# RADx-UP Publications 2023 Content Analysis Report

*Insights from Publications in Scholarly Journals*

**December 2023**

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# Executive Summary

## Purpose and Overview of Methods

The Tracking and Evaluation team utilizes content analysis to examine outcomes, impacts, and lessons learned from intervention implementation approaches in Rapid Acceleration of Diagnostics-Underserved Populations (RADx-UP) peer-reviewed publications. This report presents findings from a content analysis of 231 publications sourced from PubMed and Scopus databases and RADx-UP Project surveys and tracked from program launch through July 31, 2023. Independent reviewers abstracted study characteristics, translational science benefits, key emergent themes, and lessons learned, which are then synthesized and categorized thematically.

## Publication Characteristics

**Populations served.** Hispanic/Latino populations (*n* = 57 publications), children/adolescents (*n* = 41), and Black/African American populations (*n* = 39) were the top three underserved populations identified across RADx-UP publications.

**Publication methods.** Observational study design (*n* = 127) was the most common quantitative method employed across publications; 100% of publications cited at least one community engagement strategy in project activities regarding recruitment, planning, implementation, or dissemination.

## Translational Science Benefits Model Impacts

We adapted the four domains (clinical, community and public health, policy, and economic) and associated indicators (**Appendix B**) of the Translational Science Benefits Model (TSBM) Luke et al (2018) to code articles with translational benefits with respect to testing and vaccination. RADx-UP publications cited the community and public health benefits of both testing and vaccination the most, compared to the other three translational science benefits domains. The community and public health benefits of testing (indicators) most cited by publications included testing accessibility [ex. increasing access to the health care system and providers to address equity of testing access] (*n* = 45), public health testing practices [e.g. COVID-19 testing surveillance, contact tracing with a link to testing efforts] (*n* = 43), delivery and uptake of tests [e.g. interventions to increase testing supply distribution in a community to increase testing uptake rates] (*n* = 42), community testing services [e.g. the provision of testing through community-based or community-collaborative preventive health services, testing sites, mobile vans for testing services] (*n* = 42), testing education resources [ex. toolkits and print materials promoting testing] (*n* = 20), and software and digital health for testing [ex. mHealth/eHealth] (*n* = 4). Publications indicated projects directly increased access to testing or services that offer tests (e.g., see; Whanger et al., 2022) or improved our understanding of factors that contribute to improving testing acceptability (e.g., see; Collie-

Akers et al., 2022). For vaccination benefits, delivery and uptake was most cited (*n* = 34). Publications indicated that projects increased vaccination delivery and uptake by addressing the availability and/or distribution of vaccines to underserved communities to promote increased vaccine uptake (e.g., see; Bigelow et al., 2022).

### Thematic Categories of Impact

Publications were most frequently categorized with the key themes of social and behavioral factors influencing the access and uptake of vaccination (*n* = 48) and testing (*n* = 39) and impacts of collaborative partnerships and community engagement (*n* = 44). The following sections (A-D) provide additional detailed findings.

### A. SEBI Factors Related to Testing and Vaccination

Publications reviewed noted disparities in testing and vaccination hesitancy, motivation, access, and uptake exist among diverse underserved populations. Initiatives like in-reach and outreach through clinics, mobile units, reduced-cost/free testing and vaccination, employer-sponsored resources, and at-home testing improved access and uptake to COVID-19 testing and vaccination.

- **Sociodemographic factors.** Race/ethnicity, sex/gender, age, education, employment, socioeconomic status, presence of comorbidities, political affiliation, access to health care, and having been vaccinated against COVID-19 are associated with testing uptake. Black/African American, Hispanic/Latino, and Asian American, Native Hawaiian, and Pacific Islander populations tend to show greater vaccination hesitancy compared to other racial/ethnic groups. Other individual-level factors, including attitudes, beliefs, motivation, and behaviors, have also been shown to be facilitators or barriers to testing uptake and vaccine hesitancy and/or uptake.
- **Interpersonal and social factors.** Misinformation is identified as a factor that increases testing and vaccination hesitancy. Trusted messengers, especially people within social networks and healthcare providers, are crucial in addressing hesitancy and improving uptake.
- **Environmental, community, and other socio-political factors.** Vulnerable populations may face disparities in testing and vaccination access based on social determinants (e.g., transportation and language barriers). Facilitators at the community, organizational, and governmental levels can improve access, acceptance, and uptake, including in-school testing, syringe exchange programs, and state-run free testing sites.

## B. Structural Barriers to Testing and Vaccination

Seventeen publications cited different structural barriers to testing. These barriers include transportation or driving times, location of centers or services, inflexible work schedules, fear of losing employment while getting tested, wait times or scheduling, fear of exposure while waiting to be tested, and the cost of testing. Thirteen publications cited one or more structural barriers to COVID-19 vaccination that were parallel to testing barriers. For example, Martinez et al. (2022) argued that preferential access to and administration of COVID-19 vaccinations are critical to addressing the inequities and disparities exacerbated by COVID-19.

- **Barriers specific to certain populations.** Lack of staff to implement testing, limited internet access to telehealth and testing results (especially for Tribal Nations), and beliefs about testing (e.g., misinformation, lack of buy-in, fear of testing positive) also inhibited vulnerable populations from accessing testing.
- **Strategies addressing barriers to testing. For example,** Katzmarzyk et al. (2023) identified strategies to increase testing uptake in primarily Black communities in Louisiana. These strategies included providing testing in heavily traveled areas (e.g., supermarkets, churches, schools, neighborhoods), offering transportation and incentives, improving communication about testing, and outreach to local employers to accommodate clinical visits.
- **Strategies addressing barriers to vaccination.** Martinez et al. (2022) identified multiple strategies to address barriers to COVID-19 vaccination, particularly for the Hispanic communities in the United States-Mexico border region of California. These strategies included convenient vaccination locations or mobile vaccination services, culturally tailored vaccine literacy campaigns in multiple languages, employer support, or insurance coverage of vaccinations.

## C. Impact of Community Engagement and Collaborative Partnerships

Twenty-five out of the 44 publications coded under 'impacts of collaborative partnerships and community engagement' described these impacts in detail within the following areas.

- **Utilize multi-sector partnerships to implement, adapt, and promote testing/vaccination.** Multi-sector partnerships involving academic partners, community-based organizations, and health departments were developed or leveraged to implement, improve, and adapt research activities to community needs. These partnerships effectively promoted testing and vaccination uptake within underserved communities. Multi-sector partnerships were used to address vaccine hesitancy, adapt intervention strategies to community needs, and reduce infection transmission within schools.
- **Strengthen recruitment and data collection.** Eight publications described in detail how their community partnerships helped them identify and recruit eligible participants. Some studies specifically utilized targeted strategies such as recruiting from existing studies (Strathdee et al., 2023) or using community health workers (Barrett et al., 2022), community-based

organizations (Barrett et al., 2022; Rodriguez et al., 2022), or trained faith leaders (Berkley-Patton et al., 2022) to achieve enrollment targets.

- **Improve community capacity for research and community workforce development.** Four publications described how they partnered with community-based organizations to improve community capacity for research by hiring and training trusted members already living within communities to implement research activities.
- **Inform health messaging, outreach, and dissemination strategies.** Fifteen publications described how community partnerships, trusted leaders, and local networks were used to disseminate culturally appropriate messages and other relevant information within communities. Feedback from these partners ensured culturally appropriate messaging, while investments in social marketing campaigns and multiple dissemination channels promoted testing and vaccination.
- **Use community advisory board and community-based participatory research to guide research implementation.** Five publications employed a community-based participatory approach and developed community-based testing strategies. Additionally, seven publications established or utilized community advisory boards to provide guidance on culturally appropriate study materials, address community priorities, discuss testing barriers and facilitators, and provide feedback on outreach strategies.
- **Build sustainable trusted relationships within communities.** Three publications emphasized the importance of building trusted partnerships by engaging partners with relevant lived experience or language skills, while another publication highlighted the role of serving as a COVID-19 information resource in establishing trust within underserved communities.
- **Evaluate the impacts and strengths of community engagement.** Two publications evaluated community engagement strategies, with Barrett et al. (2022) highlighting the effectiveness of partnerships with community-based organizations in recruiting and retaining Black and Latino residents, and Stadnick et al. (2022) estimating the time commitment differences across phases of community engagement activities, showing that more time is spent during project startup and recruitment compared to the maintenance phase.

## D. Lessons Learned from Implementation and Intervention Strategies

### Intervention Implementation Successes

- **Community-driven partnerships and collaborations.** Positive outcomes in RADx-UP Projects are attributed to robust community-academic partnerships, enhancing research capacity and improving research design skills. Stakeholder involvement in intervention development resulted in more community-relevant findings and bidirectional learning.

