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An Examination of SARS-CoV-2 Transmission Based on Classroom Distancing in Schools With Other Preventive Measures in Place—Missouri, January–March 2021

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Abstract

Objectives: Classroom layout plays a central role in maintaining physical distancing as part of a multicomponent prevention strategy for safe in-person learning during the COVID-19 pandemic. We conducted a school investigation to assess layouts and physical distancing in classroom settings with and without in-school SARS-CoV-2 transmission.

Methods: We assessed, measured, and mapped 90 K-12 (kindergarten through grade 12) classrooms in 3 Missouri public school districts during January–March 2021, prior to widespread prevalence of the Delta variant; distances between students, teachers, and people with COVID-19 and their contacts were analyzed. We used whole-genome sequencing to further evaluate potential transmission events.

Results: The investigation evaluated the classrooms of 34 students and staff members who were potentially infectious with COVID-19 in a classroom. Of 42 close contacts (15 tested) who sat within 3 ft of possibly infectious people, 1 (2%) probable transmission event occurred (from a symptomatic student with a longer exposure period [5 days]); of 122 contacts (23 tested) who sat more than 3 ft away from possibly infectious people with shorter exposure periods, no transmission events occurred.

Conclusions: Reduced student physical distancing is one component of mitigation strategies that can allow for increased classroom capacity and support in-person learning. In the pre–Delta variant period, limited physical distancing (<6 ft) among students in K-12 schools was not associated with increased SARS-CoV-2 transmission.

Keywords

COVID-19, SARS-CoV-2, school health, students, physical distancing, ventilation

The COVID-19 pandemic has impacted in-school learning for students in kindergarten through grade 12 (K-12) across the country.[1] Many K-12 schools provide critical services in addition to academic instruction, including nutrition and social, physical, behavioral, and mental health support to students and communities.[1,2] The COVID-19 pandemic interrupted student learning and reduced access to these services. Given the critical role that schools play in our communities, understanding transmission dynamics within schools so that all students can learn safely in person is imperative.

Classroom layout plays a central role in maintaining physical distancing as part of a layered prevention strategy

for safe in-person learning.[3] One study demonstrated the importance of physical distancing for reducing COVID-19 incidence,[4] yet maintaining physical distancing in full-capacity classrooms is challenging. Previous investigations reported incidence rates among students in schools with various permitted minimal distances between desks[5] or measured minimum distances between students and teachers.[6] None systematically measured classroom distances between students and teachers with COVID-19 and their close contacts, and none reported measured distances between student desks in middle schools or high schools. Another school-based investigation reported that transmission can occur when layered prevention measures, such as physical distancing and face mask compliance, are not maintained.[7] A school-associated outbreak of the highly transmissible SARS-CoV-2 B.1.617.2 (Delta) variant during May–June 2021 demonstrated that infection risk was correlated with seating proximity to the teacher who was infected with COVID-19.[8] How classroom setup affects SARS-CoV-2 transmission is important to evaluate and report because most students continued to attend school in person during the 2021-2022 school year.

From December 2020 through March 2021 (prior to widespread prevalence of the Delta variant), the Centers for Disease Control and Prevention (CDC), Washington University in St Louis, state and local health departments, and local school officials in 2 Missouri counties investigated occurrences of SARS-CoV-2 secondary transmission in K-12 public schools. An initial pilot investigation during December 2020 in 2 school districts[9] was followed by a larger investigation in 6 school districts from January through March 2021, with an objective of understanding the effects of COVID-19 prevention strategies and quarantine policies on in-school transmission.[10] Here, we report on a subinvestigation in 3 of 6 school districts, with an objective of assessing how classroom distances may contribute to in-school transmission of SARS-CoV-2 among K-12 students.

