

Face Coverings Worn by Children in School Settings to Reduce SARS-CoV-2 Transmission

Description: Cloth face coverings or masks are reusable, washable, and made of different fabric types that are not standardized or intended for medical purposes. In its guidance for preventing COVID-19 in schools, the Centers for Disease Control and Prevention (CDC) recommends universal indoor masking for all students (≥ 2 years old), regardless of vaccination status. CDC also recommends face coverings should be well-fitting and cover the nose, mouth, and chin.

Intended benefit: Face masks, *used in addition to other public health measures* (i.e., hand hygiene, social distancing, and vaccination as age permits), are intended to reduce SARS-CoV-2 transmission among children and the public during the COVID-19 pandemic.

Focus: This report focuses on the effectiveness of nonmedical face masks to reduce SARS-CoV-2 transmission in children in school settings.

The Evidence Bar™



Evidence is somewhat favorable

Conclusions: COVID-19 spreads rampantly in prolonged-interaction settings in the absence of public health measures (i.e., masking, social distancing, good hand hygiene). We reviewed 18 publications providing evidence to assess the effectiveness of nonmedical face masks worn by children to reduce COVID-19 spread in schools (PreK to grade 12). Five epidemiologic studies reported COVID-19 cases and SARS-CoV-2 transmission among students is relatively rare in schools that implement mask wearing and other mitigation strategies (e.g., physical distancing, handwashing, small class size). Several studies that constructed simulation models to assess SARS-CoV-2 transmission in school settings with and without masks and additional mitigation strategies provide indirect but consistent evidence indicating face mask use by children has the potential to reduce transmission in schools. We identified 13 clinical and public health guidance documents, including from CDC, the American Academy of Pediatrics (AAP), and the World Health Organization (WHO), that state children wearing nonmedical face masks in school settings can reduce SARS-CoV-2 transmission.

Rationale: Public health measures remain the most effective measures, in addition to vaccines for people who are vaccine-eligible, for curbing SARS-CoV-2 transmission and COVID-19-related morbidity and mortality. Epidemiologic studies reported data from schools that implemented bundled mitigation strategies, which makes it difficult to attribute outcomes solely to masks.

Evidence gaps: Studies did not account for all SARS-CoV-2 variants. Studies are needed that directly or indirectly compare face mask effectiveness for reducing COVID-19 infections and stratify findings by school levels (i.e., elementary, middle school, high school). Three simulation studies assumed face mask effectiveness between 15% and 35%, which can vary by location and over time; simulation studies provide indirect evidence predicated on model inputs. Surveys collected data from five countries and may not generalize across populations or countries.



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Background

SARS-CoV-2

SARS-CoV-2 is a coronavirus that causes the infectious disease COVID-19. SARS-CoV-2 can spread to healthy people in several ways, including inhalation of very fine respiratory droplets and aerosol particles; deposition of droplets and particles on nose, eyes, or mouth; and contact of mucous membranes with hands that have been soiled with surfaces or hands containing the virus. An individual with COVID-19 can spread the virus by coughing, sneezing, singing, or talking. SARS-CoV-2 can also spread to a healthy person by inhaling SARS-CoV-2 droplets or aerosol that stay in the air for several minutes or hours. (For more information, see WHO's [Q&A on Coronaviruses \[COVID-19\]](#), WHO's statement [Transmission of SARS-CoV-2: Implications for Infection Prevention Precautions](#), and CDC's [Scientific Brief: SARS-CoV-2 Transmission](#).)

Children can be infected with SARS-CoV-2 and become sick with COVID-19. Children with mild or suspected COVID-19 are managed at home to prevent transmission to others. Children with underlying conditions (obesity, diabetes, asthma) and those one year old or younger are at high risk for severe COVID-19 illness. Newborns are at high risk of developing severe COVID-19 because they have immature immune systems and smaller airways. However, children between 10 and 18 years old are at higher risk of developing COVID-19 compared with younger children. [Remdesivir](#) is the only FDA-approved medication for treating COVID-19 in adults and children older than 12 years of age. Other treatment options for children with severe COVID-19 consist of hospitalization, respiratory support, and fluid intake. Antiviral therapy is used on a case-by-case basis for children with severe COVID-19 who meet the FDA Emergency Use Authorization (EUA) criteria. Children infected with SARS-CoV-2 are also at risk for developing a serious condition called multisystem inflammatory syndrome in children (MIS-C). MIS-C is characterized by the inflammation of different body parts, including heart, lungs, kidneys, brain, skin, eyes, or gastrointestinal organs. It is not understood why some children develop MIS-C. (For more information, see Johns Hopkins's [Coronavirus COVID-19 \[SARS-CoV-2\]](#), the National Institutes of Health article [General Management of Nonhospitalized Patients with Acute COVID-19](#), and CDC's article [For Parents: Multisystem Inflammatory Syndrome in Children \[MIS-C\] associated with COVID-19](#).)

Children can transmit SARS-CoV-2 to others. Studies have reported that children and adolescents can transmit SARS-CoV-2 effectively in household and community settings. Other studies also reported that SARS-CoV-2 loads in children are comparable or higher than those found in adults and have similar secondary infectious rates. Children, as well as adults, can transmit SARS-CoV-2 even when asymptomatic. (For more information, see the UptoDate article [COVID-19: Clinical Manifestations and Diagnosis in Children](#), the article by [Yonker et al.](#), and CDC's [Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Updated](#).)

COVID-19 prevention in children includes physical distancing, quarantining when exposed, isolating when sick, washing hands frequently, cleaning and disinfection, and masking in children older than two years of age. In August 2021, FDA approved the Pfizer-BioNTech COVID-19 vaccine for people 16 years of age or older. In May 2021, FDA expanded the EUA for the Pfizer-BioNTech COVID-19 vaccine to include 12- through 15-year-olds. The Moderna COVID-19 vaccine and the Janssen COVID-19 vaccine EUAs allow for use in people 18 years of age or older. (For more information, see CDC's [Your Guide to Masks](#) and FDA's [COVID-19 Vaccines](#).)

Face Coverings Worn by Children

Combined with good hand hygiene and physical distancing (six feet or two meters or more), face coverings are intended to contain droplets that may emanate when an infected person speaks, sings, coughs, or sneezes (i.e., source control) to reduce the amount of infectious droplets dispersed in the air. Face coverings can be disposable or reusable and are made of different materials. Disposable face masks are made of multiple layers of nonwoven material, and some may contain a nose wire to improve fit. Cloth face masks are made of fabric, reusable, and washable. Cloth face masks have been constructed in different shapes (e.g., flatfold pleats, duckbill, folded with no sewing) and fabrics (e.g., cotton, silk, nylon, polyester, nonwoven materials such as polypropylene, or a combination of these). Cloth face masks may also have different layering sequences (single-, double-, or triple-layered) with or without some type of material used as a filter between layers. Cloth face masks and nonmedical masks differ from N95 respirators' construction and fit, and their

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construction is not standardized or required to meet any specifications. The potential benefits of cloth face masks and nonmedical masks vary widely and depend on construction, materials, and fit. Thus, they are not intended for medical purposes. (For more information, see WHO's [Interim Guidance](#), CDC's article [Types of Masks](#), and the article by [Garcia Godoy et al.](#) For more information on cloth face coverings and their use during the COVID-19 pandemic, see the ECRI reports [Cloth Face Coverings Worn by the Public to Reduce SARS-CoV-2 Transmission](#) and [Cloth Face Coverings in Public to Contain COVID-19: They matter; Construction Matters.](#))

Appropriate and consistent face mask use by children in public settings depends on mask fit, construction, comfort, and masking techniques practiced at home. CDC recommends face masks that are specifically designed for children to ensure proper fit. Parents should ensure face masks cover the child's nose and mouth and fit snugly against the face. Commercial face masks for children are available in different kid-friendly designs and sizes. Homemade cloth masks have the advantage of providing better fit when they are designed for the children's age and specific craniofacial characteristics and geometries. Children's face masks should also be comfortable to wear. Various commercially available face masks incorporate designs that are intended to improve comfort, including lightweight masks, breathable fabrics, comfortable ear loops, and bendable nose pieces. Good mask wearing practices by children can be reinforced at home to ensure mask effectiveness. Parents are encouraged to explain to their children why masks are to be used and to demonstrate correct mask etiquette. [A Mayo Clinic article](#) recommends parents wear masks at home for a few hours to teach correct mask etiquette to their children. Other strategies that can be used at home to teach and motivate correct mask use in children include allowing children to decorate their own face mask or select cartoon characters they like for their masks, providing masks for toys that can be used during playtime, and taking photos of family and friends wearing face masks. (For more information, see The Strategist's news article [Where to Buy Face Masks for Kids](#), the National Public Radio article [Use of These 6 Expert Tips to Find the Best Masks for Your Kids](#), and CDC's articles [Guidance for Wearing Masks](#) and [Your Guide to Masks.](#))

Face Coverings Worn by Children in Educational Settings

Governments and school districts have implemented measures intended to reduce SARS-CoV-2 transmission in schools. However, mask mandates and mitigation strategies vary within regions and states. For example, U.S. states differ on whether masks should be used in schools, ranging from states requiring masks at schools to states prohibiting school districts from requiring masks in schools. (See the AAP article [Safe Schools during the COVID-19 Pandemic](#); for a map illustrating decisions by U.S. state, see the [USA Today](#) news article.)

