Implementation of School-Based COVID-19 Testing Programs in Underserved Populations

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abstract

Evidence suggests that coronavirus disease 2019 (COVID-19) testing in schools can add a layer of protection to reduce the spread of Severe Acute Respiratory Syndrome Coronavirus 2 and facilitate a safer return to in-person learning. Despite this evidence, implementation of testing in school settings has been challenging initially because of a lack of funding and limited availability of testing, but, as the pandemic has progressed and more funding and resources have been devoted to testing, other implementation challenges have arisen. We describe key implementation barriers and strategies that have been operationalized across 5 projects working to help schools with predominantly underserved populations who have faced significant COVID-19–related health disparities. We leveraged a key framework from the implementation science field to identify the challenges and used a matching tool to align implementation strategies to these challenges. Our findings suggest that the biggest obstacles to COVID-19 testing were the perceived relative advantages versus burden of COVID-19 testing, limited engagement with the target beneficiaries (eg, families, students, staff), and innovation complexity. Common strategies to overcome these challenges included identifying and preparing testing champions, altering incentive and allowance structures, assessing for readiness, and identifying barriers and facilitators. We aim to augment existing implementation guidance for schools by describing common barriers and recommended solutions from the implementation science field. Our results indicate a clear need to provide implementation support to schools to facilitate COVID-19 testing as an added layered mitigation strategy.

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In March 2020, most schools across the globe closed to in-person learning to curb the spread of coronavirus disease 2019 (COVID-19). During the 2020–2021 school year, accumulated evidence revealed that if mitigation measures are followed, including masking, physical distancing, and vaccinations for those eligible, schools can safely maintain in-person learning while simultaneously not contributing to community spread of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).[1–4] COVID-19 symptomatic and screening testing has also been recommended as an additional measure to detect cases and reduce the likelihood of SARS-CoV-2 transmission in schools.[5] Given the significant academic, social support, nutritional assistance, and health care benefits afforded by in-person education, keeping schools open and safe from COVID-19 is a significant public health priority for the 2021–2022 school year.[6]

The first public schools to implement COVID-19 testing at scale began in October 2020.[7] Since then, many school districts across the country have worked to implement COVID-19 testing for their staff and students. In this process, schools have had to navigate unprecedented challenges that hit at the very nature of our educational system, including a rapid switch from traditional in-person learning to virtual learning, and conflicting stakeholder opinions from school boards, unions, parents, and students. Additionally, educators had to become experts in testing for infectious diseases because no standard process existed in schools.

Although school health screening processes are not necessarily new (eg, mental health, vision, etc), schools have not had to implement testing for a highly transmissible, pandemic virus that causes respiratory infection. The ever-changing nature of operating during a pandemic, coupled with overburdened public health systems, adds unprecedented complexity. Evidence suggests the beneficial role of testing as an added mitigation strategy for schools to facilitate in-person learning.[8–12] Although not conclusive, implementation of COVID-19 testing in schools combined with other mitigation efforts may help to identify asymptomatic cases, reduce spread, and maximize the number of in-person learning days.[8–12] In the strongest study to date, Young et al[10] randomly assigned secondary schools to either require quarantining of close contacts or daily testing of close contacts if asymptomatic, with findings suggesting that transmission rates were similar between groups, but the daily testing group missed fewer days of school.[10] Even with the increased availability of vaccines, school-based testing will play a critical role in detecting cases in which SARS-CoV-2 escapes vaccine immunity, cases in high-risk populations, cases in regions with low vaccination rates, and cases in vaccine-ineligible populations until vaccines are available for all. Testing may also help school communities in areas disproportionately affected by COVID-19 because it provides an added layer of reassurance against a disease that has had devastating consequences.[13]

In contrast to the Fall of 2020, when COVID-19 testing began, federal funding has now been appropriated for large-scale testing in schools.[14] However, best practices have not been defined on how to implement testing programs in schools. In this article, we aim to provide practical guidance on the implementation of school-based COVID-19 testing by describing key barriers to screening testing, with a particular focus on implementation strategies used to address these barriers. Guided by the Consolidated Framework for Implementation Research (CFIR),[15] we describe barriers to implementation across a group of testing projects and use the Expert Recommendations for Implementation Change (ERIC)[16] to share solutions our teams used to overcome these challenges. Collectively, we represent 6 teams, working in diverse school settings and funded under the National Institutes of Health's Rapid Acceleration of Diagnostics Underserved Populations Return to School projects.[17] The focus on underserved populations is critical to help ensure that all schools have the ability to reopen safely for their students and families.

