Building School-Academic Partnerships to Implement COVID-19 Testing in Underserved Populations

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abstract

OBJECTIVE: In April 2021, the US government made substantial investments in students' safe return to school by providing resources for school-based coronavirus disease 2019 (COVID-19) mitigation strategies, including COVID-19 diagnostic testing. However, testing uptake and access among vulnerable children and children with medical complexities remained unclear.

METHODS: The Rapid Acceleration of Diagnostics Underserved Populations program was established by the National Institutes of Health to implement and evaluate COVID-19 testing programs in underserved populations. Researchers partnered with schools to implement COVID-19 testing programs. The authors of this study evaluated COVID-19 testing program implementation and enrollment and sought to determine key implementation strategies. A modified Nominal Group Technique was used to survey program leads to identify and rank testing strategies to provide a consensus of high-priority strategies for infectious disease testing in schools for vulnerable children and children with medical complexities.

RESULTS: Among the 11 programs responding to the survey, 4 (36%) included prekindergarten and early care education, 8 (73%) worked with socioeconomically disadvantaged populations, and 4 focused on children with developmental disabilities. A total of 81 916 COVID-19 tests were performed. "Adapting testing strategies to meet the needs, preferences, and changing guidelines," "holding regular meetings with school leadership and staff," and "assessing and responding to community needs" were identified as key implementation strategies by program leads.

CONCLUSIONS: School-academic partnerships helped provide COVID-19 testing in vulnerable children and children with medical complexities using approaches that met the needs of these populations. Additional work is needed to develop best practices for in-school infectious disease testing in all children.

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The Centers for Disease Control and Prevention recommended the provision of coronavirus disease 2019 (COVID-19) testing in prekindergarten-12 (Pre-K-12) schools during the 2021 to 2022 school year to minimize COVID-19 outbreaks in schools and provide readily accessible testing for students and staff.[1] In April 2021, the US government made billions of dollars available to support Pre-K-12 mitigation strategies in schools, including COVID-19 screening testing.[2] State health agencies provided resources to support testing in Pre-K-12 schools.[3,4] Coinciding with this influx of support, the National Institutes of Health launched the Safe Return to School Diagnostic Testing Initiative (RTS) as part of the Rapid Acceleration of Diagnostics Underserved Populations (RADx-UP) program to increase access to COVID-19 testing specifically for underserved and vulnerable populations.[5]

Under the RADx-UP RTS initiative, researchers from academic institutions collaborated with school districts on the design, implementation, and/or analysis of COVID-19 testing programs in schools and communities that may not have readily available access to testing.[6,7] On-site infectious disease testing was a new endeavor for most school districts. Pre-K-12 schools that introduced testing early in the pandemic identified considerations for the planning, design, setup, and evaluation of testing programs, and resources needed for testing implementation.[8] However, real-world data were unavailable on the implementation of testing programs across various school settings and diverse student populations. Herein, we evaluated program implementation, enrollment rates, and tests performed by the RADx-UP RTS Pre-K-12 testing programs during the 2021 to 2022 school year. We also identified key implementation strategies for infectious disease testing in the Pre-K-12 school setting on the basis of consensus assessment by the program leads.

METHODS: COVID-19 TESTING PROGRAMS

RADx-UP Safe Return to School Diagnostic Testing Initiative Projects

In the RADx-UP RTS initiative, a total of 16 projects were awarded by July 2021. An additional RADx-UP project that was funded before the RTS initiative in July 2020 also focused on COVID-19 testing in underserved/vulnerable pediatric populations and was included in this study (Washington University School of Medicine in St. Louis/Special School District of St. Louis County). All projects involved academic researchers who partnered with local school communities serving underserved populations. Disadvantaged school settings were defined by the RADx-UP program as school or early education programs that have >50% of students eligible for free or reduced-price meals and schools, Head Start programs, and school districts or networks that serve a large proportion of individuals from racial and ethnic minority groups.[9] Timing of initiation, target populations, and testing strategies varied by program.

