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Students' Use of School-Based Telemedicine Services and Rates of Returning to Class After These Services in a Small Elementary School District

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Even before COVID-19, school districts wanted to understand if school-based telemedicine services met student health needs during the school day and helped keep students in school all day, every day. Specifically, districts were interested in knowing if telemedicine enabled students with a school-day health issue to return to class instead of being sent home, preventing the loss of instruction. This study examined students' use of school-based telemedicine in all five of the schools in urban Robla Elementary School District in California during the first two years of implementation (2017/18 and 2018/19). The study also examined how students' use of services varied by grade level and by race/ethnicity. Districtwide, 26 percent of students used telemedicine services at least once over the two years, with 9 percent of students using telemedicine multiple times. The reasons students used telemedicine services varied, with the most frequent reasons being for non-communicable health conditions (44 percent) and communicable illnesses (19 percent). Nearly all telemedicine visits (94 percent) resulted in students returning to class. This resulted in these students receiving, on average, approximately 3 hours of instruction remaining in that school day. Students in lower and upper elementary grades did not differ in their use of telemedicine services, though there were some differences by student race/ethnicity. Black students had the highest use of telemedicine and Asian students had the lowest use. This suggests that needs, awareness, level of comfort, or rate of parent/guardian consent for receiving school-based telemedicine services may vary across student groups. Compared to visits made by students of other race/ethnicity groups, a higher percentage of the telemedicine visits by Hispanic students were for preventative/wellness reasons. Telemedicine services may hold promise to help students stay healthy and in school, and is adaptable for students at home during the pandemic and when school buildings reopen. Results indicate that telemedicine can treat students during the school day, enabling them to attend their classes for the remainder of instruction that day.

Why this study?

Regular attendance is critical to students' academic success (Allensworth & Easton, 2007; Balfanz & Byrnes, 2012; Gottfried, 2014). Even missing part of a school day can put students at risk for falling behind academically (Pennington & Delaney, 2008; Wyman, 2005). While the reasons for missing a full day or a partial day of school vary, addressing health-related absenteeism emerged as a national priority (Healthy Schools Campaign, 2019; Robert Wood Johnson Foundation, 2016) even before the COVID-19 pandemic. Given the effect of the public health crisis on school attendance, there is urgency to better understand how school-based health care approaches, like telemedicine, can help to keep students engaged in school all day and every day when instruction is in person or delivered through distance learning activities. This study examines one aspect of school-based telemedicine use—the rate of students returning to class after they received services for a school day health issue.

Research has borne out that healthy students are better learners. Healthy students have stronger academic performance (e.g., class grades, standardized test scores, graduation rates), fewer behavioral problems at school (e.g., chronic absence, discipline infractions), and better cognitive skills (e.g., concentration, memory) than students with health issues (Basch, 2011; Michael et al., 2015). Social determinants of health such as food insecurity, housing instability, exposure to trauma, and limited access to quality health care can also contribute to achievement gaps (Centers for Disease Control and Prevention, 2014).

School districts often have limited capacity to provide health services. For example, only about half (52 percent) of U.S. public schools (National Center for Education Statistics, 2020) and 43 percent of California public schools (Baker et al., 2015) employ a nurse. The Centers for Disease Control and Prevention (2011) recommends schools have one nurse for every 750 students, but in California the school nurse to student ratio in 2018/19 was one nurse to 2,720 students (California Department of Education, 2019). Given the COVID-19 pandemic, and the related widespread shift to distance learning, there is growing national interest in improving K–12 health care through telemedicine—that is, for doctors, nurses, and counselors to virtually evaluate, diagnose, and treat students where they are located—be it at school or at home—during the school day. Telemedicine provides nearly instantaneous access to a team of professionals who deliver varied services such as primary, urgent, and chronic care management; mental and behavioral health services; and access to over-the-counter and prescription medicine.

Robla Elementary School District (RESD) in California's Central Valley began offering telemedicine services during the 2017/18 school year. It is a small but diverse, urban district with 89 percent of students qualifying for free or reduced-price meals and 35 percent of the students designated as English learners, speaking 20 different languages (California Department of Education, 2020). Approximately half (46 percent) of the students are Hispanic, followed by Asian (18 percent), Black (15 percent), and White students (14 percent). The district joined several others in adopting school-based telemedicine health care services prior to the pandemic. In RESD, offering telemedicine services was part of broader "whole-child" strategies for improving student health, well-being, and attendance. Because telemedicine is a relatively new school health care option generally, and in RESD in particular, there is little publicly available information about students' use of telehealth services and associated outcomes. As a result, district leaders wanted to know more about which and how many students use telemedicine, the reasons they use these services, and if these services resulted in students returning to class or being sent home, missing instruction.

District leaders were particularly interested in learning more about ways to minimize partial-day absenteeism or early dismissals from school due to a health-related reason. Early dismissals are often an overlooked aspect of the more general school attendance challenge, which primarily focuses on full-day absences and chronic absenteeism (missing 10 percent or more of school days for any reason, excused or unexcused; Chang et al., 2019). Limited research has not fully documented the extent of partial-day absences or its effects on learning outcomes, but suggests that accounting for these absences increases chronic absence rates, especially for Black and Hispanic students (Whitney & Liu, 2016). RESD leaders want to better understand if the use of telemedicine services enables students with a school-day health issue to return to class instead of routinely being sent home, preventing partial-day absences and the loss of instructional time. Some studies suggest that, compared to students who did not receive school-based health care, students who received a school-based health treatment from a qualified provider were more likely to return to class and less likely to be sent home (Allen, 2003; Pennington & Delaney, 2008; Van Cura, 2010; Wyman, 2005). However, telemedicine was not widely available for student health care services until recently and so previous studies were limited to examining in-person school-based health care. In contrast, this study focused on students receiving school-based telemedicine services and the frequency in which they returned to class.

To investigate the return-to-class rate, this study examined the outcomes of RESD students who used school-based telemedicine services. These services were in addition to the limited in-person school nurse services available to students, and telemedicine provided a broader range of health care services to all students with family consent.

Investigating the return-to-class rate will contribute to developing a fuller picture of school-based telemedicine and its potential for keeping students in school after a health care visit. The information from this report will also help inform district- and state-level decisionmaking about investing in the use of school-based telemedicine as part of broader whole-child strategies for improving student health, well-being, and attendance. By also examining differences in the rates students use telemedicine services, the reasons they seek telemedicine care, and their return-to-class rates by grade level and by race/ethnicity, this study can help inform the ways education and health professionals target outreach and health care services for student groups. A number of Regional Educational Laboratory West stakeholders are considering adopting telemedicine and may be able to use the results of this study. Other stakeholders, such as the California School-Based Health Alliance and Clark County School District in Las Vegas, Nevada, have recently adopted or expanded the use of school-based telemedicine in the 2020/21 school year in response to the current public health crisis and have expressed interest in the study results.