Methods

During March–April 2021, we conducted an investigation of classroom layouts and COVID-19 prevention measures in 3 public school districts in Missouri. We assessed classrooms identified during the larger investigation, where a person with COVID-19 was present while possibly infectious. Data on contact tracing and case investigation were collected during the larger investigation. Details on case definition, case reporting, standardized interviews, testing, whole-genome sequencing, and case determination methods are described in the pilot investigation.[9,10] Participating school districts' policies on testing and symptom screening included the following:

- Required reporting of positive SARS-CoV-2 test results among students or staff to the school (all schools)
- Isolation, on-site testing or referral, and dismissal for students and staff who became symptomatic at school (all schools)
- Symptom screening prior to school entry (differed by district):
  - Passive reporting of symptom screening by parents or guardians (2 districts)
  - Daily on-site temperature and symptom screening (1 district)

School officials notified the investigation team of all students and staff with a positive SARS-CoV-2 test result. Close contacts were identified by the school and defined as any person who spent a cumulative total of ≥15 minutes in one 24-hour period within 6 ft of a person with COVID-19 while that person was potentially infectious, regardless of face mask use. A person with a positive COVID-19 test result was considered potentially infectious to others from 2 days before symptom onset (or 2 days before first positive SARS-CoV-2 specimen collection, if asymptomatic) until the person was isolated. Contacts were exempt from quarantine if they were infected with SARS-CoV-2 within 90 days of exposure. All school-associated quarantined contacts were invited to participate in the project, in which saliva-based nucleic acid amplification testing was provided 5-14 days after last exposure. Student or staff contacts could also choose to be tested in the community. Project participants were able to report community test results to the investigation team. This project

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was reviewed and approved by the Washington University in St Louis Institutional Review Board and CDC, and its conduct was consistent with applicable federal law and CDC policy (eg, 45 CFR part 46; 21 CFR part 56; 42 USC §241[d]; 5 USC §552a; 44 USC §3501 et seq).

Participating public school districts were in 2 urban and rural Missouri counties. During the investigation period, one county experienced high rates of community SARS-CoV-2 transmission (118-468 cases per 100 000 population, 7-day average), and another experienced moderate to high rates of transmission (17-115 cases per 100 000 population, 7-day average).[11] Data were collected before the Delta variant became prominent in Missouri.[12] School districts ranged in size from 2300 to >6000 students and served primarily non-Hispanic White populations: the race and ethnicity of students ranged from 44% to 95% non-Hispanic White, 0% to 36% non-Hispanic Black, 1% to 11% Hispanic, and 1% to 4% non-Hispanic Asian, according to a school-level survey from the larger investigation. One school used a hybrid learning model that consisted of student cohorts attending school in person 2 days per week and remote all other days. All other schools used in-person instruction with a remote learning option. In-person attendance across all 3 districts ranged from 30% to 98%.

School districts implemented a range of COVID-19 prevention measures, including wearing face masks, maximizing classroom physical distancing where possible, limiting lunchroom occupancy, sanitizing desks, requiring symptom screening and monitoring, and following local isolation and quarantine guidance.[13] One county, which covered 2 investigated school districts, adopted a modified quarantine policy for K-12 schools. Under this policy, student close contacts of a person with COVID-19 were permitted to attend school in person during their quarantine period if (1) the close contacts were students aged ≤18 years, (2) their only exposure to the person with COVID-19 was in the classroom, (3) they did not have prolonged (≥15 minutes) direct physical contact with the person with COVID-19, and (4) the close contacts and person with COVID-19 were wearing face masks during the exposure event. All but 1 school required face masks except when eating or drinking. In 1 school (at 98% capacity), students were unmasked in the classroom the entire day but masked in all other indoor school areas.

Field teams conducted on-site assessments of classroom layouts, physical distancing, and ventilation in classrooms with COVID-19 cases (Box). Classroom elements such as placement, spacing, and direction of desks and learning stations were noted as part of the classroom layout. Attempts were made to assess every classroom with a documented exposure event, defined as a situation during which a student or staff member with COVID-19 was present in a classroom for ≥15 minutes with a particular layout and seating arrangement. The same person with COVID-19 could be present in the same room during different school class periods, or different people with COVID-19 could be present in the same classroom with different exposure periods. Each situation was considered a separate exposure event.

An exposure event was considered a probable school-based secondary transmission event if (1) the person with a positive SARS-CoV-2 test result was a school-based close contact of someone with laboratory-confirmed COVID-19 who did not have any other known exposures to another person with confirmed or suspected COVID-19 in the 14 days before symptom onset or specimen collection date; (2) the person's exposure history and symptom and testing timeline was consistent with the known epidemiology of COVID-19 (eg, did not experience symptoms on the same day as the first contact with the person with COVID-19); and (3) the sequence generated from the specimen of the close contact had ≤5 single-nucleotide polymorphisms as compared with the sequence generated from the specimen of the school-based index case. This definition is consistent with previous reports of whole-genome sequencing on epidemiologically linked individuals and a previous molecular clock study.[14]

Classroom distances were measured to the nearest inch with a laser measuring tool. Distances between desks were measured from the midpoint of the edge where a person sits to approximate "nose to nose" distances between people.