Data Collection on COVID-19 Testing

All 17 funded RADx-UP projects were surveyed on the COVID-19 testing programs. Project leaders and principal investigators were contacted to participate in a survey in May 2022; contributing programs are listed in Table 1. Surveys were administered through REDCap electronic data capture tools hosted at Children's Mercy Kansas City.[10,11] The survey included descriptive information about participating school/school districts, student demographics, student populations eligible to participate in the testing programs, and actual student enrollment in testing. Participant-level race and ethnicity were self-reported, and district-level race and ethnicity data were obtained from publicly available sources. Survey respondents also reported on logistical features, including testing location, type of COVID-19 testing platform, estimated turnaround time from test to communication of results, the number of COVID-19 tests performed, and overall test positivity. All RADx-UP projects obtained individual institutional review board approval per their respective institutions for testing program implementation.

Statistical Analysis

This study provides descriptive statistics on school type, county size, type of participant (eg, student, staff, family member), participant population (eg, children with developmental disabilities, underserved populations, etc), testing program (eg, screening testing, Test to Stay, etc), tests administered (eg, pooled or individual nucleic acid amplification tests or antigen), collection method, collection locations, number of tests performed, test result turnaround time, and percent positivity of administered tests from July 1, 2021 to May 1, 2022. We examined student demographic characteristics between testing program participants and all students eligible to participate in testing programs using a t test of mean differences. A range plot of enrollment and eligibility was created to further describe the number of eligible students and the number of students enrolled by site. Data from programs that involved multiple school districts were aggregated to the program level. Analysis was performed in SAS 9.4, and figures were created by using the R statistical package.

Identifying Key Program Implementation Strategies

We used a modified Nominal Group Technique (NGT) with the purposive sample of 30 project leads, principal investigators, and other academic research team members across the RADx-UP RTS projects that implemented COVID-19 testing for ≥3 months. Fifteen projects had been testing for at least 3 months at the time of survey deployment. These individuals represent a broad range of child health experts, including pediatricians, epidemiologists, behavioral scientists, program implementers, and infectious diseases specialists. The modified NGT is a structured process for arriving at a consensus that encourages participation from all group members. Our

TABLE 1 Baseline Testing Characteristics by RADx-UP Return to School Programs

Site	School Type (Pre-K-12)	County Size	Participants	Participant Population	Type of Testing Program	Type of Test	Sample Collection Method	Location of Collection	Number of Tests Performed	Test Results Turnaround Time	Percent Positivity
Arizona State University	Pre-K/ECE	Large metro (1 million or more people)	Student, staff, family	Hispanic/Latino populations, socio-economically disadvantaged populations	Screening/asymp-tomatic, Test to Stay	Individual PCR/ NAAT	Saliva, anterior nares	School	449	25–48 h	0.04%
Children's Mercy/ ICF	K-12	Large metro (1 million or more people)	Student, staff	Black/African American and Hispanic/Latino populations, socio-economically disadvantaged populations	Screening/ asymptomatic, diagnostic/ symptomatic, exposure	Individual PCR/ NAAT	Anterior nares	School	4014	25–48 h	3.6%
Duke University	Pre-K-9	Micropolitan (10 000–49 999)	Student, staff	American Indian/ Alaska Native, Asian American, Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations; excluded populations unable to mask (eg, special needs)	Test to Stay	Antigen	Anterior nares	School	10 568	0–1 h	3.7%
University of Hawaii	K-12	Small metro (<250 000)	Student, staff, family	Asian American and Native Hawaiian and other Pacific Islander populations, socio-economically disadvantaged populations	Screening/ asymptomatic	Antigen	Anterior nares	School, community-based site, pop-up site	9569	0–1 h	2.41%
San Diego State University	Middle	Large metro (1 million or more people)	Student, staff, family	Asian American and Hispanic/Latino populations, sexual and gender minorities, socio-	Screening/ asymptomatic, diagnostic/ symptomatic, exposure	Antigen	Anterior nares	School, home	13 781	0–1 h	2.24%