Research questions

This report examines students' use of telemedicine services (beginning in February 2018) and the rate of students returning to class after school-based telemedicine visits across two school years, 2017/18 to 2018/19. Specifically, the report answers the following questions:

1. How has students' use of school-based telemedicine services changed since initial implementation in February 2018?
2. How frequently have students used school-based telemedicine services? How did this vary by race/ethnicity and grade level as of 2017/18?
3. What percentage of school-based telemedicine visits fall into the following categories: (a) communicable illnesses, (b) non-communicable physical illnesses/conditions, (c) injuries, (d) preventative/wellness, and (e) miscellaneous? How did this vary by grade level and race/ethnicity at the time of visit?
4. What was the rate of school-based telemedicine visits that resulted in students returning to class, and, on average, how much instructional time was left for those who returned? How did this vary by race/ethnicity and grade level at the time of visit?

See box 1 for definitions of the study's key terms, such as the types of telemedicine visits. See box 2 for details on the study's data sources, sample, and methods.

Box 1. Key terms

Categories for describing the reasons students received telemedicine services:

- **Communicable illnesses.** Infectious diseases that are transmissible, such as influenza and conjunctivitis.
- **Injuries.** Damage to a student's body, such as cuts and broken bones.
- **Miscellaneous.** Reasons for students to receive telemedicine services that do not fit the communicable illnesses, non-communicable physical illnesses/conditions, injuries, or preventative/wellness categories, such as dizziness and vomiting.
- **Non-communicable physical illnesses/conditions.** Diseases or symptoms that are not transmissible, such as asthma and diabetes.
- **Preventative/wellness.** Health care that protects, promotes, and maintains student health and well-being, such as routine examinations.

Lower elementary. The telemedicine service provider's database included information on student age, but not grade level, so the analysis classified students ages 5 to 8 as lower elementary (i.e., kindergarten to grade 3).

Return-to-class rate. The rate of school-based telemedicine visits that resulted in students returning to class instead of being sent home.

Telemedicine. Telemedicine is the remote evaluation, diagnosis, and treatment of patients using telecommunications technology. For this analysis, telemedicine is a school-based service available to treat students and is administered in partnership between a health care provider and school staff, but may also include parents/guardians.

Telemedicine services. Robla Elementary School District contracted with and paid Hazel Health, a telemedicine provider that operates virtual health clinics in school settings and requires no insurance, no co-pay, no cost, and no scheduled appointments. This health care service provides primary, urgent, and chronic care management; mental and behavioral health services; and access to over-the-counter and prescription medicine. Parents/guardians, school staff, or students can request to use the telemedicine service for health issues short of a recognizable emergency. Trained school staff then activate the Hazel Health app and students are typically examined within five minutes. Using the app, students with parent/guardian permission and trained school staff use a medical cart with data-transmitting equipment to interact in real-time with a doctor, nurse, or counselor through videoconferencing from a mobile device.

Students' use of telemedicine. For this analysis, students' use is defined as accessing telemedicine services at least once during the study period.

Upper elementary. The telemedicine service provider's database included information on student age, but not grade level, so the analysis classified students ages 9 to 12 as upper elementary (i.e., grades 4 to 6).

Box 2. Data sources, sample, and methods

Data sources and measures. The data used to answer the research questions are summarized in appendix A. Data were available for two successive school years (2017/18 and 2018/19). The de-identified database contained student enrollment and limited student demographic information, specifically age and race/ethnicity, obtained from the district for school years 2017/18 and 2018/19. The database also contained five trimesters of data on student-level telemedicine service provision, beginning at the end of the second trimester of the 2017/18 school year (February 2018) and ending in the spring of the 2018/19 school year.

To facilitate the usability of this report's findings at the district level, the research team used student age to classify students into grade levels. Specifically, the research team used student age as of September 1 of the 2017/18 and 2018/19 school years to approximate student grade level. Based on the California Department of Education's minimum normative age for each of the grade levels, the research team created a grade-level variable coded as either lower elementary or upper elementary. Lower elementary includes students ages 5 to 8 (approximating grades kindergarten to 3). Upper elementary includes students ages 9 to 12 (approximating grades 4 to 6).

Sample. The population of students enrolled in each school year was defined as the number of students ages 5 or older in all five of the elementary schools in Robla Elementary School District (RESD) attending at least one day of school within the school year. For examining students' use of telemedicine (use of telemedicine services at least once during the study period) over time beginning from initial implementation (research question 1) as well as frequency of telemedicine use (research question 2), the population of analysis was the cohort of elementary students enrolled during 2017/18 who were still enrolled in the district in 2018/19. Because the population of analysis consists of elementary students enrolled in RESD for the two consecutive years, eligible students were ages 5 to 10 (approximating grades K to 5) as of 2017/18 (that is, ages 6 to 11 or approximating grades 1 to 6 in 2018/19). There were 1,607 elementary students ages 5 to 10 (approximating grades K to 5) enrolled in RESD in 2017/18 who were still enrolled in 2018/19. Information about age was available for all students (100 percent), and information on race/ethnicity was available for 1,596 students (99 percent). A detailed breakdown of grade level (using the age as of 2017/18) and race/ethnicity information for the population of students for these research questions is included in tables A1 and A2 in appendix A.

To examine the type of telemedicine visits (research question 3) and the return-to-class rate after telemedicine visits (research question 4), the analysis sample consists of all telemedicine visits by elementary students (by students of all grade levels and races/ethnicities) that occurred during the first two school years of telemedicine implementation in RESD. Among the 837 telemedicine visits that occurred during this period, all visits (100 percent) had student age information, and 820 visits (98 percent) had student race/ethnicity information. A detailed breakdown of grade level at the time of the telemedicine visit (using the age information) and race/ethnicity information for the population of students for these research questions is included in tables A3 and A4 in appendix A.

Methodology. To address research question 1, for each trimester, the research team calculated the percentage of students who used telemedicine services at least once. Students' use of telemedicine was examined by trimester because initial implementation of school-based telemedicine services in RESD began in the second trimester of 2017/18.

To address research question 2, the research team calculated the percentage of students who never used telemedicine services, the percentage of students who used telemedicine services once, and the percentage of students who used telemedicine services more than once across the two years (2017/18 and 2018/19). Descriptive statistics were used to report on how students' use of telemedicine varied over the two years of the study period by student grade level as of 2017/18 and race/ethnicity.

To address research question 3, the research team used the International Classification of Diseases 10th Revision, Clinical Modification (ICD-10-CM)[1] variable in the telemedicine service provision database that categorizes the reason for telemedicine visits. This ICD-10-CM variable was consolidated into five categories (non-communicable physical illnesses/conditions, communicable illnesses, injuries, preventative/wellness, and miscellaneous) to examine the reason for telemedicine visits and the frequency of each visit type by grade level at the time of the visit and by race/ethnicity. Definitions of each telemedicine visit type are in box 1.

