C. … Kriemler, S. (2021). Evolution of SARS-CoV-2 seroprevalence and clusters in school children from June 2020 to April 2021 reflect community transmission: Prospective cohort study Ciao Corona. *Preprint.*	Jul 19, 2021	Cohort	Primary, middle and secondary schools Zurich, Switzerland	• Distancing • Cohorting • Reduced common activities • Masks (gradual adoption starting with adults then upper and middle schools, masks for lower age children not mandated) • Contact tracing • Quarantine policies • School-wide screening with RT-PCR testing in cases of suspected outbreak starting Feb 2021 • Schools remained open for physical attendance from May 2020 to the end of the 2020/21 school year	In Jun/Jul, Oct/Nov 2020, Mar/Apr 2021 classes and schools were randomly selected to take part in seroprevalence testing. 2974 children from 275 classes in 55 schools enrolled. Median participation within each class was 50%. Seroprevalence increased from 1.5% (95% CI=0.6,2.6) in Jun – Jul to 6.6% (95% CI=4.0,8.9) in Oct – Nov and 16.4% (95% CI=12.1,19.5) in Mar-Apr 2021. Community daily incidence of positive cases peaked at 88/100,000 on Oct 28, 2020. There were no differences by sex but did differ by district and age. • Higher in middle school (aged 8-13, 19.5%) vs. upper level (age 12-17, 12.4%), **p=0.02** • No difference between lower (aged 7-19, 16%) and middle or upper. At least 1 seropositive child was detected in all 55 schools and in 184/275 (67%) classes, (range 0-15 per school, 0-13 per class). 14% of classes at clusters of 3+ cases; 25 were investigated further. Within-school transmission was likely in 12/25 (48%), improbable in 7/25 (28%) and undetermined in 6/25 (24%). Most PCR-positive cases were linked to a household source.	High ***PREPRINT***

Ladhani, S.N., Ireland, G., Baawuah, F., Beckmann, J., Okike, I.O., Ahmad, S., … Ramsay, M. E. (2021). Emergence of SARS-CoV-2 Alpha (B.1.1.7) variant, infection rates, antibody seroconversion and seroprevalence rates in secondary school students and staff: active prospective surveillance, December 2020 to March 2021, England. *Preprint.*	Jul 16, 2021	Cohort	Secondary Schools Derbyshire, West London, East London, Greater Manchester, Hertfordshire and Birmingham, England	• Masks (students, except when seated in class) • Widespread full closure in Mar 2020 partial reopening in Jun 2020, in-person Sep 2020 and closure Jan 5 - Mar 8, 2021	Point-prevalence testing occurred in 18 secondary schools at points: T1, Sept 22 – Oct 17, 2020, T2, Dec 3 – 17, 2020 and T3, Mar 23 – Apr 21, 2021. At T3, only 5.7% of students and 70.3% of staff attended in-person school part-time and 11.5% of students and 29.7% of staff attended full-time. 42.9% of staff and 1.3% of students reported being vaccinated. • From T2-T3, 5.7% (62/1094) of students and 4.4% (35/792) of staff had RT-PCR confirmed infection (through study testing or national registry) • Seroprevalence increased from 11.0% at T1, to 13.3% at T2 and 20.9% at T3. • Using the N and S antibody test, at T3, seroprevalence was 36.3% (370/1018) in students and 31.9% (245/769) in staff Seroprevalence varied widely by region. Students who attended school in-person during at T3 had higher odds of seropositivity vs. those learning from home: **OR: 2.27 (95% CI=1.06,4.68)**	Moderate ***PREPRINT***
Schenk, B., Hoehl, S., Rudych, O., Menger, D., Farmand, S., Wrobel, F. … Ciesek, S. (2021). Longitudinal testing for SARS-CoV-2 RNA in day care centers in Hesse, Germany, during increased local incidence and with VOC Alpha as	Jul 3, 2021	Cohort	Daycare centers Hesse, Germany	• Not reported	SAFE KiDS 2: 577 children, 334 staff from 47 daycare centers were tested weekly for 4 weeks via RT-PCR in Jan – Feb 2021. 7-day community incidence 66.0 to 138.7 per 100,000 • 7/577 (1.21%) children tested positive • 1/334 (0.3%) staff tested positive • Only 3/8 positive cases were confirmed via health dept testing • In 6/8 positive cases, other household members also tested positive • No in-school transmission was detected • No VoC detected	Low ***PREPRINT***

dominant variant: Results of the SAFE KiDS 2 and SAFE KiDS 3 study. *Preprint.*					SAFE KiDS 3: 756 chidren, 226 staff from 46 daycares centres tested weekly for 4 weeks via RT-PCR in May – Jun 2021. 7-day community incidence 4.7-124.6 per 100,000; alpha VoC prominent. No positive results were detected. Results suggest that daycare centers have a limited role in transmission even with high community incidence.	
Goldfarb, D.M., Mâsse, L.C., Watts, A.W., Hutchison, S.M., Muttucomaroe, L., Bosman, E.S. … Lavoie, P.M. (2021). SARS CoV-2 seroprevalence among Vancouver public school staff in British Columbia, Canada. *Preprint.*	Jun 18, 2021	Prevalence	Vancouver School District Vancouver, British Columbia, Canada	• Physical distancing • Enhanced cleaning • Enhanced ventilation • Cohorts • Screening (staff and students) • Regular surface cleaning • Unidirectional flow of students • Masks (not mandatory until Feb 2021 for grades 6-12 and for grades 4-12 in Apr 2021) • Hand hygiene (hand sanitizer in classrooms and common areas) • Quarantine policies • Staggered recess and lunch breaks	Incidence was calculated amongst 47,280 students and 7071 staff using surveillance data from Sep 2020 – May 2021. • Students: 9.8/1000 students (range: 0 to 63/1000 by school) • Staff: 13/1000 classroom, 14/1000 non-classroom staff (range: 0 to 167/1000) Across 107 schools • 63% had no confirmed staff cases • 24% had 1 staff case • 13% >1 staff case • Median student cases per school was 3 21.5% (363/1686) of staff reported close contact with a positive case but only 1.4% (24/1689) of staff self-reported a positive test. 5 reported close contact with a student or staff member, 7 with a family member, 1 with both a co-worker and family member and 11 unknowns. 1556 school staff underwent seroprevalence testing Feb – May 2021. • 2.2% (95% CI=1.6,3.1) tested positive • Seroprevalence in age, sex and geography-matched donors was 2.0% (95% CI=1.5,2.7) (no difference)	Moderate ***PREPRINT***

Previously reported evidence						

Haag, L., Blankenburg, J., Unrath, M., Grabietz, J., Kahre, E., Galow, L., … Armann, J. P. (2021). Prevalence and transmission of SARS-CoV-2 in childcare facilities: A longitudinal study. *Preprint.*	Apr 18, 2021	Cohort	14 Daycare facilities Dresden, Saxony, Germany	• Masks (parents)	From Jul 15, 2020 – Jan 31, 2021, COVID-19 seropositivity of children, parents, and staff from 14 daycares was monitored during periods of low and high community prevalence. No participants were seropositive at baseline.
					
