COVID-19 Surveillance Testing in Secondary Schools: Findings and Barriers to Implementation

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ABSTRACT

Problem Considered: K-12 schools have shown minimal spread of COVID-19 when mitigation measures are employed. This study sought to determine baseline asymptomatic COVID-19 rates in secondary schools as students returned to full-time in-person learning with universal masking in place and to evaluate the logistical obstacles of implementing surveillance testing.

Methods: An observational cohort study lasting 11 weeks during spring 2021 included 2,288 students and staff in Wood County, Wisconsin. SARS-CoV-2 nasal polymerase chain reaction testing was done on consenting students and staff to determine baseline disease burden. Teacher surveys collected data on student masking compliance and classroom distancing. Information about percent positivity, secondary transmission, quarantine and distancing policies, screening participation, costs, and volunteer hour requirements were obtained. Modified quarantine for fully masked in-classroom exposures was evaluated.

Results: Percent positivity averaged 3.0% (0%-16.2% weekly) among students and 1.72% (0%-6.9% weekly) among staff. Two cases of secondary transmission were suspected out of 163 individuals quarantined. An average of 15.6% of the school population consented to participate each week. Minimum classroom distance between students ranged from 2.7 to 5.5 feet. Student masking compliance was greater than 87%. The cost of the program was $106,400 and required approximately 300 volunteer hours. The modified quarantine policy, where students were allowed to continue to attend in-person school after exposure to a case of COVID-19 if the infected and exposed parties were masking, did not result in additional transmission.

Discussion: In the setting of relatively high student masking compliance and limited distance between students, weekly secondary school screening of students and staff in an area of high community disease spread was found to be low yield, costly, and burdensome for the school district. Surveillance participation was low. A modified quarantine policy was not associated with increased in-school transmission. School funding may be better spent on targeted testing or other school expenses, especially with increasing vaccination rates.

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INTRODUCTION

COVID-19 has greatly disrupted in-person learning, and strategies regarding safe modes of instruction have varied. Some school districts in the United States maintained a fully virtual learning environment due to concern for disease spread within schools. As the 2021-2022 school year continues, an understanding of school COVID-19 transmission in varying settings is essential.

Limited COVID-19 spread among 17 K-12 schools in Wood County, Wisconsin, in the setting of universal masking has been documented during a time of high community transmission.[1] One limitation was that surveillance testing was not performed to screen for asymptomatic infections among students and staff. Subsequent studies have suggested asymptomatic transmission is low.[2,3] It is currently not known how much asymptomatic transmission may be occurring among secondary school students seated less than 6 feet apart.

This investigation aimed to determine the rate of asymptomatic cases and in-school transmission rates through a school-based SARS-CoV-2 surveillance program among secondary students in a public school district in Wood County where masking was required. Nasal polymerase chain reaction (PCR) testing was performed on consenting students and staff over an 11-week study period from February 22 through May 7, 2021. Percent positivity ranged from 0% to 13.2%, with an average of 2.7%, despite 1 week with increased asymptomatic detection. Students were reintegrated into in-person learning 5 days per week and were seated 3 feet apart, if possible, with a modified quarantine

policy in the classroom setting only. A secondary aim was to report the logistics of surveillance testing, costs, and work hours required.

METHODS

Nearly 2,300 students and staff (n=2,288) attending school in person were eligible for the study; 867 students and 126 staff at the middle school and 1,124 students and 171 staff at the high school. COVID-19 vaccinations were not yet approved for children under 16. Vaccination rates for staff and older students were not available. The school district requested consent from parents and teachers to perform nasal PCR testing to assess the burden of asymptomatic SARS-CoV-2 infection in schools. Those with a history of positive COVID-19 PCR or antigen test were excluded. Additionally, only students and staff without reported symptoms of COVID-19 underwent surveillance testing. Any individuals with symptoms were sent for PCR testing, with results tabulated as "symptomatic" individuals. The percentage of students and staff consenting to testing varied during the study period, ranging from 15.9% to 24.9% of the student body and 26.9% to 32.3% of staff. The school district purchased testing kits from Aspirus Laboratories, utilizing grant funding from the Legacy Foundation of Central Wisconsin. The reverse transcriptase–polymerase chain reaction had a limit of detection of 50 copies/mL. Results were returned to the schools within 24 hours.