To address research question 4, the research team used the telemedicine provider's visit resolution variable (return to class or home) to calculate a return-to-class rate for students who used school-based telemedicine services. The telemedicine provider's appointment check-out time stamp variable and the district's school bell schedules were used to calculate how much instructional time was left (in hours) for students who returned to class after receiving services and was examined by grade level at the time of the visit and by race/ethnicity.

For all research questions, differences less than 5 percentage points in outcomes are characterized as small and are not discussed in the text. For further detail on the study sample and analytic methods, see appendix A.

Note

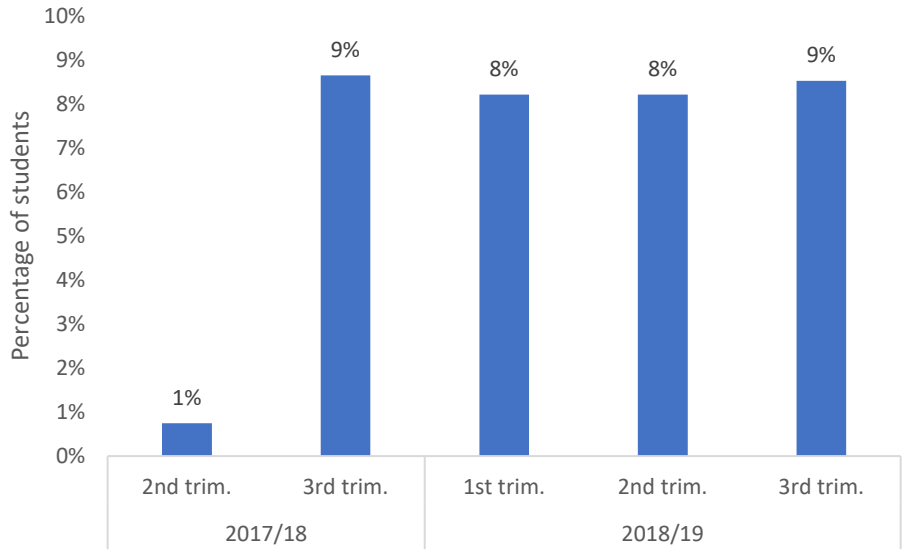
1. ICD-10-CM (National Center for Health Statistics, 2020) is provided by the Centers for Medicare and Medicaid Services and the National Center for Health Statistics for the purpose of medical coding in the United States, specifically for classifying diagnoses and reasons for visits in all American health care settings. The ICD-10-CM is based on the ICD-10 published by the World Health Organization.

Findings

Students' use of school-based telemedicine increased after the initial trimester of implementation, stabilizing at 8 to 9 percent

In the initial trimester of school-based telemedicine implementation, 1 percent of students used telemedicine services at least once. Students' use of telemedicine increased in the following trimesters, with 8 to 9 percent of the students using telemedicine services at least once in each trimester (figure 1).

Figure 1. Percentage of students who used school-based telemedicine services at least once in each trimester



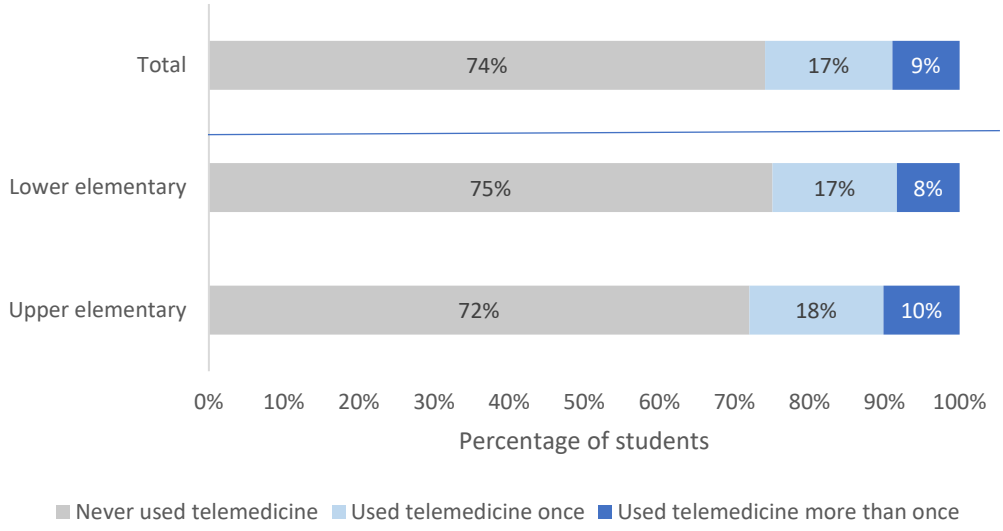
Note: Sample = 1,607 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19. The second trimester of 2017/18 was the first trimester of school-based telemedicine implementation. See table B1 in appendix B for the frequency counts that correspond to the percentages provided in the figure above.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Roughly a quarter of all students used school-based telemedicine services

Looking across the first two years of school-based telemedicine implementation, 26 percent of students used telemedicine at least once from 2017/18 to 2018/19, with 17 percent of students using telemedicine services only once and 9 percent of students using telemedicine services multiple times during the study period (figure 2). Among telemedicine users, 35 percent used services multiple times.[2]

Students in the lower and upper elementary grades did not differ much in their use of telemedicine services over the two years.[3] For students who were in lower elementary grades as of 2017/18, 25 percent of students used telemedicine services, with 17 percent of students using telemedicine services only once and 8 percent of students using telemedicine services multiple times. For students who were in upper elementary grades as of 2017/18, 28 percent of students used telemedicine services, with 18 percent of students using telemedicine services only once and 10 percent of students using telemedicine services multiple times.

Figure 2. Students' use of school-based telemedicine services from 2017/18 to 2018/19 – all students and by grade level as of 2017/18



Note: Sample = 1,607 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19. See table B2 in appendix B for the frequency counts that correspond to the percentages provided in the figure above. In addition, table B3 in appendix B presents the frequency counts disaggregated by age as of 2017/18.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

[2] Of the 26 percent of students (17 percent + 9 percent) who used telemedicine at least once, 35 percent (9 percent/26 percent) used telemedicine multiple times.