Sustainable outcomes from community partnerships include community members becoming investigators and systemic changes, such as integrating youth entrepreneurship education into high school curriculums.

- **Culturally tailored outreach and intervention strategies.** Tailored strategies, including using trusted peers and culturally specific outreach, improved vaccination and testing accessibility and uptake. Peer-led intervention sessions significantly increased testing rates and culturally tailored approaches, such as using community health workers, resulted in higher testing numbers among specific communities. Multiple media and outreach strategies, such as flyers, radio announcements, and social media, were effective in promoting interventions and recruiting participants.
- **Evidence-based intervention design and implementation approaches.** Publications grounded their interventions in evidence-based behavioral and implementation science theories, addressing knowledge gaps and attitudinal barriers. Community-based participatory research principles guided intervention design, implementation, and community outreach, allowing flexibility and cultural tailoring. Adaptive approaches were used to optimize interventions based on ongoing feedback.

### Intervention Implementation Challenges

- **Community-academic partnership and engagement challenges.** Community-engaged research is acknowledged as transactional, demanding significant time, dedication, and patience. Challenges include difficulties in maintaining and strengthening community partnerships beyond the study duration and administrative obstacles, such as IRB delays, affecting partner relationships.
- **Resource limitations.** RADx-UP publications highlight resource limitations, such as time demands, funding constraints, and staffing shortages, for community-engaged research. Fast-paced project timelines, staff shortages, and regulatory hurdles during the second COVID-19 wave affected intervention implementation and vaccination uptake.
- **Limitations of study implementation design.** Complexities of implementing randomized controlled trials in real-world settings are evident, with challenges such as ethical concerns, objections to randomization, and the need for responsiveness to establish trust. Implementing study design activities that rely on virtual communication channels may have introduced selection bias and excluded community members without internet access. Also, self-reporting for vaccine uptake behaviors could have introduced reporting bias.
- **Sampling, selection bias, and methodological limitations.** Despite multiple engagement strategies, publications identified trade-offs and limitations of sample size and representativeness. Specifically, a small sample size may limit the

ability to detect significant changes, and recruiting from a specific target population may restrict the applicability of findings to the broader population or underrepresented groups.

## Implications and Recommendations for Future Research

- **Need for rigorous studies.** RADx-UP projects emphasize the need for more rigorous comparative, longitudinal, and experimental studies to understand barriers and facilitators to successful implementation.
- **Prioritizing funding and addressing health disparities.** Future research should prioritize funding for community-engaged interventions beyond COVID-19 testing and vaccination to address health disparities in underserved populations.
- **Adaptability and flexibility in research.** Continuous adaptation of interventions, especially in response to SARS-CoV-2 variants and community priorities, is crucial for future research. Adopting flexible study designs aligned with community values and ethical considerations are emphasized for impactful health equity research interventions.
- **Building sustainable community-research partnerships.** Sustained community engagement is essential, and establishing mechanisms for ongoing feedback from community partners ensures interventions remain relevant and effective over time.

## Overview of Content Analysis

To measure Rapid Acceleration of Diagnostics-Underserved Populations (RADx-UP) Program productivity, the Tracking and Evaluation team (T&E) conducts and reports monthly on scholarly products (published peer-reviewed publications, grants, conference presentations and abstracts) and non-scholarly (community-based) products in PubMed and Scopus databases using RADx-UP Project grant numbers. Content analysis, a qualitative methodological approach, was used to organize, analyze, and interpret research findings; i.e., RADx-UP Projects' knowledge contributions were coded and abstracted from tracked peer-reviewed publications (Figure 1).

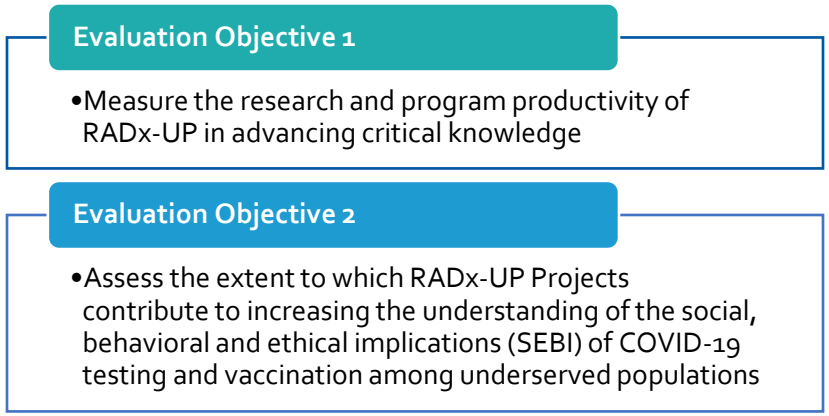


*Figure 1.* Evaluation objectives related to content analysis for the RADx-UP Program.

## Methods

This report describes findings from content analysis of RADx-UP publications in peer-reviewed journals (*N* = 231 publications; Appendix A) tracked from program launch through July 31, 2023. Using a codebook T&E developed for the analysis, independent reviewers individually coded assigned published peer-reviewed publications for study characteristics, translational science benefits, and thematic categories of impact (Figure 2). An abbreviated codebook is included in Appendix B. Study characteristics include underserved populations, geographic region, setting, design, and community outreach strategies.

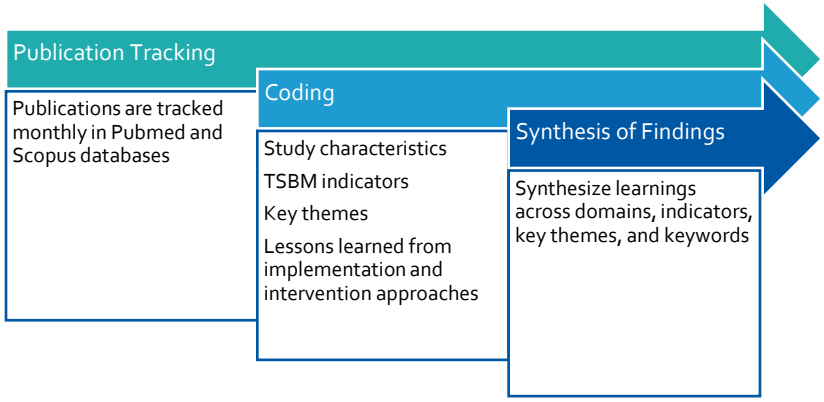


*Figure 2.* Phases of RADx-UP publication content analysis.

We used the Translational Science Benefits Model (TSBM; Luke et al. 2018) to develop and code potential or demonstrated testing or vaccination benefits of publication findings across four domains: 1) clinical and medical; 2)

community and public health; 3) economic; and 4) policy and legislative. Given the community-engaged nature of RADx-UP Project work, we also coded publications for 10 indicators within the community and public health domain for testing and vaccination.

Additionally, we developed and categorized publications for eight thematic impacts that emerged from our review of the data as relevant to evaluation. As an exploratory analysis, we selected and described publications with keywords related to intervention research and/or implementation science. Since we did not develop codes beforehand for this purpose, we conducted a scan of publication titles, abstracts, and keywords to identify relevant publications. Finally, we used the coded publication data to synthesize learning on topics relevant to RADx-UP evaluation.

# Results

## Publication Characteristics

Among the vulnerable populations served, Hispanic/Latino populations (*n* = 57 publications), children/adolescents (*n* = 41), and Black/African American populations (*n* = 39) were the top three target populations featured in the 231 RADx-UP publications (Figure 3).

RADx-UP Projects are geographically distributed across the 50 states, US territories, and Tribal Nations. Most publications took place in the Southeast (*n* = 62), followed by the West (*n* = 42), and Midwest (*n* = 37; Figure 4). However, the number of publications taking place in different regions generally reflects the number of RADx-UP Projects serving these regions (Figure 5). Appendix C includes figures with the counts of publications that described other study settings.

