Bibliometrics Report

November 2022

RADXUP

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Abbreviations

API	Application Programming Interfaces
CB	Citation Benchmarking
CDCC	Coordination and Data Collection Center
DOI	Digital object identifier
EO	Evaluation objective
FWCI	Field-Weighted Citation Impact
NIH	National Institutes of Health
NoA	Notice of Award
PMID	PubMed unique identifier
RADx-UP	Rapid Diagnostics for Underserved Populations
RCR	Relative Citation Ratio
T&E	Tracking & Evaluation
UNC	University of North Carolina at Chapel Hill

Executive Summary

Background

The National Institutes of Health (NIH) created Rapid Diagnostics® for Underserved Populations (RADx-UP) to ensure that all Americans have access to COVID-19 testing, with a focus on communities most affected by the pandemic. The RADx-UP consortium consists of a coordinating center and more than 125 research projects studying COVID-19 testing patterns in communities across the United States and its territories as well as Tribal Nations. One of the evaluation objectives of the RADx-UP Program is to measure its research and program productivity in advancing critical knowledge on reducing COVID-19 morbidity and mortality through community-engaged testing.

Methods

The Tracking and Evaluation (T&E) team identifies and tracks publications that cite a RADx-UP grant number in Scopus and PubMed databases on a bimonthly basis. From the onset of the RADx-UP Program on September 26, 2020 through March 15, 2022, the team identified 70 publications as the data sample for inclusion in this bibliometric analysis. Scopus generated citation counts for 67 of the 70 publications. PlumX metrics generated altmetric data for 66 of the 70 publications. We performed a bibliometric analysis between April 5 to May 5, 2022, to identify citation counts of the dataset. Using publication-level data from the RADx-UP Tracking & Evaluation Content Analysis, we compared the project count, the publication count, and the citation count for RADx-UP target populations, U.S. regions, minority-serving institution type, and study approach.

Results

RADx-UP publications tend to reflect the target populations, regions, settings, and institution types of the original funded projects. The target populations with the most publications are Hispanic/Latino/Latinx populations (19), Black/African American populations (16), and children and adolescents (14), as reflected in **Figure 1**. Publications on these target populations have also garnered many citations, though a smaller number of publications on older adults have gained the most citations. The publication with the most citations (27) in the dataset is "Lessons learned from frontline skilled nursing facility staff regarding COVID-19 vaccine hesitancy" (Berry, et al., 2021), which focuses on strategies to address vaccine hesitancy among staff. **Figure 1** shows the project, publication, and citation counts for key target populations in RADx-UP.

Project Count, Publication Count, and Citation Count by Target Population
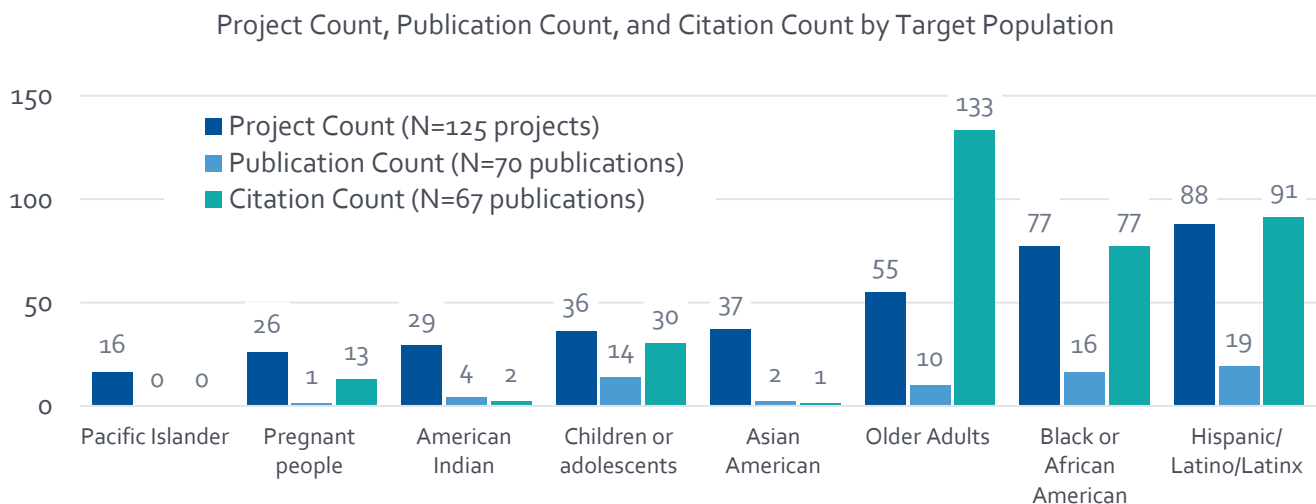
Figure 1: RADx-UP Project count, RADx-UP publication count, and RADx-UP citation count by target population

A plurality of publications (23) and their subsequent citations (51) focus on projects that conduct research in the Southeast region of the United States as shown in **Figure 2**. A majority of RADx-UP publications have a quantitative methodology component (49), with an observational design (39) being the most common among publications with a quantitative method. Counts of publications and citations from projects awarded to minority-serving institutions are comparable to the number of projects awarded to minority-serving institutions.

Total RADx-UP Citations by U.S. Region (N = 67 Publications)

Figure 2: RADx-UP citations by region of the United States (as of May 5, 2022)

There are four Historically Black Colleges and Universities and one Tribally Controlled University. One publication has originated from a Historically Black College or University, and no publications have originated from a Tribally Controlled University.

Figure 3: RCR distribution for RADx-UP publications (as of May 13, 2022)
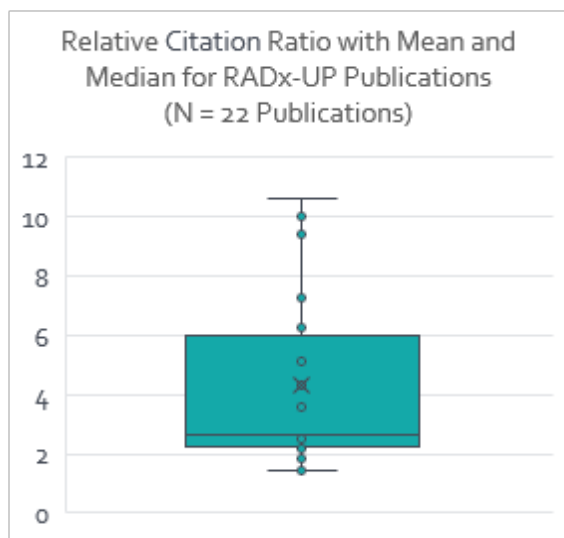
Early data from standardized citation scores indicate that RADx-UP publications are cited more than their peer publications. The Relative Citation Ratio (RCR) compares NIH-sponsored publications with a similar publication date and field, setting the NIH publication with the median number of citations to a value of one. Publications with more citations than their peers have values higher than one. All 22 RADx-UP publications for which RCR is available have values greater than one, and the median RCR of the publication dataset is 2.66, and the mean is 4.33. RADx-UP publications have received 4.33 times as many citations per year as the median NIH-funded paper in the same field.