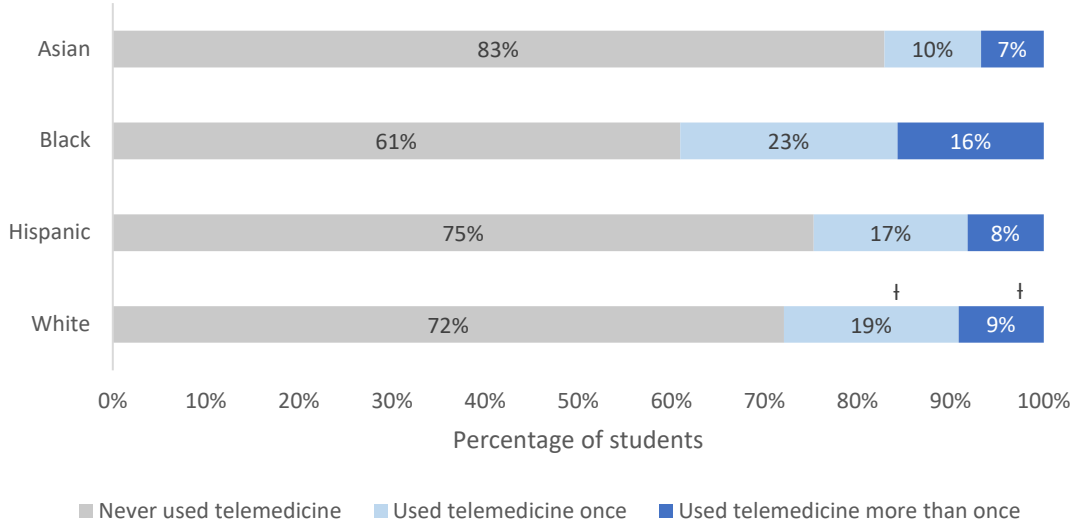
[3] Age information was used to approximate student grade level. See table B3 in appendix B for the frequency counts disaggregated by age as of 2017/18.

Asian students had the lowest rate of using school-based telemedicine services, and Black students had the highest rate of using these services compared to other race/ethnicity groups

Across the first two years of school-based telemedicine implementation, Asian students used telemedicine services the least (figure 3). A total of 17 percent of Asian students used telemedicine, with 10 percent using telemedicine services once and 7 percent using telemedicine services multiple times from 2017/18 to 2018/19. In contrast, Black students used telemedicine services the most. A total of 39 percent of Black students used telemedicine services from 2017/18 to 2018/19, with 23 percent using telemedicine services once and 16 percent using telemedicine services multiple times.

Hispanic and White students used telemedicine at similar rates as the total population (74 percent; see figure 2). This is not surprising given that Hispanic and White students account for over half of the total population (59 percent; see table A2 in appendix A). For Hispanic students, 25 percent used telemedicine services across the two school years, with 17 percent using telemedicine services once and 8 percent using telemedicine services multiple times. For White students, 28 percent used telemedicine, with 19 percent using telemedicine services once and 9 percent using telemedicine services multiple times.

Figure 3. Students' use of school-based telemedicine services from 2017/18 to 2018/19, by race/ethnicity



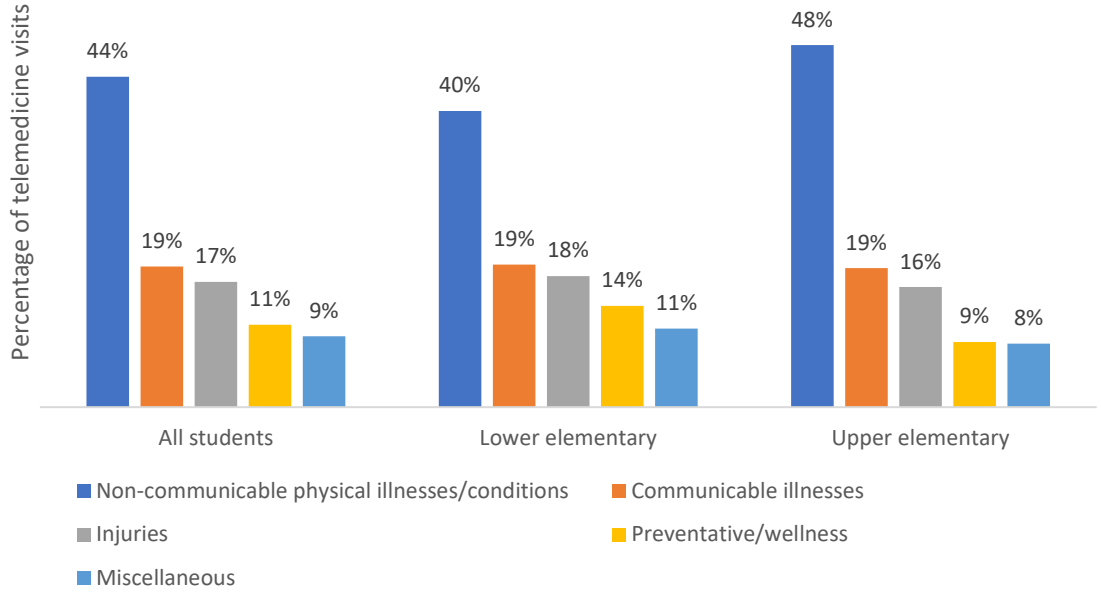
Note: Sample = 1,596 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19 with race/ethnicity information available. Results for students of Other race/ethnicity are not reported in the figure, but they are included in the total sample. See table B4 in appendix B for the frequency counts that correspond to the percentages provided in the figure above.
ł Student confidentiality was protected by rounding cell sizes to at least 10, and subsequently rounding another category down to ensure that readers cannot mathematically deduce the number of students in the small group.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Most school-based telemedicine visits were for non-communicable health issues

Of the 837 telemedicine visits that occurred during the 2017/18 and 2018/19 school years, non-communicable physical illnesses/conditions were consistently the most common reason for school-based telemedicine visits across the two years of implementation, accounting for 44 percent of the visits (figure 4). These visits were mostly for stomachaches (15 percent of all telemedicine visits) and headaches (11 percent of all telemedicine visits), but also included allergies, asthma, and ear infections.

The next two most common reasons for the telemedicine visits were communicable illnesses (19 percent, such as influenza and conjunctivitis) and physical injuries (17 percent, such as abrasions, sprains, and insect bites). The fourth most common reason was preventative/wellness visits (11 percent), which included routine heath examinations and screenings for conditions such as diabetes and obesity. Miscellaneous visits were the least frequent (9 percent). A similar pattern was found for both lower and upper elementary students, with telemedicine visit types in the same frequency order.

Figure 4. School-based telemedicine visits from 2017/18 to 2018/19 – all visits and by grade level at the time of the visit