Statistical Analysis

Distance measures were entered into Microsoft Excel, and descriptive statistics were calculated in SAS version 9.4 (SAS Institute Inc). Euclidean distances between students, teachers, and cases and contacts were then calculated in Quantum Geographic Information System version 3 (QGIS). Median distances between cases and contacts were calculated among people who were ≤6 ft apart. Multiple locations were mapped for the teacher: desks or other areas the teacher might sit (piano, laboratory bench) and a whiteboard, podium, or other point at the front or side of the classroom where the teacher might lecture (Box). We also conducted a sensitivity analysis to determine how many additional transmission events may have been missed because of limited testing of contacts. We applied the positivity rate among asymptomatic contacts from the larger investigation to the number of untested close contacts in this investigation (assuming that untested contacts were asymptomatic).

Results

In partnership with school officials, the larger investigation identified 51 laboratory-confirmed index cases of COVID-19 in 3 school districts and 1 probable in-school transmission event from a symptomatic student to another student. The investigation included 90 classrooms in which 34 cases (67%; 31 students and 3 teachers) were present while considered infectious. Twenty-four classrooms were excluded where the layout had changed since the exposure period, the investigation team was unable to accurately map the layout,

Box. Systematic approach to assessment of classroom setups, physical distancing, classroom COVID-19 prevention measures, and ventilation in classrooms with reported COVID-19 cases, 3 Missouri school districts, January–March 2021

Documenting the classroom setup

- Seating charts, contact tracing lists,[a] and school schedules were gathered prior to taking classroom measurements and used to identify classrooms and desks used by people with COVID-19, school-identified close contacts, other people present during the exposure event, and duration of exposure.
- Room dimensions and desk placements were measured with a laser measuring tool and manually recorded on individual room maps to the nearest inch.
- Desks were mapped in the room by measuring an *x* and *y* coordinate for each. For each desk or location mapped, the distances to 1 wall, designated the *x*-axis, and to a perpendicular wall, designated the *y*-axis, were measured and recorded.
- Desks were measured from the midpoint of the edge where a person sits to approximate "nose to nose" distances between people.
- Multiple critical locations were mapped for teachers.[b]
- Additional details were recorded, including the presence of any ventilation devices, whether windows were able to be opened, and desk sizes for both teacher and students.

Classroom distance measures were calculated with GIS and statistical analysis software[c]

- Euclidian distances between locations of students or teachers with COVID-19 and school-identified close contacts, and students or teachers and their nearest neighbor, were calculated with GIS software.
- The number of students within <3 ft and 3 to <6 ft of each student's desk were counted.[d]
- The number of people within <3 ft and 3 to <6 ft of a person with COVID-19 were counted.[d]
- The number of students within <6 ft of a teacher's location[e] were counted.
- Nearest neighbor distances were also measured in school cafeterias based on marked seat placements at lunch tables.

Information on classroom COVID-19 prevention measures

- 66 surveys/interviews[f] were conducted with teachers to understand the physical environment of their classrooms during the exposure event.[g] Response rate = 73%.
- Questions included details on classroom enrollment, whether students were moving around or gathered in small groups, whether the classroom setup had changed since the exposure event, whether doors or windows were generally open, whether students normally ate in the room, and where the teacher would have been during the exposure event.

Ventilation data were collected at the school level

- 10 surveys/interviews[f] were conducted with the head custodian or maintenance manager responsible for the school HVAC (heating, ventilation, and air conditioning) system. Response rate = 100%.
- Questions included details on whether the HVAC system had been modified for COVID-19 prevention, how the system normally runs, and whether the system brings outside air into the school.

Abbreviation: GIS, geographic information system.

[a]Seating charts and contact tracing lists were maintained by school nurses as part of a robust COVID-19 contact tracing program.

[b]Teacher locations were categorized into those where the teacher sat at a desk or table that could act as a physical barrier to distance the teacher from students and a lecture location at a board or podium at the front or side of the room.

[c]Data were entered into Microsoft Excel and analyzed with Geographic Information System version 3 (QGIS) and SAS version 9.4 (SAS Institute Inc).

