Disparities in Implementing COVID-19 Prevention Strategies in Public Schools, United States, 2021–22 School Year

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During the COVID-19 pandemic, US schools have been encouraged to take a layered approach to prevention, incorporating multiple strategies to curb transmission of SARS-CoV-2. Using survey data representative of US public K–12 schools (N = 437), we determined prevalence estimates of COVID-19 prevention strategies early in the 2021–22 school year and describe disparities in implementing strategies by school characteristics. Prevalence of prevention strategies ranged from 9.3% (offered COVID-19 screening testing to students and staff) to 95.1% (had a school-based system to report COVID-19 outcomes). Schools with a full-time school nurse or school-based health center had significantly higher odds of implementing several strategies, including those related to COVID-19 vaccination. We identified additional disparities in prevalence of strategies by locale, school level, and poverty. Advancing school health workforce and infrastructure, ensuring schools use available COVID-19 funding effectively, and promoting efforts in schools with the lowest prevalence of infection prevention strategies are needed for pandemic preparedness.

To prevent transmission of SARS-CoV-2, the virus that causes COVID-19, in school settings and maintain in-person learning during the 2021–22 school year, US schools implemented a range of COVID-19 prevention strategies (*1*–*4*). Since the pandemic began, the Centers for Disease Control and Prevention (CDC) has provided guidance for schools on strategies for COVID-19 prevention (*5*). This guidance evolved as new scientific evidence emerged but has consistently emphasized layering multiple prevention strategies. CDC updated guidance for COVID-19 prevention in schools in May 2022 (*5*); recommended core prevention strategies for schools included staying home when sick; optimizing ventilation; practicing proper hand hygiene and respiratory etiquette; performing cleaning and disinfection; and encouraging families, staff, and students to stay up to date on vaccines. Those core prevention strategies are important in preventing the spread of multiple infectious diseases. On the basis of local COVID-19 context, additional prevention strategies included mask requirements, COVID-19 screening and diagnostic testing, cohorting, ventilation improvements, case investigation and contact tracing, and quarantining. Many of the same strategies included in CDC guidance from May 2022 were also included in CDC guidance from August 2021 (*6*), when we conducted our study, and in COVID-19 guidance for safe schools from the American Academy of Pediatrics (AAP) in July 2021 (*7*), which included promoting vaccines, improving ventilation, testing, and cleaning.

Recommended infection prevention strategies varied in terms of expertise, staffing, infrastructure, and financial costs required for implementation. Delivery of specific health services in school settings (e.g., vaccines and tests) might require personnel with medical and public health expertise and existing infrastructure for offering services. For example, implementation studies of school-based influenza vaccination programs have underscored the importance of dedicated staff and program infrastructure for securing supplies and necessary funding, disseminating materials (e.g., consent forms), communicating about the program to students and families, and managing logistics (*8*). Numerous

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other studies on school-based delivery of vaccines and COVID-19 tests also highlight the value of workforce capacity and infrastructure (*9*–*14*). Furthermore, staff shortages and gaps in expertise within schools might interplay with urban–rural disparities. One study in New Mexico found that nurses in rural schools were more likely to serve multiple campuses, more likely to have fewer years of formal education, and less likely to have continuing education in specific health topics (e.g., anaphylaxis) (*15*). Infection prevention strategies unrelated to health services might also vary by school characteristics. Ventilation improvement strategies, particularly more costly strategies such as upgrading heating, ventilation, and air conditioning (HVAC) systems, might vary by school poverty level. Household studies have found indoor environmental exposures are more concentrated in low-income households, partially because of inadequate ventilation and low air exchange rates (*16*). Evidence on disparities in infection prevention strategies has primarily focused on a single state or school district and a single prevention strategy or a narrow set of prevention strategies. Little is known about how implementing a comprehensive set of infection prevention strategies varies across kindergarten through 12th grade (K–12) schools in the United States by school characteristics. Such findings can guide interventions to improve schools' ability to prevent transmission of infectious diseases, identify schools to prioritize in resource allocation and capacity building to reduce disparities, and contribute to current and future emergency preparedness.

Accordingly, our study aimed to describe implementing infection prevention strategies relating to vaccines, ventilation, cleaning and disinfection, mask requirements, COVID-19 screening and diagnostic testing, cohorting, case investigation, contact tracing, and quarantining among a nationally representative sample of K–12 public schools early in the 2021–22 school year. The study period coincided with the surge of the of the SARS-CoV-2 Delta variant and was one of high community transmission nationwide, necessitating that all US schools incorporate layered COVID-19 prevention strategies. Further, we characterize disparities in implementation by school level, poverty, urban or rural classification, and presence of health personnel and infrastructure.

Methods

Data

The National School COVID-19 Prevention Study (NSCPS) was initiated to better understand implementation and effectiveness of infection prevention strategies in K–12 school settings (*17*,*18*). NSCPS is a population-based, longitudinal study designed to be representative of K–12 public schools in the United States. The study used a single-stage, stratified random sample of K–12 public schools based on strata defined by region (Northeast, South, Midwest, or West), school level (elementary, middle, or high), and National Center for Education Statistics (NCES) locale (city, town, suburb, or rural). School locale was categorized on the basis of the NCES locale classification scheme, derived from the US Census Bureau's standard urban and rural definitions, which are based on population size and proximity to populated areas (*19*). The allocation was nearly proportional to ensure approximately equal probabilities for schools, which is an efficient design for a survey in which schools (rather than students) are the unit of analysis.

The sampling frame for this study consisted of public K–12 schools. We excluded the following school types: private schools, alternative schools, schools providing special services to a pull-out population enrolled at another eligible school, schools run by the US Department of Defense, and schools with <30 students. We followed the cohort of schools for 5 waves of data collection from June 2021 through May 2022. For each wave, a school-level designee was invited to complete a survey on COVID-19 prevention strategies and COVID-19–related outcomes.

We report data from a cross-sectional analysis of wave 2, the first wave of the 2021–22 school year. The wave 2 survey was administered during October 5–November 19, 2021, and included 81 survey questions primarily assessing the implementation of COVID-19 prevention strategies. A draft version of the survey was pilot-tested with a small number of school principals (n = 8), whose feedback was incorporated in the final survey. Each participant was given a unique link to complete the survey online. Of the 1,602 schools invited to participate, 437 (27%) completed the survey. The primary survey respondents were principals (n = 340, unweighted) and school nurses (n = 39, unweighted). Respondents were offered an electronic gift card valued at $50 for their time and effort. This study was approved by the Institutional Review Board of ICF, a research and evaluation consulting firm, in accordance with CDC's policies.

Measures

We examined 21 school-level prevention strategies (e.g., promoting vaccination) assessed through the survey questions (Appendix Table 1, https://wwwnc.cdc.gov/EID/article/29/5/22-1533-App1.pdf). We obtained 2 school-level characteristics

from the survey: having a school-based health center (SBHC) and having a full-time school nurse. We categorized school level as elementary (any grade from kindergarten through grade 4), middle (any grade 7 or 8), or high (any grade from 10 through 12). We did not use grades 5, 6, and 9 to categorize school level, and we considered schools categorized as multiple school levels (e.g., kindergarten through grade 8) to be separate schools for sampling purposes. We linked NSCPS surveys with the MDR database, which provides information about individual US schools (*20*). We used the percentage of students eligible for free or reduced-price meals during the 2019–20 school year as a proxy for school-level poverty (*21*,*22*). High-poverty schools had ≥76% of students eligible for free or reduced-price meals, mid-poverty schools had 26%–75% eligible, and low-poverty schools had ≤25% eligible (*23*). We categorized school locale according to the NCES locale classification scheme (town, suburb, rural, or city) (*19*). To capture local COVID-19 dynamics preceding survey administration, we pulled from CDC's county-level community transmission level data the total number of new cases per 100,000 persons within the previous 7 days in each school's county on September 23, 2021 (i.e., 2 weeks before the survey opened).