					Period of low prevalence; 4 confirmed cases:
					• 1/154 (0.7%) staff
					• 1/196 (0.5%) parent
					• 2/232 (0.9%) children
					
					Period of high prevalence; 63 confirmed cases in 8 facilities:
					• 23/87 (12.3%) staff
					  ○ More administrative staff (20.8%) vs. childcare staff (8.1%), **p=0.034**
					• 25/236 (10.6%) parents
					• 15/222 (6.8%) children
					  ○ 4 clusters, range 2-3 children
					  ○ 5/12 cases had no facility link
						Moderate
						
						PREPRINT

Gettings, J.R., Gold, J.A.W., Kimball, A., Forsberg, K., Scott, C., Uehara, A. … Vallabhaneni, S. (2021). SARS-CoV-2 transmission in a Georgia school district — United States, December 2020–January 2021. *Clinical Infectious Diseases,* ciab332.	Apr 17, 2021	Prevalence	School district in metropolitan Atlanta, Georgia, USA	• Enhanced cleaning
				• Enhanced ventilation
				• Hand hygiene
				• Masks (except during sports)
				• Physical distancing (<3 ft. in elementary schools due to higher class sizes)
				• Plastic barriers around desks
					From Dec 1, 2020 – Jan 22, 2021, 98 school cases were identified; 86 included in analysis:
					• 33 (38.4%) staff; 53 (61.6%) students
					  ○ Of 1,119 close contacts, 68 of 688 tested were positive
					
					Secondary Attack Rate (SAR) among:
					• Students: 5.8% (95% CI=3.6,8.0)
					• Staff: 13.1% (95% CI=9.0,17.2)
					
					Higher SAR occurred in:
					• Indoor high impact sports: 23.8% (95% CI=12.7,33.3)
					• Staff interactions: 18.2% (95% CI=4.5,31.8)
					• Elementary classrooms: 9.5% (95% CI=6.5,12.5)
					  ○ Elementary teachers: 15.0 (95% CI=10.2,19.8)
						Moderate

					○ Symptomatic staff; 13.7% (95% CI=9.1,17.8) Lower SAR occurred in: • Asymptomatic students: 2.3% (95% CI=0.6,4.6) • Elementary students: 2.7% (95% CI=0.7,5.3) 69 samples were sequenced. No variants of concern were detected.	
Aiano, F., McOwat, K., Obi, C., Powell, A.A., Flood, J.S., Bhardwaj, S. … Saliba, S. (2021). COVID-19 outbreaks in nurseries during rapid spread of the B.1.1.7 variant of SARS-CoV-2 in England: Cross-sectional national surveillance, November 2020 – January 2021. *Preprint.*	Apr 15, 2021	Prevalence	Daycares England, The United Kingdom (B.1.1.7)	• Cohorts • Physical distancing	From Nov 2, 2020 – Jan 31, 2021, 324/32,852 daycares reported an outbreak (0.98%). This study includes data from 173 daycares, reporting 1657 cases: 510 children (31%), 1147 staff (69%) (median 8 cases/outbreak, mode 2 cases/outbreak) Overall SAR was 9.1% (95% CI=8.65,9.48) • Child index case in 26% of outbreaks: SAR: 7.97% (95% CI=7.24,8.77) (Highest in those <1 and decreased with age) • Staff index case in 72% of outbreaks: SAR: 9.48% (95% CI=8.98,10.0) Staff to staff transmission was highest (SAR: 32.98, 95% CI=31.19,34.82), followed by child to staff (SAR: 26.28, 95% CI= 23.54,29.21) and lowest in child-to-child transmission (SAR: 3.55, 95% CI=3.01,4.19). SAR were higher in Jan 2021 when B.1.1.7 variants increased (compared to Nov 2020), suggesting variants may be more transmissible, although community rates also rose at the same time: • Children: SAR: 4.21% (95% CI=3.72,4.77) vs. 2.34% (95% CI=1.94,2.81) • Staff: SAR: 33.96% (95% CI=32.23,38.30) vs. 24.26% (95% CI=21.97,26.72)	Low ***PREPRINT***

Gandini, S., Rainisio, M., Iannuzzo, M.L., Bellerba, F., Cecconi, F., & Scorrano, L. (2021). A cross-sectional and prospective cohort study of the role of schools in the SARS-CoV-2 second wave in Italy, *The Lancet Regional Health – Europe, 5,* 100092.	Mar 26, 2021	Prevalence	Kindergarten, elementary, middle and high schools, Italy	• Ban on sports and music • Frequent ventilation • Hand hygiene • Masks (staff, high school students) • Negative test following exposure (some schools) • Physical distancing (1m between seats) • Reduced school hours • Temperature check • Unidirectional flow of students	From Sep 30, 2020 – Feb 28, 2021, incidence and positivity were lower amongst elementary and middle school students compared to general population; incidence was higher in high school students in 3 of 19 regions. Incidence in teachers was no different from other occupations after adjusting for age. Active contact tracing occurred following case identification from Nov 23 – Dec 5, 2020; mean number of tests per case ranged from 9-17. Clusters (2+ cases in 1 week) were found in 5-7% of schools with a case. Teacher to teacher transmission (37%) was more common than student to teacher (10%) **(p=0.007)**. Incidence by school level (Nov 23-28): • Kindergarten: 0.21% of children and 2.35% of teachers • Elementary: 0.35% of children and 1.83% of teachers • Middle: 0.45% of students and 1.60% of teachers Increase in R_O was not associated with staggered school reopening date but were linked to a national election. School closures in two regions did not lower R_O.	High

Hershow, R.B., Wu, K., Lewis, N.M., Milne, A.T., Currie, D., Smith, A.R., … Chu, V.T. (2021). Low SARS-CoV-2 transmission in elementary schools — Salt Lake County, Utah, December 3, 2020–January 31, 2021. *Morbidity and Mortality Weekly Report, 70*(12), 442-448.	Mar 26, 2021	Cross-sectional	K-6 schools, Salt Lake County, Utah, USA	• 6ft distance • High mask use (86%) • 81% in-person learning • Plexiglass barriers for teachers • Staggered mealtimes	From Dec 3 – Jan 21, 2021, susceptible school contacts of 51 index cases (40 students, 11 staff) were contacted: • Of 1041 close contacts, 735 (70.6%) were tested, 12 were positive (SAR: 1.6%) • 5 of 12 positive cases were classified as school-associated • Four of five events were deemed to be due to lapses in IPAC measures (<6ft distance during class (2) or lunch (2), and poor mask compliance (2). • Tertiary transmission was detected in 3 households	Moderate
van Loon, W., Hommes, F., Theuring, S., von der Haar, A., Körner, J., Schmidt, M. … Mockenhaupt, F. P. (2021). Renewed absence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections in the day care context in Berlin, January 2021. *Clinical Infectious Diseases,* ciab199.	Mar 2, 2021	Cohort	Kindergarten, Metropolitan Berlin, Germany	Not reported	From Jan 17 – 23, 2021, children, families, and staff from 12 kindergarten programs were sampled: • 149 kindergarten children • 74 staff • 472 household members All tested negative for COVID-19. Community weekly incidence in the same time period was 110/100,000. Small sample size (n=12 centres) may not be representative of the >2600 kindergartens in Berlin.	Low