In addition to universal masking, other mitigation strategies implemented in some schools include physical distancing, smaller class sizes, cohorting, cleaning, ventilation, and air filtration. In May 2021, CDC updated the physical distance recommendations in schools to three feet for some special circumstances. According to [CDC recommendations](#) for students in classrooms, three feet of physical distance should be maintained between elementary students and between middle-school and high-school students in areas of low, moderate, and substantial community transmission. CDC also states that six feet of distance should be maintained between adults and between adults and students at all times in the school building, when masks cannot be worn (e.g., while eating), during activities with increased exhalation (e.g., singing, shouting, sports), and in common areas (e.g., lobbies, auditoriums). In August 2021, CDC recommended all children older than two years old wear face masks while in school and maintain at least three feet of physical distancing. (For more information, see CDC's [Guidance for COVID-19 Prevention in K-12 Schools](#) and the articles in [Nature](#) and [The Philadelphia Inquirer.](#))

Face coverings with clear panels in the front are available for students who are deaf or hearing impaired, students receiving speech or language services, young students in early education programs, and English-language learners. [FDA notes](#) that "N95 respirators are not designed for children or people with facial hair. Because a proper fit cannot be achieved on children and people with facial hair, the N95 respirator may not provide full protection." Respirators require fit-testing, which trained personnel must conduct. Some manufacturers have falsely marketed respirators as approved by the National Institute for Occupational Safety and Health (NIOSH), according to CDC, which states "NIOSH does not approve any type of respiratory protection for children." (For more information, see AAP's [COVID-19 Guidance for Safe Schools](#), CDC's article [Counterfeit Respirators / Misrepresentation of NIOSH-Approval](#), and the [Washington Post](#) article [How to Choose and Care for Your Kid's Masks.](#))

CLINICAL EVIDENCE ASSESSMENT

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Clinical Literature

Search dates: literature published January 1, 2018, through August 19, 2021. We reviewed full text of 18 publications (including preprints).

We searched PubMed, EMBASE, Google Scholar, Medrxiv.org (a preprint database), and selected web-based resources for clinical studies relevant to this topic. Our search strategies included the following keywords: mask, covid, teachers, students, school. Please see the *Selected Resources and References* section for detailed search strategies. We excluded studies of N95 respirators because [CDC recommends](#) the public primarily use nonmedical face masks to reserve N95 respirators for healthcare workers.

Study selection criteria: We included studies of any design reporting on the effectiveness of nonmedical masks or face coverings to reduce SARS-CoV-2 transmission in children in school settings. We also sought studies directly or indirectly comparing mask use with no mask use in the school setting (defined as school grounds, school vehicles, or any activity organized by a school indoors); we identified no studies providing direct evidence for these comparisons. We identified five studies reporting clinical or epidemiologic outcomes in schools that adopted face mask use combined with other COVID-19 mitigation strategies (e.g., social distancing, contact tracing, screening) to reduce virus transmission risk. We therefore expanded our criteria to include simulation studies that constructed models to estimate face mask effectiveness in reducing SARS-CoV-2 transmission in the school setting.

Included Studies:

- We identified and included 14 full-text, peer-reviewed publications and 4 unrefereed preprint manuscripts. The information provided in preprints should be regarded cautiously because these manuscripts may not reflect the final conclusions of studies or full published articles based on the same research. Unrefereed manuscripts may reflect interim results from studies not yet finalized, might contain errors, and report on methodology that has not yet been accepted or endorsed by the scientific or medical community. (For more information, see [What Is an Unrefereed Preprint?](#))

Published, Peer-reviewed Studies

- 1 epidemiologic study (Gillespie et al. 2021) reported on outbreak clusters in two K-12 schools (3,720 students and staff) that implemented SARS-CoV-2 mitigation strategies after reopening in fall 2020. Mitigation strategies included mandatory mask use, periodic universal testing, classroom disinfecting, and social distancing.(1)
- 1 epidemiologic study (Katz et al. 2021) reported on COVID-19 cases in a preK-8 school (470 students and staff) that implemented SARS-CoV-2 mitigation strategies during September 2020 and January 2021. Mitigation strategies included physical distancing (≥ 3 feet) and masking at all times except during indoor lunch, outdoor lunch, and recess.(2)
- 1 epidemiologic study (Mossong et al. 2021) reported on COVID-19 incidence in school-aged children, teachers, and the general population in Luxembourg that implemented SARS-CoV-2 mitigation strategies after school reopening in May 2020. Mitigation strategies included physical distancing, testing, systematic contact tracing, and mask wearing.(3)
- 1 epidemiologic study (Stein-Zamir et al. 2020) reported on COVID-19 cases in a high school (1,352 students and staff) that implemented SARS-CoV-2 mitigation strategies in May 2020. Mitigation strategies included daily health reports, hygiene, facemasks, social distancing, and minimal interaction between classes.(4)
- 1 epidemiologic study (Zimmerman et al. 2021) reported on COVID-19 cases and mask compliance in 11 school districts ($> 90,000$ students and staff) that implemented SARS-CoV-2 mitigation strategies during August 2020 to October 2020. Mitigation strategies included mandatory masks (in individuals ≥ 5 years of age), social distancing (six feet), hand washing, and monitoring symptoms and temperature daily.(5)
- 1 prospective, cohort study (Ramirez et al. 2021) reported on COVID-19 cases among students (grades 1-12), bus drivers, and school aides that used school bus transportation between August 2020 and March 2021. Students and bus drivers were expected to wear masks at all times, stay 2.5 feet apart, and get tested every 2 weeks. Bus windows stayed open during transportation.(6)
- 1 simulation study (Bilinski et al. 2021) estimated COVID-19 cases over 30 days when low, medium, or high mitigation measures are implemented in elementary (638 students) and high schools (1,451 students).(7)

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- 1 simulation study (Miller et al. 2021) estimated COVID-19 cases and hospitalizations when low or high mitigation measures are implemented with contact tracing in an average-size school (596 students and staff) and a larger-size school (1,473).(8)
- 1 simulation study (Pavilonis et al. 2021) compared SARS-CoV-2 transmission scenarios in an elementary school when all students and staff were masked and when unmasked. The model assumed a 30% reduction in viral transmission from mask use by students and teachers.(9)
- 5 surveys: 1 survey of 2,954 parents with children in primary school (Assathiany et al. 2021), 1 survey of leaders from 57 educational hubs (Kaiser et al. 2021), 1 survey of 92 elementary school teachers (Mickells et al. 2021), 1 survey of 272 middle-school students (Park et al. 2021), and 1 survey of 8,569 primary school students (Chen et al. 2020) reported on mask use, adverse events, and emotional effects of wearing face masks in educational settings.(10-14)

Preprint Manuscripts Posted in medRxiv

- 1 simulation study (Head et al. 2020) estimated COVID-19 infection risk in K-12 schools with moderate to high community transmission. The model assumed students and faculty wear masks, students and faculty are tested weekly with testing achieving 85% sensitivity, and classrooms contain 20 students. The model assumed 15% mask effectiveness for elementary school students, 25% for middle-school students, and 35% for high school students.(15)
- 1 simulation study (Watson et al. 2020) that collected data from a survey to athletic directors in 991 high schools estimated COVID-19 incidence in high school athletes while playing sports indoors and wearing masks.(16)
- 1 simulation study (Panovska-Griffiths et al. 2020) estimated COVID-19 cases when secondary schools adopted mask-wearing measures. The model assumed 15% (low) and 30% (high) face covering efficacy.(17)
- 1 survey of 423 students in primary and secondary schools in Uganda (Mwesige et al. 2021) reported on mask use.(18)

Table 1 provides a summary of peer-reviewed publications we reviewed. Table 2 summarizes the preprint manuscripts. We review full text of the included studies available through open access or our library subscriptions.

Excluded Studies:

- 1 systematic review and one simulation study that implemented mask wearing in schools but report on other mitigation strategies (e.g., social distancing, surveillance testing, contact tracing)(19,20)
- 13 publications with no methodology or unclear setting(20-32)
- 1 study that assessed mask training in children with autism but did not report on mask use or mask effectiveness for preventing COVID-19(33)
- 1 systematic review that pooled outcomes from studies that implemented mask wearing and studies that did not implement mask wearing(34)
- 1 systematic review that included studies evaluating physical interventions to prevent virus transmission (e.g., influenza, H1N1) but did not include SARS-CoV-2(35)
- 1 study in which 98% of individuals wore respirators or medical masks, while only 2% of individuals wore cotton masks(36)
- 1 study of a school graduation at a large, outdoor stadium(37)
- 7 studies with unclear or absent mask-wearing strategy(38-44)
- 1 study that assesses a systematic observation protocol but does not report on mask effectiveness or mask use(45)
- 1 study that pooled outcomes between nonmedical and medical masks(46)
- 1 study that used sodium chloride as surrogate for SARS-CoV-2(47)
- 1 study of children in a summer camp that did not implement mask wearing by children(48)

Findings

We assessed 18 publications (including preprints) that addressed COVID-19 cases, adverse events, mask use, and hospitalizations among school students or school staff.