In addition to citation counts, we tracked altmetrics, which indicate engagement with publications beyond scholarly literature and possibly greater translational benefits. RADx-UP publications have also received mentions and citations in news, social media, and policy documents. State and national policy documents have cited RADx-UP publications eight times, and Twitter and Facebook posts have mentioned RADx-UP publications 2,339 times.

Conclusions

This report assesses research performance at a very early program stage by presenting an evaluative bibliometric analysis of the initial, relatively small set of RADx-UP-funded research publications. The early signals indicate effective dissemination to both scholarly and non-scholarly communities. The RADx-UP Coordination and Data Collection Center (CDCC) will continue to monitor the scholarly production of projects and should provide support to projects working with target populations and geographic areas that do not yet

have many publications. Additionally, the CDCC can work to increase awareness of RADx-UP publications and raise the profile of RADx-UP Projects in scholarly communities and the general public.

Background

RADx-UP Evaluation

The Rapid Acceleration of Diagnostics for Underserved Populations (RADx-UP) Program aims to ensure that all Americans, particularly those from underserved and vulnerable communities most affected by COVID-19, have access to COVID-19 testing to reduce the disparities in COVID-19 associated morbidity and mortality. The program seeks to achieve this primary aim through:

- Understanding and alleviating barriers to testing across the nation.
- Utilizing implementation strategies, community-based interventions, and multi-level partnerships to increase reach, access, acceptance, uptake, and sustainment of FDA-authorized/approved diagnostics among vulnerable populations in underserved geographic locations.
- Strengthening the available data on disparities in infection rates; disease progression and outcomes; differences in testing access and uptake patterns; and identifying strategies to address disparities in COVID-19 diagnostics.

The RADx-UP Program will enable a targeted public health response to COVID-19 and build evidence-based approaches to identify and address disparities in COVID-19 diagnostic testing uptake and effectiveness in underserved populations.

Two of the seven RADx-UP Evaluation Objectives (EOs) apply directly to bibliometrics analysis of RADx-UP publications. These two objectives guide the bibliometrics analysis process and interpretation below. The two objectives are:

> **EO2. Understanding of the Social, Ethical, and Behavioral Implications (SEBI) of COVID-19 testing and vaccination in target populations**: Assess the extent to which the projects within the RADx-UP Program contribute to increasing the knowledge and understanding of the social, behavioral, and ethical implication of COVID-19 testing and vaccination among underserved or vulnerable populations.
>
> **EO6. Critical knowledge advancement to address COVID-19 disparities**: Measure research and program productivity by evaluating the contribution of the RADx-UP Program in advancing critical knowledge on COVID-19 testing resource and behaviors including the importance of community-led initiatives in reducing COVID-19 mortality and morbidity disparities

Bibliometrics analysis, in conjunction with complementary evaluation methods of peer-reviewed publications, can show how RADx-UP improves understanding of COVID-19 testing in scientific communities. Along with bibliometrics, the T&E team employs content analysis and network analysis to meet the two above objectives.

Content analysis is a structured extraction of defined variables, including target population, community engagement strategy, analysis type, and COVID-19 comorbidities. Content analysis can improve the implementation of ongoing RADx-UP publications research or research methodologies through sharing publications with the most effective community engagement strategies and identifying gaps in existing publications. Network analysis reveals patterns of collaboration between coauthors and RADx-UP Projects, as well as the relationships between publication topics. Each analysis component contributes to a holistic picture of RADx-UP publications. **Figure 4** below depicts the relationships among content analysis, network analysis, and bibliometrics analysis.
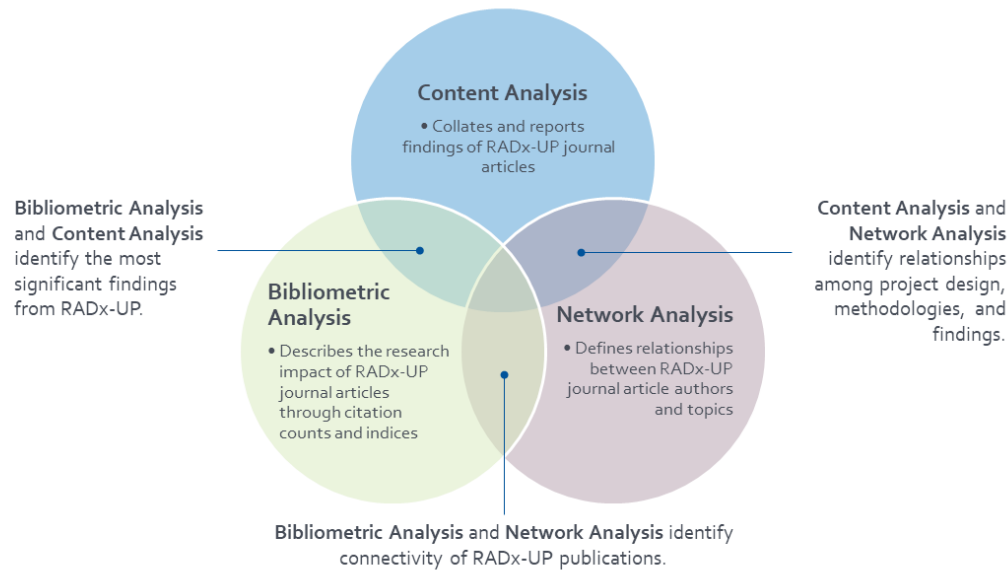
Figure 4: Visual representation of the publication analysis approach

Bibliometrics

Bibliometrics involves the use of quantitative analysis methods to examine different aspects of bibliometric data such as publication and citation data. It is especially useful for analyzing large publication data sets that cannot reasonably be reviewed manually (Sugimoto & Larivière, 2018) (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021). Bibliometric analysis is one approach used to analyze and measure the impact of research. Bibliometric indicators, such as publication counts and citation counts, are interpreted as indicators, though not direct measures, of research productivity and research impact or influence, respectively (Waltman & Noyons, 2018) (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021).

Bibliometric analyses tend to have either a descriptive or an evaluative purpose or scope. Evaluative analyses such as this one focus on the contributions of research entities and help ascertain research performance (i.e., output, influence, and collaboration patterns) of that research entity. Examples include an individual researcher's productivity, an institutional unit's research impact, or a funding award's research return on investment (Cabezas-Clavijo & Torres-Salinas, 2021) (Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo, & Cobo, 2020) (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021).