[d]The number of people within 6 ft of a student's desk or within 6 ft of a person with COVID-19 is equal to the sum of the number of people within <3 ft and within 3 to <6 ft.

[e]The number of people within 6 ft was reported only for teacher locations.

[f]Interviews were conducted in person when possible or via email or electronic survey in a database created with REDCap version 9.5.5.

[g]An exposure event was defined as a situation during which a student or staff member with COVID-19 was present in a classroom for at least 15 minutes with a particular layout and seating arrangement. The same person with COVID-19 could be present in the same room during different periods, or different people with COVID-19 could be present in the same classroom with different exposure periods. Each situation was considered a separate exposure event.

or the seating chart could not be matched to the classroom layout. The 90 assessed classrooms and 6 cafeterias were located at 10 schools: 3 high schools (62 classrooms with 22 cases), 3 middle schools (17 classrooms with 5 cases), 3 elementary schools (4 classrooms with 4 cases), and 1 K-8 school (7 classrooms with 3 cases).

In 90 classrooms, 138 exposure events were identified (Table). Schools identified 179 school-associated close contacts. Of 164 contacts who were not exempt from quarantine, 30 (18%) were tested for SARS-CoV-2 through the investigation, and an additional 8 (5%) reported results from community testing conducted during the quarantine period. Of 2 close contacts with positive SARS-CoV-2 test results, 1 was classified as a probable school-associated transmission event; whole-genome sequencing ruled out school-associated transmission for the other close contact.

In general, students sat 3-6 ft from their nearest neighbor (median [interquartile range]: classroom, 3.6 ft [2.5-4.6]; cafeteria, 4.1 ft [2.3-8.0]) (Table). In 41% (1034 of 2533) of all student locations, another student was <3 ft away; in an additional 51% (1300 of 2533) of student locations, another student was 3 to <6 ft away. Among locations with students

Table. Characteristics of 10 schools (kindergarten through grade 12) with 34 school-associated COVID-19 cases, 3 Missouri school districts, January–March 2021

Characteristic	Probable transmission	No known transmission		Grade level of all exposure events			
	Positive close contact[a]	Close contacts[b] identified	No close contacts identified	K-5	6-8	9-12	All events
Exposure events, no. (%)[c]	1 (1)	74 (54)	63 (46)	8 (6)	35 (25)	95 (69)	138 (100)
No. of classroom close contacts identified per exposure event, median (IQR)[d]	1 (1-1)	2 (1-3)	0	16 (0-19)	2 (1-3)	0 (0-1)	1 (0-2)
Exposure time per event, h:min, median (IQR)[e]	5:45	1:45 (0:45-3:15)	1:30 (0:45-3:15)	13:30 (0:00-13:45)	1:45 (1:40-2:00)	1:45 (0:45-3:15)	1:45 (0:45-3:15)
Class size, median (range)	21	21 (5-31)	12 (1-49)	19 (7-21)	21 (5-31)	16 (1-49)	19 (1-49)
Class density, people/100 ft^2, median (IQR)	3.2	2.6 (2.1-3.1)	1.6 (1.2-2.5)	2.0 (1.3-2.7)	2.7 (2.2-3.3)	2.5 (2.0-2.7)	2.3 (1.3-2.9)
Students generally seated at desks (not moving around the classroom), no. (%)[f]	1 (100)	45 (61)	39 (70)	0	21 (6)	64 (67)	85 (85)
Distance measures between people with COVID-19 and contacts[g]							
Distance from patient to all close contacts,[h] ft, median (IQR)	2.5	3.6 (2.5-4.7)	NA	4.5 (4.0-5.6)	3.6 (2.7-4.4)	3.0 (2.5-4.0)	3.6 (2.5-4.6)
No. of students 3-6 ft from patient, median (IQR)[d]	3	2 (1-3)	1 (0-2)	1 (0-3)	2 (1-3)	1 (0-2)	2 (0-3)
Distance measures between students							
No. of students within 3 ft of each student, median (IQR)[d]	1 (1-1)	1 (0-1)	0	1 (0-2)	0 (0-1)	0 (0-1)	0 (0-1)
No. of students 3-6 ft from each student, median (IQR)[d]	1 (1-3)	3 (2-4)	2 (1-3)	3 (2-5)	3 (2-4)	2 (1-3)	2 (1-4)
Distance from student to nearest neighbor in classrooms, ft, median (IQR)	2.5	2.8 (2.3-3.9)	4.3 (3.6-5.7)	2.4 (2.0-4.5)	3.1 (2.4-3.9)	3.9 (2.5-4.9)	3.6 (2.5-4.6)
Distance from student to nearest neighbor in cafeteria, ft, median (range)[i]	NA	NA	NA	4.9 (4.9-4.9)	4.2 (2.3-8.0)	3.0 (3.0-4.0)	4.1 (2.3-8.0)
Distance measures between teachers and students							
Distance from teacher to nearest student, ft, median (IQR)[j,k]	4.9 (3.9-6.0)	6.4 (4.8-8.1)	8.0 (6.7-10.2)	6.7 (4.6-8.7)	5.4 (3.9-7.3)	7.7 (6.3-9.7)	7.1 (5.2-9.0)