PreK-12 Schools

- *COVID-19 cases and transmission:* One epidemiologic study (Gillespie et al. 2021) of 2 schools (2,320 and 1,400 students and staff, respectively) in the United States that implemented masking and other SARS-CoV-2 mitigation strategies after reopening in fall 2020 identified 7 outbreak clusters (defined as any event that involved 2 or more linked cases in school) linked to noncompliance with mitigation protocols. In 1 of the schools, 112 cases were identified in 2,320 students and staff, and in the other school, 2 cases were identified among 1,400 students and staff. Of 69 traceable cases, 63 were not associated with in-school transmission; no student-to-teacher or teacher-to-student transmissions were reported. In one of the schools, 72% of the in-school transmission were attributed to noncompliance with school mask-wearing rules.(1) One epidemiologic study (Katz et al. 2021) of a preK to eighth-grade school (470 students and staff) in the United States that implemented masking and other SARS-CoV-2 mitigation strategies during September 2020 and January 2021 identified 1 cluster of in-school transmission. The cluster was among preK students and was associated with improper masking.(2) One epidemiologic study (Mossong et al. 2021) of schools in Luxemburg that implemented masking and other SARS-CoV-2 mitigation strategies during May to July 2020 reported 390 COVID-19 cases in 90,150 students and 34 COVID-19 cases in 11,667 teachers. Of these cases, 49 were transmitted within schools; in-school transmission happened mostly among students (78%).(3) One epidemiologic study (Zimmerman et al. 2021) of 11 school districts (>90,000) in the United States that implemented masking and other SARS-CoV-2 mitigation strategies during August to October 2020 reported 32 infections were acquired within schools; during that same period, the authors reported 773 community-acquired COVID-19 infections in students and staff. One outbreak cluster occurred in a district that exempted mask wearing in preK classrooms; two other outbreak clusters occurred in special-needs environments. Authors state that mask wearing is not always feasible in special-needs environments, and mask wearing compliance by special-needs students ranged between 50% and 100%.(5) One simulation study (Miller et al. 2021) that assumed 0 initial cases of COVID-19 and equal transmission risk between age groups estimated that for an average-size school of 529 students and 67 staff members, when SARS-CoV-2 community incidence thresholds were high (99 cases per 100,000 persons) mitigation strategies that are 69% effective in addition to contact tracing would result in 9% of the school population with COVID-19; if mitigation strategies were not implemented, the model estimated that even at the lowest level of community incidence, 90% of the school population would be infected with COVID-19 within 100 days.(8) One simulation study available as a preprint (Head et al. 2020) that assumed mask wearing, weekly testing with 85% sensitivity, and classrooms with 20 students, estimated COVID-19 infection risk to be highest for teachers and staff compared with students or other household members; COVID-19 infection risk was higher in high schools than in middle schools and elementary schools.(15)
- *Hospitalizations:* Miller et al. 2021 estimated hospitalizations in 0.4% of the school population for the scenario in which mitigation efforts had little impact. Authors also estimated that implementation of mask wearing and other mitigation strategies with effectiveness $\geq 69\%$ leads to nearly all hospitalizations avoided.(8)
- *Adherence to mask wearing:* Head et al. 2020 estimated that adherence to mask wearing and other mitigation strategies would reduce risk of symptomatic illness in high school teachers and school staff to <1%.(15)

Elementary Schools

- *COVID-19 cases and transmission:* One simulation study (Bilinski et al. 2021) that assumed a 5-day schedule of in-person learning, introduction of a single infectious person, and half-class sizes in an elementary school (638 students) estimated 1.7 secondary COVID-19 cases under low mitigation (minimal or no masking and distancing), 0.9 cases under medium mitigation (adherence to masking and distancing with transmission risk 66% of that found in low mitigation), and 0.3 cases under high mitigation (adherence to masking and distancing with transmission risk 33% of that found in low mitigation) over 30 days.(7) One simulation study (Pavilonis et al. 2021) estimated lower probability of transmission when all students and staff wear masks (model assumed 30% reduction in viral transmission from face mask use) compared with no masks. When mask wearing was consistent, mean probability of transmission was the highest from teacher to student (0.20) compared with student to teacher (0.14) and student to student (0.046). When masks were not worn, mean transmission increased, with the highest transmission from teacher to student (0.35), followed by student to teacher (0.26), and student to student (0.091).(9)

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- *Adverse events:* One survey of 2,954 parents (Assathiany et al. 2021) reported 81% of children felt embarrassed by masks, 49% had headaches, 45% had speaking difficulties, 45% had mood changes, and 28% experienced breathing discomfort.(10) One survey of 92 elementary school teachers (Mickells et al. 2021) reported teachers also reported mask use was associated with ear pain (12 reports), hearing difficulties (8 reports), breathing difficulties (6 reports), bathroom accidents (teachers missing facial cues or not hearing requests to go to the bathroom), and heat (7 reports).(12)
- *Mask use and comfort:* Mickells et al. 2021 reported appropriate mask use by 76.9% of students.(12) One survey of 8,569 students in China (Chen et al. 2020) reported 51.6% had good mask-wearing behavior.(14) One survey available as a preprint (Mwesige et al. 2021) of 423 students in Uganda reported 98.9% wear masks due to fear of missing classes. Students who disagreed that masks are uncomfortable were more likely to wear masks correctly.(18)

Middle Schools

- *Mask use and comfort:* One survey of 272 middle-school students (Park et al. 2021) in South Korea asked students to rate COVID-19 preventive behaviors (mask wearing, handwashing, and distancing) from 1 to 5 using a five-point Likert scale ("strongly disagree" = 1 point, "strongly agree" = 5 points). Students reported mask wearing as the item with the highest score (4.53 \pm 0.72 points), and distancing was the item with the lowest score (2.97 \pm 1.09 points).(13)

High Schools

- *COVID-19 cases and transmission:* One epidemiologic study (Stein-Zamir et al. 2020) reported an outbreak (178 students and staff with COVID-19) occurred in a high school in Israel (1,352 students and staff) that reopened on May 18, 2020. Authors state that SARS-CoV-2 infection was promoted by children returning to school after a two-month closure, a heatwave (>40°C) that involved exemption of face masks, and the use of air conditioning in classrooms.(4) Bilinski et al. assumed a 5-day schedule of in-person learning, 8 class rotations per day, introduction of a single infectious person, and half-class sizes in a high school (1,451 students) and estimated 23 secondary COVID-19 cases under low mitigation (minimal or no masking and distancing) and 2 cases under high mitigation (adherence to masking and distancing with transmission risk 33% of that found in low mitigation) over 30 days.(7) One simulation study available as a preprint (Watson et al. 2020) found an association between decreased COVID-19 cases and face mask use while playing the following sports: girls' volleyball (IRR [incidence rate ratio] = 0.53 [0.37 to 0.73], $p < 0.001$), boys' basketball (IRR = 0.53 [0.33 to 0.83], $p = 0.008$), and girls' basketball (IRR = 0.36 [0.19 to 0.63], $p < 0.001$).(16) One simulation study available as a preprint (Panovska-Griffiths et al. 2020) predicted a second COVID-19 wave would be less than half of the original wave if masks had a 30% efficacy and were mandatory (along with 24% testing, 47% tracing) in secondary schools and in community settings.(17)

Other Settings

- *COVID-19 cases and transmission:* One prospective cohort study (Ramirez et al. 2021) of 15 school buses that transported 462 students (grades 1 to 12) to school after a school reopening in September 2020 and implemented mask wearing, social distancing (2.5 feet), and testing (every 2 weeks) found 39 COVID-19 cases (37 students, 1 driver, 1 aide). However, authors state none of the COVID-19 cases identified were linked to transmission during transit.(6) One survey of leaders from 57 educational hubs (Kaiser et al. 2021) reported 0 COVID-19 transmission cases.(11)
- *Mask use and comfort:* Kaiser et al. 2021 reported 67% of children were masked while attending an educational hub to access digital classwork. Unmasking persisted after eating or drinking or during physical activity.(11)

Evidence limitations: Epidemiologic studies represent real-world data; however, all schools implemented bundled mitigation strategies, which makes it difficult to attribute outcomes solely to face masks. Also, two of five epidemiologic studies are from countries other than the United States, and three of the epidemiologic studies are from Mid-Atlantic and Southeastern states; thus, their experience with face mask implementation and compliance may not represent practices or generalize to those of other U.S. schools. The largest epidemiologic study (Zimmerman et al.) is at risk of bias because it only collected data from schools implementing public health measures to prevent SARS-CoV-2 transmission. Four epidemiologic studies pooled outcomes between students from different grades and ages. Also, mask materials used in the studies varied or were vaguely described.

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The prospective cohort study reported the experience of 1 school (1,154 students). Three simulation studies assumed face mask effectiveness between 15% and 35%, which can vary by location and over time. Survey studies collected data from five different countries, and findings may not generalize to student populations outside the countries from which the data originated. Preprint manuscripts should be regarded cautiously because they have not been peer reviewed, might reflect interim results from studies not yet finalized, might contain errors, or use unvalidated methods.