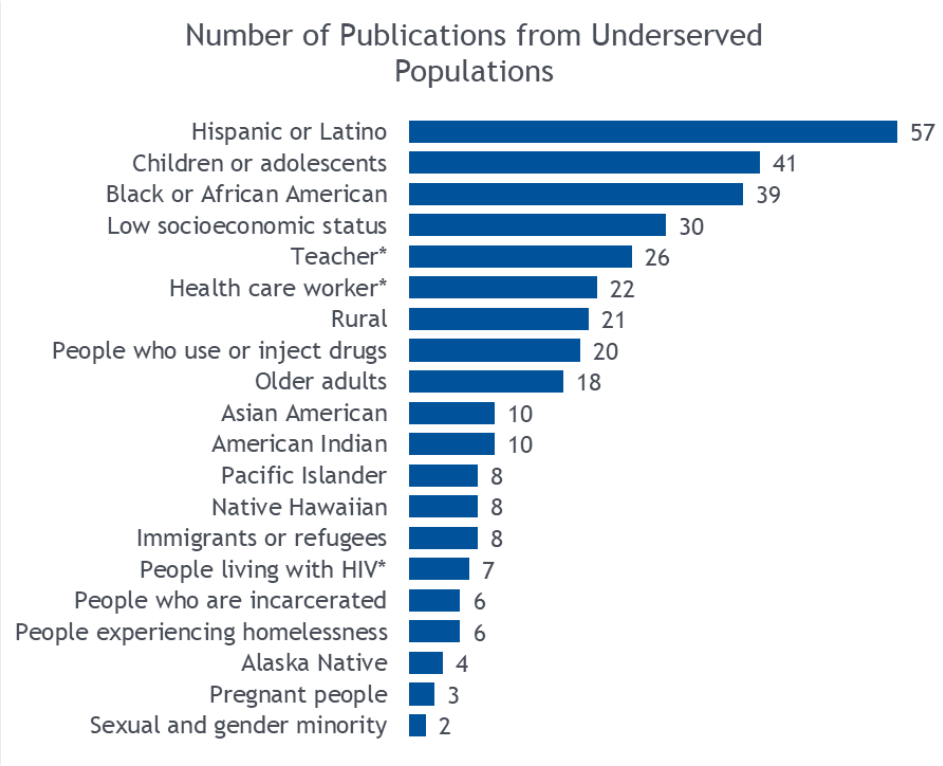


*Figure 3*. Number of RADx-UP publications (*N* = 231) about underserved populations. Populations followed by an asterisk are not populations specified by the RADx-UP Program. *Note: A publication can be coded with multiple underserved populations.*

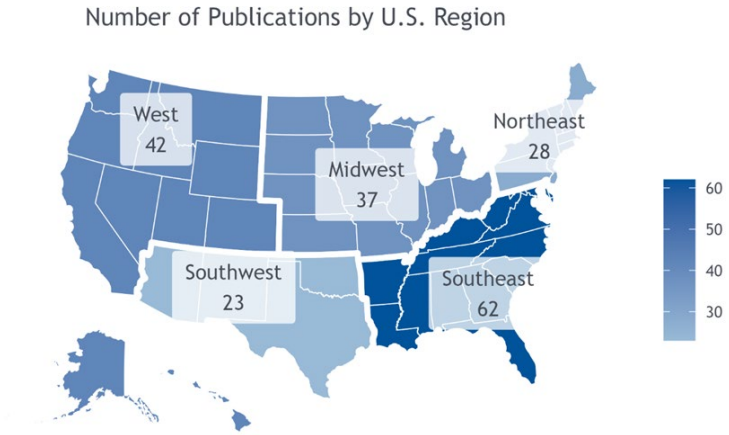


*Figure 4*. Number of RADx-UP publications (*N* = 231) taking place within U.S. regions.

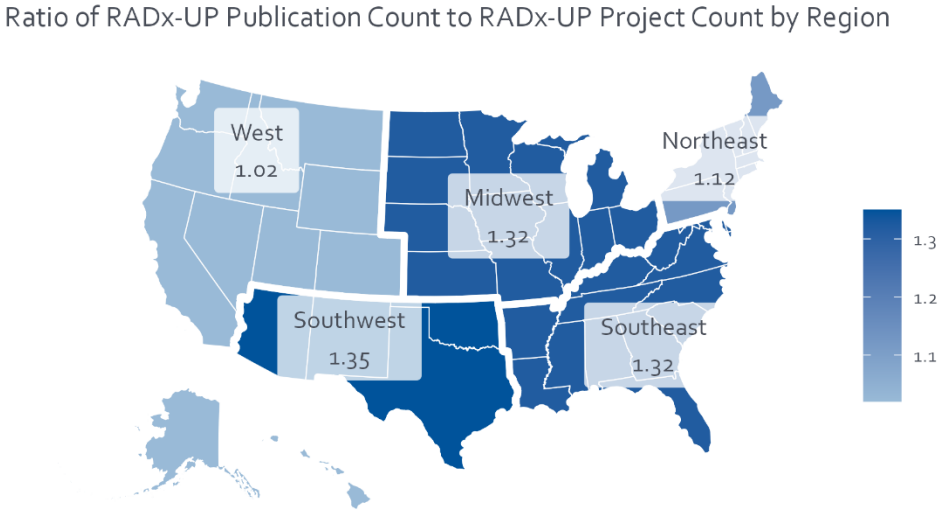


*Figure 5*. Number of RADx-UP publications (*N* = 231) taking place within U.S. regions per RADx-UP Projects serving U.S. regions (project count as of March 31, 2023).

Out of 231 publications, 141 implemented a quantitative approach to data collection and analysis. Observational study design (*n* = 127) was the most common quantitative method employed across publications. Mixed-methods (*n* = 30), qualitative methods (*n* = 29), and quasi-experimental or experimental methods (*n* = 26 and 17 respectively) rounded out the types of study designs in the RADx-UP publications that were original research publications (Figure 5).

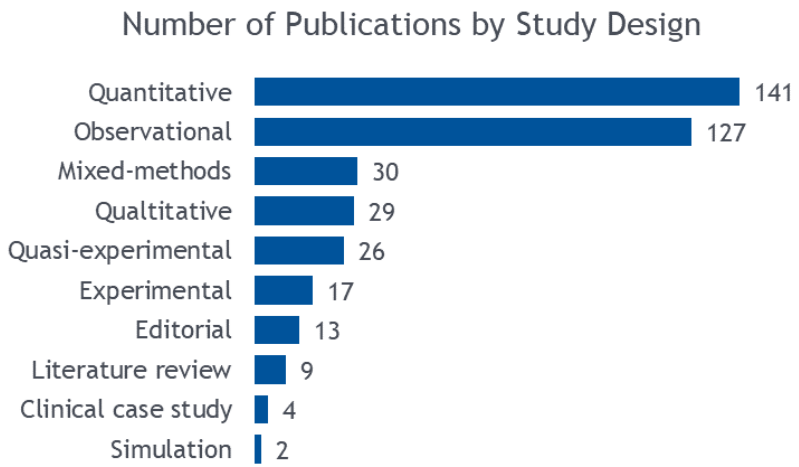


*Figure 6.* Number of RADx-UP publications (*N* = 231) with quantitative (sub-categories: experimental, quasi-experimental, simulation, observational), qualitative, mixed-methods, review, editorial, or clinical case study designs.

All publications cited at least one community engagement strategy in project activities regarding recruitment, planning, implementation, or dissemination (Figure 6). The most common engagement strategy was partnerships with community-based organizations (CBOs; *n* = 83), followed by focus groups and/or surveys (*n* = 55), and internet or social media (*n* = 35).

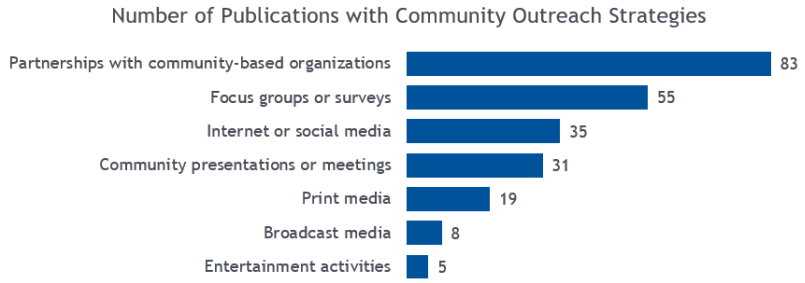


*Figure 7.* Number of RADx-UP publications (*N* = 231) that employ community outreach strategies.

Forty-four percent (*n* = 102) of publications formally acknowledged the contributions of community partners in the acknowledgement section.

## Translational Science Benefits Model Impacts

RADx-UP publications indicated that project activities led to COVID-19 testing and vaccination benefits across the four TSBM domains: 1) clinical and medical; 2) community and public health; 3) economic; and 4) policy and legislative. Figure 7 highlights the most frequently cited types of testing benefits indicated by publications, and Figure 8 highlights the most frequently cited vaccination benefits by publications.

RADx-UP publications cited both testing and vaccination community and public health benefits most frequently compared to other TSBM domains. The community and public health benefits of testing most frequently cited by publications included testing accessibility (*n* = 45), public health practices (*n* = 43), delivery and uptake (*n* = 42), community services (*n* = 42), education resources (*n* = 20), and

software and digital health (*n* = 4). Testing accessibility was most frequently cited. Publications indicated projects directly increased access to testing or services that offer tests (Whanger et al., 2022) or improved our understanding of factors that contribute to increasing the equity and ability for all community members to receive tests (Collie-Akers et al., 2022). The community and public health benefits of vaccination cited most frequently by publications included delivery and uptake (*n* = 34), accessibility (*n* = 26), public health practices (*n* = 18), education resources (*n* = 15), and software and digital health (*n* = 1). Vaccine delivery and uptake was most cited. Publications indicated that projects increased vaccination delivery and uptake by addressing the availability and/or distribution of vaccines to underserved communities to promote increased vaccine uptake (Bigelow et al., 2022).