Statistical Analyses

We accounted for survey nonresponse by creating survey weights. Examined school characteristics were not significantly associated with participation except for school affluence level, a measure in MDR's database summarizing the socioeconomic status of a school derived through a proprietary algorithm (*20*). Schools that were low or below average in affluence were more likely to participate than schools that were average, above average, or high in affluence; thus, we used school affluence to develop nonresponse adjustment classes (Appendix Table 2). We calculated the weighted prevalence of each prevention strategy and 95% CIs for the overall sample. We also calculated unweighted numbers, weighted prevalence, and 95% CIs of strategies by school-level characteristics and used χ^2 tests to identify differences. We ran separate weighted logistic regression models with each COVID-19 prevention strategy as the dependent variable and school-level characteristics (i.e., school level, NCES locale, school poverty, having a full-time school nurse, and having an SBHC) as the independent variables, controlling for new cases per 100,000 persons in the previous 7 days in the county. We selected independent and control variables on the basis of a review of literature on factors influencing implementation of infection prevention strategies in schools; selected controls satisfied criteria for confounder selection (*24*). We calculated adjusted odds ratios (aORs) and defined differences with p values <0.05 as statistically significant. We conducted analyses in R 4.1.2 (The R Foundation for Statistical Computing, https://www.r-project.org) by using the survey package (*25*).

Results

Participating schools were heterogenous in terms of school level, urban status, size, and the racial composition (Appendix Table 2). Most schools reported having had a school-based system to report COVID-19 outcomes (95.1% [95% CI 92.5%–96.8%]), had a COVID-19 isolation space in school (92.5% [95% CI 89.4%–94.7%]), quarantined students identified as close contacts (83.5% [95% CI 79.3%–87.0%]), adhered to at least daily or between-use cleaning schedules (79.7% [95% CI 75.5%–83.4%]), inspected and validated existing HVAC systems (74.6% [95% CI 69.8%–78.8%]), and maintained a physical distance of ≥3 feet in classrooms (74.3% [95% CI 69.8%–78.4%]) (Table, https://wwwnc.cdc.gov/EID/article/29/5/22-1533-T1.htm). In addition, more than two thirds of schools offered COVID-19 diagnostic testing to students and staff (68.7% [95% CI 63.8%–73.3%]) and opened windows when safe to do so (66.8% [95% CI 62.2%–71.1%]). Approximately two thirds of schools required masks for students and staff (66.4% [95% CI 61.9%–70.6%]). Less than one third of schools reported having offered COVID-19 screening testing to students and staff (9.3% [95% CI 6.9%–12.5%]), installed or used high-efficiency particulate air (HEPA) filtration systems in classrooms (27.3% [95% CI 23.3%–31.7%]), and provided COVID-19 vaccines on-campus to staff, students, or their families (30.9% [95% CI 26.5%–35.8%]).

School-Level Mask Requirements, Ventilation Improvements, and Cleaning Procedures

Bivariate analysis indicated that, among 7 strategies related to school-level mask requirements, ventilation improvements, and cleaning procedures, none varied by school level, 2 varied by NCES locale, 4 varied by school poverty, and 1 varied by whether the school had a full-time school nurse and SBHC (Appendix Table 3). After adjustment for all examined school-level characteristics and the county COVID-19 case rate, mid-poverty schools had lower odds of having inspected and validated existing HVAC systems (aOR 0.37 [95% CI 0.16–0.84]), used HEPA filtration systems in classrooms (aOR 0.52 [95% CI 0.28–0.96]), and opened

windows when safe to do so (aOR 0.48 [95% CI 0.24–0.95]) than did low-poverty schools (Appendix Table 4). Rural schools had lower odds of having installed or used HEPA filtration systems in classrooms (aOR 0.36 [95% CI 0.17–0.76]) than did city schools. However, rural schools had higher odds of having opened doors (aOR 2.08 [95% CI 1.03–4.17]) and opened windows (aOR 4.51 [95% CI 2.11–9.60]) when safe to do so compared with city schools. Town schools had lower odds of having required masks for students and staff (aOR 0.38 [95% CI 0.17–0.85]) than did city schools. Schools with a full-time school nurse had lower odds of having opened doors when safe to do so (aOR 0.57 [95% CI 0.34–0.96]) than did schools without.

Physical Distancing, Isolation Space, COVID-19 Testing and Screening, Contact Tracing, and Quarantine Protocols

Bivariate analysis indicated that, among 7 strategies relating to physical distancing, isolation space, COVID-19 testing and screening, contact tracing, and quarantine protocols, none varied by school level, NCES locale, school poverty, or having an SBHC, and 2 varied by having a full-time school nurse (Appendix Table 5). After adjustment for all examined school-level characteristics and the county COVID-19 case rate, schools that had a full-time school nurse had higher odds of having quarantined students identified as close contacts (aOR 2.02 [95% CI 1.05–3.91]) than did schools without (Appendix Table 6).

Promoting and Tracking Vaccination of Students and Staff

Bivariate analysis indicated that, among 7 strategies relating to efforts to promote and track vaccination of students and staff, 3 varied by school level, 2 varied by NCES locale, 3 varied by school poverty, 3 varied by having a full-time school nurse, and 4 varied by having an SBHC (Appendix Table 7). After adjustment for all examined school-level characteristics and the county COVID-19 case rate, compared with high schools, elementary schools had lower odds of having provided information on COVID-19 vaccines to parents (aOR 0.49 [95% CI 0.25–0.97]); provided information on COVID-19 vaccines to students (aOR 0.15 [95% CI 0.08–0.29]); provided COVID-19 vaccines on-campus to staff, students, or their families (aOR 0.47 [95% CI 0.26–0.87]); and tracked vaccination status of students (aOR 0.45 [95% CI 0.24–0.83]) (Appendix Table 8). Compared with high schools, middle schools had lower odds of having provided information on COVID-19 vaccines to students (aOR 0.39 [95% CI 0.20–0.79]); provided COVID-19 vaccines through school district events to staff, students, or their families (aOR 0.44 [95% CI 0.21–0.92]); and tracked vaccination status of staff (aOR 0.44 [95% CI 0.20–0.95]). High-poverty schools had higher odds of having provided information on COVID-19 vaccines to students (aOR 3.88 [95% CI 1.81–8.30]) and provided COVID-19 vaccines through school district events to staff, students, or their families (aOR 2.47 [95% CI 1.23–4.98]) compared with low-poverty schools. Mid-poverty schools had higher odds of having provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines (aOR 1.91 [95% CI 1.06–3.44]) compared with low-poverty schools. Rural schools had lower odds of having provided COVID-19 vaccines through school district events to staff, students, or their families (aOR 0.45 [95% CI 0.23–0.88]) and tracked vaccination status of staff (aOR 0.45 [95% CI 0.23–0.90]) than city schools. Town schools had higher odds of having tracked the vaccination status of students (aOR 3.09 [95% CI 1.36–7.01]) than city schools. Schools that had a full-time school nurse had higher odds of having tracked the vaccination status of students (aOR 1.80 [95% CI 1.07–3.03]) than those that did not. Schools that had an SBHC had higher odds of having provided COVID-19 vaccines on campus to staff, students, or their families (aOR 2.00 [95% CI 1.03–3.89]) and of having provided COVID-19 vaccines through school district events to staff, students, or their families (aOR 2.25 [95% CI 1.18–4.30]) than those that did not.

Discussion

At the time of our study, guidance from CDC and AAP recommended a layered approach to COVID-19 prevention in schools, incorporating multiple strategies to curb transmission of SARS-CoV-2 and protect students, staff, and families while maintaining in-person learning (*6*,*7*). These approaches were used to varying degrees by schools, as affirmed by our findings. This heterogeneity might be partially attributable to school-level inequities predating the COVID-19 pandemic (e.g., in terms of financial resources, available staff, and school infrastructure) that affect schools' ability to implement the recommended infection prevention strategies. The findings reflect not only school-based responses to the pandemic but also the expertise and resources required to implement infection prevention and control in schools more broadly.

In general, strategies that were less resource-intensive had greater uptake than those that were more resource-intensive. For example, most schools reported requiring masks for students and staff. In contrast, prevalence was lower for providing

COVID-19 screening testing to students and staff or providing COVID-19 vaccines on-campus to staff, students, or their families. Numerous methods to support school-based vaccination and COVID-19 testing have been documented (e.g., partnerships with local health departments, workforce capacity, and communication with parents and students), as have challenges (e.g., staffing shortages, availability of testing supplies, lack of perceived community support, difficulty reporting test results and obtaining consent forms, and low participation) (*9*–*14*). Identifying additional sources of support at school, school district, community, health department, state, and federal levels might strengthen schools' capacity to respond to public health emergencies.