Consenting students and staff were tested once weekly. The testing schedule varied during the study period: initially, testing was performed 4 days per week for students and 1 day per week for staff. During the last 8 weeks, testing was done twice per week for students and once per week for staff, generally in the mornings. An average of 64 students were tested per week, with a range of 34 to 145. An average of 16 staff were tested each week, with a range of 12 to 23. Participants initially were selected using an Excel randomize feature, but as the consented number decreased, participants were divided into 2 groups to be tested every other week. Tests were administered by school staff or volunteers who were trained by county public health officials on swabbing technique. They utilized full personal protective equipment. Students and staff with a positive PCR test result during the study period were excluded from further surveillance testing.

Surveillance testing was initiated during a hybrid model of 2 in-person days per week in order to establish a baseline. At week 4 of the study, students returned to 4 days a week in person, and by week 10, students attended in person 5 days a week. Students were able to maintain a distance of nearly 6 feet in the classroom with the hybrid model, but as additional students were added at week 4, the minimum distance between students decreased. A goal of keeping a distance of 3 feet was recommended in the classroom when possible.

Masking was mandatory for students and staff when inside the school. Current guidelines from the Centers for Disease Control and Prevention[4] recommend quarantining at home after exposure within 6 feet for 15 minutes, regardless of mask compliance. In this study, a modified quarantine policy was used where students and staff were allowed to continue attending school in-person if they were fully masked (wore a mask covering mouth and nose) during their exposure to a positive case in the classroom (who was also fully masked), even when within 6 feet of the positive case for 15 minutes or more.[5] This modified quarantine policy applied only to classroom exposures. Due to students being unmasked while eating, close lunch contacts underwent standard at-home quarantine. Standard at-home quarantine also was employed if the contact was within 6 feet for greater than 15 minutes during any extracurricular or sporting activity. Hallway passing time was thought to be too brief for transmission and did not result in quarantine.

Contact tracing was performed by parents, school staff, and public health officials. If there were positive cases in the classroom setting, the school made note of those considered close contacts. Those individuals were instructed to carefully monitor for symptoms but remained in the classroom if they had been properly masked. The Wood County COVID-19 dashboard[6] was utilized to capture weekly data on community COVID-19 data. Using descriptive statistics, trends were evaluated regarding school-related COVID-19 cases, asymptomatic positives found on school-based screening, and any changes in community COVID-19 levels.

Twice weekly, middle and high school teachers were asked to complete a Google Forms survey, administered by the research team. Information was collected regarding masking compliance and approximate minimum and average distancing between students in the classroom. Staff were asked to differentiate between proper masking with nose and mouth covered from students with nose chronically showing and students who were not masked at all.

This study received institutional review board approval through Aspirus Wausau Hospital Investigational Review, IRB # 21.01.586

RESULTS

Surveillance testing was done for 10 weeks. Of the total student population, 19.9% were entirely virtual for the 2020-2021 school year. On average, consents were obtained from 15.6% of the student and staff population (Figure 1). A total of 1,578 surveillance PCR tests were performed during this timeframe, and 35 students and 5 staff tested positive. Percent positivity of students who were tested ranged from 0% to 16.24% weekly, with an average of 3.01%. Staff percent positivity ranged from 0% to 6.9% weekly, with an average of 1.72% positivity. Together, percent positivity of students and staff averaged 2.7% weekly.

No in-school surveillance testing was done during spring break, which was week 6 of the study (March 29-April 2). On March 31, 2021, the Wisconsin statewide masking mandate was withdrawn, though the school district maintained a separate indoor masking mandate. During week 7, there was a more than 12% increase in positive results via surveillance PCR testing; 19 cases, all in students, were detected. Nine were from middle school and

10 from high school. No students reported traveling outside Wisconsin. Students and/or staff who were in the classroom and fully masked with these individuals were allowed to continue with in-person attendance via the modified quarantine policy. No cases linked solely to in-classroom contact were found through contact tracing in subsequent weeks. There was no evidence of transmission to staff by close classroom contact with an asymptomatic positive student. Throughout the subsequent weeks, surveillance percent positivity returned to 0% to 3.3%.

At the middle school, 9 students tested positive on surveillance testing during week 7. Two students subsequently tested positive while undergoing standard at-home quarantine as a result of unmasked exposures. One student was a lunchroom contact of an asymptomatic positive individual. Another student was in class with an asymptomatic positive individual but also had a positive close contact outside of school. No secondary cases were found to result from the 10 positive asymptomatic cases from the high school.