TABLE 1 Continued

Site	School Type (Pre-K-12)	County Size	Participants	Participant Population	Type of Testing Program	Type of Test	Sample Collection Method	Location of Collection	Number of Tests Performed	Test Results Turnaround Time	Percent Positivity
				economically disadvantaged populations							
University of Miami	K-12	Large metro (1 million or more people)	Student	Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations, socio-economically disadvantaged populations, underserved urban population	Screening/asymp-tomatic, diagnostic/sympto-matic, exposure	Individual PCR/NAAT	Anterior nares	School	697	0–1 h	9%
University of Rochester	Pre-K-12	Medium metro (250 000–999 999)	Student, staff	Children with developmental disabilities and American Indian/Alaska Native, Asian American, Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations	Screening/asymptomatic, diagnostic/symptomatic, Test to Stay, exposure	Individual PCR/NAAT	Anterior nares	School, home	1378	25–48 h	2%
University of Washington	K-5	Micropolitan (10 000–49 999)	Student, staff	Hispanic/Latino populations, socio-economically disadvantaged populations, underserved rural populations	Screening/asymptomatic, Test to Stay	Antigen	Anterior nares	School	11 026	0–1 h	14.93%
Washington University School of Medicine in St. Louis	Pre-K-12	Medium metro (250 000–999 999)	Student, staff, household members	Children with developmental disabilities; American Indian/Alaska Native, Asian American,	Screening/asymptomatic, diagnostic/symptomatic, exposure	Individual PCR/NAAT	Saliva	School, home, community-based site, pop-up site	11 913	2–12 h, 13–24 h, 25–48 h	3.18%

TABLE 1 Continued

Site	School Type (Pre-K-12)	County Size	Participants	Participant Population	Type of Testing Program	Type of Test	Sample Collection Method	Location of Collection	Number of Tests Performed	Test Results Turnaround Time	Percent Positivity
				Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations; socio-economically disadvantaged populations							
Washington University School of Medicine in St. Louis/Special School District of St Louis County	K-12	Medium metro (250 000–999 999)	Student, staff	Children with developmental disabilities and American Indian/Alaska Native, Asian American, Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations	Screening/asymptomatic, diagnostic/symptomatic, exposure	Individual PCR/NAAT	Saliva	School, home	11 757	2–12 h, 13–24 h	1.2%
Kennedy Krieger Institute Schools	K-12	Medium metro (250 000–999 999)	Student, staff	Children with developmental disabilities; American Indian/Alaska Native, Asian American, Black/African American, Hispanic/Latino, and Native Hawaiian and other Pacific Islander populations; socio-economically disadvantaged populations	Screening/asymptomatic	Individual PCR/NAAT	Saliva	School	6764	25–48 h	0.62%

ECE, early care and education.

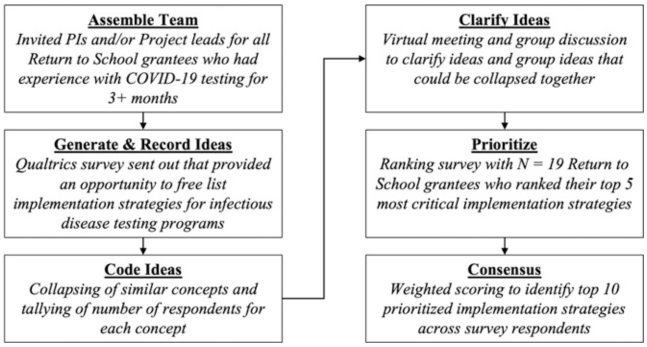

FIGURE 1
Modified NGT process.

NGT process involved 6 steps: (1) assemble the team, (2) generate and record ideas, (3) code the ideas generated, (4) clarify and refine the set of ideas, (5) prioritize ideas, and (6) construct a consensus set of ideas that can be recommended on the basis of expert opinion and experience (Fig 1).

A 2-step survey approach was used in July 2022 to identify key strategies for school-based COVID-19 testing. First, the authorship team fielded an initial Qualtrics electronic survey to 23 potential participants. These participants ranged from project principal investigators to persons appointed by the project principal investigators who were deemed knowledgeable about implementation strategies employed by schools. Participants could complete the survey on their own or based on group feedback for a specific project. The survey included a brief description of the goal (eg, to create a taxonomy of strategies schools can use to implement infectious disease testing programs) with definitions and examples of potential implementation strategies. Consistent with implementation science literature,[12] we defined implementation strategies as "the actions taken to enhance adoption, implementation, and sustainability of infectious disease testing programs." Participants were asked to list up to 10 strategies per domain of the Consolidated Framework for Implementation Research (CFIR).[13] The CFIR was used to elicit strategies that target determinants of COVID-19 testing implementation barriers under 5 different empirically supported domains of implementation (Outer Setting, Inner Setting, Intervention Characteristics, Characteristics of Individuals, and Process).