Several strategies that are recommended regardless of local COVID-19 community levels, according to updates to CDC guidance released in May 2022 (*5*), such as promoting routine vaccines, had low uptake. Differences in COVID-19 vaccination promotion by school level were likely because vaccines were not approved or widely available for most elementary school–aged children at the time. Only half of schools provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines), which is concerning given recent declines in childhood vaccination coverage (*26*–*28*). Schools can play an important role in educating about, linking to, or directly offering vaccines in accordance with local or state policies, including COVID-19 and routine pediatric vaccines, and CDC has resources for schools and community partners to support such efforts (*29*).

Schools with health infrastructure and personnel (i.e., having an SBHC or full-time nurse) were more likely to have certain prevention strategies in place even after adjustment for other school- and county-level characteristics. Schools with an SBHC might be better equipped to respond to public health emergencies and provide certain health services (e.g., vaccines). The National Association of School Nurses and AAP recommend that every school have a full-time school nurse (*30*,*31*). Nurses undergo training in infection prevention and control, serve as liaisons with local health officials, and are well-positioned to develop comprehensive emergency response procedures (*32*,*33*). Our finding that schools with a full-time school nurse were more likely to have several prevention strategies extends a robust body of research that has linked school nurses to health-promoting practices and programs in schools and positive student health- and service-related outcomes (*30*,*34*). In our study, 60.4% of schools had a full-time school nurse, and only 17.3% had an SBHC. The White House's 2022 National COVID-19 Preparedness Plan explicitly acknowledges investing in the expansion of nurses in schools as a priority (*35*). Such investments in the school nurse workforce, as well as in expanding the health infrastructure of schools, could provide immediate benefits for COVID-19 prevention in schools and also lead to long-term gains in emergency preparedness for schools, as well as positive downstream effects for other student health-related outcomes.

Since March 2020, the federal government has approved billions of dollars in funding to cover pandemic-related costs for K–12 schools through the US Department of Education's Elementary and Secondary Schools Emergency Relief Fund (*36*), the Governor's Emergency Education Relief Fund (*37*), the US Department of Health and Humans Services' Head Start and Child Care American Rescue Plan funds (*38*), and the Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases Reopening Schools supplement (*39*). Mid-poverty schools had the lowest prevalence of several prevention strategies, including higher-cost strategies to improve ventilation (e.g., HEPA filtration systems in classrooms), compared with low-poverty and high-poverty schools, as noted in a previous NSCPS publication (*17*). One possible hypothesis explaining this pattern is high-poverty schools might have more experience applying for federal funding and might be prioritized by state and local education agencies for these funds. A recent survey found school districts with a higher percentage of free or reduced-price meal eligibility were more likely to use federal COVID-19 funds for ventilation improvements (*40*). Low-poverty schools might have more existing operational and discretionary funds to rely on for implementation of prevention strategies. Taken together, although all schools might benefit from additional support in implementing prevention strategies, mid-poverty schools, in particular, could require more strategic efforts.

One limitation of our study is that the survey assessed presence of prevention strategies but not nuances related to compliance, participation, and fidelity. Second, the reporting of certain prevention strategies might be subject to social-desirability biases, leading to respondents overreporting that certain strategies were in place. Third, the response rate for our survey was low (27%); however, most school-level characteristics were not associated with survey participation based on our nonresponse analysis (Appendix Table 2), and nonresponse weight adjustments were incorporated. Fourth, because of a limited sample, the presence of unmeasured confounders,

and minimal clustering at certain levels (e.g., school district level), we were limited in the number and type of controls we could use. For example, state policies (e.g., mask mandates) may have affected schools' ability to implement specific prevention strategies (e.g., mask requirements). Future studies may benefit from examining various levels of influence (e.g., national, state, and school district), as well as their interplay with school characteristics, on schools' implementation of infection prevention strategies.

Despite those limitations, our study expands understanding of COVID-19 prevention strategies used by schools during the 2021–22 school year, by using data from a population-based sample drawn to be representative of K–12 public schools in the United States. Our study documents strategy implementation at the school level, as opposed to the school district level. Although COVID-19 prevention policies are likely set at the school district level, variation exists in what schools implement, and measuring implementation at the school-level can better capture what occurred in practice. Because survey administration coincided with the surge of the SARS-CoV-2 Delta variant, the period examined represents one of high community transmission nationally, which necessitated layered prevention strategies in all schools. Moving forward, schools might consider adapting to their local context and monitoring COVID-19 community levels to guide implementation of prevention strategies (*41*). Our findings show variation in the prevalence of strategy implementation, including lower implementation of several strategies that can be more resource-intensive, particularly among mid-poverty schools, and increased implementation for several key strategies among schools with expanded health infrastructure (e.g., having a full-time school nurse, SBHC, or both). Our findings suggest a need to enhance efforts to ensure schools can take advantage of available federal funding for COVID-19 prevention. Advancing the school health workforce and infrastructure across US schools could provide stronger support for pandemic preparedness.

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Disparities in Implementing COVID-19 Prevention Strategies in Public Schools, United States, 2021–22 School Year

Appendix

Appendix Table 1. Questionnaire items and operationalization for COVID-19 prevention strategies – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

COVID-19 prevention strategies	NSCPS survey question(s)	Operationalization
Required masks for students and staff	• At the start of the 2021-2022 school year, did your school have a mask requirement? Mark one response. Response options: Yes; No; Not applicable, my school was virtual at the start of the 2021-2022 school year • (Only shown to those who did not say "No" to previous question) For which of the following groups at your school was mask wearing required? Mark one response for each. Response options: All individuals; Only individuals who are not fully vaccinated; No requirement; My school was virtual at the start of the 2021-2022 school year · Students · Teachers and School Staff	Yes (selected mask requirement for all individuals for both students and teachers and school staff) vs. No (No mask requirement or mask requirement only for some groups of students or teachers and school staff)
Inspected and validated existing HVAC systems*	Since the start of the COVID-19 pandemic, has your school taken the following steps to increase ventilation or filter/clean air in school? Mark one response for each. Response options: Yes; No; Don't know; Not applicable, my school has been virtual since the start of the pandemic. · Inspected and validated existing HVAC systems for cleanliness, function, and code-compliant operation	Yes vs. no/don't know
Replaced/upgraded HVAC*	· Replaced/upgraded HVAC systems	Yes vs. no/don't know
Installed or used HEPA filtration systems in classrooms*	At the start of the 2021-2022 school year, did your school take the following steps to increase ventilation or filter/clean air in school? Mark one response for each. Response options: Yes; No; Don't know; Not applicable, my school has been virtual since the start of the pandemic. · Installed or used HEPA filtration systems in classrooms	Yes vs. no/don't know
Opened doors when safe to do so*	· Opened doors to hallway or outside when safe to do so	Yes vs. no/don't know
Opened windows when safe to do so*	· Opened windows when safe to do so	Yes vs. no/don't know
Adhered to at least to daily or between use cleaning schedules	Which of the following prevention strategies related to cleaning are being implemented at your school? Mark all that apply. · Adhering to at least daily or between use cleaning schedules	Yes vs. No
Maintained physical distance in classrooms	At the start of the 2021-2022 school year, for each of the following spaces, what distance between people did your school try to maintain? Mark one response for each. Response options: Less than 3 feet; At least 3 feet but less than 6 feet; 6 feet or more; Space not used; No physical distancing requirements; Not applicable, my school was virtual at the start of the 2021-2022 school year · Classrooms	No physical distancing requirements or less than 3 feet physical distancing vs. 3 feet or more
Had a school-based system to report COVID-19 outcomes	At the start of the 2021-2022 school year, was there a system for parents to self-report to school administration if any of the following are true? Mark one response for each. · Their child has been diagnosed with COVID-19 · Their child is waiting for COVID-19 test results · Their child has been exposed to someone with COVID-19 within the last 14 days	Yes to all three options vs. No/don't know to any