METHODS

The 6 research teams represent diverse regions of the country, types of schools, and populations. School partnership is at the core of these projects. All schools serve low-resource and/or underserved communities. In this article, we focus specifically on our experiences with implementation of COVID-19 testing in schools. Each project is described below with summaries of testing approaches included in Table 1.

Kennedy Krieger Institute

The Kennedy Krieger Institute (KKI) is dedicated to improving the lives of people with neurodevelopmental disorders. Individuals with neurodevelopmental disorders, such as those with intellectual and developmental delays, represent an underserved group who have suffered historic indignities and disparities.[18] Guided by a community advisory board (CAB), this project is focused on evaluating the best implementation and communication strategies to maximize the use of a SARS-CoV-2 diagnostic test approved by the US

TABLE 1 Descriptions of Testing Strategies Used in Projects

Project	School Type	Participant	Population	Type of Test	Location of Test	Collection Method	Location of Collection	Consent Required	Who Performed Testing
KKI	K–12	Students and staff	Children with developmental disabilities	PCR	Laboratory	Saliva	School	Yes	Research team
Project Safe Schools (JHCAIH)	Headstart to 12	Students and staff	Native American	Pooled PCR; rapid antigen	School	Lower nasal swab	School	Yes	Self-swab, school
School TLC study (ICF/CMKC)	K–12	Students and staff	African American, Hispanic or Latino, low-income children	PCR	Laboratory	Saliva and anterior nares	School	Yes	Research team with self-testing
SRS North County (WashU)	K–12	Students and staff	African American	PCR	Laboratory	Saliva	School	Yes	Research team
SSD (WashU)	K to ≥12	Students and staff	Children with developmental disabilities	PCR	Laboratory	Saliva	School	Yes	Research team
University of Washington Fred Hutchinson Cancer Research Center (ROSSEY)	K–8	Students and staff	Hispanic or Latino	PCR	Laboratory	Anterior nares swab	School or home	Yes	Research team at school or by adults at home

PCR, polymerase chain reaction.

Food and Drug Administration in a school setting for students with intellectual and developmental disabilities (IDDs) and school staff. Testing at KKI is considered a strategy that may help families feel safer to return to in-person learning. The testing protocol for KKI consists of weekly saliva-based diagnostic surveillance testing. Both students and staff are eligible for enrollment. The KKI partnership adds to work that is already being conducted with Washington University in St Louis (WashU) through the Intellectual and Developmental Disabilities Research Center network (P50 HD103525-01S1).

The Johns Hopkins Center for American Indian Health

The Johns Hopkins Center for American Indian Health (JHCAIH)'s Project SafeSchools builds on a ≥40-year trusted relationship with Native American communities in the Southwest and uses community-based participatory research (CBPR) methods. The project's aims are as follows: (1) understand the barriers and facilitators to school reopenings and the impact of school closures on youth from multiple stakeholder perspectives; (2) measure the acceptability, feasibility, reach, and impact of surveillance testing for COVID-19 in schools; and (3) understand the social, emotional, mental, educational, and physical health impacts of returning to school among caregivers and youth aged 4 to 16 years. The project is guided by CABs. Each school decides its own testing strategy in collaboration with Tribal partners and local and state public health departments. Testing data are collected by schools for only those participants who give their consent and are then shared with the research team for analysis through data-sharing agreements.

ICF and Children's Mercy Kansas City

ICF and Children's Mercy Kansas City (CMKC) are partnering to implement Support for Safe Return to In-Person School: COVID-19 Testing, Learning, and Consultation (School TLC Study). This project has the following aims: (1) determine the preferred type of screening testing (nasal versus saliva) for students and staff in 3 public schools (elementary, middle, and high school), (2) identify factors that parents and caregivers and school staff associate with a safe return to school (SRS) through a needs assessment and key informant interviews, and (3) apply findings and insight from the study to enhance COVID-19 testing strategies during the 2021–2022 school year. In addition to COVID-19 testing, with the study, we will provide personalized medical consultation and communication support to an expanded number of schools and assess the effects of these interventions on testing uptake compared with other schools in the same school district with access to other testing programs. Other potential outcomes to be examined in the study include parent knowledge and attitudes about COVID-19, student and staff vaccination rates, COVID-19 cases, and student absenteeism.