A single coder (author EH) collapsed strategies identified from the first survey that were similar in meaning and applied a cover term for each strategy described. The set of coded strategies was then reviewed during a virtual conference call meeting with the survey respondents to further collapse and distinguish strategies and ensure agreement on a finalized list. The agreed-on list was compiled into a second Qualtrics electronic survey that was sent to the same 23 potential participants. The second survey asked participants to identify and rank their top 5 most important strategies for the successful implementation of infectious disease testing programs in schools.

From these results, the study authors compiled a consensus list of 10 strategies. Final rankings were based on whether ≥10% of participants ranked the strategy as their top choice, and weighted prioritization was based on the cumulative percentage of participants who placed the strategy among their top 5 choices. The final set of 10 strategies was then produced, representing a consensus from participants on the most important strategies needed to implement COVID-19 testing programs in schools.

RESULTS

COVID-19 Testing Programs

In this study, 11 funded programs submitted programmatic details (Table 1). Participating educational programs were located across the United States and in county sizes ranging from micropolitan to large metropolitan counties. Overall, 4 (36%) programs included Pre-K and early care education, 8 (73%) programs engaged socioeconomically disadvantaged populations, and 4 (36%) programs focused on children with developmental disabilities.

Across programs, 81 916 COVID-19 tests were performed. Most programs provided COVID-19 screening testing (ie, testing those without symptoms and no known exposure), whereas Test to Stay/exposure testing (ie, testing those who have been exposed to someone with COVID-19 but remain asymptomatic), and symptomatic testing were offered at fewer sites. For the COVID-19 testing platform, 7 programs used individual polymerase chain reaction (PCR)/nucleic acid amplification test (NAAT), and 4 used antigen testing. Turnaround time from testing to result was typically 25 to 48 hours for PCR/NAAT and <1 hour for antigen testing. Anterior nares swabs were the primary sample collection method. All programs performed testing at school, and 5 programs offered testing at home and/or in a nonschool community setting.

Student participation in the COVID-19 testing programs ranged from 3.1% to 38.7% of the eligible population. In general, programs with smaller eligible populations enrolled a higher percentage of students (Table 2 & Fig 2).

Key Program Implementation Strategies

For the implementation strategies survey, 11 of the 15 programs (73%) that had been testing for ≥3 months participated in a component of the survey. A total of 11 participants (47.8% of full sample) completed the initial survey, which resulted in 255 strategies listed across the 5 CFIR domains. After initial coding, these 255 strategies were reduced to a total of 64 strategies. During a virtual meeting, 9 participants refined these strategies to a final list of 45 strategies. At the meeting, participants agreed that the list of strategies could not be specific to each CFIR domain as some strategies

TABLE 2 Participant Demographics for Those Eligible and Enrolled in Testing Programs

			Male		White		Black		Hispanic, Latino, or Spanish	
Site	Total students eligible	Total students enrolled[a] (%)	Enrolled[b] (%)	Eligible[c]	Enrolled[b] (%)	Eligible[c]	Enrolled[b] (%)	Eligible[c]	Enrolled[b] (%)	Eligible[c]
Arizona State University	761	220 (28.9)	99 (45)	—[e]	46 (20.9)	—	8 (3.6)	—	61 (27.7)	—
Children's Mercy/ICF	4623	683 (14.8)	303 (44.4)	51.8%	213 (31.2)	11.9%	247 (36.2)	40.4%	231 (33.8)	35.4%
Duke University	—	4114 (.)[f]	2051 (49.9)	51.3%	3224 (78.4)	71.9%	552 (13.4)	17.7%	496 (12.1)	19.6%
University of Hawaii	4500	1742 (38.7)	526 (30.2)	50%	37 (2.1)	10%	2 (0.1)	3%	64 (3.7)	1%
San Diego State University	8115	1788 (22)	785 (43.9)	41.4%	94 (5.3)	38.6%	44 (2.5)	3.3%	1379 (77.1)	77%
University of Miami	7845	2784 (35.5)	1308 (47)	52%	747 (26.8)	26%	1946 (69.9)	71%	776 (27.9)	28%
University of Rochester	434	56 (12.9)	31 (55.4)	69%	31 (55.4)	60%	7 (12.5)	33%	3 (5.4)	15%
University of Washington	15700	663 (4.2)	289 (43.6)	52%	418 (63)	15%	—	0.6%	486 (73.3)	80%
Washington University School of Medicine in St. Louis	23086	705 (3.1)	352 (49.9)	—	178 (25.2)	—	424 (60.1)	—	42 (6)	—
Washington University School of Medicine in St. Louis/Special School District of St. Louis County	722	103 (14.3)	81 (78.6)	76%	41 (39.8)	40%	50 (48.5)	52%	3 (2.9)	3%
Kennedy Krieger Institute Schools	490	50 (10.2)	41 (82)	81%	27 (54)	45%	16 (32)	40%	5 (10)	8%
Overall mean difference (95% CI)[d]	—	—	−6.5 (−20.1 to 7.2)		1.2 (−20.6 to 22.9)		−1.1 (−25.3 to 23.1)		−4.2 (−30.9 to 22.4)	