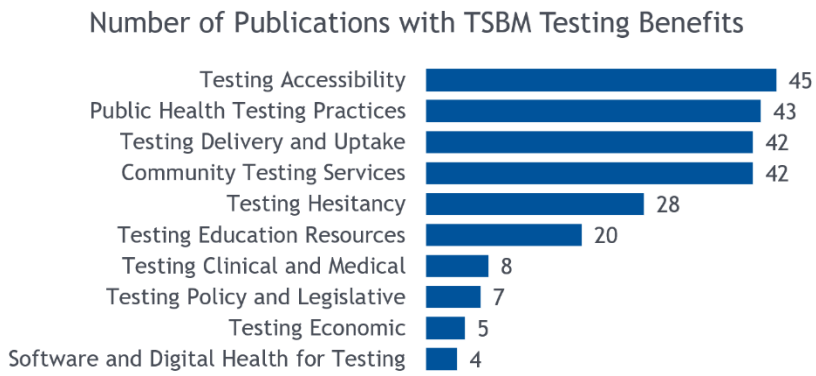


*Figure 8.* Number of RADx-UP publications (*N* = 231) with testing benefits from the Translational Science Benefits Model.

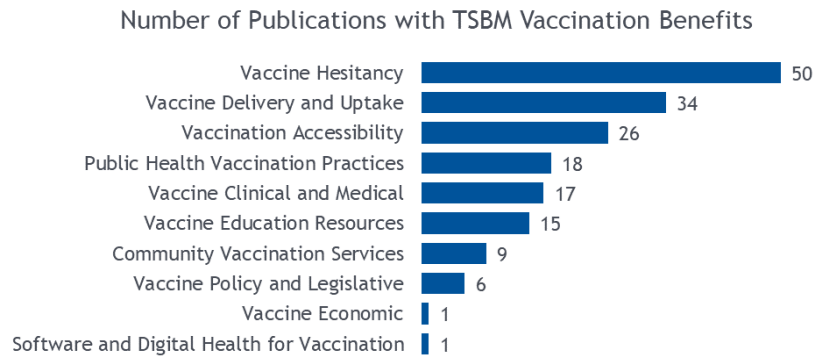


*Figure 9.* Number of RADx-UP publications (*N* = 231) with vaccination benefits from the Translational Science Benefits Model.

## Thematic Categories of Impacts

RADx-UP publications were categorized as having one or more key thematic category of impact. Publications were most frequently categorized as involving the social and behavioral factors that influence the access and uptake of vaccination (*n* = 48) and testing (*n* = 39) and the impacts of collaborative partnerships and community engagement (*n* = 44). Thirty-four publications were classified into the category of mitigation strategies on reducing COVID-19 disease burden. Twenty-seven publications were categorized into factors influencing the spread and burden of COVID-19. Publications were less frequently categorized as involving structural barriers to COVID-19 testing (*n* = 17) and vaccination access (*n* = 13), and clinical efficacy and adverse monitoring of vaccines (*n* = 11).

Figure 9 displays the number of publications that were categorized into each key theme.

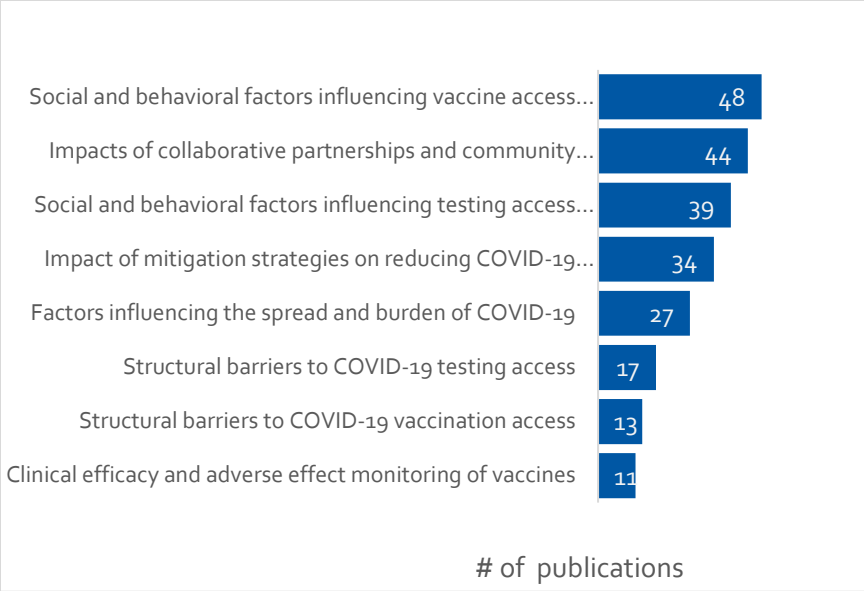


*Figure 10.* Number of RADx-UP publications (*N* = 231) with key themes related to testing, vaccination, and community engagement.

In the subsequent subsections, we present a deeper dive to summarize key findings from the analysis of categorized publications with respect to social, ethical, and behavioral (SEBI) factors and structural barriers that influence COVID-19 testing and vaccination among vulnerable populations, the impacts of collaborative partnerships on project activities, and lessons learned from our exploratory analysis of intervention research and/or implementation science.

## A. SEBI Factors Related to Testing and Vaccination

Slightly more publications were coded as involving the category social and behavioral factors influencing vaccine hesitancy, vaccine uptake, and perceived vaccine effectiveness and safety (*n* = 48) than testing access and uptake (*n* = 39). Eight publications described SEBI factors for both vaccination and testing. Many social and behavioral factors, operating at multiple socioecological levels, were associated with COVID-19 testing and vaccination.

**Sociodemographic factors.** Publications examined sociodemographic characteristics as correlates of or facilitators/barriers to testing uptake (*n* = 29) and vaccine hesitancy and uptake (*n* = 41).

Factors including race/ethnicity, sex/gender, age, education, employment, socioeconomic status (SES), presence of comorbidity, political affiliation, access to health care, and having been vaccinated against COVID-19 are associated with testing uptake (Bien-Gund et al., 2021a; D'Agostino et al., 2022; Fishman et al., 2023; Gorbach et al., 2022; Bazzi et al., 2023; Wang et al., 2022; Yeager et al., 2022; Purvis et al., 2022). In a study conducted by Wang et al. (2022), findings indicated that being female increased the odds of being previously tested for COVID-19 by 36% and having at least some college education increased the odds by 88% compared to persons with less than high school education.

Publications indicated that Black/African American, Hispanic/Latino, Asian American, Native Hawaiian, and Pacific Islander populations tend to show greater vaccination hesitancy compared to other racial/ethnic groups (Andersen et al., 2023; Willis et al., 2023) often due to factors such as distrust in healthcare systems and governmental institutions as a result of structural racism (CarlLee et al., 2023; Willis et

al., 2023; Reece et al., 2023; Harrison et al. 2021). In a survey of frontline healthcare assistants, Niznik et al. (2021) found that Black/African American and other race respondents were less confident that COVID-19 vaccines have been adequately tested in people of color, with just 16.2% and 10.5% reporting at least moderate confidence compared to 34.3% of White respondents. Other sociodemographic factors shown to be associated with lower vaccine hesitancy and/or greater uptake included older age, sex/gender, higher education, employment status, presence of comorbidities, health care access, prior testing for COVID-19, and COVID-19 vaccination status of family members/personal relationships (Al-Dahir et al., 2022; Andersen et al., 2022; CarlLee et al., 2023; McElfish et al., 2023; McElfish et al., 2022a; Strathdee et al., 2023; Willis et al., 2023; Willis et al. 2022). A survey of diverse US adults found adults who were 45 or older had 35% greater odds of being vaccinated than those between the ages of 18 and 34; odds of vaccination increased as educational attainment increased; respondents without a primary care provider had lower odds of being vaccinated (OR = 0.68); and respondents who reported knowing someone who died from COVID-19 had higher odds of being vaccinated (OR = 1.40; Andersen et al., 2023).

**Individual-level factors.** Individual-level factors, including attitudes, beliefs, motivation, and behaviors, were also found to be facilitators/barriers to testing uptake (*n* = 11) and vaccine hesitancy and/or uptake (*n* = 27) in the publications.

In a diverse sample of US adults, motivation to distribute and use COVID-19 self-test kits was found to be associated with increased test uptake and case detection, although individuals of lower SES reported lower motivation (Bien-Gund et al., 2021a). COVID-19 protective behaviors, having received at least one COVID-19 vaccine dose, and having been exposed to someone with COVID-19 were significantly associated with COVID-19 testing (Yeager et al., 2022).