COVID-19 prevention strategies	NSCPS survey question(s)	Operationalization
	Response options: Yes; No; Don't know	
Had a COVID-19 isolation space in school*	At the start of the 2021-2022 school year, did your school have a separate space, away from the general population, to isolate individuals who may have exhibited symptoms related to COVID-19? Mark one response.	Yes vs. no/don't know
	Response options: Yes; No; Don't know	
Offered COVID-19 diagnostic testing to students and staff	At the start of the 2021-2022 school year, how was onsite COVID-19 testing used at your school? Mark all that apply. · For symptomatic students (Q1A) · For students identified as close contacts of persons with confirmed or probable COVID-19 (Q1B) · For symptomatic teachers/staff (Q1C) · For teachers/staff identified as close contacts of persons with confirmed or probable COVID-19 (Q1D) · For screening all or a percentage of students (regardless of vaccination status) on a regular basis (Q1E) · For screening all or a percentage of students who are not fully vaccinated on a regular basis (Q1F) · For screening all or a percentage of teachers/staff (regardless of vaccination status) on a regular basis (Q1G) · For screening all or a percentage of teachers/staff who are not fully vaccinated on a regular basis (Q1H)	Yes to COVID-19 diagnostic testing of students (i.e., selected Q1A, Q1B, Q2A, or Q2B) *and* COVID-19 diagnostic testing to staff (i.e., selected Q1C, Q1D, Q2C, or Q2D) vs. No/don't know to COVID-19 diagnostic testing for students or staff
Offered COVID-19 screening testing to students and staff	At the start of the 2021-2022 school year, how was off-site COVID-19 testing used at your school? Mark all that apply. · For symptomatic students (Q2A) · For students identified as close contacts of persons with confirmed or probable COVID-19 (Q2B) · For symptomatic teachers/staff (Q2C) · For teachers/staff identified as close contacts of persons with confirmed or probable COVID-19 (Q2D) · For screening all or a percentage of students (regardless of vaccination status) on a regular basis (Q2E) · For screening all or a percentage of students who are not fully vaccinated on a regular basis (Q2F) · For screening all or a percentage of teachers/staff (regardless of vaccination status) on a regular basis (Q2G) · For screening all or a percentage of teachers/staff who are not fully vaccinated on a regular basis (Q2H)	Yes to COVID-19 screening testing of students (i.e., selected Q1E, Q1F, Q2E, or Q2F) *and* COVID-19 screening testing of staff (i.e., selected Q1G, Q1H, Q2G, and Q2H) vs. No/don't know to COVID-19 diagnostic testing for students or staff
	Response options: Yes; No; Don't know	
Conducted contact tracing*	Since the start of the 2021-2022 school year, has your school conducted (or partnered with another organization to conduct) contact tracing for COVID-19 infected students, teachers, or staff? Mark one response.	Yes vs. no/don't know
	Response options: Yes; No; Don't know	
Quarantined students identified as close contacts	At the start of the 2021-2022 school year, which of the following best described your school's protocols for quarantining students exposed to someone with COVID-19 at school or a school-related activity? Mark all that apply. · All students who are not fully vaccinated and who are identified as close contacts of a COVID-19 case at school or a school-related activity are required to quarantine (i.e., stay at home and not attend school in-person) · All students who are identified as close contacts of a COVID-19 case at school or a school-related activity are required to quarantine (i.e., stay at home and not attend school in-person), regardless of vaccination status	Yes to either vs. No to both
Had a COVID-19 isolation space in school*	At the start of the 2021-2022 school year, did your school have a separate space, away from the general population, to isolate individuals who may have exhibited symptoms related to COVID-19? Mark one response.	Yes vs. no/don't know
	Response options: Yes; No; Don't know	
	Since the start of the 2021-2022 school year, has your school provided information about COVID-19 vaccinations?	
	Response options: Yes; No; Don't know	
Provided information on COVID-19 vaccines to parents*	• Information for parents	Yes vs. no/don't know
Provided information on COVID-19 vaccines to students*	• Information for students	Yes vs. no/don't know

COVID-19 prevention strategies	NSCPS survey question(s)	Operationalization
Provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines) *	Since the start of the 2021-2022 school year, has your school provided parents or students with information about catching up on any healthcare that may have been missed during the pandemic, including well-child visits and routine childhood/adolescent vaccinations? Response options: Yes; No; Don't know	Yes vs. no/don't know
Provided COVID-19 vaccines on-campus*	· Since the start of the 2021-2022 school year, has your school made COVID-19 vaccinations available to school staff, eligible students, or their families on your campus? Response options: Yes; No; Don't know	Yes vs. no/don't know
Provided COVID-19 vaccines through school district events	· Does your school offer COVID-19 vaccines through school or district events (even if not on campus) to each of the following groups? Mark one response for each. • Students • Teachers or school staff • Students' families/caregivers Response options: Yes; No; Don't know	Yes to students, teachers or school staff, or students' families/caregivers vs. no/don't know to students, teachers or school staff, and students' families/caregivers
	For which groups is your school tracking COVID-19 vaccination status? Mark all that apply.	
Tracked vaccination status of students	· Students	Yes vs. No
Tracked vaccination status of teachers and other school staff	· Teachers and other school staff	Yes vs. No

HEPA = high-efficiency particulate air, HVAC = heating, ventilation, and air conditioning
*For descriptive purposes, the "don't know" category is presented as a separate category in Table (https://wwwnc.cdc.gov/EID/article/29/5/22-1533-T1.htm). For subsequent models, the "don't know" category is combined with the "no" category.

Appendix Table 2. School participation rates by school characteristics – National School COVID-19 Prevention Study, United States, October 7–November 19, 2021

School characteristic	Levels	Sampled Schools	Participating Schools	Non-Participating Schools	Response Rate	Chi-Square P-Value
School Level	Elementary	833	236	597	28.3%	0.98
	Middle	411	108	303	26.3%	
	High	358	93	265	26.0%	
Census Region	Northeast	260	69	191	26.5%	0.12
	Midwest	402	120	282	29.9%	
	South	551	132	419	24.0%	
	West	389	116	273	29.8%	
NCES Locale*	City	415	101	314	24.3%	0.42
	Suburb	462	129	333	27.9%	
	Town	179	57	122	31.8%	
	Rural	437	119	318	27.2%	
	Missing	109	31	78	28.4%	
Urban Status†	No	962	268	694	27.9%	0.52
	Yes	640	169	471	26.4%	
City‡	City	445	109	336	24.5%	0.12
	Non-City	1,157	328	829	28.3%	
School Size§	Large	1,035	266	769	25.7%	0.06
	Small	567	171	396	30.2%	
Affluence¶	Low/Below Avg	630	189	441	30.0%	0.05
	Avg/Above Avg/High	972	248	724	25.5%	
% ELL (English-limited)	Below median	789	218	571	27.6%	0.76
	Above median	813	219	594	26.9%	
Majority White	No	735	187	548	25.4%	0.13
	Yes	867	250	617	28.8%	
School % Black	Below median	802	230	572	28.7%	0.21
	Above median	800	207	593	25.9%	
School % Hispanic	Below median	801	232	569	29.0%	0.13
	Above median	801	205	596	25.6%	
School % Asian	Below median	803	219	584	27.3%	0.99
	Above median	799	218	581	27.3%	
Title 1#	<$150	370	104	266	28.1%	0.68
	≥$150	1,232	333	899	27.0%	
Poverty Level**	Below median	713	205	508	28.8%	0.24
	Above median	889	232	657	26.1%	
AIM Per Pupil Expenditure††	Below median	799	221	578	27.7%	0.73
	Above median	803	216	587	26.9%	

School characteristic	Levels	Sampled Schools	Participating Schools	Non-Participating Schools	Response Rate	Chi-Square P-Value
Current Per Pupil Expenditure‡‡	Below median	694	191	503	27.5%	0.85
	Above median	908	246	662	27.1%	
AP Offered§§	No	1,337	371	966	27.7%	0.32
	Yes	350	66	199	24.9%	
Student Computer Ratio¶¶	Below median	617	173	444	28.0%	0.59
	Above median	985	264	721	26.8%	
Student Teacher Ratio##	Below median	694	188	506	27.1%	0.88
	Above median	908	249	659	27.4%	
Before/After school care***	No	1,252	343	909	27.4%	0.84
	Yes	350	94	256	26.9%	
% College bound†††	Below median	778	201	577	25.8%	0.21
	Above median	824	236	588	28.6%	
Career and Technical Ed Offered‡‡‡	No	1,237	348	889	28.1%	0.16
	Yes	365	89	276	24.4%	
Change in enrollment§§§	Decrease	629	179	450	28.5%	0.10
	No Change	425	99	326	23.3%	
	Increase	548	159	389	29.0%	
Library/Media Center¶¶¶	No	312	81	231	26.0%	0.56
	Yes	1,290	356	934	27.6%	
Lunch Program###	Below median	807	228	579	28.3%	0.38
	Above median	795	209	586	26.3%	
Special Education****	Below median	638	171	467	26.8%	0.73
	Above median	964	266	698	27.6%	