Abbreviations: IQR, interquartile range; NA, not applicable.

[a]One probable transmission event was identified in a sixth-grade classroom.

[b]A close contact was defined as any person who spent a cumulative total of ≥15 minutes in one 24-hour period within 6 ft of a person with COVID-19 while that person was potentially infectious, regardless of face mask use. A person with COVID-19 was considered potentially infectious to others starting from 2 days before symptom onset (or, if asymptomatic, 2 days before the collection of the first positive SARS-CoV-2 test specimen) until the person was isolated. Exposure events with close contacts do not include the probable transmission event. Close contacts include contacts who received a negative test result through the investigation or community testing or did not participate in testing.

[c]An exposure event was defined as a situation during which a student or staff member with COVID-19 was present in a classroom for at least 15 minutes with a particular layout and seating arrangement. The same person with COVID-19 could be present in the same room during different school class periods, or different people with COVID-19 could be present in the same classroom with different exposure periods. Each situation was considered a separate exposure event.

[d]IQRs for number of students or staff are rounded to the nearest whole number.

[e]Of 104 exposure events, 34 events were missing information on patient symptom onset or date of test, and exposure time could not be calculated. Minutes were rounded to the nearest quarter hour.

[f]Of 100 exposure events, 38 events were missing this information, which was collected from the teacher.

[g]All categories (columns) had a median 0 students ≤3 ft from a person with COVID-19, except for the probable transmission room, which had 1 student ≤3 ft from the person with COVID-19 (data not shown).

[h]Of contacts within 6 ft of a person with COVID-19; not calculated in rooms where no close contacts were identified.

[i]Distances between seats among 10 tables measured in 6 cafeterias.

[j]Multiple locations were mapped for the teacher, including desks or other areas where the teacher might sit (piano, laboratory bench) and a whiteboard, lectern, or other point at the front or side of the classroom where the teacher might lecture.

[k]Of 132 exposure events. Teacher locations were not mapped for 6 exposure events.

and staff members with COVID-19, at least 1 student was <3 ft away in 23% (36 of 154) of locations and 3 to <6 ft away in an additional 48% (74 of 154) of locations. Teachers were a median 7.1 ft (interquartile range, 5.2-9.0) from the closest student (Figure). In 85 of 100 (85%) exposure events, students were seated at their desks and not moving around the classroom.

Of 42 close contacts who sat within 3 ft of possibly infectious people, 1 probable transmission event occurred; of 122 contacts who sat >3 ft away from possibly