Table 2: Case Reports and Case Series Following School Reopening

Reference	Date Released	Location, Setting	IPAC Measures	Summary of Findings	Quality Rating:
New evidence reported on August 12, 2021					
Loenenbach, A., Markus, I., Lehfeld, A.-S., an der Heiden, M., Haas, W., Kiegele, M. … Buchholz, U. (2021). SARS-CoV-2 variant B.1.1.7 susceptibility and infectiousness of children and adults deduced from investigations of childcare centre outbreaks, Germany, 2021. *Eurosurveillance*, 26*(21),* pii=2100433.	May 27, 2021	Daycare centers Hesse, Germany	• Cohort • Separate bathrooms • Masks (staff outside of cohort) • Parents not allowed to enter the building and mandatory mask-wearing during children's drop off and pick up	From Jan – Feb 2021, B.1.1.7 outbreaks occurred in 3 daycares 11/12 cohorts in 3 centres developed secondary cases. All children and staff were offered testing; uptake not reported. Overall SAR: • Daycare 1: 37% (95% CI=26,49) • Daycare 2: 27% (95% CI=16,42) • Daycare 3: 17% (95% CI=9,28) SAR for close contacts (<1.5m for >15 min): • Daycare 1: 53% (95% CI=30,75) • Daycare 2: 33% (95% CI=12,65) • Daycare 3: 22% (95% CI=12,37). SAR among non-close contacts • Daycare 1: 32% (95% CI=21,45) • Daycare 2: 26% (95% CI=14,42) • Daycare 3: 6% (95% CI=1,26). SAR for children • Daycare 1: 31% (95% CI=20,45) • Daycare 2: 27% (95% CI=14,46) • Daycare 3: 17% (95% CI=8,32) SAR among adults • Daycare 1: 53% (95% CI=32,73) • Daycare 2: 28% (95% CI=12,51) • Daycare 3: 17% (95% CI=7,37). Household contacts were also offered testing, but no systematic surveillance occurred. Pooled household SAR: 37% (95% CI=28,47). The authors suggest that child susceptibility and infectiousness are higher with the B.1.1.7 VoC, but no formal comparisons were made.	Moderate

Previously reported evidence					
Berke, E.M., Newman, L.M., Jemsby, S., Bhalla, N., Sheils, N.E., Oomman, N. … Cangelosi, G.A. (2021). Pooling-in-a-pod: A strategy for COVID-19 testing to facilitate safe return to school. *Preprint.*	May 25, 2021	Independent K-12 school, Washington DC	• Daily symptom screening • Masking • Physical distancing • Modified extracurriculars • "Facility optimization" • Hybrid learning (1-12 only, K all in person)	This project aimed to test the feasibility of 'pool in a pod' cohort-specific testing for early case detection and management. From Nov 30, 2020 – Apr 30, 2021, 863 students and 264 staff took part in twice a week testing (participation varied by week). Over 34 testing sessions, there were 1733 negative and 4 positive pools. Outside confirmatory testing identified a two positive cases; the rest were false positives. Weekly cost-per-person was $24.24. Return to in-person learning after initiating testing procedures with no increase in positive cases.	Moderate ***PREPRINT***
Gold, J.A.W., Gettings, J.R., Kimball, A., Franklin, R., Rivera, G., Morris, E., … Georgia K-12 School COVID-19 Investigation Team. (2021). Clusters of SARS-CoV-2 infection among elementary school educators and students in one school district- Georgia, December 2020-January 2021. *Morbidity and Mortality Weekly Report, 70*(8), 289-292.	Feb 26, 2021	Elementary schools, Georgia, USA	• Masks (except while eating) • Plastic dividers on desks (but students sat <3 ft apart)	From Dec 1, 2020 – Jan 22, 2021, 9 clusters (of ≥3 linked COVID-19 cases) involving 13 staff and 32 students at 6 schools were identified. 2600 students and 700 staff attended school during this time. 18/69 (26%) household contacts tested positive. Median cluster size (including household members) was 6 (range 3-16). Index patients were: • Staff (4 clusters) • Student (1 cluster) • Unknown (5 clusters) Probable transmission included: • Staff-to-student (8 clusters) • Student-to-student (4 clusters) • Student-to-staff (3 clusters) • Staff-to-staff (2 clusters; which was followed by staff-to-student transmission and resulted in 15/31 school-associated cases) 9 clusters involved lack of physical distancing, 5 inadequate student mask use.	Moderate

Table 3: Single Studies, Associations Between Mitigation Measures and Outcomes

Reference	Date Released	Study Design	Setting, Location	IPAC measures	Summary of Findings	Quality Rating:
New evidence reported on August 12, 2021						
Rubin, D., Eisen, M., Collins, S., Pennington, J.W., Wang, X., & Coffin, S. (2021). SARS-CoV-2 infection in public school district employees following a district-wide vaccination program — Philadelphia County, Pennsylvania, March 21–April 23, 2021. *Morbidity and Mortality Weekly Report (MMWR). 70,* 1040–1043.	Jul 30, 2021	Prevalence	School District of Philadelphia Philadelphia, United States	• Weekly antigen tests	Weekly antigen screening tests were required from all employees Mar 21 – Apr 23, 2021, following employee-targeted mass vaccination (Feb 23 – Apr 3, 2021). Among 22,808 eligible employees, 10,700 (46.9%) received ≥1 dose; 46.1% received 2 doses. By Apr 23, 34,048 tests were conducted within 54% school staff who returned to in-person learning; 0.7% were positive. • 19/21,083 (0.09%) received 2 doses • 21/1737 (1.21%) received 1 dose • 198/11,228 (1.76%) unvaccinated • RR 2 doses vs. unvaccinated = **0.04 (95% CI=0.02,0.07)** • RR 1 dose vs. unvaccinated = 0.69 (95% CI=0.44,1.07) Amongst asymptomatic staff: • 18/21,019 (0.09%) received 2 doses • 14/1717 (0.82%) received 1 dose • 134/11,007 (1.22%) unvaccinated • RR 2 doses vs. unvaccinated = **0.07 (95% CI=0.04,0.11)** • RR 1 dose vs. unvaccinated = 0.67 (95% CI=0.39,1.16)	High
Young, B.C., Eyre, D.W., Kendrick, S., White, C., Smith, S., Beveridge, G., … Peto, T.E.A. (2021). A cluster randomised trial of the impact of a policy of daily	Jul 25, 2021	Cluster randomized controlled trial	Secondary schools and colleges, England, UK	• Isolation for cases and contacts • Contact tracing • Daily rapid antigen testing	From Apr 19 – Jun 27, 2021, 201 schools were assigned to one of two conditions following identification of a school case: 10-days of home isolation (control) or continued attendance with voluntary daily rapid testing (intervention). RT-PCR confirmed cases were identified in both intervention (740 or 61.8/100,000 per	High ***PREPRINT***