Studies assessed mask wearing in addition to other mitigations strategies for SARS-CoV-2 transmission prevention but did not account for all viral variants. Only one survey study is available on middle-school students and reported only on the outcomes of mask use and comfort. Studies are needed that directly or indirectly compare face mask effectiveness for reducing COVID-19 infections and stratify findings by school levels (i.e., elementary, middle school, high school).

Table 1. Peer-reviewed Published Studies

Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Epidemiologic Studies				
Gillespie et al. 2021(1) United States Reviewed full text	"We report the experience of 2 large independent K-12 schools (School-A and School-B) that implemented an array of SARS-CoV-2 mitigation strategies that included periodic universal testing."	Study of 2 schools: school A has 2,320 students and staff, school B has 1,400 students and staff. SARS-CoV-2 mitigation strategies included mandatory masks, classroom disinfecting, social distancing, and periodic universal testing.	"In 6/7 clusters, clear noncompliance with mitigation protocols was found. The largest outbreak had 28 identified cases and was traced to an off-campus party. There was no transmission from students to staff." "Seventy-two percent of in-school transmission cases in School A were associated with noncompliance with school mask wearing rules."	"Although school-age children can contract and transmit SARS-CoV-2, rates of COVID-19 infection related to in-person education were significantly lower than those in the surrounding community."
Katz et al. 2021(2) United States Reviewed full text	"The objective of the present study was to determine the epidemiology of SARS-CoV-2 symptomatic disease, asymptomatic infection, and transmission in the school setting with strict mitigation strategies in place."	Surveillance study of 1 school (393 students and 77 staff) open to in-person instruction. SARS-CoV-2 mitigation strategies included physical distancing (≥ 3 feet) and masking at all times except during indoor lunch, outdoor lunch, and recess.	"Thirty-one of 393 (7.9%) students and 10/77 (13%) faculty/ staff had symptomatic SARS-CoV-2. Only 4 student cases and 1 staff case resulted from in-school transmission." "All in-school transmission was attributed to a single cluster among prekindergarten students early in the year and determined to be due to improper masking."	"Our study strongly supports emerging data indicating that schools with enforced mitigation strategies have little in-person transmission even when community COVID-19 rates are high."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Mossong et al. 2021(3) Luxembourg Reviewed full text	"We performed an epidemiological analysis of COVID19 cases in Luxembourg by comparing the incidence in school-age children and teachers to that of the general working population prior to the summer holidays 2020."	Study of SARS-CoV-2 incidence in children, teachers, and the general population in Luxembourg during the epidemic waves of March to April 2020 and May to July 2020. SARS-CoV-2 mitigation strategies after school reopening in May 2020 included physical distancing, testing, systematic contact tracing, and mask wearing.	"Between May and July 2020, we identified a total of 390 and 34 confirmed COVID-19 cases among 90,150 school-age children and 11,667 teachers, respectively. We further estimate that 179 primary cases caused 49 secondary cases in schools." "Of the 49 within school transmissions, 38 (78%) were pupil-to-pupil within the same class, seven (14%) were teacher-to-pupil, three (6%) were pupil-to-teacher and one was teacher-to-teacher transmission."	"Transmission of SARS-CoV-2 within Luxembourg schools was limited during an early summer epidemic wave in 2020. Precautionary measures including physical distancing as well as easy access to testing, systematic contact tracing appears to have been successful in mitigating transmission within educational settings."
Stein-Zamir et al. 2020(4) Israel Reviewed full text	"We aim to describe the investigation and epidemiological characteristics of the school's outbreak."	Study of 1 high school (1,352 students and staff) open to in-person instruction in May 2020. School districts required daily health reports, hygiene, facemasks, social distancing, and minimal interaction between classes. On May 19 to May 21, an extreme heatwave occurred during which the Ministry of Health exempted students from wearing face masks for these 3 days.	"The first case was registered on 26 May, the second on 27 May. They were not epidemiologically linked. Testing of the complete school community revealed 153 students (attack rate: 13.2%) and 25 staff members (attack rate: 16.6%) who were COVID-19 positive."	"COVID-19 prevention in schools involves studying in small groups and minimising student mixing in activities and transportation. Teachers and parents should lead by wearing facemasks, hand hygiene, keeping physical distance etc."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Zimmerman et al. 2021(5) United States Reviewed full text	"Describe secondary transmission of SARS-CoV-2 within participating school districts during the first 9 weeks of in-person instruction in the 2020–2021 academic year."	Study of 11 school districts (>90,000 students and staff) open to in-person instruction for 9 weeks. School districts required all individuals ≥5 years of age to wear a mask, keep 6-foot distancing, wash hands, and monitor symptoms and temperature daily.	<p>"Through contact tracing, health department staff determined an additional [i.e., to community-acquired SARS-CoV-2 infections] 32 infections were acquired within schools. No instances of child-to-adult transmission of SARS-CoV-2 were reported within schools."</p> <p>"One of these ABCs [The ABC Science Collaborative] clusters occurred in a district that exempted mask wearing in prekindergarten during the early days of the school year, a policy that was in accordance with NCDHHS [North Carolina Department of Health and Human Services] guidance permitting mask exemptions for younger children."</p> <p>"Two clusters occurred in the special needs environment of ABCs participating school districts, 1 of which was linked to children eating together in close proximity."</p> <p>"In the special needs environment, mask wearing is not always feasible; superintendents reported mask wearing compliance of 50% to 100% for children outside the mainstream classroom because of severe emotional and cognitive disabilities."</p>	"Our cohort study revealed that enforcing SARS-CoV-2 mitigation policies, such as mask wearing, physical distancing, and hand hygiene, resulted in minimal clusters of SARS-CoV-2 infection and low rates of secondary transmission in schools and did not cause a larger community infection burden."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Cohort Study				
Ramirez et al. 2021(6) United States Reviewed full text	"We report on the transport experience of an independent 1 to 12-grade school in Virginia."	Prospective study of 15 school buses transporting 462 students (grades 1-12) to school. Students and bus drivers were expected to wear masks at all times, stay 2.5 feet apart, and get tested every 2 weeks. Bus windows stayed open during transportation.	"There were 39 cases including 37 students, one driver, and one aide present on buses during their infectious period of COVID-19, but there was no student-to-student transmissions, no adult-to-student transmissions, and no student-to-adult transmissions. Subsequent routine testing the following week after return to school of all who were exposed as well as routine testing of all bus riders remained negative."	"While this study is a small sample size of 462 students over a 7-month period, there were no identified cases of spread among passengers which suggests that universal masking and open ventilation alone may be sufficient to limit COVID-19 transmission for school busing."
Simulation Studies				
Bilinski et al. 2021(7) United States Reviewed full text	"To assess the risk for SARS-CoV-2 transmission in schools."	Agent-based network model used to simulate COVID-19 transmission in elementary (638 students) and high school (1,451 students) communities. The model simulated low mitigation (schools with minimal or no masking and distancing), medium mitigation (schools with adherence to masking and distancing with transmission risk 66% of that found in low mitigation), and high mitigation (schools with adherence to masking and distancing with transmission risk 33% of that found in low mitigation).	"In elementary schools with low mitigation and classroom quarantine under a 5-day schedule, we projected an average of 1.7 secondary cases over 30 days after infection of a single index case patient. This decreased to 0.9 cases with medium mitigation and further to 0.3 cases with high mitigation." "In high schools, we found greater potential for larger outbreaks after a single introduction into the school, particularly when uptake of in-school prevention was low. For example, with low mitigation and classroom quarantine under a 5-day schedule, we projected 23 secondary cases in the school community over a 30-day period (in the absence of additional public health responses like school closure). High uptake of in-school mitigation reduced this to 2.0 cases."	"With controlled community transmission and moderate mitigation, elementary schools can open safely, but high schools require more intensive mitigation. Asymptomatic screening can facilitate reopening at higher local incidence while minimizing transmission risk."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Miller et al. 2021(8) United States Reviewed full text (available with subscription only)	"To aid school administrators, staff, and parents in planning and implementing mitigation strategies to reduce the risk of school-based SARS-CoV- 2 transmission."	COVIDTracer Advanced modeling Tool was used to estimate COVID-19 cases and hospitalizations averted in pre-K to grade 12 students after implementing mitigation strategies, including mask wearing, cleaning and disinfection, hand hygiene, social distancing, and contact tracing. The model assumed a population of 596 students and staff, 0 initial cases of COVID-19, and transmission risk was equal between age groups.	<p>"The lowest number of cases occurred when the combined effectiveness of mitigation strategies and contact tracing was 69% or greater. Under these conditions, even assuming a substantial level of community incidence (99 cases per 100 000 population), there would be 53 cases or less (9.0% of the school population)."</p> <p>"The number of hospitalizations was equivalent to 0.4% of the school population in the worst-case scenario (low impact of mitigation). Patterns of averted hospitalizations followed the patterns seen for reduction in cases between scenarios, such that implementation of mitigation strategies and contact tracing interventions with a combined effectiveness of 69% or greater led to nearly all hospitalizations being averted."</p> <p>"The larger-sized schools generated proportionately larger numbers of cases for each scenario, but the interpretations are the same... Under these conditions [i.e., high community transmission], a combined effectiveness for mitigation strategies and contact tracing of 69% or greater would result in 112 cases or less (18.8% of the school population)."</p>	"Our results show that for school administrators, teachers, and parents to provide the safest environment, it is important to utilize multiple mitigation strategies and contract tracing that reduce SARS CoV-2 transmission by at least 69%. This will require training, reinforcement, and vigilance to ensure that the highest level of adherence is maintained over the entire school term."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Pavilonis et al. 2021(9) United States Reviewed full text	"Estimate the risk of SARS-CoV-2 transmission among students and teachers in New York City public schools, the largest school system in the US."	Infection model using the Wells-Riley equation under steady-state conditions and varying exposure scenarios: infectious student with or without mask, and infectious teacher with or without a mask. The model assumed a 30% reduction in viral transmission from face mask use by students or teachers and 6.3 hours of exposure. Classroom size and ventilation characteristics were obtained from the New York City Department of Education.	"Consistent mask wearing was associated with lower transmission rates (with mask range: 0.0015–0.55; without mask range: 0.0031–0.81). When mask wearing was consistent, mean transmission was highest from teacher to student (0.20) compared to student to teacher (0.14) and student to student (0.046). As might be expected, when masks were not worn, mean transmission across all dyads was increased, with a similar pattern of higher transmission from teacher to student (0.35), student to teacher (0.26), and student to student (0.091)."	"Despite the generally low risk of school-based transmission found in this study, with SARS-CoV-2 prevalence rising in New York City this risk will increase and additional mitigation steps should be implemented in schools now."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Surveys				
Assathiany et al. 2021(10) France Reviewed full text	"To evaluate the acceptability and tolerance of this measure [i.e., wearing face masks] by children as well as both parents and pediatricians."	Survey of 2,954 parents with children in primary school and 663 pediatricians	<p>"When interviewed by parents, children said they were usually embarrassed (80.9%) by the mask. The main symptoms or changes of behavior attributed to the mask according to parents were headache (49.0%), speaking difficulties (45%), change in mood (45.2%) and breathing discomfort (28.1%)."</p> <p>"During the medical consultation, when the parents complained about the mask (64.3%), the main drawbacks were related to fog on glasses (reported by 68.2% of pediatricians), breathing discomfort (53.1% of pediatricians), cutaneous disorders (42.4% of pediatricians) and headaches (38.2% of pediatricians)."</p> <p>"Globally, according to parents' declarations, accepting the mask was more difficult for children aged 10 years than 6 years (50.8 vs. 23.9%, $p < 0.001$), as was understanding the reasons for wearing it (29.2 vs. 14.7%, $p = 0.002$)."</p>	"Despite the many inconveniences reported, children agree to wear the mask better than their parents think. Pediatricians should sufficiently take the opportunity during the consultation to further explain the reasons for wearing the mask because their pedagogical role is crucial."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Kaiser et al. 2021(11) United States Reviewed full text	"Our objectives were to (1) describe adherence to coronavirus disease 2019 (COVID-19) mitigation policies in these urban, low-income educational settings; (2) assess associations between policy adherence and in-hub COVID-19 transmission; and (3) identify barriers to and facilitators of adherence."	Survey of leaders from 57 educational hubs and field observations in 54 hubs. Community hubs were created for children to access digital classwork. Observations were collected using the System for Observing Play and Leisure in Youth (SOPLAY) tool adapted to focus on masking (categorized as not masked, partially masked, fully masked, or unknown) and physical distancing.	"Across all sites, a mean 67% of children and 99% of adults were masked..." "There were no significant differences in the proportions of younger versus older children masked... (masking 65% in younger and 71% in older children [$P = .66$];..." "Hub leaders reported that unmasking sometimes persisted after eating or drinking and also occurred during situations in which children were more physically active (thus became uncomfortable wearing masks). Frequent reminders helped facilitate masking, including both verbal and visual reminders (eg, posters)." "We found almost 0 hub-based COVID-19 transmission despite only 67% of children wearing masks. This may have been driven by lower risks of COVID-19 transmission from children versus from adults and/or <100% masking compliance still providing adequate protection against transmission (in the context of other mitigation efforts)."	"Our findings indicate the importance of creating a culture of collective responsibility in which both adult staff and children are motivated about keeping everyone's masks on to ensure everyone's safety. These settings must also have the capacity to support masking (supplies of extra masks) and create environmental supports (visual reminders, designated unmasking zones). Because children often forget to remask after eating, creating staggered schedules of smaller lunch cohorts may also be helpful."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Mickells et al. 2021(12) United States Reviewed full text	"Assess the usage of cloth face masks in grades pre-K-2 and identify associated characteristics and adverse events."	Survey of 92 pre-kindergarten, kindergarten, first, and second-grade teachers in Atlanta, Georgia.	"The mean percentage of the school day with appropriate mask usage was 76.9%." "There were 12 reports of students' ears hurting and/or headaches... Teachers noted 8 times total (in both issues and adverse events sections) that students were frustrated by difficulty hearing and communicating with both the teachers and their classmates. An increase in bathroom accidents was mentioned twice and attributed by the teachers to missing facial cues or not hearing the student's request to go to the bathroom. Students complained about difficulty breathing 6 times which were all easily managed (eg, a small break from the mask in appropriate settings). Teachers mentioned 7 times that the students were hot from the masks. There were no serious medical events requiring intervention."	"For a majority of the day while conducting in-person instruction, children in grades pre-K-2 are able to adhere to mask wearing as a key mitigation strategy for limiting SARS-CoV2 infection spread and possible future use."
Park et al. 2021(13) South Korea Reviewed full text	"Understand factors related to COVID-19 preventive behaviors using the theory of planned behavior (TPB) and the health belief model (HBM) among adolescents in South Korea."	Survey of 272 middle-school students that asked questions about preventive behaviors (hand hygiene, mask wearing, social distancing).	"Among the COVID-19 preventive behaviors, the score for the item wearing a mask was the highest (4.53 ± 0.72), and the score for the distancing item was the lowest (2.97 ± 1.09)."	"Attention to mitigate social isolation is important to improve compliance with COVID-19 preventive behaviors. Perceived susceptibility, perceived severity, subjective norms, perceived behavioral control, and intention explained 61.3% of adolescents' COVID-19 preventive behaviors, there is a need for education to promote relevant factors."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Chen et al. 2020(14) China Reviewed full text	"To make up the gap and better understand the current situation of hand hygiene and face masks among primary school students."	Survey of 8,569 students from 15 primary schools in Wuhan, China.	"51.60% [of primary school students] had a good behavior of mask-wearing."	"The behaviors of hand-washing and mask-wearing among primary school students were influenced by gender, grade, and other factors, therefore, parents should make efforts of behavior guidance whereas governments should enlarge medium publicity."