CI, confidence interval.
[a] Percentages are calculated on the basis of the total number of students eligible.
[b] Percentages are calculated on the basis of the total number of participants enrolled.
[c] Percentages are directly collected in the RedCap survey and are approximated by the school district.
[d] t test of mean difference of eligible versus enrolled populations.
[e] Data unavailable.
[f] Unable to calculate due to unavailable data.

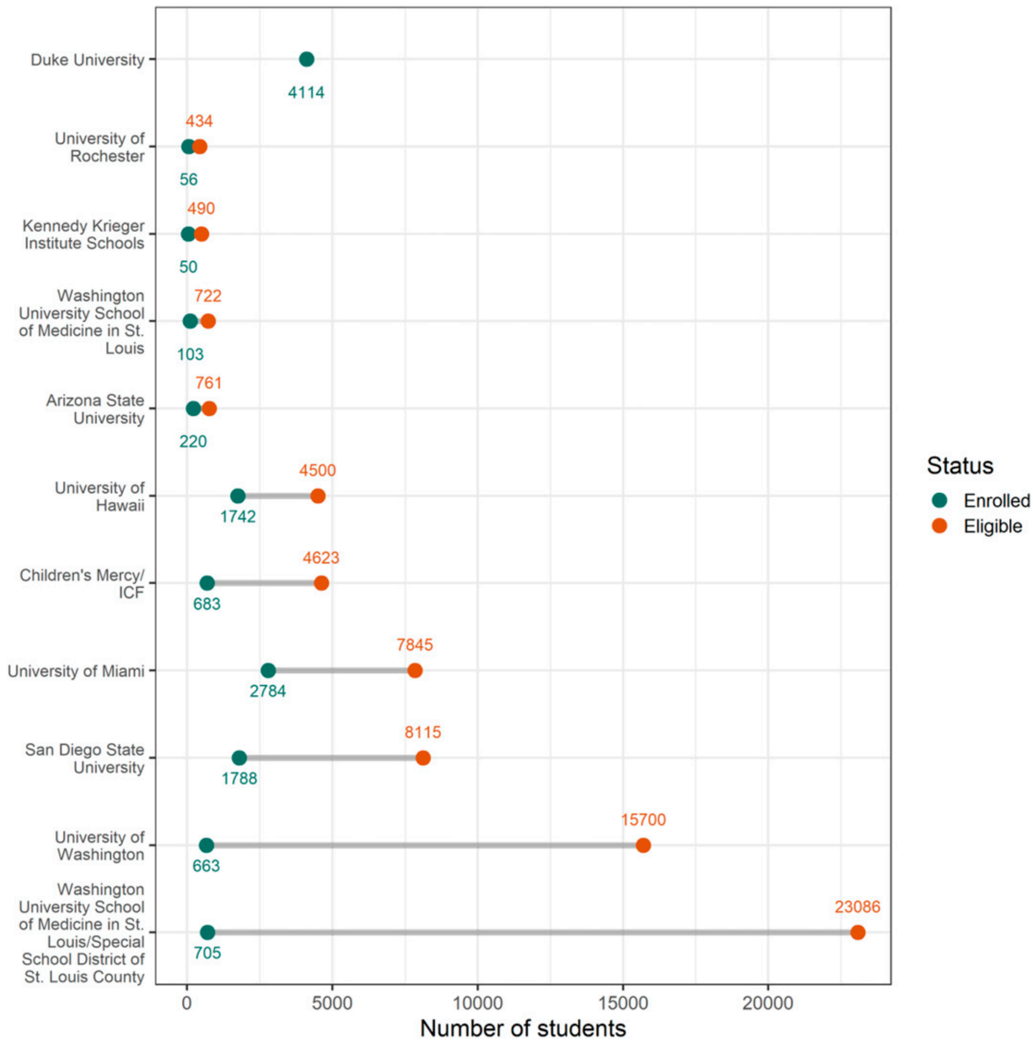

FIGURE 2
Difference between the number of students participating in a COVID-19 testing program compared with the number of students eligible for the program.

spanned multiple domains. As a result, further prioritization and consensus activities did not include strategies separated by specific CFIR domain.