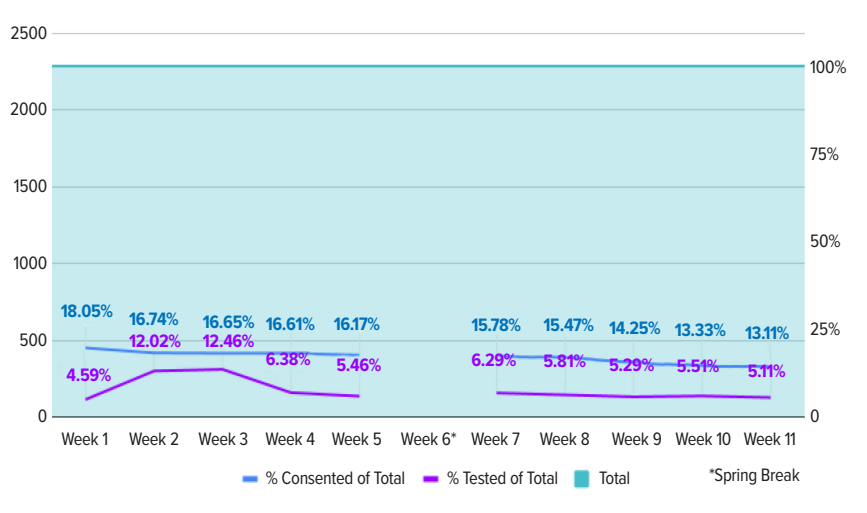
The number of symptomatic COVID-19 cases during the study period ranged from 0 to 4 new cases per week, even during and after the increase in asymptomatic cases seen in week 7 of surveillance testing (Figure 2).

During the study period, the Wood County COVID-19 case rates had an upward trend, ranging from 21.76 new cases/100,000 persons per week (the week of March 15, 2021) to 116.9 cases/100,000 per week (the week of May 3, 2021). During week 2 of the study period, the public health department performed an audit of its records and found 5 cases incorrectly counted as positive from prior months, accounting for the apparent decrease in county cases that week. Percent positivity in the county ranged from 2.5% to 14.18% (Figure 3).

The teacher survey was sent to a total of 208 educators twice weekly. Survey response rate was 52%. Regarding distancing in the classroom, while in hybrid mode with half of the students attending in person at a time, the middle school reported an average distance of 4.74 feet between students (with average minimum distance of 3.72 feet), and the high school reported an average distance of 6.07 feet (with average minimum distance of 5.5 feet). When all students returned during week 4 for full-time in-person learning, the middle school reported an average distance of 3.52 feet between students (with average minimum distance of 2.74 feet), and the high school reported an average distance of 4.59 feet (with average minimum distance of 3.69 feet) (Figure 4).

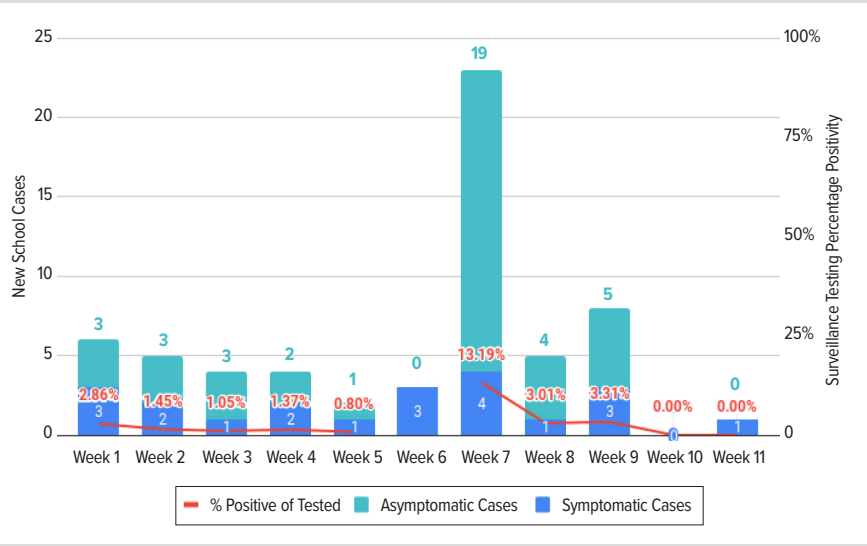
Student masking compliance remained high. At least 87.13% of middle and high school students were reported to have mouth and nose covered at all times.

Figure 1. Percentage of Asymptomatic Students and Staff Consented and Tested for COVID-19, Wood County, Wisconsin, Feb 22-May 7, 2021



Total student and staff population: N=2288.