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Table 3. Preprint Manuscripts

Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Simulation Studies				
Head et al. 2020(15) United States Reviewed preprint full text (version posted August 7, 2020)	"The objectives of this study were to: 1) estimate social contact patterns among school-aged children...; 2) estimate the cumulative incidence of COVID-19 throughout the 2019-2020 spring semester..., and 3) estimate the effect of various school reopening strategies."	Individual-based stochastic model to simulate COVID-19 transmission dynamics in various K-12 schools. Data were collected from a survey to families with school-aged children. The model assumed students and faculty wear masks, students and faculty are tested weekly with 85% sensitivity, and classrooms contained 20 students. The model also assumed 15% mask effectiveness for elementary school students, 25% for middle school students, and 35% for high school students.	"The estimated risk of symptomatic infection during the fall 2020 semester—across moderate to high transmission contexts—is highest for teachers and all other school staff, followed by students and other household members of students and teachers/staff. Owing to larger average school sizes, high schools are at higher risk, followed by middle schools, then elementary schools. Staggered 2-day school weeks with halved class sizes provided the largest reduction in risk, followed by strong stable cohorts of class groups, then mask wearing." "We found that regardless of the relative susceptibility of children to adults, across both moderate and high community transmission settings, a strict adherence to a combination of strong distancing interventions (e.g., combining staggered half classes or staggered grades with stable cohorts; combining stable cohorts with mask wearing and monthly testing) is needed to reduce the excess risk of symptomatic illness for high school teachers and all other school staff to less than 1%."	"Safely reopening high schools may require combining multiple strict contact reduction measures, including staggering school days, halving class sizes, or maintaining small, stable cohorts, while safely reopening elementary schools may be achieved with a more limited set of interventions, including use of stable cohorts and masks."