testing for contacts of COVID-19 cases on attendance and COVID-19 transmission in English secondary schools and colleges. *Preprint.*					week) and control (657 or 59.1/100,000 per week). Using intention to treat analysis: • Symptomatic RT-PCR confirmed infection (vs. control): Incidence Rate Ratio (IRR): 0.96 (95% CI=0.75,1.22) • Any community RT-PCR confirmed infection (vs. control): IRR: 0.96 (95% CI=0.76,1.20) • % of asymptomatic contacts testing positive on study-related PCR test (vs. control): IRR: 0.73 (95% CI=0.33,1.61) • % of symptomatic contacts testing positive on routine community test: IRR: 1.21 (95% CI=0.82,1.79) Daily testing is non-inferior to self-isolation in infection control and is a safe alternative to home isolation for school-based exposure.	
Oster, E. (2021, May 23). *National COVID-19 school response dashboard.*	May 23, 2021	Prevalence	Schools, USA	• Varied by county	From Aug 31, 2020 – May 23, 2021, 7,770,832 students learning in-person and 1,641,392 in-person staff were included in the dashboard. From May 10 – 23, 2021 • Daily case rate = 8 per 100,000 students (0.11%). • Daily case rate = 6 per 100,000 staff (0.09%) • The community case rate in school-matched population was 9 per 100,000, positivity rate of 3.22%. Case rates (per 100,000) by mitigation strategies include: Student masking vs. no mask Low/moderate community transmission (<50 total new cases per 100,000 persons in the past 7 days, or approximately <7 cases per day) • Students: 4/10,279 (0.04%) vs. 2/1428 (0.14%) • Staff: 5/10,320 (0.05%) vs. 4/1427 (0.28%)	Low ***NOT PEER REVIEWED***

					Substantial community transmission (50-99 total new cases per 100,000 persons in the past 7 days, or ~7-14 cases per day) • Students: 8/26,051(0.03%) vs. 7/5137 (0.14%) • Staff: 8/25,813 (0.03%) vs. 7/5121 (0.14%) High community transmission ≥100 total new cases or more per 100,000 persons in the past 7 days, or approximately >14 cases per day • Students: 25/101,874 (0.02%) vs. 19/20,342 (0.09%) • Staff: 32/99,628 (0.03%) vs 18/20,047 (0.09%) <u>6-feet student distancing vs. 3-feet vs. no distancing</u> Low/moderate community transmission • Students: 5/6294 (0.08%) vs. 3/661(0.45%) vs. 1/3132 (0.03%) • Staff: 5/6292 (0.08%) vs. 3/661 (0.45%) vs. 4/3133 (0.13%) Substantial community transmission • Students: 9/17,669 (0.05%) vs. 7/1285 (0.54%) vs. 5/8487 (0.06%) • Staff: 8/17,647 (0.05%) vs. 7/1285 (0.54%) vs. 6/8485 (0.07%) High community transmission • Students: 26/79,167 (0.03%) vs. 19/3271 (0.58%) vs. 15/19,718 (0.08%) • Staff: 30/78,712 (0.04%) vs. 32/3271 (0.98%) vs. 26/19,700 (0.13%) <u>Increased ventilation vs. no ventilation</u> Low/moderate community transmission • Students: 5/6129 (0.08%) vs. 2/3877 (0.05%) • Staff: 5/6129 (0.08%) vs. 5/3877 (0.13%)	

					Substantial community transmission
					• Students: 9/17,476 (0.05%) vs. 6/9891 (0.06%)
					• Staff: 8/17,460 (0.05%) vs. 7/9883 (0.07%)
					
					High community transmission
					• Students: 25/70,635 (0.04%) vs. 21/31,286 (0.07%)
					• Staff: 31/70,571 (0.04%) vs. 27/30,877 (0.09%)
					
					<u>In-person student density</u>
					Low/moderate community transmission
					• Students:
					  ○ Density <60%: 6/5622 (0.11%)
					  ○ Density 60-90%: 4/8118 (0.05%)
					  ○ Density >90%: 2/8462 (0.02%)
					• Staff:
					  ○ Remote: 4/186 (2.15%)
					  ○ Density <60%: 8/4984 (0.16%)
					  ○ Density 60-90%: 8/8063 (0.10%)
					  ○ Density >90%: 5/8447 (0.06%)
					
					Substantial community transmission
					• Students:
					  ○ Density <60%: 8/18,839 (0.04%)
					  ○ Density 60-90%: 8/21,500 (0.05%)
					  ○ Density >90%: 5/12,062 (0.08%)
					• Staff:
					  ○ Remote: 11/401 (2.74%)
					  ○ Density <60%: 10/17,209(0.06%)
					  ○ Density 60-90%: 11/21,333 (0.05%)
					  ○ Density >90%: 10/12,062 (0.08%)
					
					High community transmission
					• Students:
					  ○ Density <60%: 25/65,225 (0.04%)
					  ○ Density 60-90%: 22/67,042 (0.03%)
					  ○ Density >90%: 15/33,841 (0.04%)
					• Staff:
					  ○ Density >90%: 15/33,841 (0.04%)
					  ○ Remote: 43/1601 (2.69%)	

					○ Density <60%: 31/57,607 (0.05%) ○ Density 60-90%: 36/65,322 (0.06%) ○ Density >90%: 28/33,532 (0.08%)	
Previously reported evidence						
Oster, E., Jack, R., Halloran, C., Schoof, J., & McLeod, D. (2021). COVID-19 mitigation practices and COVID-19 rates in Schools: Report on data from Florida, New York and Massachusetts. *Preprint.*	May 21, 2021	Quasi-experimental	Florida, New York and Massachusetts, USA	• Cohorts • Enhanced ventilation • Masks • Reduced student density • Physical distancing (6 ft.) • Symptom screening • Temperature checks Varied by state	Student IRRs for mitigation practices were calculated by State over the 2020-2021 school year: • Florida: ○ Student density ≥80 vs. 10-49%: **IRR: 0.576, p<0.001** ○ Student density 50-79 vs. 10-49%: **IRR: 0.773, p<0.001** ○ Staff mask mandate vs. none: IRR: 0.990, p>0.05 ○ No mask mandate vs. any: IRR: 1.116, p>0.05 ○ Ventilation improvements: IRR: 0.858, p>0.05 • Massachusetts: ○ Student density ≥80 vs. 10-49%: **IRR: 0.627, p<0.001** ○ Student density 50-79 vs. 10-49%: **IRR: 0.655, p<0.01** • New York ○ Student density ≥80% vs. 10-49%: **IRR: 0.628, p<0.001** ○ Student density 50-79 vs. 10-49%: **IRR: 0.708, p<0.001** ○ Ventilation improvements vs. none: IRR: 0.938, p>0.05 Higher in-person learning density is consistently associated with lower student cases.	Moderate ***PREPRINT***