Positive attitudes and beliefs towards vaccination generally and COVID-19 vaccination specifically, such as greater perceived severity of COVID-19, motivation to vaccinate, and engaging in COVID-19 protective behaviors, were indicative of lower vaccine hesitancy (Al-Dahir et al., 2022; Algarin et al., 2023; Cioffi et al., 2022; Frietze et al., 2023; McElfish et al., 2022a; McElfish et al., 2022b; Page et al., 2022; Purvis et al., 2022; Purvis et al., 2023). In a study conducted with undocumented migrants, Page et al. (2022) found that while self-perceived accessibility of COVID-19 vaccination was high (86.4%), demand for vaccination was low (41.1%). However, after adjustment, positive views about vaccination in general and COVID-19, older age, and the presence of comorbidities were all significantly associated with increased demand for vaccination (Page et al., 2022). Findings from several studies indicated that motivation for vaccination included a desire to keep themselves and/or others around them healthy and safe (Al-Dahir et al., 2022; Jones et al., 2022; Kenworthy et al., 2022). Results from studies conducted with people who use and inject drugs (PWID) showed that participants who engaged in at least one protective behavior (e.g., social

distancing, isolating oneself, wearing masks, increasing handwashing) were significantly less likely to be vaccine hesitant (unadjusted OR: 0.43; 95% CI: .23-.81; Strathdee et al., 2022). Those who were more worried about getting COVID-19 were also less likely to be vaccine hesitant (OR: 0.86 per point increase; 95% CI: .79-.93; Strathdee et al., 2022).

Studies also identified individual-level factors as barriers to testing and vaccination uptake. Concerns about the testing process and contracting COVID-19 at testing sites, consequences of a positive result, cost of testing, belief that testing was not necessary if asymptomatic, and mistrust in the healthcare system were identified as barriers to testing uptake (Bruening et al., 2022; Collie-Akers et al., 2022; D'Agostino et al., 2022; Katzmarzyk et al., 2023; Lee et al., 2023; Mast et al., 2023).

Concerns about the safety and efficacy of vaccines, cost of vaccines, mistrust in the vaccine development process and institutions, and low perceived severity of COVID-19 were identified as barriers to vaccination uptake (Berry et al., 2021; Cioffi et al., 2022; Frietze et al., 2023; Hallgren et al., 2021; Izeogu et al., 2023; Juarez et al., 2022a; Juarez et al., 2022b; Kenworthy et al., 2022; Kreuter et al., 2022; Moore et al., 2022a; Myneni et al., 2023; Pulgaron et al., 2023; Purvis et al., 2022). In a study conducted by Wang et al. (2021) that examined determinants driving COVID-19 vaccine uptake and hesitancy, findings indicated that of respondents who expressed vaccine hesitancy, one-third were concerned about side effects and one-fourth did not trust the vaccine would be safe. A study conducted by Kreuter et al. (2022) examined how racially- and ethnically-diverse parents of Medicaid-enrolled children 5 years old or younger felt about a prospective COVID-19 vaccine for their children and found considerable resistance to the idea of getting their child vaccinated; fewer than half of respondents indicated it was important, and fewer than one-third believed the benefits would outweigh any rare side effects. However, publications also indicated that vaccine hesitant individuals may still get vaccinated themselves (McElfish et al., 2022a; Moore et al., 2022b; Purvis et al., 2022), and perspectives on vaccine skepticism and decisions around vaccination can evolve over time in certain communities from initial concerns about secondary effects, trials data, and experiences of failed public health interventions in minority populations to reversals in personal opposition to vaccination (Rivera-Núñez et al. 2022).

**Interpersonal and social factors.** Some publications indicated that misinformation was a factor that could increase testing and vaccination hesitancy and reduce uptake (Buro et al., 2022; Collie-Akers et al., 2022; Katzmarzyk et al., 2023; Mast et al., 2023; Moore et al., 2022b; Myneni et al., 2023; Strathdee et al., 2023). Communication channels and trusted messengers were found to be important factors (*n* = 26) in addressing testing and vaccine hesitancy and improving uptake. Media, including traditional and social media, was the most widely described communication channel where individuals received messages about COVID-19, testing, and

vaccination but could also foment dissemination of misinformation (Al-Dahir et al., 2022; Buro et al., 2022).

The most trusted messengers identified as important for decreasing testing and vaccine hesitancy and improving uptake were social networks (family, friends, co-workers, etc.), healthcare providers/experts, and governmental/official messengers (Al-Dahir et al., 2022; Algarin et al., 2023; Berry et al., 2021; Frietze et al., 2023; Hallgren et al., 2021; Juarez et al., 2022b; Kenworthy et al., 2022; Purvis et al., 2022). Communication channels and messengers that potentially provide different messages around vaccination than official ones may increase vaccine hesitancy and/or decrease uptake. In a study conducted with Native Hawaiians and other Pacific Islanders (NHPIs), Juarez et al. (2022b) found a significant positive association between uptake of the COVID-19 vaccine and degree of trust in official sources and a significant negative association between vaccine uptake and degree of trust in unofficial sources.

**Environmental, community, organizational, and governmental factors.** Some vulnerable populations experience disparities in testing and vaccination access due to social determinants such as experiencing homelessness and residing in/being part of communities with high social vulnerability, urban and rural areas, racial minority populations, and migrant or immigrant populations (Bazzi et al., 2023; Buro et al., 2022; Hendricks et al., 2021; Jimenez et al., 2021; Lee et al., 2022). Lack of support for languages other than English were a challenge for some populations to access testing (Bigelow et al., 2022; Collie-Akers et al., 2022). Lack of transportation or use of public transportation were found to be barriers to access testing sites, such as drive-through sites, and can increase risk of exposure when traveling long distances (Collie-Akers et al., 2022; Lee et al., 2022; Katzmarzyk et al., 2023). Organizational policies presented barriers to employee testing based on employment type (e.g., contractors; Rivera-Núñez et al. 2022).

However, community, organizational, and governmental-level facilitators (e.g., resources, programs, and policies) can improve vulnerable populations' access to, acceptance and uptake of testing and vaccination. Providing access to in-school testing was found to increase testing uptake overall (Mast et al., 2023) and after in-school exposures (Boutzoukas et al., 2022). Offering testing at syringe exchange programs was shown to be an effective strategy for facilitating access to testing among PWID (Cioffi et al., 2022). Among underrepresented populations, community-engaged approaches including culturally tailored outreach interventions delivered in community settings are effective in increasing testing (Bigelow et al., 2022; D'Agostino et al., 2022; DeGarmo et al., 2022) and vaccination access and uptake (Feifer et al., 2021; Purvis et al., 2022). Health care organizations (HCOs) and employers can facilitate COVID-19 testing and vaccination by offering on-site-services, providing referral information, and addressing concerns (Berry et al., 2021; Berry et al., 2022a; Feifer et al., 2021; Hallgren et al., 2021; Harrison et al., 2021). Finally, despite some limitations and challenges, state-run sites that are free of charge and

open to everyone can improve population testing access (Lee et al., 2022).

Overall, publication findings indicated that many SEBI factors operating at multiple socioecological levels contributed to vulnerable communities' hesitancy towards, access to, and uptake of COVID-19 testing and vaccination. Disparities in hesitancy, motivation, access, and uptake exist but vary among populations. Health education campaigns aimed to decrease vaccine hesitancy and increase testing and vaccination access and uptake among vulnerable populations are most effective when they are culturally tailored and delivered by trusted messengers. Community, organizational and governmental-based initiatives and interventions that reduced barriers to COVID-19 testing and vaccination such as mobile clinics in underserved communities, reduced/no-cost and/or incentivized testing and vaccination, employer-sponsored resources, events and locations, and at home-testing were shown to be effective in improving access and uptake (Barrett et al., 2022; Bien-Gund et al., 2021b; Bigelow et al., 2022; Gupta et al., 2022; Lee et al. 2022; Shah et al., 2023; Hallgren et al., 2021).

### B. Structural Barriers to Testing and Vaccination

Seventeen publications cited one or more structural or systemic barriers that may limit access to COVID-19 testing. Structural barriers mostly entailed getting to testing sites in terms of geographic proximity, time, and cost in addition to issues that were specific to particular underserved populations. Barriers across populations included: transportation or driving times ($n$ = 7), location of centers or services ($n$ = 5), inflexible work schedules or fear of losing employment while getting tested ($n$ = 5), wait times or scheduling ($n$ = 4), fear of exposure while waiting to be tested ($n$ = 3), and the cost of testing ($n$ = 4). Language barriers ($n$ = 3) and fear of deportation ($n$ = 3) were unique to Hispanic/Latino populations. Lack of staff to implement testing ($n$ = 2), internet access to telehealth and testing results (especially for Tribal Nations; $n$ = 3), and beliefs about testing (e.g., misinformation, lack of buy-in, fear of testing positive; $n$ = 4) also inhibited vulnerable populations from accessing testing.