Using data from the sampling frame and other extant data sources (MDR database), the association between school-level characteristics and participation in the study was modelled, as shown in the table above. We developed nonresponse adjustment classes based on the dichotomous affluence level variable which was found to be significantly associated with participation. The nonresponse weight adjustment starts with the school sampling weight (W). The adjustment was performed within a weighting class (k) defined by whether the school was indicated as low/below average affluence or average/above average/high affluence. Within each weighting class, the adjustment was computed as the ratio of two sums of weights: (1) the sum of the school sampling weights over all the sample schools; (2) the sum of these weights for the 437 participating schools. Post-stratification cells were based on the design strata. For schools in each stratum, the post-stratification weight adjustments were calculated as the total number of schools in the frame for that post-stratum divided by the sum of the product of the nonresponse adjusted weights over all participating schools in the post-stratum. The final weights were the result of the post-stratification adjustments. For each post-stratum (jk), the weights can be expressed as the following product of the post-stratification and nonresponse adjustments and the school sampling weights. Final survey weights incorporated these nonresponse adjustment classes, as well post-stratification based on the design strata, and were used in all analyses.

$$W_{NRjk} = \frac{\sum j \varepsilon S \, W_{jk}}{\sum j \varepsilon P \, W_{jk}}$$

$$W_{Final\ jk} = W_{jk} * W_{NRjk} * W_{PSjk}$$

*The National Center for Education Statistics (NCES) locale classifications categorizes the area where schools are located based on the U.S. Census Bureau's standard urban and rural designations.

†Urban status is an alternate categorization of the NCES locale classification, such that "no" includes suburbs and rural locales and "yes" includes city and town locales.

‡City is an alternate categorization of the NCES locale classification, such that "city" includes city areas and "non-city" includes suburb, town, and rural areas.

§Small schools contained fewer than 28 students at any grade level and large schools contained greater than or equal to 28 students at any grade level.

¶The Affluence Indicator uses a proprietary algorithm developed to rank the socioeconomic status of a school.

#Schools that allocated greater than or equal to $150 of Title 1 funding per student were categorized as "≥$150" and schools that allocated less than $150 of Title 1 funding per student were categorized as "<$150".

**Poverty level data is sourced from the U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program. Median poverty is determined by a formula (Orshansky Indicator) based on family income and size.

††AIM Per Pupil Expenditure refers to the total dollar amount of instructional material expenditures. The per student data is determined by dividing the whole dollar for all instructional materials expenditures by district enrollment.

‡‡Current Per Pupil Expenditure represents the total operating cost for the district per student, including teacher salaries, instruction, support service, and food service. The per student data is determined by dividing the whole dollar current expenditures by district enrollment.

§§AP Offered refers to advanced placement courses offered within schools.

¶¶Student Computer Ratio refers to total computers in a school per enrolled student.

##Student Teacher Ratio is the total number of students per teacher within a school.

***Before/After School Care refers to schools that provide care to students outside of school hours.

†††% College bound is the percentage of 2- or 4-year college bound 12th grade students. Data is applied to all schools within a district.

‡‡‡Career and Technical Ed Offered refers to schools within districts providing a broad scope of vocational subjects.

§§§Change in enrollment describes the change in school or district enrollment from the previous year.

¶¶¶Library/Media Center refers to schools with a formal library or media center.

###Lunch Program is the percentage of students that are enrolled in a free/reduced price lunch (FRPL) program using 2020 MDR data.

****Special Education identifies institutions that provide special education classes to children with special needs.

Appendix Table 3. Prevalences and unadjusted associations between school-level characteristics and school-level mask requirements, ventilation improvements, and cleaning procedures – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

	Required masks for students and staff		Inspected and validated existing HVAC systems		Replaced/upgraded HVAC		Installed or used HEPA filtration systems in classrooms		Opened doors when safe to do so		Opened windows when safe to do so		Adhered to at least to daily or between use cleaning schedules	
Characteristic	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
School level														
Elementary (n=236)	139	64.7 (58.5–70.5)	169	71.9 (65.1–77.7)	85	37.2 (30.9–44.0)	69	29.0 (23.3–35.4)	156	68.4 (61.9–74.3)	162	70.5 (64.2–76.1)	178	78.4 (72.4–83.3)
Middle (n=108)	66	70.7 (61.5–78.6)	79	76.0 (66.2–83.7)	40	40.1 (30.7–50.2)	29	26.7 (19.2–35.8)	65	60.7 (50.7–69.9)	67	64.3 (55.3–72.4)	82	80.0 (70.4–87.1)
High (n=93)	58	65.1 (55.6–73.6)	70	79.6 (68.5–87.5)	36	42.5 (32.3–53.3)	23	23.8 (16.7–32.9)	57	65.8 (56.8–73.9)	54	60.5 (50.0–70.1)	71	82.8 (73.3–89.3)
P-value‡		0.50		0.40		0.69		0.63		0.36		0.17		0.70
NCES locale														
City (n=117)	81	79.7 (70.7–86.4)	87	74.9 (64.8–82.9)	50	44.3 (34.6–54.5)	47	39.9 (30.9–49.6)	70	62.5 (53.2–70.9)	68	59.1 (49.0–68.4)	86	78.7 (69.7–85.7)
Suburb (n=121)	88	78.4 (68.4–85.9)	95	79.7 (71.1–86.3)	50	42.9 (34.1–52.2)	39	30.0 (22.5–38.8)	84	67.4 (58.0–75.5)	84	67.6 (59.3–75.0)	97	83.4 (75.1–89.4)
Town (n=55)	27	49.2 (37.4–61.2)	38	72.5 (57.9–83.5)	17	37.9 (25.7–51.8)	15	28.6 (17.8–42.5)	32	64.7 (51.0–76.3)	31	59.9 (45.7–72.5)	36	69.0 (54.3–80.7)
Rural (n=102)	48	51.8 (42.2–61.2)	70	68.4 (57.6–77.5)	36	34.5 (25.4–44.9)	15	14.2 (8.6–22.5)	66	67.6 (58.0–75.9)	73	75.9 (66.3–83.5)	80	79.9 (70.5–86.8)
P-value‡		p<.001		0.33		0.48		p<.001		0.83		0.05		0.24
School poverty														
Low-poverty (n=77)	53	76.8 (64.7–85.7)	66	88.1 (77.4–94.1)	33	46.7 (34.9–58.8)	29	39.1 (28.0–51.4)	52	69.3 (57.1–79.3)	56	75.6 (63.5–84.6)	61	81.7 (70.0–89.6)
Mid-poverty (n=227)	118	57.4 (50.7–63.8)	159	71.0 (64.2–77.0)	73	33.2 (27.1–40.0)	51	21.4 (16.5–27.2)	139	62.8 (56.1–69.1)	142	64.0 (57.5–70.0)	167	76.9 (70.6–82.1)
High-poverty (n=96)	73	82.1 (71.3–89.4)	70	73.0 (61.8–81.9)	44	47.0 (36.5–57.8)	32	31.9 (22.8–42.6)	65	69.1 (57.9–78.5)	64	67.7 (56.4–77.3)	78	85.2 (75.5–91.5)
P-value‡		p<.001		0.02		0.03		0.009		0.48		0.24		0.26
Full time school nurse														
Yes (n=244)	159	69.1 (63.2–74.4)	186	75.3 (69.1–80.7)	93	39.9 (33.7–46.4)	70	26.5 (21.2–32.5)	150	61.3 (55.1–67.1)	161	65.9 (59.9–71.4)	184	77.4 (71.4–82.4)
No (n=179)	104	62.2 (54.5–69.4)	132	73.4 (65.7–79.9)	68	37.8 (30.6–45.6)	51	28.6 (22.4–35.7)	128	72.9 (65.7–79.1)	122	68.2 (60.7–74.9)	147	83.3 (76.9–88.2)