WashU SRS

WashU is partnering with 5 school districts in predominantly African American communities in St Louis County, Missouri, to help promote an SRS. The SRS project's aims are as follows: (1) identify the best testing strategy (weekly screening testing plus symptomatic testing versus symptomatic testing alone) for middle and high school students and staff to best prevent school-based SARS-CoV-2 transmission; (2) evaluate the mitigation strategies in addition to testing used in schools; and (3) partner with community-based organizations to understand the social, ethical, and behavioral implications of COVID-19 testing, vaccination, and in-person school. Listening sessions are used to obtain stakeholder feedback, and a saliva-based testing strategy is being used for the testing approach. A CAB informs the research through input on study messaging and recruitment strategies.

WashU Special School District

WashU is partnering with the Special School District of St Louis County (SSD). The SSD operates 6 schools dedicated solely to the education of students with IDDs from kindergarten to beyond high school. Similar to the work at KKI, this project works with students who are underserved. This aims of the project are as follows: (1) determine the most effective implementation strategies and messaging to maximize SARS-CoV-2 testing for children with IDDs and school staff and (2) assess national perspectives among parents of children with IDDs and school staff regarding the impact of COVID-19 and the importance of SARS-CoV-2 testing. Similar to SRS, the SSD uses listening sessions with primary stakeholders and a saliva-based testing strategy. Fuzzy cognitive mapping sessions and custom surveys will be leveraged to assess testing sustainability in schools.

University of Washington

The University of Washington's ReOpening Schools and Educating Youth (ROSSEY) project builds on a 10-year partnership with the community in the Yakima Valley of Eastern Washington State. ROSSEY is a school-academic partnership with 1 large school district, which includes predominantly Hispanic families in the Yakima Valley. The project's aims are as follows: (1) identify the community's social, ethical, and behavioral needs and resources for students to return to school and maintain on-site learning; (2) evaluate the effectiveness of a testing program on student attendance by using a cluster randomized controlled trial; and (3) assess implementation outcomes of the testing program with school stakeholders, parents, and children. Children in the testing program receive weekly testing and can choose to be swabbed in school by the research team or at home by an adult. Before the launch of the effectiveness trial, the study protocol, study materials, and workflow have been pilot tested from April through July 2021.

Identifying Implementation Barriers, Their Relative Importance, and Strategies

We based the identification of implementation barriers and strategies for COVID-19 testing on the CFIR.[15] The CFIR contains 43 constructs across the following 5 domains: (1) the Characteristics of the Intervention (ie, the key attributes of an innovation), (2) the Outer Setting (ie, the economic, political, and social context within which an organization resides), (3) the Inner Setting (ie, the structural, political, and cultural contexts through which the implementation process will proceed), (4) the Characteristics of Individuals (ie, the individuals involved with the implementation process), and (5) the Implementation Process (ie, the active change process aimed to promote use of the intervention as designed).[15] The CFIR allows consistent use of terms and reporting of findings for implementation studies.

To identify implementation barriers to school-associated testing, each research team from the 6 project sites rated the CFIR's 43 constructs and associated barriers by using a four-point scale: 0: “not a barrier,” 1: “a small barrier,” 2: “a moderate barrier,” and 3:“a large or significant barrier.” We then examined the magnitude of the barriers for each CFIR domain (eg, Characteristics of the Intervention, Inner Setting, etc) by averaging the ratings across projects for each set of constructs in that domain. For example, the Intervention Characteristics domain includes 8 constructs. To examine the magnitude of the barriers across projects, we added scores for these 8 constructs by project and then divided by 8 to get an average rating for each domain by site. We then obtained an average of these domain ratings across project sites. As an organizing heuristic to specify the implementation strategies that our teams have adopted to help address some of these barriers, we used the CFIR–ERIC[16] strategy matching tool.[19] This tool provides the strength of expert endorsement for implementation strategies matched to barriers. This tool is based on a survey of 169 experts who selected and ranked up to 7 ERIC strategies that addressed barriers on the basis of the CFIR constructs. The resulting tool is used to match CFIR barriers to ERIC strategies on the basis of the proportion of experts who endorsed the strategy as effective for addressing the barrier. For example, if a program or organization does not adequately understand patient needs or resources, most experts (ie, 71% of experts) believe that involving patients and/or consumers and family members in the implementation process would address this barrier. For this article, we focused on matching strategies to the most significant barriers identified across projects. We report on the strength of ERIC expert endorsement for strategies that were endorsed by an average of 10% of experts across our top barriers. We then described how these strategies were operationalized in each project along with descriptions of additional strategies used.