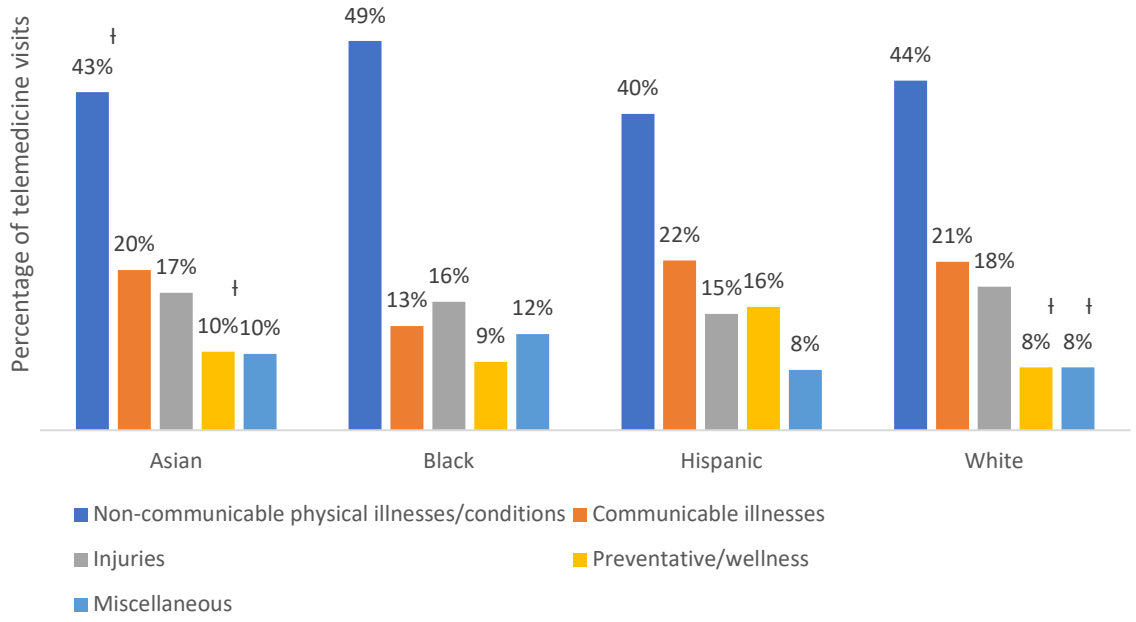


Note: There were 837 telemedicine visits during the 2017/18 and 2018/19 school years. The visit category percentages may not sum to 100 percent for each student group because of rounding. See table B5 in appendix B for the frequency counts that correspond to the percentages provided in the figure above.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Among the school-based telemedicine visits by Black students, there was a lower rate of visits for communicable illnesses and a higher rate of visits for non-communicable physical illnesses/ conditions compared to visits by students of other race/ethnicity groups. Among visits by Hispanic students, there was a higher rate of visits for preventative/wellness reasons compared to visits by students of other race/ethnicity groups.

Overall, the reasons for telemedicine visits showed a similar pattern across the race/ethnicity groups, with non-communicable physical illnesses/conditions as the most common school-based telemedicine visit type, followed by communicable illnesses, injuries, preventative/wellness, and miscellaneous (figure 5). However, there were two exceptions. Among the school-based telemedicine visits by Black students, there was a lower rate of visits for communicable illnesses (13 percent of visits) compared to visits by students of other race/ethnicity groups (20 to 22 percent of visits), as well as a higher rate of visits (49 percent of visits) for non-communicable physical illnesses/conditions (40 to 44 percent of visits by students of other race/ethnicity groups). Among telemedicine visits by Hispanic students, there was a higher rate of visits for preventative/wellness reasons (16 percent of visits) compared to visits by students of other race/ethnicity groups (8 to 10 percent of visits).

Figure 5. School-based telemedicine visits from 2017/18 to 2018/19, by race/ethnicity



Note: There were 820 telemedicine visits during the 2017/18 and 2018/19 school years by students who had race/ethnicity information available. The visit category percentages may not sum to 100 percent for each student group because of rounding. Results for telemedicine visits by students of Other race/ethnicity are not reported in the figure, but they are included in the total number of visits. See table B5 in appendix B for the frequency counts that correspond to the percentages provided in the figure above.

ǂ Student confidentiality was protected by rounding cell sizes to at least 10, and subsequently rounding another category down to ensure that readers cannot mathematically deduce the number of students in the smaller group.

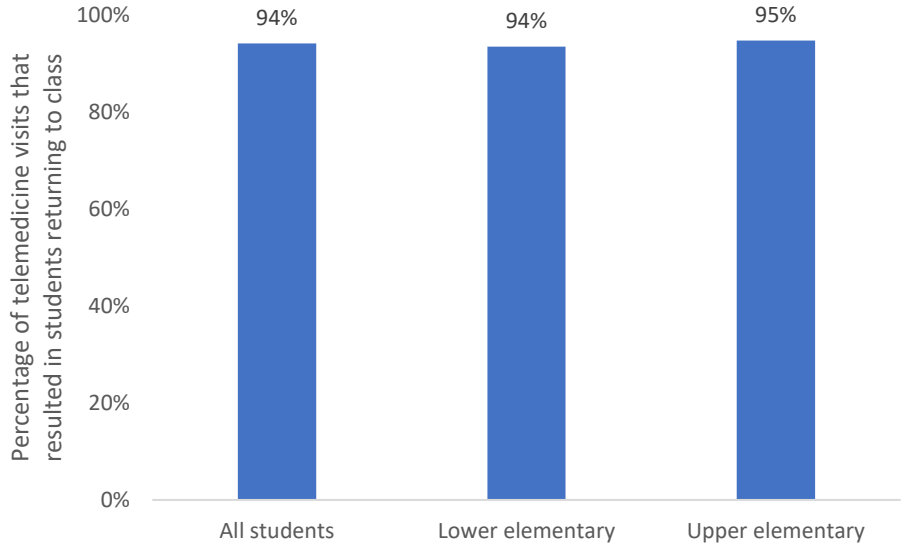
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Nearly all students who had a school-based telemedicine visit returned to class afterwards, receiving, on average, approximately 3 hours of instructional time that remained in that school day

Across the two years of implementation, school-based telemedicine visits overwhelmingly resulted in students returning to class that day. Specifically, lower elementary students had a 94 percent return-to-class rate and upper elementary students had a 95 percent return-to-class rate (figure 6). Given the small number of students who were sent home after telemedicine visits, the research team does not present detailed results broken down by race/ethnicity in order to protect student confidentiality. Across all race/ethnicity groups, the return-to-class rate was higher than 90 percent.[4]

Students who returned to class after a school-based telemedicine visit received, on average, approximately 3 hours of instructional time upon return. This was the instructional time remaining during that school day, which would likely have been lost if the student had instead been sent home. The average instructional time ranged from 2.63 to 2.73 hours across the grade level and race/ethnicity groups.[5]

Figure 6. Return-to-class rates for school-based telemedicine visits during 2017/18 and 2018/19 – all visits and by grade level at the time of the visit



Note: There were 837 telemedicine visits during the 2017/18 and 2018/19 school years. See table B6 in appendix B for the frequency counts that correspond to the percentages provided in the figure above.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

[4] See table B6 in appendix B for rounded approximate results.
[5] Given the lack of variation, the group means are in table B7 in appendix B.

Limitations

Several important cautions for interpreting the results of this study are worth noting. Only two demographic variables, age and race/ethnicity, were made available to REL West for analysis. The study used age as a proxy for grade level, and this potentially could introduce some mis-categorization of grades. This seems most likely for students who started kindergarten early or late, and for students ages 8 or 9 who were on the cut-points for lower elementary (ending at grade 3) and upper elementary (starting at grade 4). However, additional analyses broken down by age (appendix B) suggest that there was not a systematic difference whether outcomes were broken down by age or its proxy, grade level.