For the final survey, a total of 19 participants responded (82.6%). Overall, 19 of the 45 strategies were not prioritized by any respondent as one of their top 5 most important strategies. All participants considered "Adapting testing strategies to meet the needs, preferences, and changing guidelines" as the most important implementation strategy. Participants shared the following examples of this strategy: (1) "instead of setting [testing] up in a room and bringing the person being tested to the room, go to the room where the person is located," (2) "modify the testing strategy to align with the preferred testing strategy," and (3) "design intentional opportunities to adapt and change course." The second most important strategy was "Holding regular meetings with school leadership and staff." Participants described this strategy as follows: (1) "regularly scheduled meetings with district testing champions, supervisors, and support staff as well as our local team and members of [the local health facility] to discuss problems and problem-solving," (2) "regular meetings with school officials," and (3) "continuously communicating with health center and school staff/administration." The third most important strategy was "Assessing and responding to community needs." All other prioritized strategies are included in Table 3.

DISCUSSION

The US federal government invested substantial COVID-19 testing resources in Pre-K-12 schools to directly support a

TABLE 3 Final List of Implementation Strategies Ranked in Order of Importance

Strategy	Percentage Top Choice	Cumulative Percentage of Participants Who Ranked in Top 5	Final Importance Ranking
Adapt testing strategies to needs and preferences; change guidelines	32%	84%	1
Meet regularly with school leadership and staff	16%	37%	2
Assess and respond to community needs	11%	32%	3
Establish/maintain Community Advisory Board	11%	21%	4
Integrate into existing infrastructure when possible	0%	53%	5
Identify, empower, and train champions	5%	47%	6
Develop materials tailored to community you serve (eg, communication, consent forms)	0%	37%	7
Report and disseminate data regularly	5%	32%	8
Meet with local stakeholders	5%	16%	9
Raise awareness through outreach and strategic communications	0%	21%	10

safe return to schools 1 year into the pandemic. Implementing infectious disease testing in schools during the 2021 to 2022 school year involved the rapid deployment of severe acute respiratory syndrome coronavirus 2 testing by school administrators and nurses, state and federal agencies, and testing companies. Despite this influx of support, testing program uptake and access in Pre-K-12 schools remain poorly understood. The RADx-UP RTS programs provide new information about testing uptake in pediatric populations and highlight key recommended strategies for testing program implementation in school populations.

With support from the National Institutes of Health, a variety of testing programs were developed to meet the needs of underserved and vulnerable children. We learned that a one-size-fits-all approach does not apply to all children, schools, and school systems when considering testing approaches and that testing enrollment can vary greatly across districts. A consensus was met by the RADx-UP RTS project leads and principal investigators, identifying key considerations for the implementation of diagnostic testing programs focused on underserved and/or vulnerable children.

RADx-UP RTS programs sought to implement testing strategies on the basis of community needs and implementation capabilities. Although individual states and the Centers for Disease Control and Prevention have provided broad programmatic guidance for COVID-19 school testing programs, little information is available on testing methods for vulnerable children or children with medical complexities. Challenges to testing included obtaining consent when most schools were not allowing caregivers inside school buildings because of the pandemic, communicating with non-English-, non-Spanish-speaking families, and developing safe and effective processes for testing young children and those with developmental disabilities outside of the medical setting.

Models to determine the efficacy of COVID-19 testing programs should be based on the realities of program enrollment and participation. Minimizing COVID-19 infections and transmission in schools is multifaceted and complex, with vaccination rates, community COVID-19 rates, mitigation strategies, and activities all contributing to transmission risk.[14–16] Recent studies reveal that in-school testing programs can help reduce in-school transmission when the participation rates of students and staff are high (~90% to 100%).[8,17,18] However, inferences from existing studies of school testing programs across the United States are limited because they provide the number of tests performed but lack testing participation or enrollment data.[19–21] We observed variable enrollment across RADx-UP RTS testing programs. Participant enrollment mirrored eligible participant demographics, suggesting that programs were able to effectively provide COVID-19 testing to diverse populations.