Based on results from focus groups with primarily Black/African American communities in Louisiana, Katzmarzyk et al. (2023) identified approaches to increase testing uptake that addressed concerns of proximity, transportation, and buy-in. These strategies included: providing testing in heavily traveled areas (e.g., supermarkets, churches, schools, neighborhoods), offering transportation and incentives, and improving communication about testing (e.g., engaging local celebrities or expert leaders; providing information via health fairs, social media, or other advertisements). Additionally, outreach to local employers to accommodate clinical visits may reduce economic barriers to testing.

Thirteen publications cited one or more structural barriers to COVID-19 vaccination that were parallel to testing barriers. Martinez et al. (2022) argued that preferential access to and

administration of COVID-19 vaccinations are critical to addressing the inequities and disparities exacerbated by COVID-19, including access to deferred preventative screening and treatment due to the pandemic. They identified multiple strategies to address barriers to COVID-19 vaccination (particularly for Hispanic communities in the United States-Mexico border region of California), including convenient vaccination locations or mobile vaccination services (*n* = 8) to mitigate transportation and access issues and culturally tailored vaccine literacy campaigns in multiple languages (*n* = 3) to increase buy-in (Martinez et al., 2022). Employer support (*n* = 1) or insurance coverage (*n* = 1) of vaccinations can also reduce economic costs of vaccination according to other RADx-UP publications.

## C. Impact of Community Engagement and Collaborative Partnerships

Twenty-five RADx-UP publications described the impact of community engagement and collaborative partnerships in the following areas:

- Utilizing multi-sector partnerships to implement, adapt, and promote testing and vaccination.
- Strengthening recruitment and data collection
- Improving community capacity for research and workforce development
- Informing health messaging, outreach, and dissemination strategies
- Utilizing community advisory boards (CABs) and community-based participatory research (CBPR) to guide research implementation
- Building sustainable, trusted relationships within communities
- Evaluating the impacts and strengths of community engagement

### Sub-Theme 1: Utilizing Multi-Sector Partnerships to Implement, Adapt, and Promote Testing and Vaccination (n = 12)

Twelve publications described how they developed or leveraged multi-sector partnerships (e.g., academic partners, CBOs, health departments) to implement, improve, and adapt research activities to community needs in order to effectively promote testing and vaccination uptake within underserved communities (Gillard et al., 2022; Vazquez et al., 2022; McCollum et al., 2022; Berkley-Patton et al., 2022; Budd et al., 2022; Singler et al., 2023). Some publications described how they used their multi-sector partnerships to address vaccine hesitancy (Gillard et al., 2022), adapt intervention strategies to community needs (Goldman et al., 2023), or reduce infection transmission within schools (Zimmerman et al., 2022).

"*Leveraging local partnerships within each AHEC service area, the COVID COMET AL team was consistently able to provide testing services within jails and other congregate living facilities throughout the state. The team conducted 3852 tests in jails, 11% (n = 382) of which were positive" (McCollum et al., 2022)*

*"Community health promoters intervention was associated with 3.84 times more Latinx individuals tested per event than control sites, and the intervention was associated with testing a greater proportion of the Latinx populace per event" (DeGarmo et al., 2022)*

### Sub-Theme 2: Strengthening Recruitment and Data Collection (n = 8)

Eight publications described how their community partnerships helped them identify and recruit eligible participants. Some studies utilized targeted strategies such as using community health workers (Barrett et al., 2022), existing studies (Strathdee et al., 2023), CBOs (Rodriguez et al., 2022; Barrett et al., 2022), or trained faith leaders (Berkley-Patton et al., 2022) to achieve enrollment targets.

A study comparing participant engagement rates between recruiting through CHWs and CBOs versus HCOs found that community-based approaches to expanding at-home COVID-19 testing among Black and Latino residents of New Jersey were more successful than HCO-based approaches (Barrett et al., 2022).

*"More participants were recruited through CBOs than HCOs at every stage in the process, including 97% (n = 5183) of screener completions, 97% (n = 2342) of informed consents, 94% (n = 1037) of questionnaire completions, 92% (n = 371) of tests requested, and 90% (n = 211) of tests completed" (Barrett et al., 2022)*

### Sub-Theme 3: Improving Community Capacity for Research and Workforce Development (n = 4)

Four publications described how they partnered with community-based organizations to improve community capacity for community-engaged research and invested in community workforce by hiring and training trusted members already living within communities to implement research activities. One study published their data on how they built research capacity by training 24 community leaders through community workshops and assessing test-score improvement to ascertain their readiness to deliver health messaging within communities (Marzan-Rodríguez et al., 2023).

### Sub-Theme 4: Informing Health Messaging, Dissemination, and Outreach Strategies (n = 15)

Fifteen RADx-UP publications described how their established community partnerships, trusted leaders, and networks helped disseminate relevant information seamlessly within communities. Some studies sought feedback from community partners and trusted leaders to ensure messaging was culturally appropriate (e.g., translation of study materials) and tailored to communication needs. Others invested in social marketing campaigns, multiple dissemination channels, and local community groups to advertise and deliver study promotional materials as well as promote testing and vaccination.

*"Local health department directors served as the primary spokespeople for the campaign and were supported by community leaders who spoke about the importance of testing*

*and shared their testing stories […] Before campaign launch, the SYCT communications team identified local influencers, businesses, and groups with the largest amount of social media followers for their geographical area […] For newspaper and radio advertisements, we established local media partnerships, with a particular focus on Black and Hispanic-owned media" (Singler et al., 2023)*

*"Outreach strategies included dissemination of information about testing events via trusted community organizations and leaders (e.g., churches) and directly, using social media, Spanish language radio, and flyers" (Budd et al., 2022)*

**Sub-Theme 5: Utilizing Community Advisory Boards and CBPR to Guide Research Implementation (n = 10)**

Five RADx-UP publications utilized community-based participatory research to develop and implement their intervention (Haroz et al., 2022; Chen et al., 2022; Berkley-Patton et al., 2022) or develop community-based testing interventions (DeGarmo et al., 2022). Seven RADx-UP publications established or utilized a CAB to provide implementation guidance on culturally appropriate study materials and methods (Stadnick et al., 2022; Budd et al., 2022; Strathdee et al., 2023; Haroz et al., 2022; Rabin et al., 2023), identify key priorities within communities (Chen et al., 2022; Rabin et al., 2023), discuss barriers and facilitators to testing (Chamie et al., 2022), or provide feedback on outreach and dissemination strategies (Stadnick et al., 2022).

*"Using a community-based participatory research approach, African American faith leaders and local health department staff were engaged in the conceptualization, design, implementation, and evaluation of the project to ensure appropriate cultural and religious tailoring for the church context" (Berkley-Patton et al., 2022)*

*"CABs proffered implementation guidance such as translation of study materials, use of native-speaking interpreters, extending hours and mobile clinics for testing and vaccination, low-technology solutions for scheduling and culturally appropriate target outreach by trusted messengers" (Stadnick et al., 2022)*

**Sub-Theme 6: Building Sustainable, Trusted Relationships Within Communities (n = 3)**

Three publications described how they fostered trusting partnerships and relationships within their research communities by utilizing partners/community ambassadors with relevant lived experience or language skills (Budd et al., 2022). Another publication described how serving as a COVID-19 information resource within their underserved community led them to build trust in the communities (Dillard et al., 2022). DeGarmo et al. (2022) described how they maintained relationships and established sustainable agreements with testing procurement agencies, which allowed them to complete their testing intervention activities successfully.

*"Leadership with intimate cultural knowledge, relevant lived experience, and Spanish-English language skills was instrumental in fostering trusting partnerships and effectively*

*developing the Promotores de Salud intervention in a relatively short period of time" (Budd et al., 2022)*

**Sub-theme 7: Evaluating the Impacts and Strengths of Community Engagement (n = 2)**

Two publications assessed the impacts of community engagement strategies. In an intervention study, Barrett et al. (2022) found that partnerships with community partners and CBOs led to much higher recruitment, engagement, and retention of Black and Latino NJ residents than partnerships with local HCOs and academic research teams. Stadnick et al. (2022) characterized and estimated the time commitment associated with community engagement activities. They found that more time was spent during startup and identifying and recruiting CAB members than during the maintenance phase of their projects.