This report presents an evaluative bibliometric analysis of the initial, relatively small set of RADx-UP-funded research publications that is focused on assessing research performance at a very early program stage.

Methods

Project Demographics

RADx-UP Projects Funding Cycle Characteristics. At the time of this analysis, there are 125 NIH-supported RADx-UP Projects, funded in two phases: Phase I and II. See **Figure 5** below for counts of projects by RADx-UP Grant notice of award (NoA) dates. Most Phase I projects (69) received their NoA in September 2020, six months after major community transmission of coronavirus SARS-CoV-2 in the United States.

COVID-19 Target Populations Served by and Geographic Reach of RADx-UP Projects. In aggregate, RADx-UP Projects reach all underserved target populations and regions of the US. Some projects serve multiple COVID-19 target populations or more than one region of the US (**Figure 6**). Across projects, the most common vulnerable populations served are Hispanic/Latino/Latinx populations (88), Black/African American populations (77), and older adults (55). RADx-UP Projects are geographically distributed across the country, with the plurality of projects located in the US Southeast regions (**Figure 7**).

Minority-serving Institution (MSI) Representation among RADx-UP Projects. The NIH awarded some RADx-UP Projects to four key types of minority-serving institutions. Across projects, the most common designations are Asian American and Pacific Islanders-serving (12), Hispanic-serving (10), Historically Black College and University (4), and Tribally Controlled Institutions (1) (National Center for Education Statistics, 2021). The remaining projects are not minority-serving institutions from these four main categories. **Figure 8** below shows project count by the type of minority-serving institution.[1]

Please note that we count parent projects and supplement projects separately in these graphs. These project counts may not match official project counts available on the RADx-UP.org website, which counts projects and supplements together. Projects and supplements sometimes publish separately, which leads us to think of them as separate bibliometrically.

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[1] We rely on the United States Department of Education to categorize awardee institutions according to four categories of minority-serving institution: Asian American and Pacific Islander-serving institution, Hispanic-serving institutions Historically Black College or University, and Tribally controlled institution. The Department of Education determines Asian American and Native American Pacific Islander-serving institution and Hispanic-serving institution status through undergraduate demographic targets, which means that if an institution's proportion of Hispanic or Asian American students varies significantly from year-to-year, the status of the institution could change (Higher Education Act, 1965). The Department of Education designates an institution a Historically Black College or University if that institution "was established prior to 1964, whose principal mission was, and is, the education of [B]lack Americans" (U.S. Department of Education, n.d.). The Department of Education recognizes the designation of Tribally Controlled institutions through the American Indian Higher Education Consortium (U.S. Department of Education, n.d.).
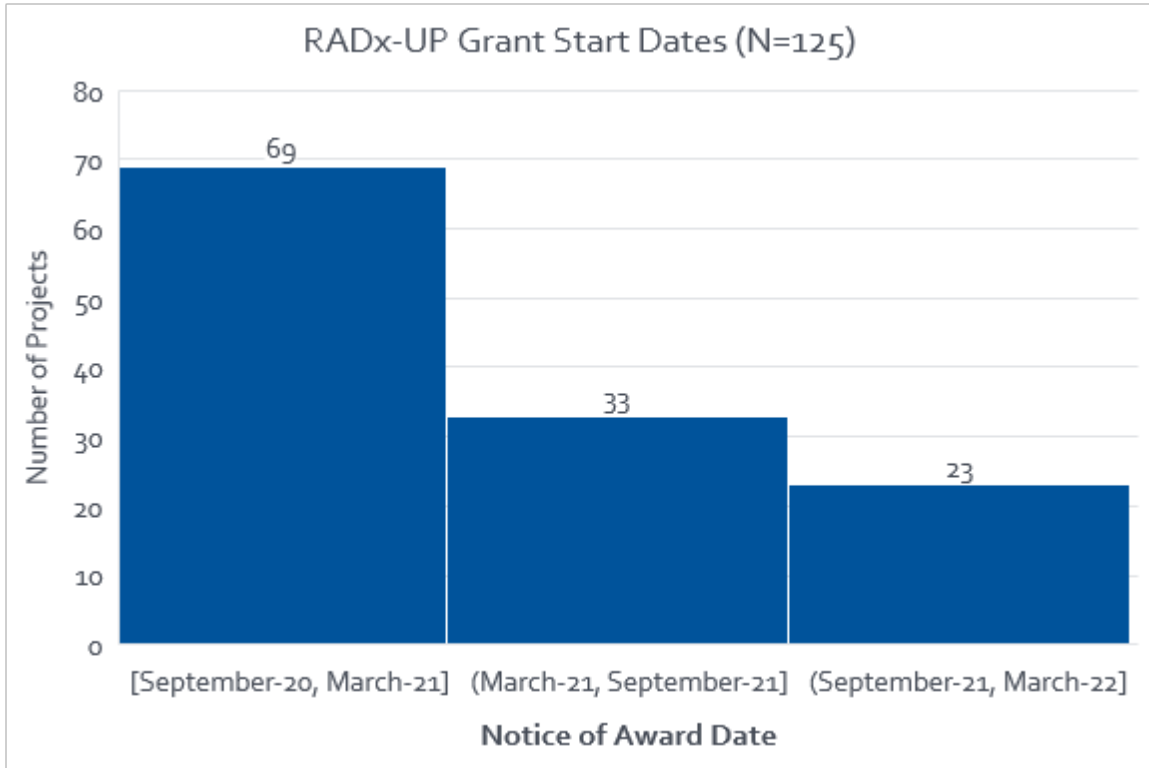
Figure 5: RADx-UP Project count by Notice of Award date (as of March 15, 2022)
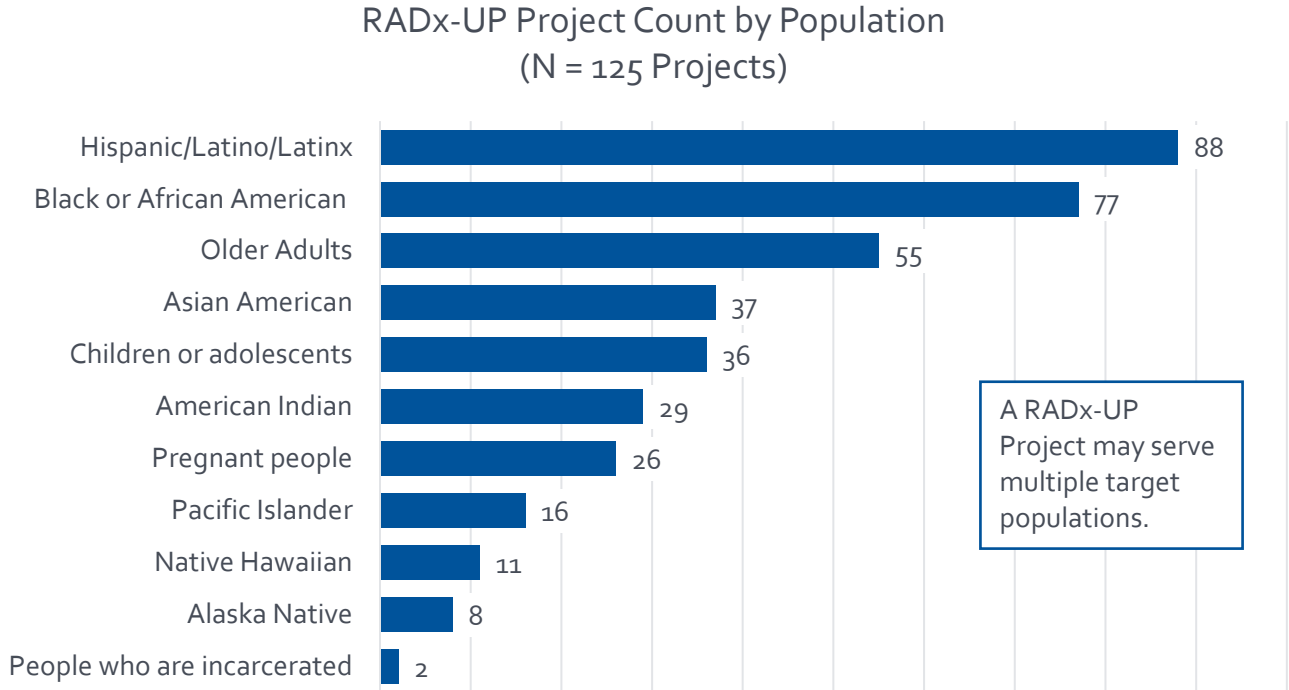
Figure 6: RADx-UP Project count by target population (as of March 15, 2022)