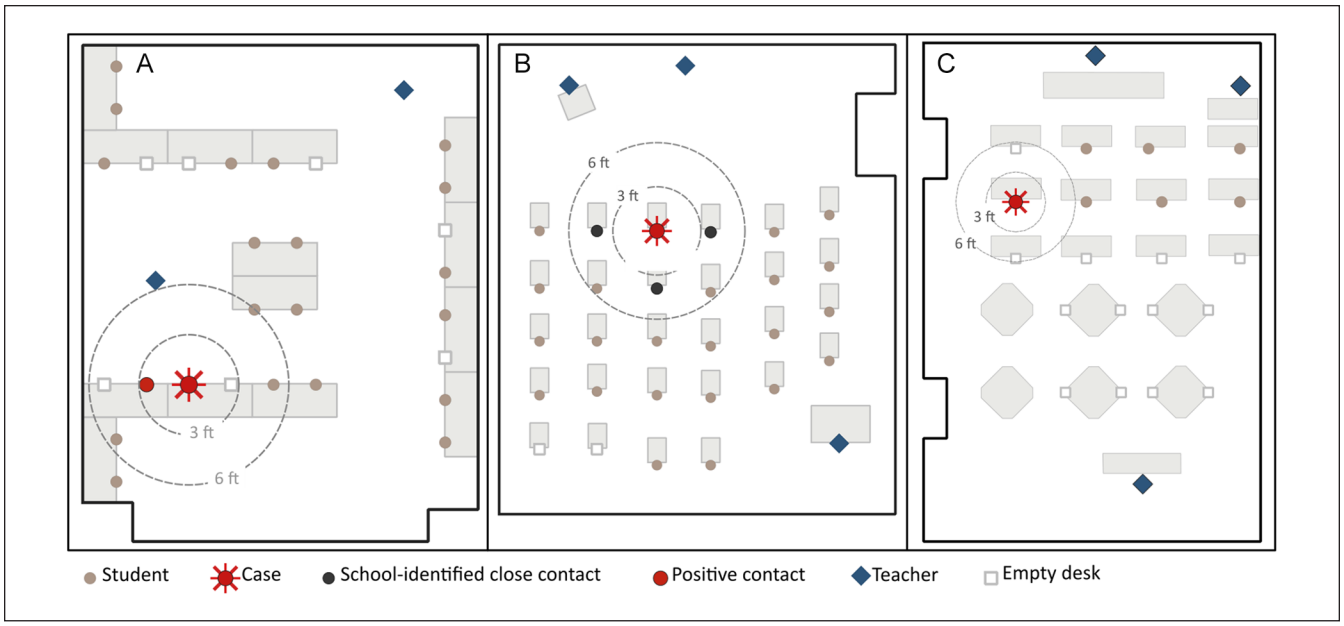

Figure. Maps of classrooms with reported exposure events, Missouri, January–March 2021. A, Probable transmission room. B, Room with close contacts identified. C, Room with student with COVID-19 but no school-identified close contacts.

infectious people, no transmission events were identified. The probable transmission event was identified in a grade 6 classroom with <3 ft of physical distancing, higher student density, and longer exposure time than most other exposure events (Table). The student with COVID-19 and the contact with the positive SARS-CoV-2 test result had 2.5 ft between desks as compared with the median 3.6 ft between the desks of other people with COVID-19 and their contacts. The transmission event occurred in a classroom with higher density (3.2 people/100 ft^2) and longer exposure time (5 hours 45 minutes) than the median for other events with close contacts (density, 2.6 people/100 ft^2; exposure time, 1 hour 45 minutes). The primary case occurred in a student who was in the classroom for 7 days while considered infectious, including 5 days while symptomatic. The patient did not appropriately self-screen, and early mild symptoms (sore throat) were not reported to the school until after symptoms worsened and the patient received testing. Among all other exposure events with known cases of symptomatic COVID-19 (n = 78), 52 (67%) were present in the classroom ≤1 day while symptomatic. In the room where transmission likely occurred, face masks were required, students were generally sitting at their desks, and desks were directly next to one another in rows facing different directions (Figure, panel A). The school in which transmission occurred was at 93% capacity in a county that experienced moderate to high rates of COVID-19 transmission during the investigation period.

In the larger investigation, 1% (3 of 307) of tested asymptomatic contacts received a positive test result. Applying this same rate in the sensitivity analysis to the 126 untested contacts in this investigation (assuming that untested contacts were asymptomatic), we determined that 1 additional asymptomatic positive contact may not have been identified by the investigation.

Windows were reportedly closed in most classrooms (84 of 138, 61%) during exposure events, but doors were reportedly open to a hallway during 31% (43 of 138) of exposure events. In 28% (n = 39) of exposure events, students reportedly ate in classrooms; eating in the classroom occurred more frequently in grades 9-12 (32/95, 34%) and K-5 (4/8, 50%) than in grades 6-8 (3/35, 9%). In 35 (25%) exposure events, students' desks were facing each other, most without physical barriers. In 22 (16%) exposure events, a ventilation device or machine identified by the teacher that could affect ventilation was reportedly present in the classroom (most often a fan; 17 of 22, 77%), but teachers in only 5 of 22 (23%) exposure events with such a device reported using the device during the exposure event. No schools used portable HEPA (high-efficiency particulate absorbing) devices in the classroom. Of 10 assessed schools, HVAC (heating, ventilation, and air conditioning) systems brought in outdoor air in 6 schools, and 5 schools met the American Society of Heating, Refrigerating and Air-Conditioning Engineers' outdoor air code requirement for indoor air quality (ANSI/ASHRAE standard 62.1-2019)[15]; no HVAC systems ran at maximum outside airflow during exposure events.