Lessler, J., Grabowski, K., Grantz, K.H., Badillo-Goicoechea, E., Metcalf, J.E., Lupton-Smith, C. … & Stuart, E.A. (2021). Household COVID-19 risk and in-person schooling. *Science, 327*(6546), 1092-1097.	Apr 29, 2021	Cross-sectional	Schools, USA	• Cancelled extracurriculars • Closed common spaces (playgrounds, cafeterias) • Cohorting • Masks • Physical distancing (extra space, separators between desks) • Reduced class size • Restricted entry • Symptom screening • *Substantial heterogeneity in number and type of IPAC measures mandated across states.	From Nov 24 – Dec 23, 2020, and Jan 11 – Feb 10, 2021, data on schooling behaviours and COVID-19 outcomes from 50 states were collected via an online survey (2,142,887 respondents, 284,789 reported living with at least one child in in-person schooling). Compared to full-time in-person, part-time in-person was not associated with risk of COVID-19 outcomes once mitigation measures are accounted for. For every additional IPAC measure implemented there was a decrease in odds of a positive test **(adjusted OR: 0.93, 95% CI=0.92,0.94)**; symptoms screening was associated with the greatest risk reduction. When 7 or more IPAC measures were implemented, risk largely disappeared (with a complete absence of risk with 10 or more IPAC measures). Among those reporting 7 or more mitigation measures, 80% reported student/teacher mask mandates, restricted entry, desk spacing and no supply sharing. Associations between IPAC measures and positive tests varied; outdoor instruction, restricted entry, no extracurriculars, and daily symptom screening were associated with significant risk reductions: • Student mask mandate: adjusted OR: 0.91 (95% CI=0.83,1.00) • Teacher mask mandate: adjusted OR: 0.91 (95% CI=0.83,1.00) • Same teacher all day: adjusted OR: 1.00 (95% CI=0.93,1.08) • Same students all day: adjusted OR: 0.93 (95% CI=0.86,1.00) • Outdoor instruction: **adjusted OR: 0.88 (95% CI=0.80,0.98)** • Restricted entry: **adjusted OR: 0.88 (95% CI=0.81,0.95)**	Moderate

					• Reduced class size: adjusted OR: 1.01 (95% CI=0.94,1.09) • Closed cafeteria: adjusted OR: 1.03 (95% CI=0.95,1.11) • Closed playground: adjusted OR: 1.01 (95% CI=0.92,1.10) • Desk shields: **adjusted OR: 1.12 (95% CI=1.04,1.22)** • Extra desk space: adjusted OR: 0.96 (95% CI=0.89,1.04) • No extracurriculars: **adjusted OR: 0.73 (95% CI=0.68,0.79)** • No sharing supplies: adjusted OR: 0.92 (95% CI=0.85,1.00) • Daily symptom screen: **adjusted OR: 0.78 (95% CI=0.73,0.84)** • Part-time in person: adjusted OR: 0.97 (95% CI=0.91,1.03)	
van den Berg, P., Schechter-Perkins, E.M., Jack, R.S., Epshtein, I., Nelson, R., Oster,E., & Branch-Elliman, W. (2021). Effectiveness of 3 versus 6 feet of physical distancing for controlling spread of coronavirus disease 2019 among primary and secondary students and staff: A retrospective, statewide cohort study. *Clinical Infectious Diseases,* ciab230.	Mar 10, 2021	Cohort	242 public schools, Massachusetts	• Cohorting • Dedicated isolation space for symptomatic students • Enhanced cleaning • Enhanced ventilation • Hand hygiene • Masks (staff, students ≥ grade 2) • Physical distancing (>3 vs. >6 feet) • Symptom screening (staff, students)	From Sep 24, 2020 – Jan 27, 2021, daily incidence in students and staff were compared in school physical distancing requirements of 3 vs. 6 feet. In total, 4226/537,336 (0.79%) students and 2382/99,390 (2.4%) staff tested positive. Cases were similar in all districts: • Staff IRR: 0.989 (95% CI=0.73,1.33) • Student IRR: 0.891 (95% CI=0.59,1.34) After adjusting for community incidence: • Staff IRR: 1.02 (95% CI=0.75,1.37) • Student IRR: 0.904 (95% CI=0.62,1.33)	Moderate

Table 4: Single Studies, Community-level Impact of School Reopening

Reference	Date Released	Study Design	Setting, Location	IPAC measures	Summary of Findings	Quality Rating:
New evidence reported on August 12, 2021.						
Sebastiani, G. & Palù, G. (2021). COVID-19 Pandemic: Influence of Schools, Age Groups, and Virus Variants in Italy. *Viruses, 13*(7), 1269.	Jun 29, 2021	Quasi-experimental	Italy, post-Christmas Break, post delayed school closures	Not reported	From Jan – Feb 2021, the incidence of COVID-19 in school aged children was compared staggered school re-openings across the country. • Hospital ICU admissions consistently decreased over the course of Jan 2021 which coincided with a delay in school re-opening after the Christmas Break (values not provided) • The increased incidence of COVID-19 among those 0-9 in the first 10 days of Jan 2021 is statistically significant **(p<0.001)** (data not provided). • Incidence peak occurred 14-days after return to remote schooling (data not provided)	Low
Previously reported evidence						
Bignami-van Assche, S., Boujija, Y., Fisman, D., & Sandberg, J. (2021). In-person schooling and COVID-19 transmission in Canada's three largest cities. *Preprint.*	Mar 23, 2021	Case series	School-aged children, Montreal, Toronto, and Calgary, Canada	• Masks (varied): ○ Toronto: mandatory for elementary and secondary schools; encouraged for kindergarten. ○ Montreal: mandatory in common areas for elementary, and later, in classrooms for secondary schools.	Levels of community transmission were low when schools reopened (Aug 25 – 31, 2020): • 11.3/100,000 Montreal • 10.0/100,000 Toronto • 26.7/100,000 Calgary Montreal and Toronto implemented IPAC measures (restaurant and recreation closures, gathering restrictions) in Oct 2020; by Dec, all 3 cities had implemented these and additional measures (work from home, business closures). Levels of community transmission had risen by end of study period (Jan 6 – 12, 2021): • 356.9/100,000 Montreal • 165.9/100,000 Toronto • 153.5/100,000 Calgary	Low ***PREPRINT***

				○ Calgary: mandatory K-12, could be removed when seated in classrooms (cohorts, physically distanced) • Optional remote or hybrid learning	In Toronto and Calgary, infection trends in 0–19-year-olds paralleled adults; in Montreal, increased rates among adults were preceded by increases among 10–19-year-olds, suggesting Montreal school IPAC measures were insufficient. One week after schools closed for winter holiday break, weekly incidence declined among 0–19-year-olds but continued to rise in other age groups.	
Perramon, A., Soriano-Arandes, A., Pino, D., Lazcano, U., Andrés, C., Català, M., … Soler-Palacin, P. (2021). Epidemiological dynamics of the incidence of COVID-19 in children and the relationship with the opening of schools in Catalonia (Spain). *Preprint.*	Feb 17, 2021	Quasi-experimental	Primary and secondary schools, Catalonia, Spain	• Cohorting • Enhanced ventilation • Hand hygiene • Infographics • Masks (students aged ≥6) • Mass screening campaigns • Cohort screening/ quarantining with positive case	From Sep 14, 2020 – Jan 31, 2021, 48,914 (of 942,881) children (aged <18) tested positive for COVID-19 (5.2%). Variant B.1.1.7 was first detected in Catalonia at end of December. Incidence for aged <12 lower than general population; incidence aged 12-17 similar or higher. Age associated with higher incidence. Incidence impacted by changes in active screening/testing. Daily tests and cases among children, compared with the general population, decreased when schools were closed **(p<0.001)**. During first 11 weeks, positivity rate in children (≤5%) was lower than general population; positivity rate increased when schools were closed for holidays **(p<0.001)** due to a decrease in screening/testing. Rate of cases in children was significantly lower than for adults during whole study period **(p<0.001)**.	Low ***PREPRINT***