RADx-UP Project Count by U.S. Region (N = 125 Projects)

West 38
Northeast 25
Midwest 29
Southwest 18
Southeast 45

45
40
35
30
25
20
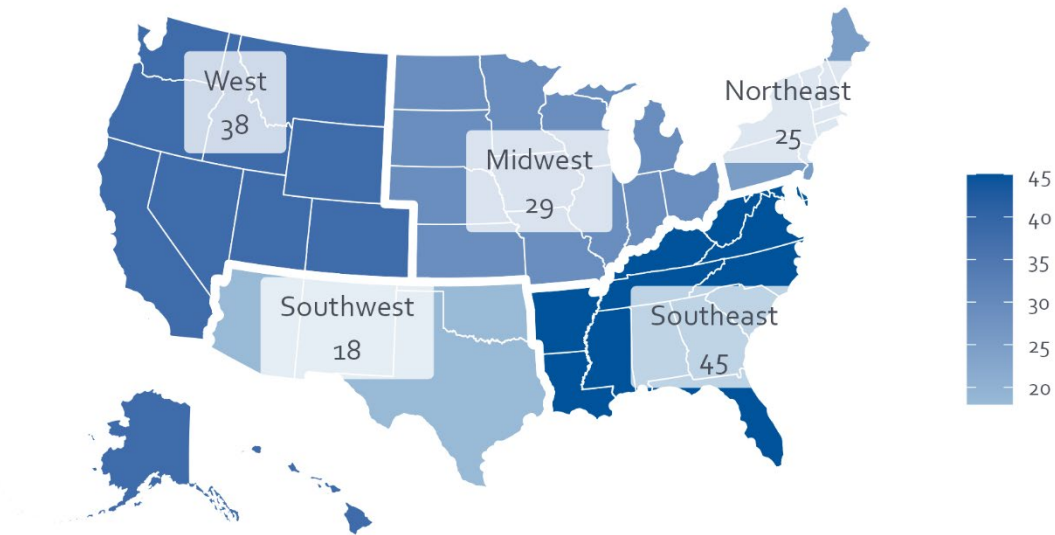
Figure 7: RADx-UP Project count by region of the United States (as of March 15, 2022)

RADx-UP Project Count by Minority-Serving Institution (N = 125 Projects, n = 22 Projects from Minority-Serving Institutions)

Asian American and Pacific Islander Serving Institution	12
Hispanic-Serving Institution	10
Historically Black College and University	4
Tribally Controlled Institution	1

An institution may have more than one minority-serving designation.

Figure 8: RADx-UP Project count by awardee Minority-serving Institution type (as of March 15, 2022)

Data Sample

We find RADx-UP scholarly publications through (1) Scopus and PubMed using automated searches of RADx-UP Project grant numbers and (2) Quarterly surveys to RADx-UP Project staff. From September 26, 2020 through March 15, 2022, we identified seventy (70) total publication citations. At this data collection point for the initial analysis, PubMed had indexed all 70 publications, and Scopus had indexed 67 of the 70 publications. Of the two databases, only Scopus tracks citations; we conducted all citation-based analyses with the 67 RADx-UP publications for which citation data were available at the time of the citation analysis. We conducted other analyses not based on citation data for all 70 RADx-UP publications.

Data Tools

Scopus

Scopus is a subscription-based Elsevier research intelligence product. Specifically, it is a database of peer-reviewed literature that tracks citations. Citation counts are retrievable in Scopus citation exports or document records.

Through its integration of PlumX Metrics, Scopus also provides alternative metrics indicating types and levels of engagement, such as reader count and policy citations, with Scopus-indexed publications. PlumX Metrics data are accessible via the Scopus API. The **Bibliometric Measures** section includes additional information about PlumX Metrics.

iCite

iCite is a web application hosted by the NIH Office of Portfolio Analysis (OPA) that provides a dashboard of bibliometric information for journal publications within a defined analysis group provided to the tool for analysis (e.g., the set of 70 RADx-UP publications) (Hutchins, Yuan, Anderson, & Santangelo, 2016). An analysis group can consist of one publication or a large group of publications. iCite allows a maximum of 10,000 PMIDs at a time in queries and analyses (National Institutes of Health Office of Portfolio Analysis, n.d.). The iCite database currently contains PubMed published from 1980 to present.

Data from iCite can further understanding the scientific influence of the scholarly publications in the analysis group of publications; citations to a paper indicate influence. iCite uses the Relative Citation Ratio (RCR) normalized citation score assigned to papers based on comparing the number of citations per year to NIH-funded papers published in the same field and year.