RESULTS

Implementation Barriers

Overall, 20 of the 43 constructs (46.5%) were identified as a “large or significant barrier” in at least 1 of the 6 testing programs. Across domains, the average ratings ranged from 0.75 for Characteristics of Individuals to 0.95 for Inner Setting (Table 2), indicating that the magnitude of implementation barriers at the domain level were considered on average to be small. Unique barriers were identified across project sites. For example, WashU (SSD) was the only site to identify the networks and communication construct, or the lack of productive social networks and communication strategies, as a significant barrier (rated 3 or “a large or significant barrier”). The Peer Pressure construct, or the lack of pressure from similar organizations that are implementing the program, was rated by the WashU (NC) site as a significant barrier but was rated by other sites as not a barrier or only a small barrier. Finally, the Cosmopolitanism construct, or the degree to which the organization is networked with external organizations, was identified by the JHCAIH site as a barrier (rated 3 or “a large or significant barrier”) and largely relates to the rural context of this project site.

The most significant barriers across studies are identified in Table 3. The relative advantage construct, or the degree to which stakeholders view the relative advantage of implementing COVID-19 testing in schools compared with an alternative or keeping things the same, was rated as a large or significant barrier across 5 of 6 project sites. The next most significant barrier was a lack of multifaceted strategies to attract and involve the target beneficiaries, which 4 of 6 project sites rated as a large or significant barrier. The Innovation Complexity (3 of 6 sites rated as a large or significant barrier), Patient Needs and Resources (4 of 6 sites rated as a moderate barrier), and Organizational Incentives and Rewards (3 of 6 sites rated as a moderate barrier) constructs were all rated as the next most significant barriers across projects. Ratings across all domains and descriptions can be found in the Supplemental Information.

Implementation Strategies Used to Overcome Barriers

Using the CFIR–ERIC strategy matching tool, we identified 28 ERIC strategies that have been endorsed by experts to address our

TABLE 2 Average Barrier Severity Rating by Domain

Domain	Total Score Range	Average Score Across Sites	Range of Average Scores Within Sites
Intervention characteristics (total score range: 0–24)	5–11	0.94	0.63–1.38
Outer setting (total score range: 0–12)	1–5	0.83	0.25–1.25
Inner setting (total score range: 0–42)	6–20	0.95	0.43–1.43
Characteristics of individuals (total score range: 0–2)	1–5	0.75	0.25–1.25
Process (total score range: 0–24)	2–9	0.77	0.25–1.13

Average scores of 0–1 indicate not a barrier to a small barrier; 1–2 indicate a small to moderate barrier; and 2–3 indicate a moderate to large/significant barrier.

TABLE 3 Most Significant Constructs and Barriers Identified Across Projects

Construct	Associated Barrier	JHCAIH	SRS	WashU (SSD)	ICF and CMKC	KKI	UW and FHCRC	Total
Relative advantage	Stakeholders do not see the advantage of implementing the innovation compared with an alternative solution or keeping things the same.	3	3	3	3	3	2	17
Patients and customers	Multifaceted strategies to attract and involve patients/customers in implementing or using the innovation (eg, through social marketing, education, role modeling, training) are ineffective or nonexistent.	3	1	3	3	1	3	14
Complexity	Stakeholders believe that the innovation is complex on the basis of their perception of duration, scope, radicalness, disruptiveness, centrality, and/or intricacy and number of steps needed to implement.	3	1	0	2	1	3	10
Patient needs and resources	Patient needs, including barriers and facilitators to meet those needs, are not accurately known and/or this information is not a high priority for the organization.	1	2	2	2	2	1	10
Organizational incentives and rewards	There are no tangible (eg, goal-sharing awards, performance reviews, promotions, salary raises) or less tangible (eg, increased stature or respect) incentives in place for implementing the innovation.	3	2	2	1	2	0	10
Cost	Stakeholders believe the innovation costs and/or the costs to implement (including investment, supply, and opportunity costs) are too high.	2	2	1	1	0	3	9
Compatibility	The innovation does not fit well with existing workflows nor with the meaning and values attached to the innovation, nor does it align well with stakeholders' own needs and/or it heightens risk for stakeholders.	3	1	1	2	2	0	9
Available resources	Resources (eg, money, physical space, dedicated time) are insufficient to support the implementation of the innovation.	3	0	0	3	0	3	9

TABLE 3 Continued

Construct	Associated Barrier	JHCAIH	SRS	WashU (SSD)	ICF and CMKC	KKI	UW and FHCRC	Total
Knowledge and beliefs about the intervention	Stakeholders have negative attitudes toward the innovation, they place low value on implementing the innovation, and/or they are not familiar with facts, truths, and principles bout the innovation.	2	1	1	1	2	1	8
Evidence strength[a] and quality	Stakeholders have a negative perception of the quality and validity of evidence supporting the intervention.	2	1	1	1	1	1	7
Tension for change[a]	Stakeholders do not see the current situation as intolerable or do not believe they need to implement the innovation.	1	1	1	2	1	1	7
Individual stage of change[a]	Stakeholders are not skilled or enthusiastic about using the innovation in a sustained way.	2	1	0	2	1	1	7