Other student characteristics such as socioeconomic status, as well as the intersection between socioeconomic status and race, would be important to examine, as students from low-income households may be less likely to have a regular source of health care and more likely to have unmet health care needs compared to their peers from higher-income households (Larson et al., 2016). It is plausible that unaccounted student characteristics could be correlated with the study's measures and drive the patterns of interest. Additionally, this study only examined the return-to-class rate after telemedicine visits. Student absenteeism data collected by school districts before and after the introduction of school-based telemedicine services—such as full-day and partial-day absences and whether absences were health-related—would allow an investigation to develop a more complete picture of the extent to which health-related partial-day absences are common and whether telemedicine services are associated with reduced health-related absenteeism.

Implications

Study findings suggest that students receiving school-based telemedicine services might help districts reduce the loss of instructional time due to student illness or injury during the school day, but more information is needed to determine whether telemedicine services reduce rates of partial-day, full-day, and chronic absenteeism. Both before and during the pandemic, many California districts struggled to keep students in school all day, every day. For districts like RESD, adopting school-based telemedicine is part of a broader whole-child approach aimed to improve student health and well-being outcomes as well as attendance outcomes. This study found that nearly all telemedicine visits (94 percent) resulted in students returning to class. That is, following treatment, students received instruction instead of being sent home and missing out on that day's learning opportunities.

A more detailed understanding of the reasons for student telemedicine visits is warranted to ensure that the services appropriately match health care needs. For example, knowing if students are experiencing a physical or a mental health condition, or family crisis, has implications for services. This study identified that the most common reason for telemedicine visits was for symptoms related to non-communicable physical illnesses/conditions, specifically for unspecified stomachaches and headaches. School-based health care providers and the literature recognize that these symptoms can be associated with a physical health condition or they can be symptoms of a mental health condition or of emotional stress because they are somatic ways that children often express anxiety (Crawley et al., 2014). Knowing the reasons can also help district leaders and telemedicine service providers plan for adjusting health care service options to meet the full range of student needs.

More information is needed to better understand which students use school-based telemedicine and if there are barriers to accessing or benefiting from telemedicine for students who either opt out of using the services or remain unserved. Districts may want to consider ways to increase the overall rate of telemedicine use through family outreach and enrollment campaigns or through better familiarizing students with the range of services that are offered and how to access them. This study found that across the first two years of telemedicine implementation, 26 percent of students used the services. The study also found differences in telemedicine use by student race/ethnicity. For instance, Asian students used telemedicine services the least in the first two years of implementation (17 percent of Asian students). In contrast, Black students used telemedicine the most (39

percent of Black students). Future studies might want to investigate if this variation is related to different health care needs or awareness about, level of comfort with, or rate of consent for school-based telemedicine, or other factors related to race/ethnicity. In particular, knowing if students' use of telemedicine services is tied to language or culture differences could indicate that districts and telemedicine vendors need to become more culturally responsive in strategies for promoting school-based telemedicine services to families and in the provision of services to students.

Districts might also want to better understand the reasons for telemedicine visits for specific student groups, given the study's findings about variation by race/ethnicity. Better understanding these reasons might help district leaders and telemedicine vendors better promote the use of the full range of health care options. One topic of investigation could be examining the rates for wellness visits, which are intended to provide early diagnosis and early intervention for illnesses or developmental conditions that might be underutilized by some student groups. This study found that among the school-based telemedicine visits by Black students, there was a lower rate of visits for communicable illnesses compared to visits by students of other race/ethnicity groups, as well as a higher rate of visits for non-communicable physical illnesses/conditions. Among telemedicine visits by Hispanic students, there was a higher rate of visits for preventative/wellness reasons compared to visits by students of other race/ethnicity groups. An explanation for these group differences is not presently well understood. Canvasing students and families through surveys or interviews about their awareness of available telehealth support and its range of services, level of satisfaction with currently available telemedicine services, and perceived barriers, such as their level of comfort using technology to receive treatment, is critical for health care equity.

School-based telemedicine is relatively new, and more research is needed to better understand the relationship between its services and education outcomes. For example, previous research on health-related absenteeism and the rate of returning to class after a health care visit did not examine outcomes based on the use of telemedicine. This study, which looks only at telemedicine, nevertheless found similar results to those studies; that is, the use of telemedicine services in lieu of in-person health care provided students with immediate treatment that largely enabled them to return to class that day. This study also contributes new knowledge about school-based telemedicine, adding information about how it may prevent the loss of instructional time. It suggests that further investigations are needed to understand if telemedicine is an effective strategy for reducing health-related full- and partial-day absences, whether attending school in person or through distance learning. As part of such an effort, future studies may choose to examine trends in telemedicine service use and student health-related absenteeism for different grade levels such as at middle school and high school, as older students present some developmentally different issues and have more agency to seek out medical attention than younger students. Studies may also choose to examine telemedicine services in a range of school district and community contexts, especially focusing on families that are historically underserved by school-based student supports.

Appendix A. Details on the sample and analytic methods

Data sources

The telemedicine provider's database included all students from all five elementary schools in the urban Robla Elementary School District (RESD) during 2017/18 and 2018/19. The data received by REL West included no direct identifiers and, to reduce the risk of inadvertent re-identification, included only two demographic variables: age and race/ethnicity, which were obtained by the telemedicine provider from the school district. In addition, the data included information on visit resolution (whether student returned to class or went home); the International Classification of Diseases 10th Revision, Clinical Modification (ICD-10-CM) diagnoses from the Hazel Health visit; and appointment check-out time (to calculate instructional time remaining). All data were from 2017/18 (second and third trimesters only) and 2018/19.

Sample

The study population for research questions 1 and 2 was the cohort of elementary students enrolled during 2017/18 who were still enrolled in RESD in 2018/19. Students were included in the study sample as long they were enrolled in RESD any time during the 2017/18 school year and were still enrolled in the 2018/19 school year (1,607 students). All 1,607 students (100 percent) had information on age as of September 1, 2017 for the main analysis and grade-level group analysis for research questions 1 and 2. A total of 1,596 students (99 percent) had information on race/ethnicity and were included in the race/ethnicity group analysis for research question 2 (tables A1 and A2).

Table A1. Cohort of students followed from 2017/18 to 2018/19 for research questions 1 and 2 – overall and by grade level as of 2017/18

	Number of students	Percent
Total	1,607	100%
Grade level as of 2017/18		
Lower elementary	1,086	68%
Upper elementary	521	32%

Note: The research team used student age to approximate student grade level as of 2017/18. Student age as of September 1, 2017, was calculated, because September 1 is the California Department of Education's cutoff date for each grade's minimum age requirements. Lower elementary includes ages 5 to 8 (the approximated ages for grades kindergarten to 3). Upper elementary includes ages 9 to 10 (the approximated ages for grades 4 and 5).
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table A2. Cohort of students followed from 2017/18 to 2018/19 for research question 2 – analysis by race/ethnicity

	Number of students	Percent
Total	1,596	100%
Race/ethnicity		
Asian	327	20%
Black	210	13%
Hispanic	745	47%
White	197	12%
Other	117	7%

Note: Due to low cell sizes, findings for students of Other race/ethnicity are not reported in the report. However, students of Other race/ethnicity are included in the total sample.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

The study population for research questions 3 and 4 were all telemedicine visits by students in grades kindergarten to 6 that occurred during the first two school years of telemedicine implementation in RESD (from the second trimester of 2017/18 to third trimester of 2018/19). Among the 837 telemedicine visits that occurred during this period, all visits (100 percent) had corresponding student age at the time of visit information, and 820 visits (98 percent) had student race/ethnicity information (tables A3 and A4).