Bibliometric Measures

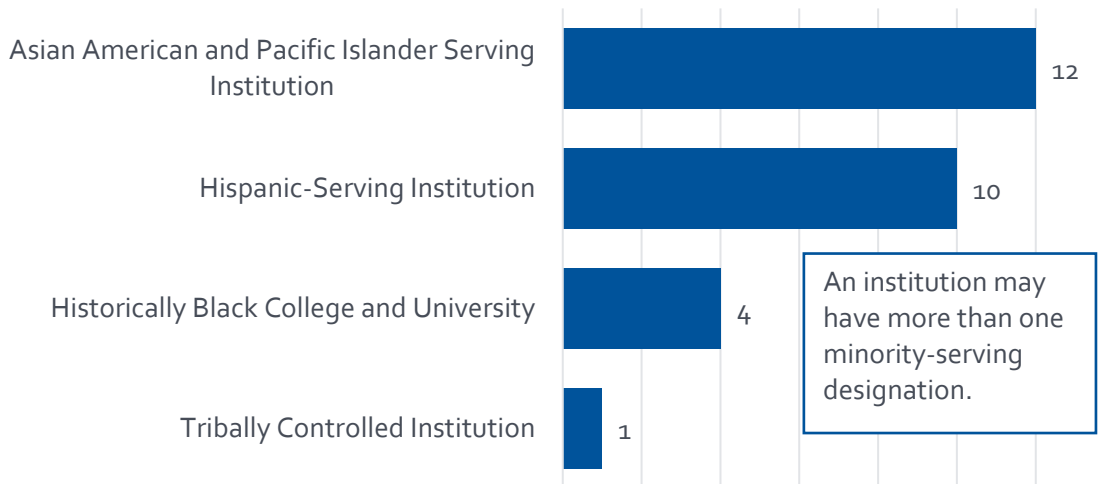We used Scopus to obtain citation counts and PlumX metric data associated with the 67 RADx-UP citations indexed in Scopus as of March 15, 2022. We collected the last citation counts for these 67 publications on May 5, 2022. We captured PlumX metrics data on May 13, 2022. **Table 1** below presents an overview of bibliometric measures. We chose Relative Citation Ratio (RCR) as a key indicator of impact because RADx-UP is an NIH-funded project, and the RCR specifically compares NIH-funded publications to peer NIH publications. We also chose to capture altmetrics with PlumX because altmetrics may indicate translation to other media beyond scientific literature.

Bibliometric Measure	Metrics	Data Source	Analysis Tool
Research Productivity	• Total number of publications in a calendar year • Total publications by institution type • Total publications by target population • Total publication by project type • Total publications by methodology	Database search results determined to be COVID-19-related	Microsoft Excel
Publication by Document Type	Number of publications for each document type	Scopus, PubMed & manually curated dataset	Microsoft Excel
Publication by Source Title	Top publishing journals of the included publications	Scopus, PubMed & manually curated dataset	Microsoft Excel
Citation Impact	• Total citation counts • Citation counts by institution type, target population, project type, methodology • Citations per publication • Relative Citation Ratio (RCR)	Scopus, PubMed & iCite	Microsoft Excel
PlumX Metrics	• Captures • Citations • Mentions • Social Media • Usage	Scopus (API)	Microsoft Excel

Research Productivity: The total count of RADx-UP publications published in the calendar year that T&E analysts determined to be COVID-related.

Publication by Source Title: The count of RADx-UP scholarly publications categorized by the journal titles that published the papers. We included journal titles publishing two or more RADx-UP publications in visualizations.

Citation Impact: The accrual of citations by papers is an indicator of scientific influence. Citations take time to accrue, and the cumulative citation count will typically increase over the months and years after publication.

Total Citation Count: The total citation count shows how many times this publication has been cited in other scholarly publications.

Citations Per Publication: Citations per publication indicate the average citation impact of each set of publications. Dividing the total citation count by the number of publications in the analysis set yields the citations per publication.

$$Citations\ per\ publication = \frac{total\ citation\ count}{total\ publications\ in\ the\ analysis\ group}$$

Outlying publications in a small data set and excessive self-citation can artificially inflate this average value. Additionally, RADx-UP citations have only had a short time to accrue, this metric should also be used with care in assessing the performance of publications in the very early stages of a new research effort or authored by early-career researchers (Elsevier, 2019). As more time passes, the cumulative citation count across RADx-UP publications will increase.

Relative Citation Ratio (RCR): The RCR metric developed by the NIH Office of Portfolio Analysis represents a citation-based measure of scientific influence of one or more scholarly publications. The NIH Office of Portfolio Analysis defines RCR as the citations per year of each paper, compared to the citations per year received by NIH-funded papers in the same field and year (Hutchins, Yuan, Anderson, & Santangelo, 2016).

$$Relative\ Citation\ Ratio = \frac{a\ paper's\ average\ number\ of\ citations\ per\ year}{citation\ rate\ of\ NIH\ funded\ papers\ in\ the\ same\ field\ and\ year}$$

A paper with an RCR of 1.0 has received the same number of citations per year as the typical (median) NIH-funded paper in its field. RCR values greater than 1.0 indicate greater citations per year than the median NIH-funded paper in its field. For the RCR calculation co-citation network, which includes all the publications cited alongside the scholarly publications, define the field for each scholarly publication. Developers of the RCR metric argue that a scholarly publications' co-citation networks more flexibly and precisely represent the interdisciplinary nature of biomedical and health sciences research than traditional bibliometric categories like "biology and biochemistry" or "molecular biology." The displayed RCR values are the maximum (MAX), the average (MEAN), the standard error of the mean (SEM), and the median (MED) of the papers in the analyzed group (National Institutes of Health Office of Portfolio Analysis, n.d.).

PlumX Metrics (Altmetrics): PlumX collects indicators of people's interactions with individual research outputs and categorizes them in the five categories described below to enable comparisons of similar interaction types across these outputs (Plum Analytics, n.d.). These "alternative metrics" or indicators tend to accrue substantially faster than citations and can provide early indicators of engagement with research outputs.

Scopus document records integrate PlumX Metrics where applicable and are accessible via the Scopus API. Of the 67 Scopus citations included in this bibliometric analysis, 66 publications had PlumX Metrics based on API retrieval on May 13, 2022.

- **Captures** – This metric indicates that someone wants to come back to a paper or other work. Captures can be a leading indicator of future citations. Examples include bookmarks, code forks, favorites, followers, readers, watchers, exports/saves and subscribers.
- **Citations** - This category contains citations from both traditional citation indexes such as Scopus, as well as citations that help indicate societal impact such as citations by clinical or policy documents. Examples include citation indexes, patent citations, clinical citations, and policy citations.
- **Mentions** – This category measures activities such as news articles or blog posts about research. Mentions are an indicator that people are engaging with the research. Examples include blog mentions, comments, news media mentions, reviews, and Wikipedia references.