Little guidance is available for best practices related to in-school COVID-19 testing programs. Pilot testing programs in K-12 schools provided early insights, recommendations, and implications to guide testing programs.[8] Adapting testing strategies and modifying guidelines were identified as the most important implementation strategy among RADx-UP project leaders. This likely reflects both the focus of the RADx-UP RTS program to bring testing to vulnerable pediatric populations and highlights the need to be flexible and adapt to ongoing updates and modifications of COVID-19 school protocols. Engaging communities and meeting with school leadership were also identified as key integration factors. These implementation strategies should be considered by vendors and program developers when constructing initiatives for school communities.

The limitations of this study include the self-reported implementation details, the variation in testing program design and context, and the potential lack of generalizability to schools across the country. However, the RADx-UP RTS programs represent a wide variety of pediatric populations in geographically distinct locations. We did not look specifically at the impact of COVID-19 testing on safe return to school as this was beyond the scope of this study and is being explored in additional work.[22,23] Additionally, the key implementation strategies were identified by the project leads and principal investigators only, and input from schools and families was not evaluated in this study.

CONCLUSIONS

In conclusion, collaborations between academic centers and schools helped to provide COVID-19 testing for vulnerable children and children with medical complexities. Testing can be conducted by using different approaches that meet the unique needs of the population. Additional work is needed to develop best practices for the implementation of infectious disease testing for all children at school.

ACKNOWLEDGMENTS

Brooke Walker, MS, Duke Clinical Research Institute, provided editorial review and submission. Ms Walker did not receive compensation for her contributions, apart from her employment at the institution in which this study was conducted.

ABBREVIATIONS

CFIR: Consolidated Framework for Implementation Research
COVID-19: coronavirus disease 2019
NAAT: nucleic acid amplification test
NGT: Nominal Group Technique
PCR: polymerase chain reaction
Pre-K-12: prekindergarten-12
RADx-UP: Rapid Acceleration of Diagnostics Underserved Populations
RTS: Safe Return to School Diagnostic Testing Initiative

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Drs Goldman, Schuster, Kalu, and Haroz conceptualized and designed the study, designed the data collection instruments, conducted the initial analyses, and critically reviewed and revised the manuscript for important intellectual content; Drs Zimmerman, Benjamin, Newland, Foxe, Zand, Ko, Gurnett, Kalb, Inkelas, Manuel, Lee, Okihiro, Gwynn, McDaniels-Davidson, Coller, DeMuri, McCulloh, Keener Mast, and Wu conceptualized and designed the study, coordinated and supervised data collection, and critically reviewed and revised the manuscript; Dr Brookhart and Mr Erickson conducted data analyses and critically reviewed and revised the manuscript; Drs Dewhurst, Oh, Wetter, Murugan, Kramer, Broadhurst, Pulgaron, Kiene, Oren, and Stump and Mr Sherby, Mr Walsh, Mr Watterson, Ms Godambe, Ms Shinde, Ms Archuleta, and Mr Fist coordinated and supervised data collection and critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DOI: https://doi.org/10.1542/peds.2022-060352C

Accepted for publication Apr 4, 2023

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FUNDING: Funded by the National Institutes of Health (NIH). Research reported in this publication was supported by the Office of the Director of the NIH under award number U24MD016258; NIH Agreement No.'s OT2HD107543, OT2HD107544, OT2HD107553, OT2HD107555, OT2HD107556, OT2HD107557, OT2HD107558, OT2HD107559, OT2HD108103, OT2HD108101, OT2HD108105, OT2HD108111, OT2HD108106, OT2HD108112, OT2HD108097, OT2HD108110, 3P0HD103525-03S1; the National Center for Advancing Translational Sciences of the NIH under award number U24TR001608; and the National Institute of Child Health and Human Development of the NIH under contract HHSN275201000003I.

The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

CONFLICT OF INTEREST DISCLOSURES: Dr Kalu reports funding from the Centers for Disease Control and Prevention (CDC) Epicenter and the NIH, and receives consultancy fees from IPEC Experts and Wayfair. Dr Zimmerman reports funding from the NIH and the United States Food and Drug Administration (FDA). Dr Goldman reports funding from the NIH. Dr Schuster reports funding from the NIH, CDC, and Merck. Dr Newland reports funding from NIH, Pfizer, and Merck. The other authors have no conflicts of interest to disclose.

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