Discussion

Prior to predominance of the Delta variant, 138 exposure events occurred involving 164 close contacts (23% tested); within these, no transmission events were identified among students seated >3 ft apart, and a single known transmission event was

confirmed by whole-genome sequencing among students with prolonged exposure while <3 ft apart. The prolonged exposure to a symptomatic student and <3 ft of physical distancing could have overwhelmed other prevention measures in this school.

The field investigation team followed an extensive protocol for case determination to determine epidemiologic links between cases and their school-associated contacts and rule out nonschool sources of exposure.[9,10] The case determination protocol included whole-genome sequencing to rule out infections that were not genetically linked. Given these procedures, the likelihood of the identified transmission event being a true school-associated transmission is high.

These findings add to the growing evidence base supporting the benefits of a layered approach to COVID-19 prevention in K-12 schools, which includes isolating symptomatic people, wearing face masks, vaccinating eligible staff members and students, testing to identify people with SARS-CoV-2, improving ventilation, conducting routine cleaning, and maintaining physical distancing >3 ft in classroom settings. Local health and education officials can use this information to inform guidance for COVID-19 prevention in K-12 schools. The large number of assessed classrooms without reported transmission events after exposure to a person with COVID-19 supports the recommendation to maintain in-person learning while implementing standard prevention policies and continuing to monitor local transmission dynamics in accordance with CDC guidance.[16]

Evaluated classrooms often maximized physical distancing while minimizing the number of close contact exposures by keeping small groups of students together in the classroom. Desks were often in groups of 2 or 3 instead of individually staggered throughout the classroom. Consistent with CDC guidance on close contacts in the K-12 indoor classroom setting,[17] allowing students to sit within 3-6 ft of one another with other prevention measures in place can simplify contact tracing and limit the number of exposed students requiring quarantine. Furthermore, many schools at full-capacity learning likely have some students sitting within 3 ft of one another. In these settings, the use of layered prevention strategies, including wearing face masks, becomes even more important. In this investigation, only 1 transmission event was identified despite 42 close contacts sitting within 3 ft of possibly infectious people.

Limitations

This assessment had several limitations. First, fewer than one-quarter of close contacts had testing data reported to the school, leaving the potential for undocumented asymptomatic transmission and underestimation of secondary transmission. Additionally, those who were not included in the definition of a close contact could have been missed in our assessment (ie, infected at farther distances or shorter time than 6 ft for 15 minutes). However, if contacts received positive test results outside this investigation, the field team was notified through school reporting mechanisms, and no clusters were identified in participating schools during the investigation period. It is likely that the proportion of tested contacts was underestimated, as the investigation team was not notified of all students who received a negative test result in the community. Furthermore, the sensitivity analysis demonstrated that only 1 additional positive contact was likely missed because of low testing of contacts, which would not substantially alter conclusions. Second, the identification of only 1 transmission event limited opportunities to compare rooms with and without transmission. Third, some classroom layouts were assessed several weeks after the exposure event occurred. Efforts were made to determine if the assessed classroom environment represented the environment during the exposure event, but desks might have been moved and school staff members might have had difficulty recalling layout details. Most schools kept dated, detailed seating charts, which were used to determine the locations of cases and contacts during the exposure event. Finally, other factors could have contributed to the lack of transmission demonstrated in this investigation, including face mask use among students and staff (face masks were required in all but 1 school, but compliance was not directly observed by the investigation team), ventilation, and isolation and quarantine of symptomatic students or staff and contacts.

Conclusion

In 3 school districts in Missouri with moderate to high rates of community SARS-CoV-2 transmission, no transmission was documented in close contacts seated at desks at least 3 ft apart. These results support CDC school guidance[16] indicating that student classroom density can be safely increased by reducing the minimum physical distancing to 3 ft when other recommended prevention strategies are applied, including wearing face masks. Implementation of this guidance will support in-person education for K-12 students.

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