Table A3. Study sample for research questions 3 and 4 – overall and by grade level at the time of the visit

	Number of visits	Percent
Total number of telemedicine visits	837	100%
Grade level at time of telemedicine visit		
Lower elementary	400	48%
Upper elementary	437	52%

Note: The 837 telemedicine visits were made by 518 unique students. Students can use telemedicine services multiple times; thus, this table presents student grade level at the time of each telemedicine visit. Age information was used to approximate student grade level. Student age as of September 1 of each school year was calculated, because September 1 is the California Department of Education's cutoff date for each grade's minimum age requirements. Lower elementary includes ages 5 to 8. Upper elementary includes ages 9 to 12.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table A4. Study sample for research questions 3 and 4 – analysis by race/ethnicity

	Number of visits	Percent
Total number of telemedicine visits	820	100%
Telemedicine visits by students' race/ethnicity		
Asian	103	13%
Black	196	24%
Hispanic	338	41%
White	126	15%
Other	57	7%

Note: The 820 telemedicine visits were made by 505 unique students with race/ethnicity information available. Due to low cell sizes, findings for telemedicine visits by students of Other race/ethnicity are not reported in the report. However, students of Other race/ethnicity are included in the total number of visits.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Definitions of analysis variables

Age. To protect personally identifiable information, the telemedicine provider provided a data file with student age as of September 1 for the 2017/18 school year instead of date of birth.

Race/ethnicity. The district race/ethnicity variable included the following categories: American Indian or Alaska Native, Asian, Black or African American, Filipino, Hispanic, Hawaiian or Other Pacific Islander, two or more races, unknown, and White. The research team created an "Other race/ethnicity" category, which included the following: American Indian or Alaska Native, Filipino, Hawaiian or Other Pacific Islander, and two or more races. Findings for students of Other race/ethnicity were not reported in the report in order to protect student confidentiality when group sample sizes are small. However, students of Other race/ethnicity were included in the "total" samples, and estimates are reported in the appendices whenever cell sizes made it possible.

Grade level. Student grade-level information was not available; however, student age information was available for all students from the district. To examine students' use of school-based telemedicine (research question 2), the research team used age information as of September 1, 2017, as provided by the telemedicine provider. A binary grade-level variable was created, coded as lower elementary for students ages 5 to 8 (based on California Department of Education's minimum normative age of students enrolled in grades kindergarten to 3) and upper elementary for students ages 9 to 12 (based on California Department of Education's minimum normative age of students enrolled in grades 4 to 6). To disaggregate telemedicine visits by grade level (research questions 3 and

4), depending on when the visit occurred (in the 2017/18 or 2018/19 school year), student age of that school year was used to approximate grade level at the time of the visit.

Return-to-class. The telemedicine provider's visit resolution variable (return to school and home) was used to identify which telemedicine visits resulted in students returning to class.

Visit category. The telemedicine provider's administrative database included a variable aligned to the International Classification of Diseases 10th revision, Clinical Modification (ICD-10-CM) that categorized the reason for each telemedicine visit.

Analysis methods

To address research question 1, the research team calculated the percentage of students who used telemedicine services at least once for each trimester.

To address research question 2, the research team calculated the percentage of students who never used telemedicine services, the percentage of students who used telemedicine services once, and the percentage of students who used telemedicine services more than once across the two years (2017/18 and 2018/19). Descriptive statistics were calculated to report on how telemedicine use varied over the two years of the study by student grade level as of 2017/18 and race/ethnicity.

To address research question 3, the research team used the ICD-10-CM variable in the administrative database that categorizes the reason for each telemedicine visit. The 837 Hazel Health telemedicine visits from 2017/18 and 2018/19 were associated with 184 unique values in the ICD-10-CM variable. To examine the classifications of what students were being treated for, the research team collaborated with telemedicine providers' staff to consolidate the ICD-10-CM variable into a fewer number of categories that could be easily understood by school district leaders without a medical background. First, the research team examined the ICD-10-CM values and proposed four categories: communicable illnesses, non-communicable physical illnesses, injuries, and mental/behavioral health. Then, one research team member conducted a thorough review of the ICD-10-CM values and applied the four categories. Separately, the other research team member reviewed the ICD-10-CM values and the applied categories to determine if there was agreement. Next, the research team convened and discussed the coding, proposed a fifth additional category, refined the names of the categories, and reached agreement on the coding. The research team then shared with the telemedicine provider the ICD-10-CM values with the proposed five category coding for review and feedback. The provider agreed with most of the coding and recommended four changes to the coding based on its insights; the research team accepted all four recommended changes. The final five categories for coding telemedicine visits were: communicable illnesses, non-communicable physical illnesses/conditions, injuries, preventative/wellness, and miscellaneous (for symptoms that can be caused by either communicable or non-communicable illnesses/conditions but is undesignated in the dataset). The frequencies of the five visit types are provided in table A5. Descriptive statistics were calculated to report on how the frequency of telemedicine visit type varied by grade level at the time of the visit and by race/ethnicity.

Table A5. Reasons for school-based telemedicine visits and related ICD-10-CM categories

Reason for telemedicine visit	Number of visits	Percent
Communicable illnesses	157	18.76
Injuries	140	16.73
Miscellaneous	79	9.44
Non-communicable physical illnesses/conditions	369	44.09
Preventative/wellness	92	10.99
Total	837	100

Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

To address research question 4, the research team used the telemedicine provider's visit resolution variable (return to school and home) to calculate the return-to-class rate of telemedicine visits. The research team used the telemedicine provider's appointment check-out time (a time stamp variable) to calculate how much instructional time was left for students who returned to class after the telemedicine appointment. For the telemedicine visits that resulted in students returning to class, RESD's school bell schedules (https://www.robla.k12.ca.us/) and the telemedicine appointment check-out time were used to calculate remaining instructional time (in hours). Because the school day includes not only educational time but also time for support services, instructional time was defined as the time students were available in school to learn or access support services, consistent with previous research (for example, Van Cura, 2010). For example, if a student's telemedicine appointment resulted in the student returning to class at 10:00 a.m. and school dismissed at 2:20 p.m., then 4.33 hours of instructional time remained for that student. The analysis accounted for grade-level–specific bell schedules, minimum days, and early releases on Thursdays in the district when calculating remaining instructional time. Specifically, Stata's *dow* command was used to generate a variable indicating the day of the week based off of the school date variable. Dates of minimum days were obtained from the district's academic calendars for the 2017/18 and 2018/19 school years; those dates were used to account for earlier releases on minimum days before calculating remaining instructional time. Descriptive statistics were calculated to report on how the return-to-class rate and the average instructional time remaining for students who return to class after receipt of services varied by grade level at the time of the visit and by race/ethnicity.