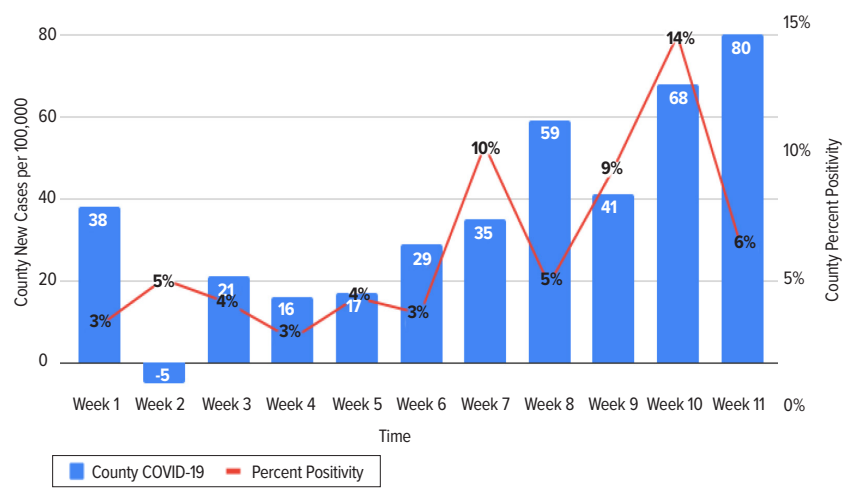
Figure 2. Symptomatic vs Asymptomatic School COVID-19 Cases, Wood County, Wisconsin, Feb 22-May 7, 2021



DISCUSSION

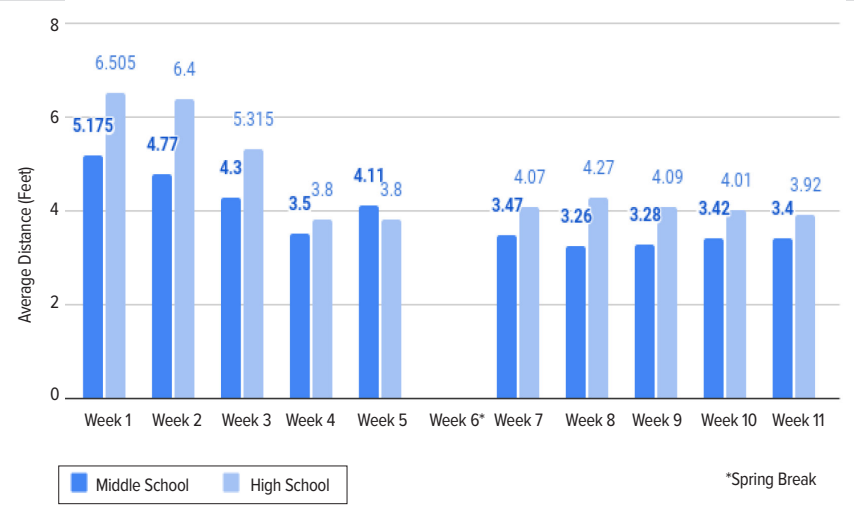
Surveillance testing of asymptomatic middle and high school students in rural central Wisconsin provided reassurance while rein-

Figure 3. Community COVID-19 Cases per 100,000 and County Percent Positivity, Wood County, Wisconsin, Feb 22-May 7, 2021



During week 2 of the study period, the public health department performed an audit of its records and found 5 cases incorrectly counted as positive from prior months, accounting for the apparent decrease in county cases that week.

Figure 4. Classroom Distancing By Feet at Middle and High Schools, Wood County, Wisconsin, Feb 22-May 7, 2021



troducing the entire student body to full-time, in-person learning. In the setting of mandatory masking, the baseline asymptomatic infection rate was low. There was no appreciable change from baseline in asymptomatic case rates found on surveillance or on reported symptomatic case rates as the number of students in the building increased. During week 7 of the study, following spring break, asymptomatic percent positivity increased dramatically to 13.24% at the middle school and 13.16% at the high school.

Our surveillance testing program found asymptomatic spread within the school to be minimal to nonexistent. No asymptomatic transmission to staff was identified despite 40 cases being identified during the study period and over a 24-hour delay before test results were returned. Two middle school students tested positive while quarantining at home; however, 1 student had close contact during lunch and the other had contact both in the classroom (while masked) and socially outside of school (while unmasked).

While distance within the classrooms was maximized, due to class density, more than 6 feet of distance between students was not possible, and students were in some classes less than 3 feet apart. Student masking compliance, with correct masking of mouth and nose was reported to be high (87%) in these classrooms. No outbreaks were identified related to minimal distancing, and in-school transmission was also found to be rare. There was insufficient statistical power to determine the impact of masking or classroom distancing on disease spread with 2 potential cases spread within the school. Modified classroom quarantining policy did not result in any identification of in-school transmission, and over 2,000 days of quarantine were avoided with the implementation of this policy.