- **Social Media** - This category includes tweets, Facebook likes, etc. that reference the research. Social Media can help measure "buzz" and attention research is receiving. Social media can also be a good measure of the promotion of a particular piece of research. Examples include comments, tweets, shares, likes, ratings, and recommendations.
- **Usage** - This category includes indicators that suggest people are reading a scholarly publication or otherwise using a research output. Examples include abstract views, clicks, downloads, full text views, library holdings, and video plays. According to Plum Analytics the Usage category that researchers want to know after citations (Plum Analytics, n.d.).

Process

Automated search alerts were set up in Scopus and PubMed. These recurring searches query the funding fields for RADx-UP Project numbers or keywords. For this initial bibliometric analysis, we selected a publication collection cutoff date (March 15, 2022) at which time we had collected seventy (70) total RADx-UP publications on the topic of COVID-19. As of March 15, 2022, Scopus indexed 67 of the 70 total RADx-UP scholarly publications. We exported final citation data for analysis, including citation counts, from Scopus for these papers on May 5, 2022. PubMed indexed all seventy (70) of the select RADx-UP publications. We imported the 70 PubMed unique identifiers (PMIDs) to NIH iCite. A PMID is the unique identifier number used in PubMed for each scholarly publication. We downloaded iCite generated citation statistics, NIH RCRs, for further analysis. We used Excel to clean and standardize the Scopus and PubMed citation data and to produce charts. At a later point (May 13, 2022), we queried and exported PlumX Metrics data for the 67 Scopus-indexed publications via the Scopus API.

Data Analysis & Visualization

We analyzed and visualized data exported from Scopus and iCite using Microsoft Excel for this bibliometric analysis.

Results

Seventy total scholarly publications were generated by those projects from September 26, 2020 through March 15, 2022. RADx-UP Projects published one scholarly publication in 2020. In 2021, RADx-UP Projects published 44 scholarly publications. Fewer than 3 months into 2022, RADx-UP Projects published 25 additional scholarly publications. As of March 15, 2022, there are 0.56 publications per RADx-UP Project, and we anticipate the number of 2022 publications to surpass 2021 output by the end of the year.

Table 4 (**Appendix**) details the RADx-UP Projects' demographic characteristics alongside those of the data sample of RADx-UP publications. Overall, the publications reflect the demographic characteristics of the projects. The first and second most common COVID-19 target populations of projects and publications in the sample were Hispanic/Latino/Latinx (19) and Black/African American (16). The third most common target population in the publication sample, however, was children or adolescents (14) rather than older adults (10). This latter group was fourth most common among publications. There are no publications focusing on Alaska Native and Pacific Islander target populations in the current data sample. The most common geographic location of projects (US Southeast) was the same as for publications in the data sample. Minority-serving institutions are present in the publications in the sample except for Tribally Controlled Institutions.

Research Productivity

Quantifying published research outputs represents one aspect of research productivity. Total publication count alone is not a proxy for research productivity. Citation impact, RCR, collaboration impact, etc., combined are a good representation of research productivity. In this initial analysis of the RADx-UP Program, the quantity of published scholarly articles produced by RADx-UP Projects and indexed in Scopus as of March 15, 2022 is described and visualized.

RADx-UP Publication Count by Year
(N = 70 Publications)
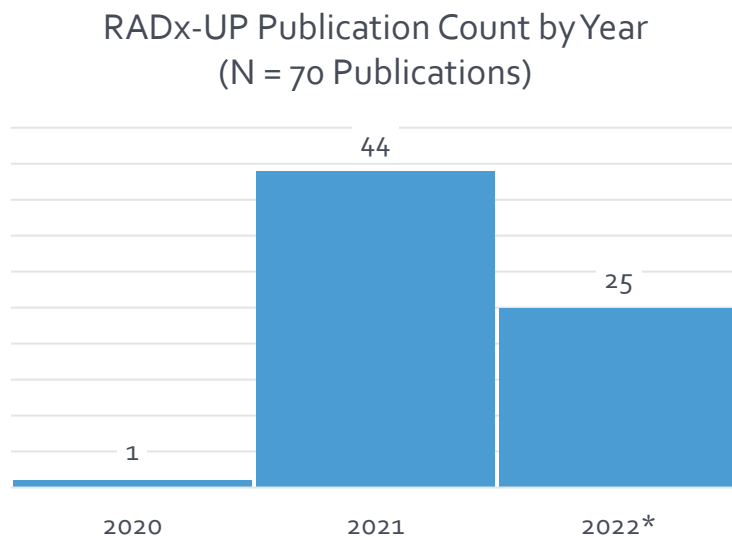
Figure 9: RADx-UP publication count by year (as of March 15, 2022)

* The data from the year 2022 is incomplete – the data only includes publications from January 1, 2022 to March 15, 2022.

RADx-UP Publication Count by Target Population
(N = 70 Publications)

Target Population	Count
Hispanic/Latino/Latinx	19
Black or African American	16
Children and adolescents (< 18 yo)	14
Older Adults	10
Low socioeconomic status	8
People who use/inject drugs	4
American Indian	4
Immigrants/refugees	3
Rural	2
People experiencing homelessness	2
Asian American	2
Pregnant people	1
People who are incarcerated	1
Sexual/gender minority	0
Pacific Islander	0
Native Hawaiian	0
Alaska Native	0

An article may identify multiple target populations.

Figure 10: RADx-UP publication count by target population (as of March 15, 2022)

RADx-UP Publication Count by U.S. Region (N = 70 Publications)

West
4

Northeast
9

Midwest
8

Southwest
4

Southeast
23

20
15
10
5
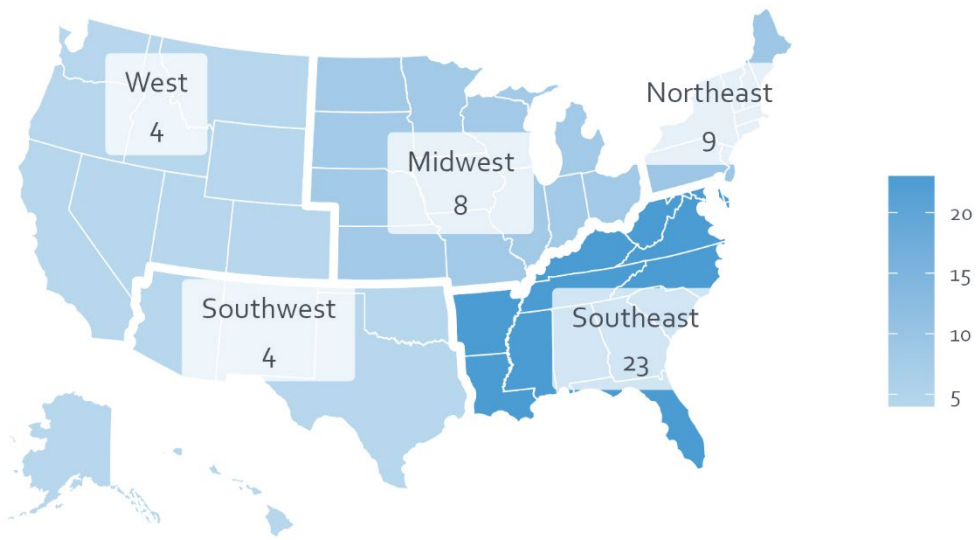
Figure 11: RADx-UP publication count by region of the United States (as of March 15, 2022)