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Author/ Year	Study Aim	Study Description	Findings Reported by Authors	Authors' Conclusions
Watson et al. 2021(16) United States Reviewed preprint full text (version posted January 20, 2021)	"To determine the associations between COVID-19 risk and specific sports, sport characteristics, and face mask use among US high school athletes."	Mixed effects Poisson regression model to evaluate associations between estimated COVID-19 incidence in high school students while playing sports indoors and wearing masks. COVID-19 incident data were collected from a survey to athletic directors in 991 high schools.	"Face mask use was associated with a decreased incidence in girls' volleyball (IRR [incidence rate ratio] =0.53 [0.37-0.73], $p<0.001$), boys' basketball (IRR=0.53 [0.33-0.83], $p=0.008$) and girls' basketball (IRR=0.36 [0.19-0.63], $p<0.001$), and approached statistical significance in football (IRR=0.79 [0.59-1.04], $p=0.10$) and cheer/dance (IRR=0.75 [0.53-1.03], $p=0.081$)."	"Face mask use was associated with decreased COVID-19 incidence among indoor sports, and may be protective among outdoor sports with prolonged close contact between participants."
Panovska-Griffiths et al. 2020(17) United Kingdom (UK) Reviewed preprint full text (version posted October 8, 2020)	"Assess the potential importance of mandatory masks in the parts of community and in secondary schools."	Mathematical model using <u>Covasim</u> with data up to August 28, 2020, from the U.K. The model assumes 15% (low) and 30% (high) face covering efficacy in schools.	"Our results suggest that there is a greater benefit of mandatory masks in secondary schools if the effective coverage of masks is high (30%). Under current testing and tracing levels (24% testing, 47% tracing) and masks' effective coverage of 30%, the predicted second COVID-19 wave would be less than half of the original wave if masks were mandatory in secondary schools as well as used in community settings. If the effective coverage of masks is less (15%), the effect of the mask wearing in schools on the predicted wave is much less."	"In summary, our modelling suggests that while adoption of masks in secondary schools in addition to community settings may contribute to reducing the size of a second wave, it is not sufficient to prevent a secondary COVID-19 wave in the UK. Instead, a masks policy would need to be combined with adequate TTI [test-trace-isolate] strategy that can test a large proportion of symptomatic people during their infectious period, effectively trace their contacts and isolate them."

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Surveys				
Mwesige et al. 2021(18) Uganda Reviewed preprint full text (version posted July 2, 2021)	"Assessing the face mask usage and associated factors among students in schools in rural Eastern Uganda amidst the COVID-19 pandemic."	Survey of 423 students in primary and secondary schools in Uganda	"Almost all, 98.9% of the participants mentioned that they wore face masks due to fear of missing classes and 49.0% disagreed that they were vulnerable to COVID-19. Students in boarding schools (AOR = 1.61, 95%CI: 1.05-2.47), those who believed that they were vulnerable to COVID-19 (AOR = 1.70, 95%CI: 1.11-2.10), and those who disagreed that masks are uncomfortable (AOR = 1.62, 95%CI: 1.06-2.46) were more likely to wear facemasks correctly."	"This study revealed that more than a third of the students did not wear face masks correctly. Correct wearing of face masks was associated with being in a boarding school, belief that they were susceptible to COVID-19, and disagreeing that masks were uncomfortable. This therefore highlights the need for sensitization programmes in academic institutions in order to improve students' perceptions toward COVID-19 and face masks, and consequently increase correct face mask usage in schools."

Guidelines, Position and Consensus Statements

Searched PubMed, EMBASE, and ECRI Guidelines Trust® (EGT) for relevant documents published January 1, 2018, through August 19, 2021. We identified 13 documents.

We sought guidelines that address use of face masks by children during the COVID-19 pandemic. (None of the identified documents are included in EGT.) EGT is a publicly available online repository of guidelines supported by systematic reviews and developed by nationally and internationally recognized medical organizations and specialty societies. These guidelines must meet certain U.S. National Academy of Medicine criteria.

- AAP. *COVID-19 Guidance for Safe Schools*. July 2021. This guidance recommends:
 - All students older than 2 years and all school staff should wear face masks at school (unless medical or developmental conditions prohibit use).
 - The AAP recommends universal masking in school at this time for the following reasons:
 - a significant portion of the student population is not eligible for vaccination
 - protection of unvaccinated students from COVID-19 and to reduce transmission lack of a system to monitor vaccine status among students, teachers and staff
 - potential difficulty in monitoring or enforcing mask policies for those who are not vaccinated; in the absence of schools being able to conduct this monitoring, universal

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masking is the best and most effective strategy to create consistent messages, expectations, enforcement, and compliance without the added burden of needing to monitor vaccination status

- possibility of low vaccination uptake within the surrounding school community
- continued concerns for variants that are more easily spread among children, adolescents, and adults
- An added benefit of universal masking is protection of students and staff against other respiratory illnesses that would take time away from school.
- AAP. *Face Masks*. August 2021. This guidance document states:

[AAP] strongly endorses the use of safe and effective infection control procedures to protect children and adolescents. During the COVID-19 pandemic, effective infection prevention and control requires the correct and consistent use of a well-fitting face mask. Face masks should fit over the mouth and nose and fit snugly along the side of the face without any gaps.
- Canadian Pandemic Influenza Preparedness Task Group, Technical Advisory Committee, and Special Advisory Committee. *Planning for the 2021-2022 School Year in the Context of COVID-19 Vaccination*. August 2021. This document recommends:

In settings where there is low vaccination coverage (e.g., primary schools where most of the students are under 12 years of age, or populations where large numbers of individuals choose not to receive the vaccine), the introduction and transmission of SARS-CoV-2 within the school setting and into the local community is possible. This may include transmission to individuals who are not vaccinated and those who are at an increased risk for severe disease or outcomes. Implementing PHMs [public health measures] in these settings, such as improved indoor ventilation, screening and testing strategies, mask wearing and physical distancing, may be considered to reduce the risk of transmission of SARS-CoV-2 and/or local outbreaks. When determining whether these measures may be appropriate, it will be important to consider both COVID-19 risk and the risk of unintended consequences of the measures.

A well-constructed, well-fitting and properly worn non-medical mask has been shown to protect the wearer and those around them. Mask wearing may also be encouraged when physical distancing is not possible (i.e., indoor public places, crowded outdoor settings, during activities with close contact with others). It is important to recognize that some people may choose to wear a mask based on a personal risk-assessment (e.g., those who are at a higher risk of severe disease or outcomes). It is also important that these individuals are not stigmatized for their choice. Further, school administrators will need to accommodate the needs of students with disabilities and ensure that they have access to the same public health information and, to the extent possible, appropriate mitigation measures (e.g., assistance with mask wearing).

Compared to the potential negative consequences associated with school closures and online learning noted above, mask wearing can prevent SARS-CoV-2 transmission among unvaccinated children and may also help reduce transmission of other respiratory conditions within school settings (e.g., influenza, RSV). Existing studies show that mask use among children does not significantly impair their physiological health (i.e., respiratory function); however, consistent adult supervision on the correct and safe wearing of masks is strongly encouraged to prevent respiratory impairments. There is no strong evidence suggesting negative consequences of mask wearing in children.
- CDC. *Guidance for COVID-19 Prevention in K-12 Schools*. August 2021. This document states: "Due to the circulating and highly contagious Delta variant, CDC recommends universal indoor masking by all students (age 2 and older), staff, teachers, and visitors to K-12 schools, regardless of vaccination status."
- CDC. *Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Updated*. July 2021. This document states:

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CDC guidance identifies multiple prevention strategies that schools can implement in a layered approach to promote safer in-person learning and care. These include promoting vaccination, consistent and correct use of masks for people who are not fully vaccinated, physical distancing, screening testing in schools to promptly identify cases, improved ventilation, handwashing and respiratory etiquette, staying home when sick and getting tested, contact tracing in combination with isolation and quarantine, and routine cleaning with disinfection under certain conditions.

In summary, the preponderance of the available evidence from United States schools indicates that even when students were placed less than 6 feet apart in classrooms, there was limited SARS-CoV-2 transmission when other layered prevention strategies were consistently maintained; notably, masking and student cohorts. International studies further support these conclusions. However, greater physical distancing (at least 6 feet) between people who are not fully vaccinated should be prioritized whenever masks cannot be used (for example, while eating indoors).

Consistent with recommendations from WHO81 and the American Academy of Pediatrics, using a distance of at least 3 feet between students in classrooms could provide a feasible definition of physical distancing so long as other prevention strategies are maximized. These include mask requirements for children aged 2 years and older, adolescents, and staff who are not fully vaccinated, ensuring good ventilation that includes air cleaning, frequent hand hygiene, and encouraging children, adolescents, and staff to stay home when they have symptoms of COVID-19 or, for those not fully vaccinated, when they have been in close contact with someone who has known or suspected COVID-19.