There were many barriers to school surveillance testing implementation. First, less than one-fifth of students and staff consented to being part of the surveillance pool. That percentage continued to decline as surveillance testing progressed over the 10-week study period. This was in spite of school board support, administration encouragement, and medical liaison promotion. The low number of those consenting limited the ability to test a random sample of the population and, thus, reduced the generalizability of the results.

Second, there are many logistical issues for school administration and school nurses in developing an infrastructure for surveillance testing. Testing was not able to be secured through the state of Wisconsin, so it was contracted through a local health system with a 24-hour wait for a result. School administration organized testing lists, made labels, handled results, organized volunteer schedules to perform testing, and performed contact tracing. It is estimated that initially, at least 20 hours of staff time were required per week. Once established, school nursing staff devoted an aver-

age of 1 to 2 hours per week, and school administration spent 6 hours per week. This was in addition to their usual and COVID-19 pandemic-related workload. Additionally, 8 volunteers were recruited, and each spent 1 to 2 hours 1 to 3 times a week testing—or approximately 300 hours in total—which defrayed the burden on school nurses. Not all school districts may have access to school nurses or volunteers able to assist in this way. Third, the cost of implementing surveillance testing was $106,400 for the study period. Nasal PCR kits were $70 per test, and a total of 1,578 tests were performed. Grant funding through the Legacy Foundation of Central Wisconsin covered the cost of testing.

There are several limitations to this study. First, given that students and staff opted into testing, there is potential selection bias that might not represent true asymptomatic disease burden in the secondary school population. Second, student masking compliance and distancing data relied on voluntary teacher survey completion. Third, no information was collected on other mitigation measures the schools might have employed to reduce infection burden, such as staff vaccination, disinfection policies, and ventilatory practices. Fourth, no racial or socioeconomic information is available regarding the study population, possibly reducing generalizability. Finally, it remains unknown what the role of surveillance testing might be in a more highly vaccinated and/or mask-optional school setting. "Test to Stay" programs, which test exposed students even in unmasked exposures, may allow more students to remain in the classroom at lower cost and school district burden than surveillance testing.[7]

With 40 positive cases over the study period, only 2 potential cases of secondary spread were identified and none among staff, despite relaxing distancing and quarantining guidelines. However, mandatory masking indoors at school was required, with a reported student masking compliance of 87%. This was consistent with what was found in 20 elementary schools in Salt Lake City, Utah.[3] Their study also was able to rule out a number of cases of suspected in-school transmission with genomic testing, which was not conducted in our study. This type of surveillance testing required substantial funding in addition to volunteer hours and, while it provided reassurance, the detected in-school spread was minimal—even without at-home quarantine of students after masked classroom exposures. We found surveillance testing to have limited utility and substantial cost in our secondary school environment.

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REFERENCES

1. Falk A, Benda A, Falk P, Steffen S, Wallace Z, Høeg TB. COVID-19 cases and transmission in 17 K-12 schools - Wood County, Wisconsin, August 31-November 29, 2020. *MMWR Morb Mortal Wkly Rep.* 2021;70(4):136-140. doi:10.15585/mmwr.mm7004e3

2. Gillespie DL, Meyers LA, Lachmann M, Redd SC, Zenilman JM. The experience of two independent schools with in-person learning during the COVID-19 pandemic. *medRxiv.* Preprint posted online January 29, 2021. doi:10.1101/2021.01.26.21250065

3. Hershow RB, Wu K, Lewis NM, et al. Low SARS-CoV-2 transmission in elementary schools - Salt Lake County, Utah, December 3, 2020-January 31, 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70(12):442-448. doi:10.15585/mmwr.mm7012e3

4. COVID-19: when to quarantine. Centers for Disease Control and Prevention. Accessed May 11, 2021. https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html

5. Ohio Schools COVID-19 Evaluation: Final Report. Ohio Schools COVID-19 Evaluation Research Team; 2021. Accessed May 11, 2021. https://coronavirus.ohio.gov/static/responsible/schools/OSCE_evaluation.pdf

6. Wood County Wisconsin COVID-19 dashboard. Wood County Health Department. Accessed May 11, 2021. https://woodwi.maps.arcgis.com/apps/dashboards/da7f0d6815494e4b85e614e042671b14

7. Young BC, Eyre DW, Kendrick S, et al. Daily testing for contacts of individuals with SARS-CoV-2 infection and attendance and SARS-CoV-2 transmission in English secondary schools and colleges: an open-label, cluster-randomised trial. *Lancet*. 2021;398(10307):1217-1229. doi:10.1016/S0140-6736(21)01908-5

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