Ratio of RADx-UP Publication Count to RADx-UP Project Count by Region

West
.11

Northeast
.36

Midwest
.28

Southwest
.22

Southeast
.51

0.5
0.4
0.3
0.2
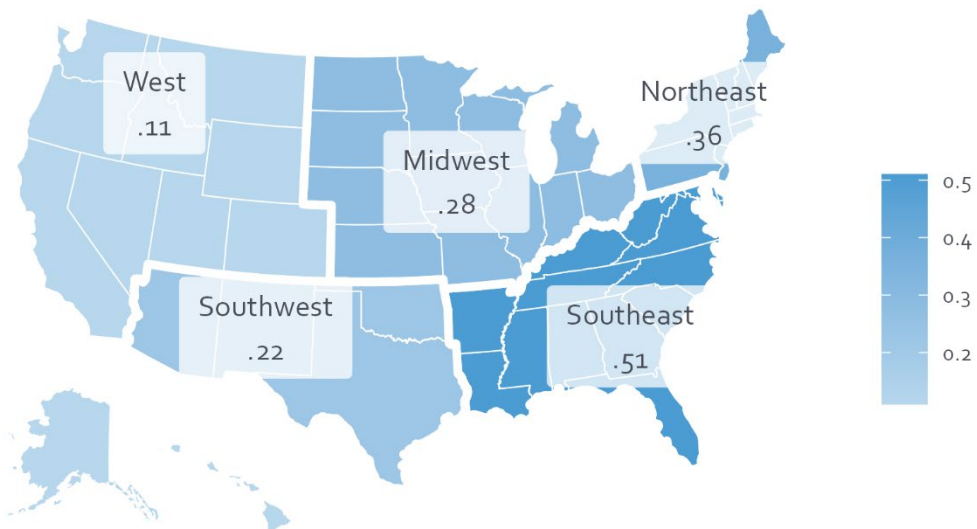
Figure 12: Ratio of RADx-UP publication count to RADx-UP Project count by region (as of March 15, 2022)

Among all 70 RADx-UP publications included in analysis, only 48 clearly specify a single region of the United States as displayed in **Figure 11** and **Figure 12**. The remaining 22 articles publications are editorials, reviews, publications using primarily national-level data, or publications missing a location.

RADx-UP Publication Count by Study Approach (N = 70 Publications)

Study Approach	Count
Quantitative	44
Editorial	8
Review	6
Mixed Methods	5
Qualitative	4
N/A	2
Clinical Case Study	1
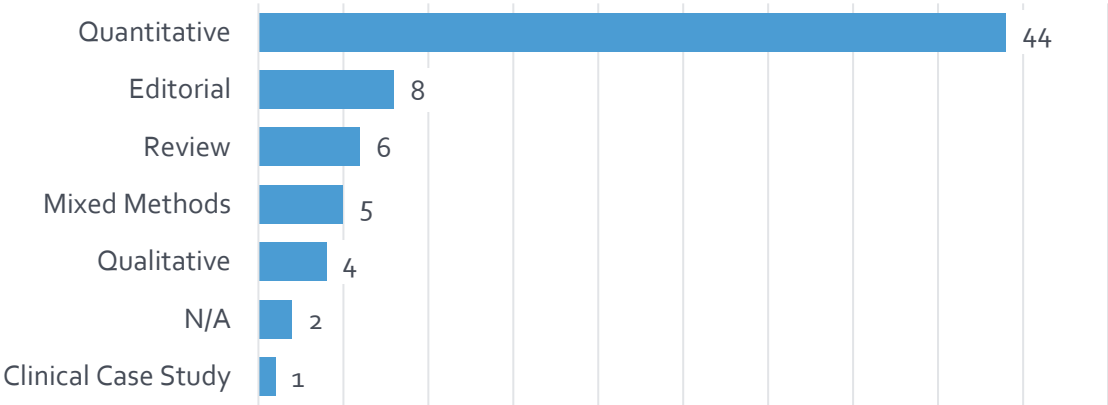
Figure 13: RADx-UP publication count by study approach (as of March 15, 2022)

RADx-UP Publication Count by Quantitative Methodology (N = 49 Quantitative Publications)

Quantitative Methodology	Count
Observational	39
Evaluation	6
Formative/Exploratory	2
Experimental	2
Dissemination & implementation	1
Simulation	1
Cost-benefit	0

An article may have more than one quantitative methodology.
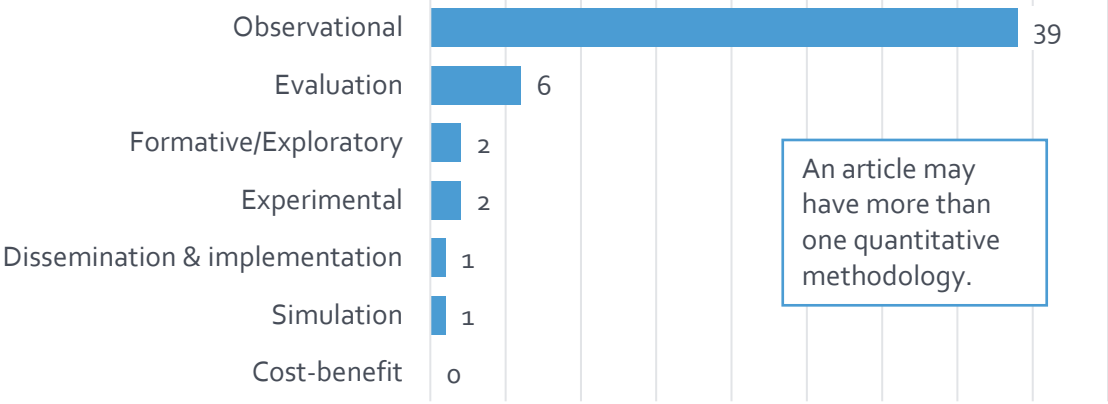
Figure 14: RADx-UP publication count by quantitative methodology (as of March 15, 2022)

RADx-UP Publication Count by Study Setting
(N = 70 Publications)

Setting	Count
School	13
Residential care facility	12
Community health center	6
Hospital	5
Prison/jail	1
In-home	1

An article may identify multiple settings or not clearly identify any setting.