Characteristic	Required masks for students and staff		Inspected and validated existing HVAC systems		Replaced/upgraded HVAC		Installed or used HEPA filtration systems in classrooms		Opened doors when safe to do so		Opened windows when safe to do so		Adhered to at least to daily or between use cleaning schedules	
	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
P-value‡		0.16		0.67		0.68		0.64		0.01		0.62		0.15
School based health center														
Yes (n=69)	48	76.9 (64.6–85.9)	52	75.5 (62.6–85.0)	32	49.6 (36.9–62.3)	24	30.9 (20.6–43.6)	39	54.8 (42.1–66.8)	44	61.9 (48.9–73.3)	50	74.6 (62.2–84.0)
No (n=354)	215	64.2 (59.0–69.1)	266	74.4 (69.1–79.0)	129	36.8 (31.8–42.2)	97	26.5 (22.2–31.3)	239	68.2 (63.0–73.0)	239	67.8 (62.8–72.5)	281	80.8 (76.2–84.7)
P-value‡		0.06		0.85		0.06		0.47		0.04		0.36		0.26

CI = confidence interval; HEPA = high-efficiency particulate air; HVAC = heating, ventilation, and air conditioning; NCES = National Center for Education Statistics
*Unweighted numbers are presented.
†Weighted percents and 95% confidence intervals are presented.
‡Chi-square p-values are presented examining bivariate associations between each school-level characteristic and prevention strategy.

Appendix Table 4. Adjusted* odds ratios examining associations between school-level characteristics and school-level mask requirements, ventilation improvements, and cleaning procedures – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

Characteristic	Required masks for students and staff (n=344)	Inspected and validated existing HVAC systems (n=360)	Replaced/upgraded HVAC (n=360)	Installed or used HEPA filtration systems in classrooms (n=359)	Opened doors when safe to do so (n=360)	Opened windows when safe to do so (n=359)	Adhered to at least to daily or between use cleaning schedules (n=360)
	aOR (CI)[a]						
School level							
Elementary	1.08 (0.55–2.12)	0.56 (0.26–1.19)	0.66 (0.36–1.20)	1.27 (0.68–2.36)	0.98 (0.56–1.71)	1.40 (0.78–2.50)	0.66 (0.33–1.33)
Middle	1.19 (0.56–2.54)	0.70 (0.30–1.64)	0.86 (0.44–1.68)	1.12 (0.56–2.24)	0.68 (0.36–1.29)	0.97 (0.50–1.86)	0.85 (0.36–2.00)
High	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
NCES locale							
City	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Suburb	1.40 (0.68–2.89)	1.29 (0.63–2.64)	1.10 (0.61–1.98)	0.71 (0.39–1.30)	1.45 (0.78–2.71)	1.58 (0.85–2.93)	1.76 (0.83–3.73)
Town	**0.38 (0.17–0.85)†**	1.02 (0.44–2.36)	1.01 (0.48–2.16)	0.83 (0.39–1.78)	1.60 (0.78–3.27)	1.55 (0.71–3.38)	0.69 (0.31–1.57)
Rural	0.65 (0.32–1.30)	0.93 (0.45–1.95)	0.99 (0.51–1.91)	**0.36 (0.17–0.76)‡**	**2.08 (1.03–4.17)†**	**4.51 (2.11–9.60)§**	1.14 (0.51–2.55)
School poverty							
Low-poverty	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mid-poverty	0.57 (0.29–1.12)	**0.37 (0.16–0.84)†**	0.61 (0.33–1.12)	**0.52 (0.28–0.96)†**	0.75 (0.39–1.45)	**0.48 (0.24–0.95)†**	0.77 (0.35–1.68)
High-poverty	2.73 (0.98–7.59)	0.43 (0.17–1.08)	1.05 (0.53–2.08)	0.72 (0.35–1.50)	1.11 (0.50–2.47)	0.75 (0.32–1.74)	1.45 (0.58–3.62)
Full time school nurse							
Yes	1.21 (0.70–2.10)	1.11 (0.64–1.92)	0.93 (0.58–1.49)	0.85 (0.51–1.41)	**0.57 (0.34–0.96)†**	0.98 (0.59–1.62)	0.57 (0.31–1.06)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
School based health center							
Yes	1.67 (0.68–4.11)	1.14 (0.54–2.40)	1.57 (0.84–2.94)	1.30 (0.69–2.46)	0.69 (0.36–1.34)	0.92 (0.47–1.82)	0.65 (0.33–1.27)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

aOR = adjusted odds ratio; CI = confidence interval; HEPA = high-efficiency particulate air; HVAC = heating, ventilation, and air conditioning; NCES = National Center for Education Statistics
*For each COVID-19 prevention measure, models adjusted for school-level characteristics (school-based health center, school level, NCES locale, % of students eligible for free or reduced-price meals [FRPM], full-time school nurse) and the total number of new cases per 100,000 persons within the last 7 days in each county the school resides on September 23, 2021. Adjusted odds ratios, 95% confidence interval, and number of observations included are presented for each model.
†p<0.05, ‡p<0.01, §p<0.001; bolding indicates any finding that is significant at p<0.05.

Appendix Table 5. Prevalences and unadjusted associations between school-level characteristics and school-level physical distancing, isolation space, COVID-19 testing and screening, contact tracing, and quarantine protocols – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

	Maintained physical distance in classrooms		Had a school-based system to report COVID-19 outcomes		Had a COVID-19 isolation space in school		Offered COVID-19 diagnostic testing to students and staff		Offered COVID-19 screening testing to students and staff		Conducted contact tracing		Quarantined students identified as close contacts	
Characteristic	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
School level														
Elementary (n=236)	168	75.1 (69.1–80.3)	220	96.7 (93.4–98.4)	210	92.7 (88.4–95.5)	154	65.9 (58.9–72.2)	19	7.8 (5.0–11.8)	122	53.3 (46.4–60.0)	172	81.3 (75.3–86.2)
Middle (n=108)	77	73.5 (63.4–81.6)	96	92.7 (85.1–96.6)	96	93.8 (87.4–97.1)	79	75.9 (67.4–82.7)	13	12.0 (7.0–19.8)	55	51.9 (41.3–62.2)	81	87.1 (79.1–92.4)
High (n=93)	65	73.3 (62.7–81.7)	79	93.9 (86.7–97.4)	77	90.2 (80.3–95.4)	60	67.1 (54.5–77.7)	–‡	–‡	51	55.8 (45.9–65.3)	69	84.6 (73.5–91.6)
P-value¶		0.92		0.26		0.65		0.21		0.48		0.86		0.46
NCES locale														
City (n=117)	82	74.8 (65.2–82.4)	106	96.3 (90.6–98.6)	103	93.8 (87.3–97.1)	86	75.7 (65.9–83.3)	16	13.2 (8.2–20.5)	59	50.8 (41.0–60.6)	90	86.3 (77.5–92.0)
Suburb (n=121)	86	74.9 (65.7–82.3)	110	95.6 (89.5–98.2)	105	91.3 (84.0–95.5)	76	63.7 (54.2–72.2)	–‡	–‡	57	48.8 (39.2–58.5)	96	87.5 (79.2–92.8)
Town (n=55)	40	76.0 (62.8–85.6)	51	97.6 (84.0–99.7)	50	96.4 (85.2–99.2)	35	63.4 (46.7–77.4)	–‡	–‡	31	54.2 (40.1–67.7)	37	82.4 (67.6–91.3)
Rural (n=102)	74	73.2 (63.5–81.1)	90	91.6 (83.9–95.8)	89	91.2 (83.5–95.5)	72	73.9 (63.6–82.1)	–‡	–‡	55	57.1 (47.3–66.3)	73	81.2 (70.9–88.4)
P-value¶		0.98		0.35		0.62		0.18		0.46		0.66		0.63
School poverty														
Low-poverty (n=77)	53	72.5 (60.6–81.9)	73	100.0 (–)	65	89.3 (78.8–94.9)	47	63.2 (51.0–73.9)	–‡	–‡	44	59.4 (47.0–70.8)	60	87.0 (76.3–93.4)
Mid-poverty (n=227)	162	72.9 (66.5–78.6)	205	94.2 (90.1–96.6)	203	93.7 (89.7–96.2)	156	69.2 (62.4–75.2)	15	7.0 (4.2–11.6)	112	50.9 (43.9–57.8)	164	80.8 (74.4–85.9)
High-poverty (n=96)	71	77.8 (67.6–85.5)	86	94.4 (87.3–97.6)	87	93.7 (85.0–97.5)	64	68.0 (56.9–77.4)	15	15.2 (9.2–24.0)	52	53.8 (42.8–64.5)	76	89.9 (81.8–94.7)
P-value¶		0.66		0.12		0.47		0.66		0.09		0.49		0.11
Full time school nurse														