FHCRC, Fred Hutchinson Cancer Research Center; UW, University of Washington.
[a] Three-way tie of constructs by total severity rating.

highest ranking barriers (Table 4). For example, the strategies to address the relative advantage barrier included identifying and preparing champions, which was endorsed by 45% of the ERIC experts as a strategy for this barrier, and conducting cyclic small tests of change, which was endorsed by 37% of experts. Across all implementation barriers, identifying and preparing champions was the highest endorsed strategy, followed by altering incentive and allowance structures, assessing for readiness, and identifying barriers and facilitators. However, the results were heterogeneous, with higher percentages of expert endorsement for strategies other than those we identified. For example, for the barrier of organizational incentives and awards, the strategy of altering incentive and allowance structures was endorsed by 71% of the ERIC experts, whereas no other strategy was endorsed by >35% of ERIC experts for this barrier (Table 4). For the barriers identified, all of the strategies with an average of ≥10% endorsement by experts were used by these projects (Table 5). The strategies operationalized by the projects are presented as follows.

KKI

Two of the most significant challenges faced by the KKI's project were related to the complexities of research funding for implementation of testing and perceived relative advantage. Although it is critical to ensure appropriate protections for human subjects in any research study, the use of an institutional review board reliance, required by the National Institute of Health for multisite trials, has significantly slowed study initiation. Communication and negotiation between institutional review boards proved challenging, slowing the pace of enrollment and, thereby, the delivery of testing resources. Second, community interest waned as well, particularly with historically low SARS-CoV-2 transmission during the spring and summer months. Recent data from KKI reveal that staff ranked surveillance testing as not highly important to keeping schools open, and families have not shown high levels of interest in school-based testing for their children. Numerous strategies are being implemented to overcome these challenges, including the use of financial incentives to increase testing uptake.

Johns Hopkins Center for American Indian Health

The JHCAIH project team has engaged in a number of community outreach activities, including conducting educational meetings and local consensus discussions, informing local opinion leaders about the project, and capturing and sharing local knowledge. For

TABLE 4 Top Barriers Identified Across Projects Matched With ERIC Implementation Strategies and Level of Expert Endorsement on Strategy Appropriateness for Each Barrier

		Most Common CFIR Barriers Across Project Sites										
ERIC Strategies	Average Endorsement Top Barriers, %	Evidence Strength and Quality, %	Relative Advantage, %	Complexity, %	Cost, %	Patient Needs and Resources, %	Tension for Change, %	Compatibility, %	Organizational Incentives and Rewards, %	Available Resources, %	Knowledge and Beliefs About the Intervention, %	Individual Stage of Change, %	Patients and/or Customers, %
Identify and prepare champions	28	41	45	30	12	5	48	21	25	4	40	44	23
Alter incentive and allowance structures	22	3	28	7	44	10	22	10	71[a]	17	16	32	0
Assess for readiness and identify barriers and facilitators	21	13	24	30	16	33	35	34	13	13	20	12	14
Conduct local consensus discussions	21	41	24	7	4	29	43	41	8	0	12	20	18
Conduct educational meetings	19	47	24	13	12	10	17	10	0	0	56[a]	20	18
Access new funding	18	3	10	3	72[a]	0	0	3	38	78[a]	8	0	5
Promote adaptability	18	3	24	40	16	14	17	45	4	4	16	28	5
Conduct local needs assessment	18	3	34	3	4	57[a]	43	21	8	0	24	0	18
Inform local opinion leaders	18	38	28	13	12	0	39	3	17	0	28	28	5
Involve patients and/or consumers and family members	16	13	3	0	0	71[a]	22	10	4	0	0	12	59[a]
Conduct cyclical small tests of change	15	3	31	37	8	10	4	38	13	13	12	8	9
Tailor strategies	15	6	17	27	12	14	13	38	17	9	12	8	9
Capture and share local knowledge	15	25	17	27	4	10	13	14	8	22	24	12	5
Obtain and use patients and/or consumers and family feedback	15	6	7	0	4	76[a]	9	10	13	0	4	8	41