- CDC. *Your Guide to Masks*. August 2021. This document outlines special considerations for children wearing masks, including:
 - Find a mask that is made for children to help ensure proper fit.
 - Check to be sure the mask fits snugly over the nose and mouth and under the chin and that there are no gaps around the sides.
 - Do NOT put on children younger than 2 years old.
- European Centre for Disease Prevention and Control. *COVID-19 in Children and the Role of School Settings in COVID-19 Transmission*. August 2020. This guidance document recommends:

In primary schools, use of face masks is recommended for teachers and other adults when physical distancing cannot be guaranteed, while it is not recommended for the students. In secondary schools, the use of face masks is recommended for both students and adults.
- French Pediatric Society. *COVID-19 and Schools. Guidelines of the French Pediatric Society*. September 2020. This guideline states: "Wearing a mask by middle and high school students is useful. It can be less restrictive in classes where physical distancing is possible."
- New Zealand Ministry of Health. *COVID-19: Use of Masks and Face Coverings in the Community*. June 2021. Regarding mask wearing in schools at Alert Levels 1, 2, or 3, this guidance document recommends:
 - Children and young people do not need to wear a mask or face coverings at Alert Levels 1 and 2 because the risk of infection within early learning services and school environments is low.
 - Children and young people do not need to wear masks or face coverings at Alert Level 3 if they remain within their early learning or school bubbles of up to 20 children. This includes staying at least 2 metres away from children from other early learning or school bubbles outside.
 - Children and young people are not required to wear masks or face coverings on school transport at Alert Levels 1 and 2. This includes buses or vans chartered or used by schools or early learning services to carry children, students and staff.
 - Children and young people aged 6 years and over can choose to wear a mask or face covering when they are on school transport.
- WHO. *Advice on the Use of Masks for Children in the Community in the Context of COVID-19. Annex to the Advice on the Use of Masks in the Context of COVID-19*. August 2021. This guidance document recommends:

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To facilitate the operationalization of this guidance in school settings (as per national standards) it is advised that the age categories be adapted to the national/local education level structure.

The use of masks by children and adolescents in schools should only be considered as one part of a comprehensive strategy to limit the spread of COVID-19.

As part of the comprehensive school safety strategy for reopening, the views of teachers and educators on the perception of risks and the time burden required to ensure adherence to COVID-19 policies in schools and classrooms—including the use of masks by children—should be considered. Situations where wearing a mask can significantly interfere with the learning process and have a negative impact on critical school activities like physical education, meal programs, play time and sports – as well as learning – require special consideration.

If wearing of fabric masks is recommended in schools, specific instructions and supplies should be provided for the safe storage, handling and availability of fabric masks (see above). A sufficient supply of appropriate masks should be ensured for all school children. Basic water, sanitation and hygiene requirements should be met in the school building so that comprehensive IPC measures can be implemented, linked to specific age-appropriate educational activities.

If medical or disposable masks are used in specific situations, a system for waste management including disposal of used masks will need to be established to reduce the risk of contaminated masks being disposed of in classrooms and playgrounds.

No children should be denied access to education because of mask wearing or the lack of a mask because of low resources or unavailability.

- WHO. *Considerations for School-related Public Health Measures in the Context of COVID-19. Annex to Considerations in Adjusting Public Health and Social Measures in the Context of COVID-19*. September 2020. This guidance document states:

In countries or areas where there is intense community transmission of SARS-CoV-2 and in settings where physical distancing cannot be achieved, WHO and UNICEF advise decision makers to apply the following criteria for use of masks in schools (either in classes, corridors or communal areas) when developing national policies:

- Children aged 5 years and under should not be required to wear masks.
- For children between six and 11 years of age, a risk-based approach should be applied to the decision to use a mask.
- Children and adolescents 12 years or older should follow the national mask guidelines for adults.
- All efforts should be made to ensure the use of a mask does not interfere with learning.
- Children should not be denied access to education because of mask wearing or the lack of a mask because of low resources or unavailability.

The use of masks by children and adolescents in schools should only be considered as one part of a comprehensive strategy to limit the spread of COVID-19. Schools should establish a system for waste management including disposal of used masks to reduce the risk of contaminated masks being disposed of in classrooms and playgrounds.

- WHO. *Coronavirus Disease (COVID-19): Children and Masks*. August 2020. This guidance document recommends:

Children aged 5 years and under should not be required to wear masks. This is based on the safety and overall interest of the child and the capacity to appropriately use a mask with minimal assistance.

WHO and UNICEF advise that the decision to use masks for children aged 6-11 should be based on the following factors:

- Whether there is widespread transmission in the area where the child resides
- The ability of the child to safely and appropriately use a mask

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- Access to masks, as well as laundering and replacement of masks in certain settings (such as schools and childcare services)
- Adequate adult supervision and instructions to the child on how to put on, take off and safely wear masks
- Potential impact of wearing a mask on learning and psychosocial development, in consultation with teachers, parents/caregivers and/or medical providers
- Specific settings and interactions the child has with other people who are at high risk of developing serious illness, such as the elderly and those with other underlying health conditions

WHO and UNICEF advise that children aged 12 and over should wear a mask under the same conditions as adults, in particular when they cannot guarantee at least a 1-metre distance from others and there is widespread transmission in the area

- WHO. *Mask Use in the Context of COVID-19. Interim Guidance*. December 2020. This guidance document states:

WHO advises that the general public should wear a non-medical mask in indoor (e.g. shops, shared workplaces, schools...) or outdoor settings where physical distancing of at least 1 metre cannot be maintained.

For children between six and 11 years of age, a risk-based approach should be applied to the decision to use a mask; factors to be considered in the risk-based approach include intensity of SARS-CoV-2 transmission, child's capacity to comply with the appropriate use of masks and availability of appropriate adult supervision, local social and cultural environment, and specific settings such as households with elderly relatives, or schools.

Selected Resources and References

Search Summaries

Our master's-level medical librarians searched the following databases to identify the literature and related materials.

ECRI Resources [searched 2018 Jan 1 through 2021 Aug 19].

Search Strategy:

Covid AND mask*; scan of [COVID-19 resource center](#)

Results:

- [Ask ECRI: Masks and hand sanitizer](#). [Aging Services Risk, Quality, & Safety Guidance]. 2020 Apr 21.
- [Cloth face coverings in public to contain COVID-19: They matter; Construction matters](#). [2020 Aug 14].
- [Cloth face coverings to reduce transmission of viral respiratory infection in healthcare workers](#). [Clinical Evidence Assessment]. 2020 Jun 29.
- [Cloth face coverings worn by the public to reduce SARS-CoV-2 transmission](#). [updated 2021 Mar 5].
- [Cloth masks worn by the public to reduce SARS-CoV-2 dose and attenuate COVID-19 severity](#). [2020 Oct 27].
- [COVID-19 resources for supply chain](#). [Resource Center]. [cited 2020 Mar 20].
- [Disinfectant concentrations and contact times for EPA's list of products effective against novel coronavirus SARS-CoV-2, the cause of COVID-19](#). [Evaluations and Guidance]. Updated 2021 Jun 2.
- [Face Mask \(nonsurgical\)](#). [FDA Approvals & Clearances]. 2020 Apr 20.

PubMed. Bethesda (MD): National Library of Medicine [searched 2018 Jan 1 through 2021 Aug 19]. Available from: <http://www.pubmed.gov>.

Search Strategy:

- #1 "Masks"[Mesh:NoExp] OR mask* OR "mask wearing" OR "face cover*" OR (face[ti] AND cover*[ti])

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- #2 (cloth* OR fabric* OR woven OR cotton OR polypropylene OR silk OR paper OR handmade OR hand-made OR "hand made" OR homemade OR home-made OR "home made" OR sewn)
- #3 public OR community OR communities OR city OR cities OR town OR towns OR household OR dwelling OR home OR neighborhood* OR store* OR outside* OR outdoor* OR non-hospital OR non-healthcare OR school OR schools OR classroom OR teacher* OR student* OR elementary OR "K through 12" OR "K-12" OR bus OR buses OR train OR trains OR transportation OR flight OR flights OR airplane OR airplanes OR airline*
- #4 pediatric* OR paediatric* OR child* OR preschool* OR pre-school* OR kindergarten* OR kindergarten* OR "elementary school*" OR "nursery school*" OR schoolchild* OR toddler* OR boy OR boys OR girl OR girls OR elementary OR "middle school*" OR "school age*" OR kid OR kids OR juvenile* OR teen* OR youth* OR adolesc* OR pre-pubesc* OR prepubesc* OR child[MeSH Terms] OR adolescent[MeSH Terms] OR pediatrics[MeSH Terms] OR young adult[MeSH Terms] OR young adult*[TIAB] OR young person*[TIAB] OR young individual*[TIAB] OR young people*[TIAB] OR young population*[TIAB] OR youngster*[TIAB] OR first-grader*[TIAB] OR second-grader*[TIAB] OR third-grader*[TIAB] OR fourth-grader*[TIAB] OR fifth-grader*[TIAB] OR sixth-grader*[TIAB] OR seventh-grader*[TIAB] OR secondary school*[TIAB] OR secondary education*[TIAB] OR high school*[TIAB] OR highschool[TIAB] OR high education[TIAB]
- #5 #1 AND #2 AND #3 AND #4
- #6 #5 AND ("delta" OR "B.1.617.2" OR "COVID-19" OR "COVID-19"[MeSH Terms] OR "SARS-CoV-2" OR "sars-cov-2"[MeSH Terms] OR "Severe Acute Respiratory Syndrome Coronavirus 2" OR "NCOV" OR "2019 NCOV" OR "coronavirus"[MeSH Terms] OR "coronavirus" OR "COV")

EMBASE. Amsterdam (The Netherlands): Elsevier B.V. [searched 2018 Jan 1 through 2021 Aug 19]. Available from: www.embase.com. Subscription required.