	Maintained physical distance in classrooms		Had a school-based system to report COVID-19 outcomes		Had a COVID-19 isolation space in school		Offered COVID-19 diagnostic testing to students and staff		Offered COVID-19 screening testing to students and staff		Conducted contact tracing		Quarantined students identified as close contacts	
Characteristic	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
Yes (n=244)	186	76.5 (70.4–81.7)	235	98.1 (95.5–99.2)	224	93.6 (89.6–96.1)	169	68.9 (62.3–74.8)	23	9.2 (6.1–13.6)	132	53.7 (47.1–60.2)	198	88.0 (82.8–91.8)
No (n=179)	124	71.0 (63.6–77.4)	160	90.5 (84.7–94.3)	159	90.7 (85.2–94.3)	124	68.6 (60.9–75.3)	17	9.5 (5.9–14.8)	96	53.0 (45.4–60.4)	124	76.6 (69.0–82.8)
P-value¶		0.23		p<.001		0.28		0.95		0.93		0.88		0.005
School based health center														
Yes (n=69)	52	74.4 (61.7–84.0)	63	94.3 (86.2–97.8)	64	94.4 (85.0–98.0)	52	75.5 (62.8–84.9)	–‡	–‡	40	58.3 (45.1–70.4)	56	89.5 (78.6–95.2)
No (n=354)	258	74.3 (69.4–78.7)	332	95.3 (92.3–97.1)	319	92.1 (88.6–94.5)	241	67.3 (61.9–72.4)	31	8.5 (6.0–11.8)	188	52.4 (46.9–57.9)	266	82.3 (77.5–86.3)
P-value¶		0.99		0.72		0.51		0.21		0.22		0.41		0.17

*Unweighted numbers are presented.
†Weighted percents and 95% confidence intervals are presented.
‡Estimate suppressed due to a relative standard error ≥30%.
¶Chi-square p-values are presented examining bivariate associations between each school-level characteristic and prevention strategy.

Appendix Table 6. Adjusted* odds ratios examining associations between school-level characteristics and school-level physical distancing, isolation space, COVID-19 testing and screening, contact tracing, and quarantine protocols – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

	Maintained physical distance in classrooms (n=362)	Had a COVID-19 isolation space in school (n=357)	Offered COVID-19 diagnostic testing to students and staff (n=357)	Offered COVID-19 screening testing to students and staff (n=357)	Conducted contact tracing (n=357)	Quarantined students identified as close contacts (n=332)
Characteristic	aOR (CI)					
School level						
Elementary	1.45 (0.77–2.74)	1.77 (0.56–5.60)	1.06 (0.53–2.09)	0.69 (0.27–1.73)	0.87 (0.51–1.50)	1.11 (0.45–2.75)
Middle	0.95 (0.46–1.95)	1.55 (0.45–5.29)	1.62 (0.74–3.56)	1.16 (0.40–3.35)	0.68 (0.36–1.30)	1.41 (0.50–3.96)
High	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
NCES locale						
City	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Suburb	1.11 (0.58–2.16)	0.73 (0.25–2.18)	0.57 (0.30–1.10)	0.69 (0.27–1.74)	0.95 (0.53–1.71)	1.18 (0.48–2.89)
Town	1.11 (0.49–2.53)	5.44 (0.60–49.30)	0.57 (0.24–1.35)	0.93 (0.29–2.98)	1.23 (0.59–2.56)	0.68 (0.24–1.93)
Rural	1.12 (0.55–2.28)	0.75 (0.25–2.28)	0.94 (0.44–2.01)	0.70 (0.24–2.03)	1.30 (0.70–2.43)	0.86 (0.34–2.15)
School poverty						
Low-poverty	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mid-poverty	1.05 (0.54–2.01)	1.94 (0.72–5.21)	1.56 (0.83–2.95)	0.68 (0.25–1.89)	0.60 (0.33–1.11)	0.65 (0.28–1.56)
High-poverty	1.44 (0.65–3.17)	1.71 (0.55–5.27)	1.06 (0.51–2.21)	1.32 (0.49–3.60)	0.78 (0.39–1.57)	1.93 (0.61–6.06)
Full time school nurse						
Yes	1.37 (0.81–2.34)	1.55 (0.65–3.70)	0.95 (0.58–1.56)	0.89 (0.43–1.86)	1.09 (0.68–1.73)	**2.02 (1.05–3.91)†**
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
School based health center						

Characteristic	Maintained physical distance in classrooms (n=362)	Had a COVID-19 isolation space in school (n=357)	Offered COVID-19 diagnostic testing to students and staff (n=357)	Offered COVID-19 screening testing to students and staff (n=357)	Conducted contact tracing (n=357)	Quarantined students identified as close contacts (n=332)
	aOR (CI)					
Yes	1.06 (0.53–2.15)	1.23 (0.30–5.07)	1.59 (0.77–3.28)	1.49 (0.60–3.71)	1.11 (0.59–2.10)	1.97 (0.62–6.31)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

aOR = adjusted odds ratio, CI = confidence interval, NCES = National Center for Education Statistics

*For each COVID-19 prevention measure, models adjusted for school-level characteristics (school-based health center, school level, NCES locale, % of students eligible for free or reduced-price meals [FRPM], full-time school nurse) and the total number of new cases per 100,000 persons within the last 7 days in each county the school resides on September 23, 2021. Adjusted odds ratios, 95% confidence interval, and number of observations included are presented for each model.

†p<0.05; bolding indicates any finding that is significant at p<0.05.

Appendix Table 7. Prevalences and unadjusted associations between school-level characteristics and school-level efforts to promote vaccination and track vaccination status of students and staff – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