TABLE 4 Continued

ERIC Strategies	Average Endorsement Top Barriers, %	Most Common CFIR Barriers Across Project Sites: Evidence Strength and Quality, %	Relative Advantage, %	Complexity, %	Cost, %	Patient Needs and Resources, %	Tension for Change, %	Compatibility, %	Organizational Incentives and Rewards, %	Available Resources, %	Knowledge and Beliefs About the Intervention, %	Individual Stage of Change, %	Patients and/or Customers, %
Identify early adopters	13	22	17	20	8	0	13	10	13	0	20	24	9
Create a learning collaborative	13	16	7	33	8	0	9	14	13	9	16	28	5
Develop educational materials	13	28	14	13	0	10	0	3	0	4	36	20	27
Build a coalition	13	6	14	0	4	14	9	21	17	17	16	16	18
Fund and contract for clinical innovation	12	0	14	3	28	0	9	10	21	39	4	12	0
Conduct educational outreach visits	11	34	10	7	4	5	4	0	4	0	28	24	9
Prepare patients/ consumers to be active participants	10	0	0	0	0	48	9	3	4	0	0	0	55[a]
Use advisory boards and workgroups	10	9	10	0	0	29	13	3	4	4	8	4	32
Increase demand	9	0	24	3	12	10	13	0	8	4	20	8	9
Stage implementation scale up	9	3	10	30	8	0	4	10	4	13	20	8	0
Visit other sites	9	13	21	3	16	0	13	10	4	9	12	8	0
Intervene with patients and/or consumers to enhance uptake and adherence	9	3	7	3	4	24	0	3	4	0	0	8	50[a]
Distribute educational materials	9	31	10	3	0	5	13	0	0	0	16	8	18
Develop a formal implementation blueprint	9	0	7	43	8	5	13	3	8	4	4	4	5
Facilitation	9	0	10	20	8	0	0	24	4	4	20	8	5

[a] Footnote indicates 50% or more of experts who identified the strategy for the barrier.

TABLE 5 Implementation Strategies Used Across Projects

ERIC Strategies	Average Expert Endorsement for This Strategy Across Top Barriers, %	KKI	JHCAIH	ICF and CMKC	WashU (NC)	WashU (SSD)	UW and FHCRC
Identify and prepare champions	28	—	—	X	X	X	X
Alter incentive and allowance structures	22	X	X	X	—	—	X
Assess for readiness and identify barriers and facilitators	21	X	—	—	—	—	—
Conduct local consensus discussions	21	X	X	X	X	X	X
Conduct educational meetings	19	X	X	X	X	X	X
Access new funding	18	X	X	—	X	X	—
Promote adaptability	18	—	X	X	X	—	—
Conduct local needs assessment	18	—	—	X	—	—	X
Inform local opinion leaders	18	X	X	X	—	—	X
Involve patients and/or consumers and family members	16	X	X	X	X	X	X
Conduct cyclical small tests of change	16	—	—	—	X	X	X
Tailor strategies	15	—	X	X	X	X	—
Capture and share local knowledge	15	—	X	X	X	X	X
Obtain and use patients and/or consumers and family feedback	15	X	X	X	X	X	X
Identify early adopters	13	—	X	X	X	—	—
Create a learning collaborative	13	X	X	—	—	—	X
Develop educational materials	13	X	X	X	X	X	X
Build a coalition	13	X	—	—	X	—	X
Fund and contract for clinical innovation	12	—	X	—	X	—	—
Conduct educational outreach visits	11	X	X	—	—	—	—
Prepare patients and/or consumers to be active participants	10	—	—	—	X	X	—
Use advisory boards and workgroups	10	X	X	X	X	X	X

FHCRC, Fred Hutchinson Cancer Research Center; UW, University of Washington; —, not applicable.

example, the process for schools to initiate testing usually starts with an informational meeting with a school superintendent, followed by meetings with the school boards and school leadership teams. These meetings are educational and include sharing of experiences from other schools and a menu of testing approaches shown to reduce COVID-19 spread.[8] Regular meetings with those implementing testing and school leadership have also been key to enhance communication about the program and tailor strategies to each school setting. Training champions, often school leaders, in the importance of testing has been key to overcoming the relative advantage barrier identified as they set out expectations for their districts and staff in terms of participation in the testing programs. One of the biggest barriers identified has been the uptake of the program as measured through completed consent forms by families and staff. To overcome this barrier, several strategies have been used, including raffles for completed consent forms, enhanced communication strategies (eg, social media, printouts, and radio), and partnerships with local health providers to deliver information and consent forms at prescheduled health fairs and events (eg, vaccination clinics).

ICF and CMKC

The School TLC Study from ICF and CMKC is being conducted with the input and support of key stakeholders and the CAB. Preliminary data suggest that parents and caregivers like that testing is offered at the school, but numerous barriers exist. Although the school district has been supportive, regular screening testing requires increased personnel to coordinate testing, perform testing, and report results.