*"We identified that the community engagement activities in the startup phase required the greatest number of person-hours compared to the early and maintenance phases of the projects. This study contributes to the community engagement and implementation science literature by providing a pragmatic tracking and measurement approach and recommendations for planning for and assessing costs to facilitate meaningful community engagement in public health implementation research" (Stadnick et al., 2022)*

## D. Lessons Learned from Implementation and Intervention Strategies

### Intervention Implementation Successes

**Sub-Theme 1: Outcomes and Impacts of Community-Driven Partnerships and Collaborations**

RADx-UP publications credited their positive outcomes to robust community-academic partnership developments and active community engagement. For example, Strathdee et al. (2023) reported that these collaborations helped identify a variety of barriers to COVID-19 vaccination among PWID. Community-academic partnerships also supported projects in disseminating accurate information about COVID-19 testing and vaccination, combatting misinformation, and educating underserved communities in Delaware (Dillard et al., 2022). RADx-UP Projects enhanced the research capacity of community partners and improved their research design and implementation skills (Dillard et al., 2022; Ko et al., 2022; DeGarmo et al., 2022).

Stakeholders were actively involved in intervention development, providing contextual insights and guiding research implementation processes (Ko et al., 2022). This involvement of stakeholders allowed projects to produce more community-relevant findings (Dillard et al., 2022) and foster bidirectional learning (Ko et al., 2022; Budd et al., 2022).

DeGarmo et al. (2022) attributed their project's success in increasing COVID-19 testing rates and sustaining test

procurements to engaging community partners and building trusting relationships with stakeholders.

Community partnerships also led to sustainable outcomes, such as enabling community members to become community investigators (Ko et al., 2022), allowing project teams to respond to new requests for proposals using community-engaged research methodologies (Dillard et al., 2022), and spurring systemic changes, like formalizing a youth entrepreneurship education program as part of the standardized high school curriculum (Ko et al., 2022).

### Sub-Theme 2: Impacts of Culturally Tailored Outreach, Recruitment, and Intervention Implementation Strategies

Tailored intervention strategies, such as using trusted peers that have similar lived experiences or other outreach strategies tailored to the unique needs and cultural contexts of target communities, improved vaccination and testing accessibility and uptake (Strathdee et al., 2023; Valasek et al., 2022; Bazzi et al., 2023; Ko et al., 2022; Budd et al., 2022; Dillard et al., 2022).

For example, results from the "LinkUP" intervention indicated that peer-led intervention sessions at intervention sites improved testing uptake (Bazzi et al., 2023) and increased the likelihood of PWID receiving a new COVID-19 vaccine by 57% (adjusted relative risk: 1.57; 95% CI: .99-2.48; Strathdee et al., 2023). The LinkUP testing and vaccination intervention, which incorporated tailored education, motivational interviewing, problem-solving, and planning, significantly increased testing uptake compared to the control program. The provision of services and on-site health care referrals enhanced the accessibility of COVID-19 testing among PWID.

Budd et al. (2022) attributed the success of their outreach intervention, "Promotores de Salud," to adopting a culturally tailored approach. This intervention engaged bilingual, bicultural community health promoters who were intimately connected to local Latinx communities, resulting in 3.84 times more Latinx individuals tested per event compared to the control group. Their involvement increased trust and strengthened community engagement. The publication also highlighted the positive impacts of utilizing multiple media and outreach strategies such as flyers, door hangers, radio announcements, WhatsApp messages, and social media including local businesses/organization sites (grocery stores, churches, schools, and mental health centers) to promote the intervention and recruit participants.

### Sub-Theme 3: Utilizing Evidence-Based Intervention Design and Implementation Approaches

Publications grounded their intervention approach in evidence-based behavioral and implementation science theories. Strathdee et al. (2023) and Bazzi et al. (2023) addressed knowledge gaps and attitudinal barriers to vaccination and testing by incorporating elements like tailored education, motivational interviewing, and problem-solving and planning from the social cognitive theory. Berry et al. (2022b)'s use of a cluster randomized trial design was instrumental in assessing vaccination outcomes in a study involving 133 skilled nursing facilities across 16 states, with

82.5% vaccinated in the intervention arm compared to 79.8% in the control arm.

RADx-UP research used CBPR principles to guide intervention design, implementation, and community outreach strategies (Dillard et al., 2022; Ko et al., 2022; Budd et al., 2022; Windsor et al., 2022). Applying CBPR principles allowed projects to be flexible in making iterative refinements based on ongoing feedback from community partners and ensured interventions were tailored to specific cultural contexts, making them more likely to be accepted and leading to positive outcomes and sustainable changes. Windsor et al. (2022) described how they utilized a Sequential Multiple Assignment Randomized Trial (SMART) to optimize and test evidence-based HIV prevention interventions for COVID-19 prevention. Their adaptive approach allows for modifications based on participant responses and real-time assessment of outcomes.

Finally, publications described utilizing multi-component evidence-based intervention approaches. Berry et al. (2022b) incorporated community needs assessment, intervention mapping, and large-scale agile community assessments to address misinformation complexity by considering personal, cultural, and social influences. Windsor et al. (2022) adapted evidence-based intervention strategy (that was effective in engaging communities in HIV prevention and treatment) to develop a comprehensive approach covering a spectrum of prevention measures, including testing, social distancing, quarantine, hospitalization, contact tracing, and acceptance of COVID-19 vaccination.

## Intervention Implementation Challenges

### Sub-Theme 1: Community-Academic Partnership and Community Engagement Challenges

Publications described challenges in actively engaging community partners. Dillard et al. (2022) acknowledged that community-engaged research is transactional and requires significant time, dedication, and patience. Publications highlighted potential difficulties in maintaining and strengthening community partnerships beyond the study duration (Dillard et al., 2022; Myeni et al., 2023). Despite a multi-component approach to their intervention design, Myeni et al. (2023) struggled to foster active engagement with their target population and increase the reach of vaccination and testing. Administrative challenges, such as IRB and protocol delays, may have affected community-academic partner relationships when partners' suggestions could not be immediately implemented due to grant-related limitations or human subjects research requirements (Budd et al., 2022).

### Sub-Theme 2: Resource Limitations: Time, Funding, and Human Resources

RADx-UP publications highlighted resource limitations related to time demands, limited funding for community-engaged research, and staffing shortages (Myeni et al., 2023; Dillard et al., 2022; Berry et al., 2022b; Budd et al., 2022). Berry et al. (2022b) described how an aggressive timeline to

meet vaccination demands, staff shortages, and regulatory hurdles during the second wave of COVID-19 affected the project's capacity to fully implement their intervention components and achieve high vaccination uptake among nursing facility staff. Budd et al. (2022) also described how the fast-paced nature of the project, coupled with staffing shortages in CBOs, led to challenges in implementing tasks initially envisioned. The demands on CBOs for various services strained their resources, requiring adjustments to the project timeline.

### Sub-Theme 3: Limitations of Study Implementation Design

Publications, especially those involving randomized intervention studies, described the complexities and limitations of their implementation strategies. A study implementing school-based randomized controlled trials had to change their study design and study objectives due to ethical concerns raised by the comparison school site about not being offered COVID-19 testing intervention (Ko et al., 2022). Similarly, DeGarmo et al. (2022) reported that some community partners objected to randomization and wait-listed sites before vaccine availability, requiring responsiveness to concerns from county officials and CBOs to establish trust. These challenges demonstrate the complexities of implementing randomized controlled trials in real-world settings.

Relying on virtual communication channels to recruit and engage participants may have unknowingly excluded community members without internet access (Shah et al., 2022). Despite the convenience of remote communication, forming relationships through virtual means was challenging Budd et al. (2022). Also, reliance on self-reporting of vaccine uptake behaviors introduced potential bias due to socially desirable responses, which may have impacted the accuracy of study findings (Strathdee et al., 2023; Bazzi et al., 2023; Valasek et al., 2022).

### Sub-Theme 4: Sampling, Selection Bias, Representativeness, and Other Methodological Limitations

Despite using multiple engagement strategies to recruit samples from the target population, many publications identified limitations and trade-offs of sample size and representativeness (Strathdee et al., 2023; Bazzi et al., 2023; Valasek et al., 2022; Windsor et al., 2022; Ko et al., 2022; DeGarmo et al., 2022). A small sample size may have limited the ability to detect significant changes in intervention effects or outcomes. Recruiting from a specific target population may restrict the applicability of findings to the broader population or other underrepresented groups.

## Implications and Recommendations for Future Research

### Sub-Theme 1: Need for More Rigorous Studies on COVID-19 Testing and Vaccination

RADx-UP Project publications highlighted the need for more rigorous comparative studies, longitudinal research, and experimental studies to better understand the barriers and facilitators to successful implementation and provide a nuanced understanding of intervention impacts and

comparative effectiveness (Strathdee et al., 2023; Bazzi et al., 2023; Shah et al., 2022; Valasek et al., 2022).