Search Strategy:

- #1 'covid 19'/exp OR 'coronavirus disease 2019'/exp OR 'covid 19':ti,ab OR ((covid NEAR/2 19):ti,ab) OR ((sars NEAR/2 'cov 2'):ti,ab) OR '2019 ncov':ti,ab OR ((wuhan:ti,ab OR hubei:ti,ab) AND coronavirus*:ti,ab) OR ([2019-2020]/py AND (new:ti,ab OR novel:ti,ab OR pandemic:ti,ab OR epidemic:ti,ab) AND ('coronavirus infection'/exp OR coronavirus*:ti,ab OR 'corona virus*':ti,ab))
- #2 ('sars-related coronavirus' OR 'coronavirinae' OR 'betacoronavirus' OR 'coronavirus infection') AND ('epidemic' OR 'pandemic')
- #3 ncov*:ti,ab,kw OR 2019ncov:ti,ab,kw OR 19ncov:ti,ab,kw OR covid19*:ti,ab,kw OR covid:ti,ab,kw OR 'sars cov 2':ti,ab,kw OR 'sarscov 2':ti,ab,kw OR 'sars cov2':ti,ab,kw OR sarscov2:ti,ab,kw OR 'severe acute respiratory syndrome coronavirus 2':ti,ab,kw OR 'severe acute respiratory syndrome corona virus 2':ti,ab,kw
- #4 (new:ti,ab,kw OR novel:ti,ab,kw OR '19':ti,ab,kw OR '2019':ti,ab,kw OR wuhan:ti,ab,kw OR hubei:ti,ab,kw OR china:ti,ab,kw OR chinese:ti,ab,kw) AND ((coronavirus*:ti,ab,kw OR corona:ti,ab,kw) AND virus*:ti,ab,kw OR betacoronavirus*:ti,ab,kw OR cov:ti,ab,kw OR hcov:ti,ab,kw)
- #5 ((coronavirus*:ti,ab,kw OR corona:ti,ab,kw) AND virus*:ti,ab,kw OR betacoronavirus*:ti,ab,kw) AND (pandemic*:ti,ab,kw OR epidemic*:ti,ab,kw OR outbreak*:ti,ab,kw OR crisis:ti,ab,kw)
- #6 ((Wuhan or Hubei) AND pneumonia):ti,ab,kw
- #7 "delta":ti,ab,kw OR "B.1.617.2":ti,ab,kw
- #8 OR/1-7
- #9 'cloth mask'/de OR ('mask'/exp OR (mask:ti OR masks:ti OR masking:ti OR (face* AND cover*):ti) AND (cloth OR fabric OR woven OR cotton OR polypropylene OR silk OR paper OR handmade OR hand-made OR "hand made" OR homemade OR home-made OR "home made" OR sewn))
- #10 #8 AND #9
- #11 #10 AND ('childhood'/exp OR 'adolescence'/exp OR 'pediatric'/exp OR 'pediatrics'/exp OR 'school age'/exp OR 'high school'/exp OR 'kindergarten'/exp OR 'middle school'/exp OR 'nursery school'/exp OR 'primary school'/exp OR 'young adult'/exp OR 'juvenile'/exp OR 'adolescent'/exp OR 'child'/exp OR (young NEXT/2 (adult* OR person* OR individual* OR people* OR population*)):ti,ab OR (pediatric* OR paediatric* OR child* OR preschool* OR pre-school* OR kindergarten* OR kindergarden* OR "elementary school*" OR "nursery school*" OR schoolchild* OR toddler* OR boy OR boys OR girl OR girls OR elementary OR "middle school*" OR "school age*" OR kid OR kids OR

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juvenile* or teen* or youth* or "high school*" or adolesc* or pre-pubesc* or prepubesc* OR juvenile* OR youngster* OR first-grade* OR second-grade* OR third-grade* OR fourth-grade* OR fifth-grade* OR sixth-grade* OR seventh-grade* OR highschool* OR high-school OR 'high school' OR secondary school* OR secondary education*):ti,ab)

— #12 #11 NOT ('conference abstract'/it OR 'note'/it OR 'tombstone'/it)

Guidelines, Position and Consensus Statements [searched 2018 Jan 1 through 2021 Aug 19].

Search Strategy:

— Covid* AND mask*; school* AND mask*; (face AND (mask OR masks OR covering*)) AND school*

Selected Standards and Guidelines:

- American Academy of Pediatrics (AAP). [COVID-19 Guidance for safe schools](#). [updated 2021 Jul 18].
- AAP. [Face masks](#). [updated 2021 Aug 11].
- Canadian Pandemic Influenza Preparedness (CPIP) Task Group, Technical Advisory Committee (TAC), and Special Advisory Committee (SAC). [Planning for the 2021-2022 school year in the context of COVID-19](#). [modified 2021 Aug 17]. Note: "This interim guidance provides schools with advice for planning and operating during the 2021-2022 school year, including how they can adjust PHMs in the context of COVID-19 vaccination in Canada. It combines the archived versions of guidance for [Schools Kindergarten to Grade 12](#) (published in August 2020) and [Post-Secondary Institutions](#) (published in July 2020)."
- Centers for Disease Control and Prevention (CDC). [Guidance for COVID-19 prevention in K-12 schools](#). [updated 2021 Aug 5].
- CDC. [Your guide to masks](#). [updated 2021 Aug 13].
- CDC. [Science Briefs](#). [cited 2021 Aug 19].
 - [Transmission of SARS-CoV-2 in K-12 schools](#). [2021 Jul 8].
- European Centre for Disease Prevention and Control. [COVID-19 in children and the role of school settings in COVID-19 transmission](#). 2020 Aug 6.
- French Pediatric Society. Cohen R, Delacourt C, Gras-Le Guen C, Launay E; French Pediatric Society. [COVID-19 and schools. Guidelines of the French Pediatric Society](#). Arch Pediatr. 2020 Oct;27(7):388-392. doi: 10.1016/j.arcped.2020.09.001. Epub 2020 Sep 4. PMID: 32921531; PMCID: PMC7473250
- New Zealand Ministry of Health. [COVID-19: Use of masks and face coverings in the community](#). [last updated 2021 Jun 23].
- World Health Organization (WHO). [Advice on the use of masks for children in the community in the context of COVID-19. Annex to the Advice on the use of masks in the context of COVID-19](#). 2020 Aug 21.
- WHO. [Considerations for school-related public health measures in the context of COVID-19. Annex to Considerations in adjusting public health and social measures in the context of COVID-19](#). 2020 Sep 14.
- WHO. [Coronavirus disease \(COVID-19\): Children and masks](#). 2020 Aug 21.
- WHO. [Mask use in the context of COVID-19. Interim guidance](#). 2020 Dec 1.

Selected Web Resources [searched 2021 Aug 19].

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- Esposito S, Cotugno N, Principi N. [Comprehensive and safe school strategy during COVID-19 pandemic](#). Ital J Pediatr. 2021 Jan 9;47(1):6. doi: 10.1186/s13052-021-00960-6.
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- Furukawa NW, Brooks JT, Sobel J. Evidence supporting transmission of severe acute respiratory syndrome coronavirus 2 while presymptomatic or asymptomatic. *Emerg Infect Dis*. 2020 Jul [cited 2021 Aug 19]. <https://doi.org/10.3201/eid2607.201595>
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- Kaiser Family Foundation. Hamel L, et al. Coronavirus: Reopening, Schools, and the Government Response. Jul 27, 2020.
- Kuehn BM. Fewer COVID-19 cases in schools with masks and improved ventilation. *JAMA*. 2021;326(2):125. doi:10.1001/jama.2021.10044

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Face Coverings Worn by Children in School Settings to Reduce SARS-CoV-2 Transmission

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ECRI developed The Evidence Bar™ to provide a visualization of our judgment about the balance of benefits and harms of the technology after assessing the available published clinical evidence in light of key outcomes and comparisons of interest. The Evidence Bar™ rubric shows five possible choices for our expert judgment. After review and analysis of evidence identified through literature searches conducted by master's-level medical librarians, ECRI research analysts, extensively trained in methods of evidence assessment, weigh potential benefits and harms of a technology to arrive at their expert judgment.



Policy Statement

The information presented in this Clinical Evidence Assessment is highly perishable and reflects the state of the literature on this topic at the time at which searches were conducted and the Clinical Evidence Assessment was prepared. Clinical Evidence Assessments provide a guide to the published clinical literature and other information about a topic on which we received a client inquiry. The scope is customized to address the specific information needs of the requestor. The content reflects the information identified from searches of the available, published, peer-reviewed scientific literature, gray literature, and websites at the time the searches were conducted. Publications referenced in this Clinical Evidence Assessment are generally limited to the English language. Clinical Evidence Assessments are developed by a multidisciplinary staff of doctoral level research analysts, clinicians, and medical librarian information specialists. For quality assurance, all reports are subject to review within ECRI before publication. Neither ECRI nor its employees accept gifts, grants, or contributions from, or consult for medical device or pharmaceutical manufacturers. The Clinical Evidence Assessment may be based on review of abstracts of published articles as well as full text articles. Abstracts do not always accurately reflect the methods and findings of full-length articles and limit full interpretation of published data. This Clinical Evidence Assessment is not intended to provide specific guidance for the care of individual patients. ECRI implies no warranty and assumes no liability for the information contained in the Clinical Evidence Assessment.

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