Appendix B. Supplemental tables

Table B1. Number and percentage of students who used telemedicine services at least once in each trimester

		2017/18		2018/19		
		2nd trim.	3rd trim.	1st trim.	2nd trim.	3rd trim.
Total	n	12	139	132	132	137
	%	1%	9%	8%	8%	9%

Note: Sample = 1,607 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19. The second trimester of 2017/18 was the first trimester of school-based telemedicine implementation.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B2. Rate of students' use of school-based telemedicine services from 2017/18 to 2018/19, by grade level as of 2017/18

	Number of students who never used telemedicine (%)	Number of students who used telemedicine once (%)	Number of students who used telemedicine more than once (%)
Total	1,190 (74%)	273 (17%)	144 (9%)
Grade level as of 2017/18			
Lower elementary	815 (75%)	180 (17%)	91 (8%)
Upper elementary	375 (72%)	93 (18%)	53 (10%)

Note: Sample = 1,607 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B3. Rate of students' use of school-based telemedicine services from 2017/18 to 2018/19, by age as of 2017/18

	Number of students who never used telemedicine (%)	Number of students who used telemedicine once (%)	Number of students who used telemedicine more than once (%)
Total	1,190 (74%)	273 (17%)	144 (9%)
Age as of 2017/18			
6 or younger	416 (78%)	81 (15%)	33 (6%)
7	200 (73%)	52 (19%)	23 (8%)
8	199 (71%)	47 (17%)	35 (12%)
9	227 (73%)	54 (17%)	31 (10%)
10	148 (71%)	39 (19%)	22 (11%)

Note: Sample = 1,607 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B4. Rate of students' use of school-based telemedicine services from 2017/18 to 2018/19, by race/ethnicity

	Number of students who never used telemedicine (%)	Number of students who used telemedicine once (%)	Number of students who used telemedicine more than once (%)
Total	1,183 (74%)	269 (17%)	144 (9%)
Race/ethnicity			
Asian	271 (83%)	34 (10%)	22 (7%)
Black	128 (61%)	49 (23%)	33 (16%)
Hispanic	561 (75%)	123 (17%)	61 (8%)
White	142 (72%)	>30 ǂ (19%) ǂ	>15 ǂ (9%) ǂ
Other	81 (69%)	>25 ǂ (22%) ǂ	<10 ǂ (9%) ǂ

Note: Sample = 1,596 students continuously enrolled in Robla Elementary School District in 2017/18 and 2018/19 with race/ethnicity information available.
ǂ Student confidentiality was protected by rounding cell sizes to at least 10, and subsequently rounding another category down to ensure that readers cannot mathematically deduce the number of students in the smaller group.
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B5. Number and percentage of telemedicine visit types from 2017/18 to 2018/19, by grade level at the time of the visit and by race/ethnicity

Number of telemedicine visits (%)	All students	Grade level at the time of the visit		Student race/ethnicity			
		Lower elementary	Upper elementary	Asian	Black	Hispanic	White
Total number of visits	837	400	437	103	196	338	126
Communicable illnesses	157	76	81	21	26	73	27
	(19%)	(19%)	(19%)	(20%)	(13%)	(22%)	(21%)
Injuries	140	70	70	18	32	50	23
	(17%)	(18%)	(16%)	(17%)	(16%)	(15%)	(18%)
Miscellaneous	79	42	37	10	24	26	<10 ǂ
	(9%)	(11%)	(8%)	(10%)	(12%)	(8%)	(8%) ǂ
Noncommunicable physical illnesses/conditions	369	158	211	>40 ǂ	97	136	56
	(44%)	(40%)	(48%)	(43%) ǂ	(49%)	(40%)	(44%)
Preventative/wellness	92	54	38	<10 ǂ	17	53	>10 ǂ
	(11%)	(14%)	(9%)	(10%) ǂ	(9%)	(16%)	(8%) ǂ

Note: There were 837 telemedicine visits during the 2017/18 and 2018/19 school years, of which 820 telemedicine visits were by students who had race/ethnicity information available. The visit category percentages may not sum to 100 percent for each student group because of rounding. Results for telemedicine visits by students of Other race/ethnicity are not reported in the table, but they are included in the total number of visits.

ǂ Student confidentiality was protected by rounding cell sizes to at least 10, and subsequently rounding another category down to ensure that readers cannot mathematically deduce the number of students in the smaller group.

Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B6. Return-to-class rates for telemedicine visits from 2017/18 to 2018/19, by grade level at the time of the visit and by race/ethnicity

Number of telemedicine visit resolutions (%)	All students	Grade level at the time of the visit		Student race/ethnicity			
		Lower elementary	Upper elementary	Asian	Black	Hispanic	White
Total number of visits	837	400	437	103	196	338	126
Return-to-class resolution	788	374	414	>90 ǂ	>180 ǂ	317	>110 ǂ
	(94%)	(94%)	(95%)	(90%) ǂ	(95%) ǂ	(94%)	(92%) ǂ
Home resolution	49	26	23	<10 ǂ	<10 ǂ	21	<10 ǂ
	(6%)	(7%)	(5%)	(10%) ǂ	(5%) ǂ	(6%)	(8%) ǂ

Note: There were 837 telemedicine visits during the 2017/18 and 2018/19 school years, of which 820 telemedicine visits were by students who had race/ethnicity information available. Results for telemedicine visits by students of Other race/ethnicity are not reported in the table, but they are included in the total number of visits. The visit resolutions may not sum to 100 percent for each student group because of rounding.

ǂ Student confidentiality was protected by rounding cell sizes to at least 10, and subsequently rounding another category down to ensure that readers cannot mathematically deduce the number of students in the smaller group.

Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

Table B7. Average instructional hours remaining for telemedicine visits that resulted in students returning to class from 2017/18 to 2018/19, by grade level at the time of the visit and by race/ethnicity

	Number of visits that resulted in students returning to class	Mean instructional time remaining
Total	788	2.68
Grade level at the time of the visit		
Lower elementary	374	2.63
Upper elementary	414	2.73
Student race/ethnicity		
Asian	>90 ǂ	2.69
Black	>180 ǂ	2.69
Hispanic	317	2.72
White	>110 ǂ	2.69

Note: The sample consists of telemedicine visits during the 2017/18 and 2018/19 school years that resulted in students returning to class. Results for telemedicine visits by students of Other race/ethnicity are not reported in the table, but they are included in the total number of visits.
ǂ Rounded counts of telemedicine visits that resulted in students returning to class were provided to protect the confidentiality of students who were sent home after telemedicine visits (see table B6).
Source: Authors' analysis of the telemedicine service providers' data described in appendix A.

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