Table 5: In-progress Single Studies

Title	Anticipated Release Date	Setting	Description of Document
New evidence reported on August 12, 2021			
Universitätsmedizin Greifswald. (2021). *Analyzing the incidence of SARS-Cov-2 infected children and teenager in Western Pomerania. German Clinical Trials Register, DRKS00024635.*	Not reported	Not specified	This seroprevalence study will measure the infection rate of COVID-19 and temporal changes in COVID specific antibodies in children aged 6 months – 17 years.
Universitätsklinikum Heidelberg. (2021). *The Potential of home-based screening for SARS-CoV-2 when opening schools in Baden-Württemberg (COVID-19). German Clinical Trials Register, DRKS00024845.*	Not reported	School	This surveillance study will monitor the incidence and prevalence of COVID-19 in students and staff in a primary school using an at home rapid test with confirmation through PCR testing.
Previously reported evidence			
Zimmerman, K. (2021). *Coronavirus-19 (COVID-19) and related outcomes in school aged children (ABC health outcomes in children). ClinicalTrials.gov, NCT04757831.*	Feb 15, 2026	Schools	This study will measure the incidence of non-severe and severe COVID-19 disease including risk factors and outcomes, among children (aged ≤21).
Chu, H. (2021). Reopening schools safely and educating youth (ROSEY) research study (ROSEY). *ClinicalTrials.gov, NCT04859699.*	Jun 2023	Schools	This pilot study includes a clustered randomized control trial (RCT) assessing the effectiveness of a testing program on student attendance in K-8. Incidence of COVID-19 will be compared between the control; students who receive weekly PCR testing and the intervention; students who receive weekly testing and risk mitigation communication materials to educate them on COVID-19 health and safety measures.
Zimmerman, K. (2021). *COVID-19 surveillance and exposure testing in school communities. ClinicalTrials.gov, NCT04831866.*	Apr 15, 2023	Schools	This study will compare incidence of COVID-19 in schools performing weekly surveillance testing on 10-20% of students and 100% with schools performing exposure testing on students and staff after close contact with a confirmed COVID-19 case.
Newland, J. G. (2021). Assessing Testing Strategies for Safe Return to K-12 Schools in an Underserved Population. *ClinicalTrials.gov, NCT04875520.*	Mar 31, 2023	Schools	This clustered RCT will compare the incidence of school-based COVID-19 transmission between weekly student and staff surveillance testing vs. testing only symptomatic students and staff.
Duysburgh, E. & Vermeulen, M. (2020). *Prevalence and incidence of antibodies against SARS-CoV-2 in children measured for one year in Belgium: A sero-epidemiological prospective cohort study. ClinicalTrials.gov, NCT04613817.*	Aug 31, 2021	Schools	This study will determine the seroprevalence and seroconversion of antibodies against the virus that causes COVID-19 in primary and secondary school-aged children at different time points.
Kaiser, R. (2021). *SARS-CoV-2 surveillance in childcare facilities. German Clinical Trials Register, DRKS00023507.*	Not reported	Daycare	This study will assess the feasibility of testing children and staff at daycares for COVID-19 twice per week for two weeks.

Sweeney-Reed, C.M., Wolff, D., Niggel, J., Kabesch, M., & Apfelbacher, C. (2021). Pool testing as a strategy for prevention of SARS-CoV-2 outbreaks in schools: Protocol for a feasibility study. *JMIR Research Protocols, 10*(5), e28673.	Not reported	School	This study will assess the feasibility of an infection monitoring program in schools in an effort to enable targeted quarantining in place of full school closures.
Zinszer, K., McKinnon, B., Bourque, N., Zahreddine, M., Charland, K., Papenburg, J. … Quach, C. (2021). Seroprevalence of anti-SARS-CoV-2 antibodies among school and daycare children and personnel: Protocol for a cohort study in Montreal, Canada. *Preprint.*	Not reported	Daycares, schools	This longitudinal cohort study will estimate the seroprevalence and seroconversion of antibodies against the virus that causes COVID-19 among students and staff in primary and secondary school and daycares in Montréal, Canada.
Universitätsklinikum Rostock. (2020). *Prospective Study initiated by University Hospital Rostock concerning COVID-19 in mothers, nursery and school teachers of children in Rostock. German Clinical Trials Register, DRKS00022504.*	N/A	Daycare, schools	This study will measure prevalence of COVID-19 and associated antibodies in mothers, daycare nurses and teachers, and schoolteachers over the period of 12 months.

Table 6: Syntheses

Reference	Date Released	Review Conclusions	Quality Rating
New evidence reported on August 12, 2021			
Martinoli, C., Raimondi, S., Bellerba, F., Sasso, C., Basso, A., Cammarata, G., Gandini, S. (2021). Estimating SARS-CoV-2 circulation in the school setting: A systematic review and meta-Analysis. *Preprint.*	Jul 19, 2021 (Search completed May 15, 2021)	This systematic review and meta-analysis included 41 studies that estimate COVID-19 prevalence and transmission in primary and secondary school settings. Studies that conducted random or longitudinal screening for infection (n = 21) identified 323 confirmed cases in >120,000 subjects; pooled mean percent positive was 0.44% (95% CI=0.13,0.92) with high heterogeneity across studies (I^2=92%) • Estimates differed significantly between cross-sectional (0.31%, 95% CI=0.05,0.81) and cohort studies (1.14%, 95% CI=0.01,4.19), **p=0.03** • Children were no more likely to be positive than adults, pooled OR: 0.83 (95% CI=0.53,1.29) Seroprevalence studies (n = 9) identified 354 confirmed cases among 17,879 subjects; pooled mean seroprevalence was 3.9% (95% CI=1.15,8.19), I^2=100% • Estimates differed significantly between cross-sectional (1.49%, 95% CI=0.07 4.69) and cohort studies (10.31%, 95% CI=2.44,22.74), **p=0.005** • Children were less likely to be seropositive than adults; **OR: 0.57, 95% CI=0.49,0.68)**, I^2=21% Contact tracing studies (n = 15) included 747 index cases and 112,622 contacts; pooled mean SAR: 2.54 (95% CI=0.76,5.31), I^2=100% • Child index cases had lower odds of transmitting to a secondary case vs. adults, pooled **OR: 0.26 (95% CI=0.11,0.63)**, I^2=44% • Child close contacts were no more likely to be positive than adult close contacts, pooled OR: 0.60 (95% CI=0.25,1.47), I^2=63% Findings suggest that although infection does occur in schools, there is low COVID-19 circulation and limited child-to-adult or child to child transmission.	Moderate ***PREPRINT***
Viner, R., Waddington, C., Mytton, O., Booy, R., Ladhani, S., Panovska-Griffiths, J., … Melendez-Torres, G.J. (2021). Transmission of SARS-CoV-2 by children and young people in households and schools: A meta-analysis of population-based and contact-tracing studies. *Preprint.*	Jul 9, 2021 (Search completed Apr 5, 2021)	This systematic review and meta-analysis included 24 studies (16 population-based, 6 contact tracing and 2 that used both approaches) on transmission of COVID-19 from those aged 0-19 to other children and adults in school settings. The pooled SAR from child index cases in school studies (n=8) was 0.5% (95% CI=0.1,1.6), I^2=94.79%. Odds of transmission was not different from child vs. adult index cases in school settings, pooled OR: 0.27 (95% CI=0.06,1.28), I^2=87.97%.	Moderate ***PREPRINT***