	Provided information on COVID-19 vaccines to parents		Provided information on COVID-19 vaccines to students		Provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines)		Provided COVID-19 vaccines on-campus to staff, students, or their families		Provided COVID-19 vaccines through school district events to staff, students, or their families		Tracked vaccination status of students		Tracked vaccination status of staff	
Characteristic	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
School level														
Elementary (n=236)	143	62.6 (55.6–69.0)	70	30.4 (24.5–37.0)	114	50.6 (43.6–57.6)	53	23.2 (18.0–29.5)	120	54.0 (47.4–60.4)	66	29.0 (23.2–35.6)	138	60.6 (54.2–66.7)
Middle (n=108)	67	65.9 (55.3–75.0)	54	50.7 (40.9–60.5)	56	56.3 (45.3–66.7)	37	37.9 (27.9–49.0)	49	46.3 (36.4–56.5)	33	33.3 (23.9–44.3)	53	53.9 (43.5–63.9)
High (n=93)	65	73.8 (62.3–82.7)	59	68.3 (56.8–77.9)	45	51.6 (39.2–63.8)	34	42.0 (32.0–52.7)	50	58.8 (46.3–70.3)	40	46.0 (35.3–57.1)	56	65.4 (54.0–75.2)
P-value‡		0.22		p<.001		0.7		0.002		0.26		0.03		0.29
NCES locale														
City (n=117)	81	72.1 (61.9–80.5)	51	48.0 (38.8–57.4)	65	59.5 (49.2–69.1)	32	30.8 (22.3–40.9)	64	59.1 (48.8–68.7)	35	30.8 (22.3–40.9)	77	71.8 (62.0–79.9)
Suburb (n=121)	81	69.5 (59.7–77.8)	45	38.6 (30.4–47.5)	57	50.0 (39.9–60.1)	37	34.1 (25.3–44.3)	68	60.2 (51.0–68.7)	34	30.4 (22.1–40.2)	74	63.3 (53.4–72.2)
Town (n=55)	32	63.0 (48.9–75.2)	22	43.7 (32.4–55.7)	29	56.0 (39.6–71.2)	18	36.7 (26.1–48.7)	26	45.8 (30.7–61.8)	24	50.6 (36.7–64.3)	31	61.4 (47.5–73.7)
Rural (n=102)	57	58.3 (47.6–68.4)	46	45.8 (35.6–56.2)	46	46.8 (36.3–57.7)	24	24.1 (16.2–34.3)	39	41.8 (32.0–52.4)	31	31.3 (22.2–42.0)	40	41.1 (31.5–51.5)
P-value‡		0.20		0.48		0.36		0.34		0.03		0.08		p<.001
School poverty														
Low-poverty (n=77)	51	69.2 (56.8–79.4)	24	30.5 (20.6–42.7)	30	41.6 (30.2–54.0)	16	21.2 (12.9–32.7)	32	46.2 (34.5–58.3)	29	41.5 (30.1–53.9)	47	66.0 (53.8–76.4)
Mid-poverty (n=227)	128	59.4 (52.3–66.1)	84	39.2 (32.7–46.0)	118	55.2 (47.9–62.3)	62	30.5 (24.3–37.5)	111	50.4 (43.7–57.1)	72	32.9 (26.5–40.1)	117	54.1 (47.2–61.0)
High-poverty (n=96)	71	77.1 (66.6–85.1)	55	60.3 (49.3–70.4)	51	54.3 (43.1–65.0)	31	32.5 (23.1–43.5)	58	65.5 (54.7–74.9)	25	28.5 (19.4–39.8)	57	63.9 (53.2–73.4)
P-value‡		0.01		p<.001		0.16		0.29		0.03		0.28		0.12
Full time school nurse														
Yes (n=244)	162	65.9 (59.2–72)	111	44.8 (38.7–51)	135	56.7 (49.7–63.5)	82	36.6 (30.4–43.2)	136	55.7 (49–62.2)	93	39.2 (32.9–45.8)	152	63.6 (57.1–69.7)

Characteristic	Provided information on COVID-19 vaccines to parents		Provided information on COVID-19 vaccines to students		Provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines)		Provided COVID-19 vaccines on-campus to staff, students, or their families		Provided COVID-19 vaccines through school district events to staff, students, or their families		Tracked vaccination status of students		Tracked vaccination status of staff	
	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†	n*	% (95% CI)†
No (n=179)	113	65.6 (57.8–72.7)	72	41.8 (34.3–49.6)	80	45.5 (37.7–53.5)	42	22.3 (16.5–29.5)	83	48.9 (41.1–56.8)	46	25.3 (19.2–32.6)	95	54.2 (46.4–61.7)
P-value‡		0.96		0.55		0.03		0.003		0.20		0.004		0.07
School based health center														
Yes (n=69)	50	73.9 (60.8–83.8)	38	56.6 (43.4–69)	40	61.6 (48.4–73.3)	33	49.4 (36.6–62.3)	47	71.3 (58.3–81.5)	29	41.7 (29.7–54.8)	49	73.8 (60.9–83.6)
No (n=354)	225	64.1 (58.5–69.4)	145	40.9 (35.7–46.3)	175	50.4 (44.6–56.1)	91	27.2 (22.4–32.6)	172	49.3 (43.9–54.8)	110	32.0 (27–37.5)	198	57.1 (51.7–62.3)
P-value‡		0.15		0.03		0.11		p<.001		0.002		0.15		0.01

CI = confidence interval; HEPA = high-efficiency particulate air; HVAC = heating, ventilation, and air conditioning; NCES = National Center for Education Statistics
*Unweighted numbers are presented.
†Weighted percents and 95% confidence intervals are presented.
‡Chi-square p-values are presented examining bivariate associations between each school-level characteristic and prevention strategy.

Appendix Table 8. Adjusted* odds ratios examining associations between school-level characteristics and school-level efforts to promote vaccination and track vaccination status of students and staff – National School COVID-19 Prevention Study, United States, October 5–November 19, 2021

Characteristic	Provided information on COVID-19 vaccines to parents (n=355)	Provided information on COVID-19 vaccines to students (n=355)	Provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines) (n=355)	Provided COVID-19 vaccines on-campus to staff, students, or their families (n=355)	Provided COVID-19 vaccines through school district events to staff, students, or their families (n=355)	Tracked vaccination status of students (n=355)	Tracked vaccination status of staff (n=355)
	aOR (CI)						
School level							
Elementary	**0.49 (0.25–0.97)†**	**0.15 (0.08–0.29)§**	1.13 (0.59–2.14)	**0.47 (0.26–0.87)†**	0.63 (0.33–1.20)	**0.45 (0.24–0.83)†**	0.67 (0.34–1.31)
Middle	0.58 (0.26–1.25)	**0.39 (0.20–0.79)‡**	1.32 (0.63–2.78)	0.76 (0.37–1.57)	**0.44 (0.21–0.92)†**	0.50 (0.23–1.07)	**0.44 (0.20–0.95)†**
High	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
NCES locale							
City	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Suburb	1.18 (0.60–2.30)	1.04 (0.57–1.91)	0.73 (0.39–1.34)	1.69 (0.84–3.40)	1.29 (0.71–2.33)	0.88 (0.45–1.74)	0.78 (0.41–1.49)
Town	0.89 (0.40–2.00)	1.02 (0.50–2.12)	0.98 (0.42–2.32)	1.66 (0.81–3.41)	0.52 (0.24–1.15)	**3.09 (1.36–7.01)‡**	0.79 (0.36–1.72)
Rural	0.79 (0.39–1.61)	1.31 (0.65–2.66)	0.67 (0.34–1.31)	1.05 (0.49–2.27)	**0.45 (0.23–0.88)†**	1.28 (0.62–2.67)	**0.45 (0.23–0.90)†**
School poverty							
Low-poverty	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mid-poverty	0.65 (0.34–1.25)	1.27 (0.65–2.48)	**1.91 (1.06–3.44)†**	1.70 (0.82–3.54)	1.43 (0.80–2.57)	0.67 (0.35–1.30)	0.85 (0.46–1.57)
High-poverty	1.40 (0.65–3.02)	**3.88 (1.81–8.30)§**	1.71 (0.84–3.47)	2.13 (0.93–4.88)	**2.47 (1.23–4.98)†**	0.60 (0.28–1.28)	1.34 (0.62–2.90)
Full time school nurse							
Yes	0.78 (0.47–1.30)	0.85 (0.52–1.41)	1.18 (0.73–1.91)	1.69 (0.98–2.91)	1.01 (0.63–1.63)	**1.80 (1.07–3.03)†**	1.50 (0.92–2.45)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
School based health center							

Characteristic	Provided information on COVID-19 vaccines to parents (n=355)	Provided information on COVID-19 vaccines to students (n=355)	Provided parents or students with information about catching up on missed healthcare (e.g., routine vaccines) (n=355)	Provided COVID-19 vaccines on-campus to staff, students, or their families (n=355)	Provided COVID-19 vaccines through school district events to staff, students, or their families (n=355)	Tracked vaccination status of students (n=355)	Tracked vaccination status of staff (n=355)
	aOR (CI)						
Yes	1.40 (0.68–2.87)	1.27 (0.67–2.40)	1.35 (0.72–2.54)	**2.00 (1.03–3.89)†**	**2.25 (1.18–4.30)†**	1.25 (0.67–2.34)	1.87 (0.87–3.99)
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

aOR = adjusted odds ratio, CI = confidence interval, NCES = National Center for Education Statistics

*For each COVID-19 prevention measure, models adjusted for school-level characteristics (school-based health center, school level, NCES locale, % of students eligible for free or reduced-price meals [FRPM], full-time school nurse) and the total number of new cases per 100,000 persons within the last 7 days in each county the school resides on September 23, 2021. Adjusted odds ratios, 95% confidence interval, and number of observations included are presented for each model.

†p<0.05, ‡p<0.01, §p<0.001; bolding indicates any finding that is significant at p<0.05