Assessing changes over time, both in testing and vaccination behaviors and intervention impacts, is crucial for understanding long-term effectiveness and adapting strategies accordingly (Valasek et al., 2022; Ko et al., 2022). Valasek et al. (2022) emphasized the importance of structural supports in increasing vaccine and testing uptake. Future research should delve deeper into the effectiveness of these structural interventions, such as mobile vaccination sites and community outreach, to guide public health initiatives for underserved population (Valasek et al., 2022).

Publications also acknowledged the need to prioritize funding for community-engaged interventions beyond COVID-19 testing and vaccination to address health disparities and promote equitable health outcomes, especially in underserved and marginalized populations (Berry et al., 2022b; Windsor et al., 2022).

*"Given the evolving nature of COVID-19 vaccination guidelines, future research should explore beliefs and experiences related to booster doses and additional shots. This will help inform interventions and support strategies in the context of changing vaccination recommendations" (Valasek et al., 2022)*

### Sub-Theme 2: Increasing Adaptability and Flexibility in Research Design and Implementation

Continuous adaptation of interventions, particularly in response to SARS-CoV-2 variants and community priorities, should be a focus in future research (Budd et al., 2022). Adopting flexible study designs that align with community values and ethical considerations is crucial to achieve impacts in health equity research interventions (Ko et al., 2022).

### Sub-Theme 3: Building Sustainable Community-Research Partnerships

Sustained community engagement is essential for the success of interventions. Publications recognized the need for sustainable research practice partnerships and the exploration of strategies to strengthen community engagement beyond the study period (Dillard et al., 2022; Williams et al., 2022). Projects also acknowledged the importance of establishing mechanisms to receive ongoing feedback from community partners to ensure that interventions stay relevant to community needs and are effective over time (Budd et al., 2022; Myeni et al., 2023; Windsor et al., 2022).

## Conclusion

Content analysis of RADx-UP publications provided valuable insights into the complex landscape of COVID-19 testing and vaccination in underserved communities. Key findings from primary themes highlighted the profound impact of social, behavioral, and structural factors on testing and vaccination, and the vital role of community engagement and collaborative partnerships in achieving projects' implementation goals.

Sociodemographic factors, including race/ethnicity, age, education, employment, and access to healthcare, were found to shape testing and vaccination behaviors, alongside individual attitudes, beliefs, and motivations. Culturally tailored health education campaigns, delivered by trusted messengers, were effective in increasing testing and vaccination uptake.

Structural barriers, such as transportation, location, work schedules, and cost, posed challenges to access. Recognizing and addressing these barriers, particularly for vulnerable populations, were crucial steps towards achieving equitable health outcomes.

Lessons learned from successful RADx-UP interventions revealed the power of community-driven partnerships, culturally tailored outreach campaigns, and community advisory boards, which, when paired with robust approaches like CBPR, can alleviate structural barriers and boost community members' motivation to participate in intervention activities.

Community engagement and collaborative partnerships emerged as powerful tools for addressing disparities. Multi-sector partnerships strengthened recruitment and data collection efforts and enhanced community capacity for research, contributing to more effective interventions.

However, the implementation of these community-engaged interventions was not without challenges. Engaging community partners requires significant time and dedication. Administrative hurdles, resource limitations, methodological challenges, and the complexities of translating research into real-world settings all posed obstacles. These constraints impacted the capacity to fully implement intervention components, emphasizing the need for adequate resources to support community-engaged research.

Despite these challenges, lessons learned from RADx-UP publications underscored the importance of flexibility, sustained community engagement efforts, streamlined research partnership processes, and adequate resources to support community-engaged research.

More comparative studies, longitudinal research, and experimental designs are needed to understand the barriers and facilitators to successful implementation (Strathdee et al., 2023; Bazzi et al., 2023; Shah et al., 2022; Valasek et al., 2022). Assessing changes over time and the long-term effectiveness of structural supports, such as mobile vaccination sites and community outreach, should guide future public health initiatives (Valasek et al., 2022; Ko et al., 2022). The insights gained from RADx-UP publications will be invaluable in refining and adapting community-engaged implementation approaches and ensuring the long-term success of future interventions.

# Appendix

## Appendix A. Citations for Publications in Dataset

https://duke.box.com/s/aeswutshk2lbop1lodes1qr5mzoy585d

## Appendix B. Abbreviated Codebook

| Domain or Category | Description |
|---|---|
| Translational Science Benefits Model (TSBM) - A publication is categorized with the benefit if it: | |
| Clinical and Medical | Describes 1 or more of the following indicators related to COVID-19 testing and/or vaccination:<br>(1) Clinical Guidelines: the development, study, or use of formal recommendations for or principles to assist patient care or clinical circumstances;<br>(2) Procedures: research methods in a preclinical, clinical or other scientific study to assess the safety, efficacy or effectiveness of testing and/or vaccination;<br>(3) Technology: the biomedical technological development of COVID-19 tests and/or vaccines |
| Economic | Describes 1 or more of the following indicators related to COVID-19 testing and/or vaccination:<br>(1) License Agreements and Patents: study activities relate to obtaining or the potential to obtain government permits, authority or licenses based on intellectual property;<br>(2) Non-Profit or Commercial Entities: study activities addressed or resulted in the creation of non-profit or commercial entities;<br>(3) Cost Effectiveness: study described methods, results and/or implications of a cost-effectiveness analysis related to the comparison of testing or vaccination versus another COVID-19 mitigation strategy/or current practice;<br>(4) Cost Savings: study activities addressed cost savings |
| Policy and Legislative | Describes 1 or more of the following indicators related to COVID-19 testing and/or vaccination:<br>(1) Advisory Activities: study activities related to or involved the development of: 1. Committee Participation; 2. Expert Testimony; and/or 3. Scientific Research Reports;<br>(2) Policies and Legislation: study activities related to or involved the development of: 1. Legislation; 2. Policies; and/or 3. Standards. |
| Community and Public Health | Describes the following with respect to COVID-19 testing and/or vaccination:<br>○ Community Testing or Vaccination Services: study activities related to the provision of preventive health services with a testing and/or vaccination focus/program component provided for individuals in a community<br>○ Testing or Vaccine Education Resources: study activities that involved the development, tailoring or use (for outreach, engagement or investigation) of testing and/or vaccine educational resources for individuals, populations, or communities<br>○ Testing or Vaccination Accessibility: study methods, approaches or activities that involve either directly increasing or improving understanding of factors that contribute to increasing the equity and ability for all to receive tests/testing or vaccines regardless of race, ethnicity, age, income, ability, sex, gender, sexual orientation, geographic location, or health status, etc.<br>○ Testing or Vaccine Delivery and Uptake: study methods, approaches or activities that involve addressing the availability and/or distribution of tests or vaccines to communities to promote |

| | |
|---|---|
| | increased vaccine uptake (e.g. vaccination rates)<br>○ Software and Digital Health for Testing or Vaccination: study activities related to the development, testing, piloting and/or use of digital/mobile technologies/applications for use by individuals and communities to improve delivery and uptake<br>○ Public Health Testing or Vaccination Practices: study activities related to the organization or delivery of public health testing or vaccination services that benefit communities or populations. |
| Thematic Categories of Impact - A publication is categorized as the following if it: | |
| Clinical efficacy and adverse effect monitoring of vaccines | Examines the clinical impact of vaccines with a biomedical focus |
| Factors influencing the spread and burden of COVID-19 (Surveillance, Community Spread) | Addresses the determinants of health in the impact of COVID-19, including exposure risk and severity |
| Impacts of collaborative partnerships and community engagement | Describes the use of collaborative partnerships to influence the study outcome. Partners may be public, private, community, etc. |
| Impact of mitigation strategies on reducing COVID-19 disease burden | Assesses the impact of symptomatic/asymptomatic testing, social distancing, masking, etc. |
| Social and behavioral factors influencing testing access and uptake | Investigates the relationship between testing uptake and social/behavioral factors, not publications that merely mention the connection. Social factors include population demographics. Behavioral factors include attitudes, acceptance, hesitancy or deliberation, trust, confidence, and motivation |
| Social and behavioral factors influencing vaccine access and uptake | Investigates the relationship between vaccine uptake and social/behavioral factors, not publications that merely mention the connection. Social factors include population demographics. Behavioral factors include attitudes, acceptance, hesitancy or deliberation, trust, confidence, and motivation |
| Structural barriers to COVID-19 testing access | Investigates (direct study or review of literature) the structural and systemic issues that may limit the ability of or access to COVID-19 testing. Structural barriers include the cost of the clinical visit and test; geographic & functional proximity to tests and supply chain constraints or disruptions |
| Structural barriers to COVID-19 vaccination access | Investigates (direct study or review of literature) the structural and systemic issues that may limit the ability of or access to COVID-19 vaccinations. Structural barriers include the cost of the clinical visit and vaccine; geographic & functional proximity to vaccines and supply chain constraints or disruptions |

Appendix C. Number of Publications by Additional Settings