		Factors associated with lower school prevalence detected by RT-PCR include: • Age ≤7, 0.05% (95% CI=0.005,0.50) vs. any age 0.45% (95% CI=0.23,0.87%), **p=0.009** Factors associated with higher school prevalence detected by RT-PCR include: • Age 12-19, 1.62% (95% CI=0.30,8.78) vs. any age 0.45% (95% CI=0.23,0.87%), **p=0.014** • Current community incidence per 100,000, **OR: 1.003 (95% CI=1.001,1.004)** • Last month community incidence per 100,000, **OR: 1.003 (95% CI=1.001,1.006)** • Masks vs. no masks in secondary schools, **OR: 4.43 (95% CI=1.71,11.47)** • Masks vs. no masks in primary and secondary schools, **OR: 4.64 (95% CI=1.89,11.37)** No association was found between school prevalence detected by RT-PCR and: • Age 5-12, 0.40% (95% CI=0.08,2.11%) vs. any age 0.45% (95% CI=0.23,0.87%), p=0.829 • Number of school mitigation measures, OR: 1.64 (95% CI=0.79,3.39) • Two-month prior community incidence per 100,000, OR: 1.002 (95% CI=0.997, 1.006) • % face-to-face learning, OR: 1.007 (95% CI=0.985,1.029) Factors associated with lower school seroprevalence include: • Masks vs. none, primary and secondary schools, **OR: 0.13 (95% CI=0.05,0.37)** No association was found between school seroprevalence and: • Age 5-12, 3.57% (95% CI=0.11,12.1%) vs. any age 1.44% (95% CI=0.31,6.70%), p=0.37 • Age 12-19, 5.22% (95% CI=0.19,17.7) vs. any age 1.44% (95% C=0.31,6.70%), p=NR • Current community incidence per 100,000, OR: 1.001 (95% CI=0.998,1.004) • Last month community incidence per 100,000, OR: 1.006 (95% CI=0.999,1.013) • Two-month prior community incidence per 100,000, OR: 1.015 (95% CI: 0.988,1.042) • Number of school mitigation measures, OR: 1.006 (95% CI=0.74,1.37) • Masks vs. no masks in secondary schools, OR: 0.95 (95% CI=0.63,1.43) • % face-to-face learning, OR: 1.007 (95 %CI=0.97,1.04)	

European Centre for Disease Control and Prevention. (2021, July 8). *COVID-19 in children and the role of school settings in transmission - second update.*	July 8, 2021 (Search date NR)	This review explores the role of schools on the transmission of COVID-19 in Europe, and strategies to reduce risk. The number of studies included were not reported.
		
		Risk of infection in school settings:
		• When mitigation measures are in place, infection spread in schools is limited (moderate confidence); however determining source of transmission is difficult.
		• Secondary infections in school settings are more likely to occur if the index case is a teacher than a student, other factors being equal (moderate confidence).
		• Staff and adults working within the school setting are not at an increased risk of severe COVID-19 compared to the general population (low confidence).
		• Authors conclude susceptibility and infectiousness of children, adolescents, and educational staff is higher with current community transmission compared to pre-VOC time points (data not provided to support this).
		
		Strategies to mitigate risk:
		• Implementing multiple physical distancing and hygiene measures can significantly reduce the possibility of transmission within schools (high confidence). These include:
		  ○ De-densification (classroom distancing, staggered arrival times, cancellation of certain indoor activities, especially among other students)
		  ○ Hygiene measures (handwashing, respiratory etiquette, cleaning, ventilation, and face masks for certain age groups).
		• Timely testing and isolation or quarantine of symptomatic cases is important
		• Rapid antigen tests should be considered
			Low

Reynolds, C., Ng, S., & Yang, W. (2021). Factors affecting the transmission of SARS-CoV-2 in school settings. *Preprint.*	Jun 22, 2021 (Search completed Feb 17, 2021)	This meta-analysis includes 17 studies with 26 school clusters, including 630 secondary cases among 8322 contacts, median SAR: 0.007 (IQR=0,0.17). Factors associated with lower odds of transmission, adjusting for other measures): • Surveilling all contacts vs. only symptomatic, OR: 0.54 (95%CI: 0.45,0.65) • Mixed school (primary and secondary) vs. preschool: **OR: 0.26 (95% CI=0.18,0.39)** • Primary schools vs. preschool: **OR: 0.12 (95% CI=0.07,0.20)** • Social distancing: adjusted **OR: 0.26 (95% CI=0.18,0.37)** • Mask wearing, **OR: 0.52 (95% CI=0.35,0.78)** Factors associated with higher odds of transmission, adjusting for other measures: • Community transmission, per 10 cases/100,000 per week, **OR: 1.26 (95% CI: 1.22,1.30)** • Increase in class sizes: **OR: 1.26 (95% CI=1.21,1.30)** No association found in final model between high school vs. preschool, average class size, weekly death rate, humidity.	Low ***PREPRINT***

Table 7: In-progress Syntheses

Title	Anticipated Release Date	Setting	Description of Document
New evidence reported on August 12, 2021			
Lopes-Junior, L.C., Siqueira, P.C., & Maciel, E.L.N. (2021). *School reopening and risks accelerating the COVID-19 pandemic: a systematic review and meta-analysis of the observational studies. PROSPERO CRD42021265283.*	Sep 30, 2021	Community, daycares, schools	This review and meta-analysis will summarize available evidence on school reopening and its impact on the transmission rate of COVID-19 among children, adolescents and young adults.
Luquine Jr., C.D., Milhomens, L.M., Domene, F.M., De Lucca Da Silva, J., de Araújo, B.C., Lopes Bezerra da Silva, L.A. … Barreto, J.O.M. (2021). *SARS-CoV-2 infection in schools: rapid review. PROSPERO, CRD42021257375.*	Jun 26, 2021	Schools	This rapid review will summarize differences in COVID-19 infection rates between students and staff in primary and secondary schools, post re-opening.
Previously reported evidence			
Little, T., Reinhard, D., & White, S. *K-12 non-pharmacological responses to influenza-like and Coronavirus illness outbreaks in US schools – A systematic review. PROSPERO, CRD42021247217.*	Aug 31, 2021	Schools	This review will summarize available evidence as to the effectiveness of non-pharmaceutical interventions and/or prevention strategies employed by K-12 school on the transmission of COVID-19.
Bhamani, S., Tabani, A., Ahmed, D., & Saleem, A. (2020). *A rapid systematic review on COVID transmission trends in children on schools reopening in lower middle income countries. PROSPERO, CRD42020204925.*	Jul 31, 2021	Schools	This review will summarize virus transmission among children and outbreaks occurring after schools re-open in lower middle-income countries.
Karki, S.J., Lange, B., Heinsohn, T., & Joachim, A. (2021). *The risk of infection and contribution to transmission of SARS-CoV-2 in school staff - a systematic review. PROSPERO, CRD42021239225*	Apr 15, 2021	Schools	This systematic review will summarize the risk and rate of COVID-19 transmission from staff working in schools, including secondary attack rates among students and the general population.
Lange, B., Ott, J., & Karki, S. J. (2021). *Evidence synthesis gaps in understanding disease burden of children, transmission parameters in schools and households and effects of measures implemented in schools during the COVID-19 pandemic – a rapid systematic review of systematic reviews. PROSPERO, CRD42021231866.*	Mar 31, 2021	Home, school	This rapid review of systematic reviews will summarize evidence syntheses on the disease burden of COVID-19 in children, their role, and the role of schools in transmission, and the effects of mitigation measures.