This could be the responsibility of the school nurse, COVID-19 task force leader, or other personnel; however, often these people already have increased responsibilities because of the pandemic. Another major barrier to testing has been consent. Access to parents and caregivers is limited, given visitor restrictions and virtual parent activities. Working with a multilingual population necessitates consent forms that are written in multiple languages and delivered in a variety of different manners (eg, text, paper, and verbally). Strategies to overcome these barriers have included providing incentives, working with after school programs in which study staff can interact directly with parents on-site, and working with bilingual or bicultural stakeholders.

WashU SRS

Similar to other projects, the development of a CAB has been essential for the WashU SRS project. In particular, student participation on the CAB has provided key insights into the methods used to increase recruitment for the testing project. Because this project contains 2 different testing strategies, the clinical research coordinators have performed small tests of change to maximize the efficiency of the testing process. A significant barrier is making the school districts aware of the ongoing testing that occurs 6 days a week. The research team has used flyers that were reviewed by the CAB to be disseminated to stakeholders. Additionally, the research team has participated in different school activities, including vaccine events and back-to-school nights. Ongoing communication with school district leadership through regular and frequent meetings has been invaluable. Lastly, a newsletter and Web site have been developed to provide weekly testing numbers, a schedule of upcoming listening sessions, and up-to-date COVID-19 information from local and national sources.

WashU SSD

Establishing a weekly meeting with SSD administration and district stakeholders has been important to address the barriers and concerns with COVID-19 testing. The most challenging barrier has been communication with families. The research team, with stakeholder input, designed flyers that were distributed by each school. To garner more interest from families, school nurses contacted families and informed the research team of interested families. Other efforts to inform families and staff of the SSD weekly testing included organizing town halls, visiting each school during staff development days, hanging posters within the school, and emailing weekly reminders to participants to maintain study participation. Finally, a quarterly newsletter has been developed to share study updates, testing numbers, information on the importance of testing, and up-to-date COVID-19 information.

University of Washington

School representatives are engaged in the ROSSEY project throughout the research project as CAB members and community investigators. The CAB meets bimonthly, reviews and approves all study materials, and provides input on how to address challenges experienced in the field. The community investigators meet weekly as part of the investigators' team and ensure that the study has access to the community's input in real-time. A point of contact from the district meets weekly with the field team to liaise the research activities between the district and the research team. Although the district and the CAB have been highly engaged, the research team experienced challenges in gaining interest from families to participate in the pilot phase of the study because of the following constraints: a limited ability to conduct outreach activities on school grounds because of school policies that limited the number of visitors, the families' lack of ability to navigate through the consent process online, and testing fatigue in the community. Working with the school district leadership and community stakeholders, strategies to increase testing uptake that were deemed acceptable and effective included: (1) instituting an in-person study kick-off event in the school; (2) enhancing the visibility of the ROSSEY project by using social media, television, and radio advertisements; and (3) improving the usability of the consent form.

DISCUSSION

COVID-19 has brought unprecedented challenges to schools since March 2020. Both the Centers for Disease Control and Prevention and the American Academy of Pediatrics recommend a layered mitigation strategy to reduce the risk of infection during in-person learning. COVID-19 testing is 1 layer that has been shown to reduce and limit the spread of COVID-19 within schools.[8] Despite limited resources for schools to provide testing for the 2020–2021 school year, numerous federal programs exist for 2021–2022. Knowledge on the effective implementation of testing is needed to appropriately use funding for current and future testing programs involving respiratory-borne illnesses.

Drawing on our collective experience across a wide range of settings and populations, our projects have confronted significant challenges and employed many strategies to implement school-based testing programs. Major challenges included the characteristics of COVID-19 testing programs, including the amount of protection they may afford in relation to obstacles with their implementation, and the recruitment of families to participate in the program. Key strategies emerged across the projects including, enhanced communication with school communities to promote uptake, regular meetings between all key stakeholders, and collaboration with local public health and medical personnel.