Chatterji, M., Kitamura, K., Muenig, P., Willson, G.E., De Leon Jr., R., & Allegrante, J.P. (2020). *The relative effectiveness of multilevel interventions in reducing risks of transmission of lethal viruses in Grade K-12 school communities and school linked populations: a systematic review and best-evidence synthesis. PROSPERO, CRD42020201930.*	Aug 29, 2020	School and school-linked populations	This review will report on the relative efficacy of multilevel intervention in reducing risks of COVID-19 and other lethal viruses among kindergarten to grade 12 school communities and in school linked populations.

Table 8: Canadian Surveillance Data

Reference	Date Released	Study Design	Setting, Location	IPAC measures	Summary of Findings	Quality Rating:
New evidence reported on August 12, 2021.						
Government of Alberta. (2021, July 30). *COVID-19: Education and child care*.	Jul 30, 2021	Prevalence	Primary and secondary schools, Alberta	• Cohorting • Enhanced cleaning • Hand hygiene • Masks (staff, students grade 4+, when physical distancing not possible) • Physical distancing (staff, students) • Screening • Strict symptomatic stay-at-home policy[1]	School (185 total) status classification as of Jun 30, 2021 • 30 outbreaks (10+ cases) • 21 outbreaks (5-9 cases) • 55 alerts (2-4 cases) • 79 open (i.e., no status to report)	Moderate ***NOT PEER REVIEWED***
Government of Ontario. (2021, July 28). *COVID 19 cases in child care centres*.	Jul 28, 2021	Prevalence	Licensed child care centres and agencies, Ontario, Canada	All daycares: • Cohorting • Enhanced cleaning • Masks, eye protection (staff) • No non-essential visitors • Record keeping • Screening • Drop-off, pick-up protocols[2]	From Jun 12, 2020 - Jul 28, 2021, a total of 7568 cases occurred in those connected to daycare settings in Ontario: • 4540 child cases • 3028 staff/provider cases As of Jul 28, 2021, 28 (0.52%) centres were currently reporting a case; 3 (0.06%) centres were closed. Reported daycare closures are due to outbreaks or operational considerations (i.e., # of staff in isolation resulting in insufficient # of staff available to keep school or daycare centre open; regional closures in local public health unit areas not considered. Transmission source unknown for cases, therefore unable to report the proportion of cases due to in-daycare transmission.	High ***NOT PEER REVIEWED***

[1] Government of Alberta. (2021, January 19). *COVID-19 information: guidance for school re-entry - scenario 1*.

[2] Government of Ontario. (2020, January 12). *COVID-19: Reopening child care centres*.

Government of Québec. (2021, July 26). *Daily numbers for the province – public and private school systems highlights*.	Jul 26, 2021	Prevalence	Public and private school system, Québec	• Alternating in-person/remote attendance (secondary schools in red and orange zones) • Cohorting • Enhanced cleaning • Masks (staff, students grades 5+; in red and orange zones, all students, except preschoolers) • Physical distancing[3]	Data from 2740 public schools, 254 private schools including over 1,300,000 students and 226,000 staff. Confirmed positive cases in the school from start of school in Sep - Dec 22, 2020: • Public: 14,929 students, 3558 staff • Private: 2443 students, 480 staff • Total: 17,372 students (~1.3% of all students), 4038 staff (~1.8% of all staff) Confirmed active cases in school system on Jun 7, 2021: • Public: 643 students, 58 staff • Private: 167 students, 8 staff • Total: 810 students (~0.06% of all students), 6 staff (~0.003% of all staff) Confirmed variant cases since March 12, 2021: • Public: 1097 • Private: 288 • Total: 13,855 Number of schools that have had a positive case Jan 5 – Apr 29, 2021: • 2576 (94%) At the close of the 2021 school year (Jun 23) there were a total of 3381 completed outbreaks in school environments (no additional data provided) As of Jul 26, 2021 childcare establishments reported 2 active outbreaks and 1300 completed outbreaks (no additional data provided)	Low ***NOT PEER REVIEWED***

[3] Government of Québec. (2021, January 11). *Organization of educational activities in 2020-2021 (COVID-19)*.

Government of Ontario. (2021, July 20). *COVID-19 cases in schools and child care centres*.	Jul 5, 2021	Prevalence	Primary, secondary schools, and daycares, Ontario, Canada	All schools: • Cohorting • Enhanced cleaning • Masks, eye protection (staff) • No non-essential visitors • Record keeping • Screening Primary and secondary schools (in addition): • Hand hygiene • Student masks grades 1-12, in school (hallways, class), on school transportation, outdoors (when cannot distance) • Physical distancing • Scheduled remote learning days (grades 9-12) • Staggered bell times (suggested) • Targeted testing (voluntary, participating schools)[4]	From Sep 5, 2020 – Jul 5, 2021, a total of 15,292 school-related cases were reported in publicly funded schools in Ontario: • 11,462 student cases • 2661 staff cases • 1169 'other' cases (not identified) As of Apr 9, 2021, schools moved to remote learning due to increasing COVID-19 cases in communities. From Apr 19 – Jun 30, 2021 there were 260 additional cases reported: • 120 student cases • 140 staff cases **Cases may be those not captured prior to April closure as well as students with special education needs who continued in-person learning and staff who support them.* Transmission source unknown for cases, therefore unable to report the proportion of cases due to in-school transmission	Moderate ***NOT PEER REVIEWED***
Previously reported						
Government of Ontario. (2021, July 9). *COVID-19: data for asymptomatic testing of students and school staff.*	Jul 9, 2021	Prevalence	Primary, secondary schools, Ontario, Canada	All schools: • Cohorting • Enhanced cleaning • Masks, eye protection (staff) • No non-essential visitors • Record keeping • Screening Primary and secondary schools (in addition): • Hand hygiene	From Feb 1, 2021 - Apr 30, 2021, 64,526 rapid asymptomatic tests were conducted across 602 schools; a total of 411 additional cases were detected (0.73%). The number of cases identified by school board ranged from 0 to 151, and percent positive tests per school board ranged from 0 to 2.6%.	Low ***NOT PEER REVIEWED***

[4] Government of Ontario. (2020, November 27). *Guide to reopening Ontario's schools*.

				• Student masks grades 1-12, in school (hallways, class), on school transportation, outdoors (when cannot distance) • Physical distancing • Scheduled remote learning days (grades 9-12) • Staggered bell times (suggested) • Targeted testing (voluntary, participating schools)[5]		

[5] Government of Ontario. (2020, November 27). *Guide to reopening Ontario's schools*.

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