The largest barrier identified across projects was the limited perceived advantages of COVID-19 testing among school stakeholders when weighed against the perceived burden of testing in schools (ie, “relative advantage”). The rapid switch to virtual learning and ongoing and persistent school closures have placed new demands on schools to dramatically change operational procedures. Adding the logistics of implementing testing can seem like “one more thing” to an immensely demanding set of responsibilities. Concerns about further loss of services and a lack of child care in the event of a positive result have also been anecdotally reported. Particularly for low-income and underserved families, the lack of child care may have a significant impact on a caregiver’s ability to work and, thus, affect the overall income stability of the family. Despite the potential burden of regular testing, school-based COVID-19 testing has been found to enhance mitigation efforts, detect asymptomatic cases, limit in-school spread, and maximize in-person learning days.[4,9–11,20] Communicating the value of testing to stakeholders, in both educational and public health terms, is critical to generating buy-in and participation. Finding testing models that are both effective and easy to implement are key to wide scale uptake.[17] Additional funding to support implementation with any testing strategy will help overcome this barrier.

Obtaining consent forms also emerged as a challenge across projects, and our teams presented a wide variety of strategies to overcome this barrier. First, consent forms must be in formats that are relevant to the local context, including online or paper and in multiple languages. Use of plain language writing techniques, particularly for settings serving children with disabilities, is strongly encouraged.[21] Strategies that our projects have used to increase consent form uptake include educational presentations, informational handouts, including consent forms within enrollment packets, explicit outreach to families that have not returned consent forms to answer questions, raffles and prizes, community-wide engagement through the health system or other organizations, and media outreach.

Engagement with local medical personnel and public health communities has also been key across projects. Testing inevitably results in the detection of COVID-19 cases. Medical personnel and local public health departments need to be key collaborators in any school-based testing approach. Implementation of school-based testing requires heavy data tracking and reporting. Local public health agencies can be critical in helping to facilitate this process. Contact tracing is also paramount to maximizing in-person learning opportunities while mitigating risk. Finally, schools need to understand the local pandemic situation (eg, case rates in the community) and adjust plans accordingly. Partnerships with the medical and public health fields are critical to ensuring a school can respond appropriately to the ever-changing nature and course of the pandemic.[22]

All projects have been guided by CABs, which are a key component of CBPR processes and serve a critical role in guiding the community-academic partnership.[23] Our programs involve partnerships with communities that have been disproportionately impacted by COVID-19,[24] which often may not trust academic and/or medical partners, making the use of CBPR processes even more necessary as these approaches are specifically designed to respect, engage, and support populations that face health disparities.[25,26] Despite challenges with CABs (ie, virtual meetings, additional work for community members), having guidance that represented the community’s voice was critical to the success of all testing programs. Establishing a new CAB, leveraging an existing CAB, or engaging with school boards or parent-teacher association meetings will help schools implement successful COVID-19 testing and mitigation procedures.

Our findings should be interpreted with the consideration of several limitations. Our process for identifying implementation barriers and strategies was based on the opinions of key personnel who have experience implementing COVID-19 testing in partnerships with schools. Although expert opinion is valuable, future empirical research should explicitly focus on the identification of implementation barriers and facilitators and testing of implementation strategies. This process may have also limited the enumeration of the full spectrum of barriers and strategies relevant to

COVID-19 testing in schools. Despite using tools from the implementation science literature, we are unaware of studies in which researchers have evaluated the reliability and validity of the CFIR–ERIC strategy matching tool. This potentially adds error and uncertainty to our conclusions. Finally, although the CFIR–ERIC tool allowed for consistency of reporting with concepts in implementation science, expert endorsement is also not empirical evidence. In future research, researchers should test the effectiveness of different strategies for the implementation of COVID-19 testing programs in schools.

CONCLUSIONS

Taken together, lessons from these projects point to an urgent need to communicate the value of COVID-19 testing to all school stakeholders for educational and public health reasons. Moreover, going forward, it is imperative that funding not only be focused on access to COVID-19 testing supplies but also support the implementation of testing programs through increased personnel detailed to schools, platforms to support collaboration and community engagement, and education to illustrate the benefits of testing. Testing for COVID-19 holds promise for making schools safer during the COVID-19 pandemic[4,7,8,27] and can offer lessons for future infectious disease outbreaks and pandemics.

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ABBREVIATIONS

CAB: community advisory board
CBPR: community-based participatory research
CFIR: Consolidated Framework for Implementation Research
CMKC: Children's Mercy Kansas City
COVID-19: coronavirus disease 2019
ERIC: Expert Recommendations for Implementation Change
FDA: Food and Drug Administration
IDD: intellectual and developmental disability
IRB: institutional review board
JHCAIH: Johns Hopkins Center for American Indian Health
KKI: Kennedy Krieger Institute
ROSSEY: ReOpening Schools and Educating Youth
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2
School TLC: Support for Safe Return to In-Person School: Coronavirus Disease 2019 Testing, Learning, and Consultation
SRS: safe return to school
SSD: Special School District of St Louis County
WashU: Washington University in St Louis

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