Figure 15: RADx-UP publication count by study setting (as of March 15, 2022)

Among all 70 RADx-UP publications included in analysis, only 37 clearly specify a one or multiple settings as displayed in **Figure 15**. The remaining 33 articles publications are editorials, reviews, publications noting a generic location like "testing site" without further specification, or publications missing a setting.

Publications by Top Publishing Journals

Top Publishing Journals for RADx-UP Publications
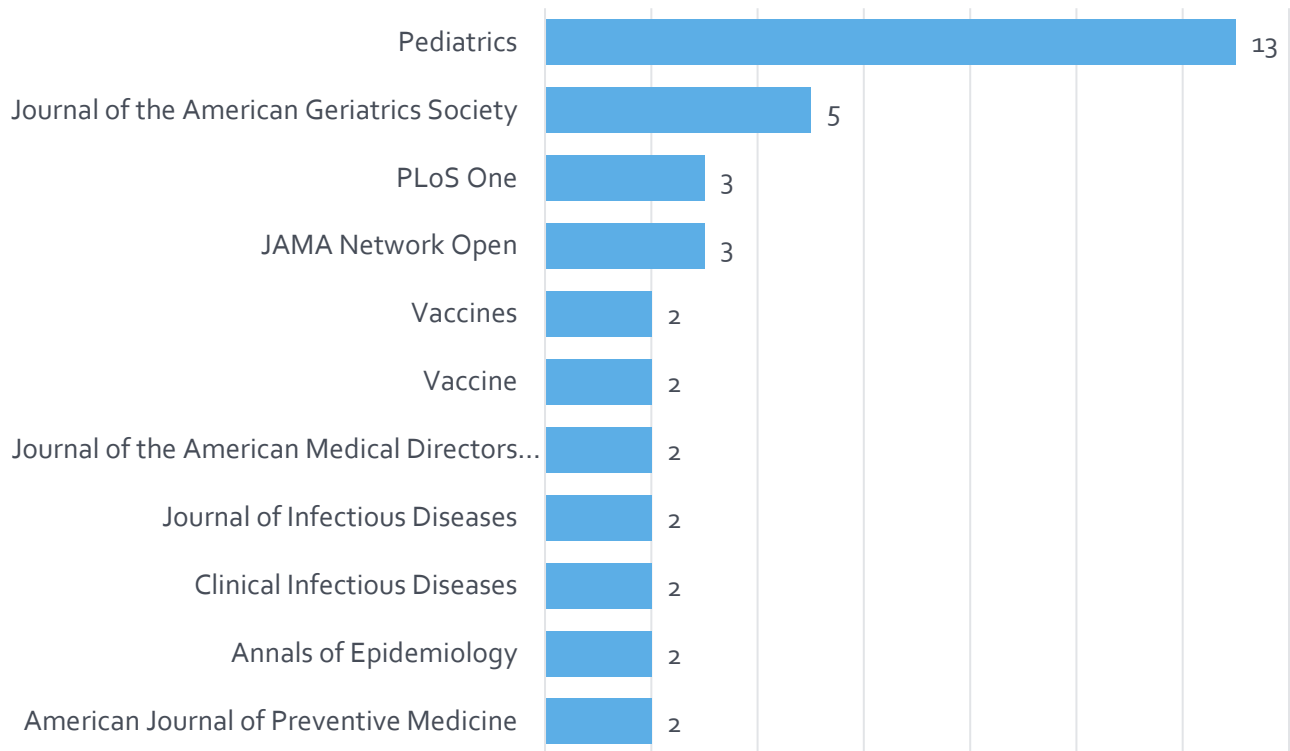
Figure 16: RADx-UP publication count by top sources (as of March 15, 2022)

Citation Impact

Scopus Citation Counts

Of the 70 total RADx-UP publications examined in this analysis, 67 of them were retrieved from Scopus. The citation overview in Scopus shows these 67 publications have accumulated

- **287 citations** – self-citations *included* (as of 5/4/2022)
- **252 citations** – self-citations *excluded* (as of 5/4/2022)

Citation counts in Scopus are based on citing scholarly publications indexed in Scopus.

Particularly, three scholarly publications "**Lessons learned from frontline skilled nursing facility staff regarding COVID-19 vaccine hesitancy**" (Berry, et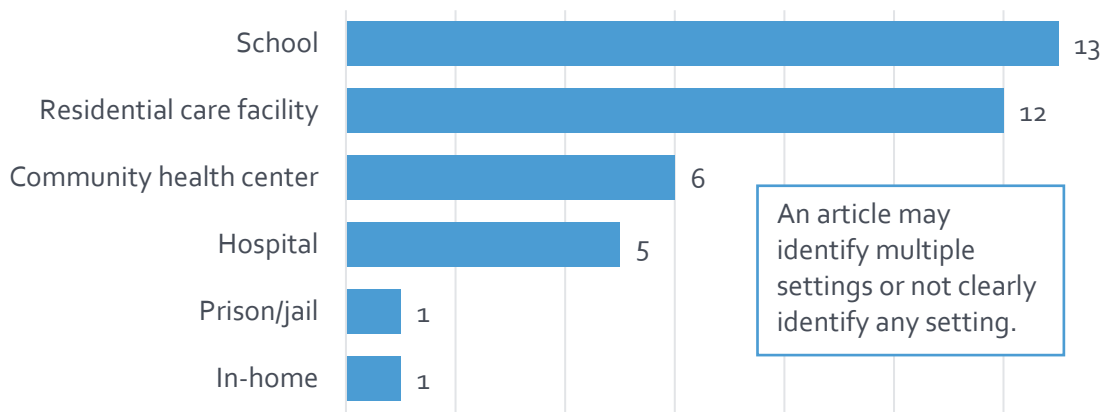 al., 2021), **"'Somebody Like Me": Understanding COVID-19 Vaccine Hesitancy among Staff in Skilled Nursing Facilities**" (Harrison, Berry, Mor, & Gifford, 2021), and **"Effectiveness of interventions to reduce COVID-19 transmission in a large urban jail: a model-based analysis**" (Malloy, Puglisi, Brandeau, Harvey, & Wang, 2021) have received more than 12 citations each indicating significant research influence on peers since their publication in 2021. Berry, et al. and Harrison, et al. originate from the same project; these publications focus on strategies to address vaccine hesitancy among skilled nursing facility staff. Berry, et al. find significant vaccination misinformation and hesitancy among staff (2021), and Harrison, et al. find that staff indicate that seeing someone like themselves, instead of a celebrity or politician, receive the vaccine would be more persuasive in reducing their vaccine hesitancy (2021). Malloy et al. evaluate the impact of three sequentially implemented COVID-19 mitigation strategies in

a large jail and find that decreasing the prison population, asymptomatic COVID-19 testing, and single-cell occupancy significantly reduce COVID-19 transmission (2021).

New RADx-UP Citations by Year
(Not Cumulative)
(N = 67 Publications)
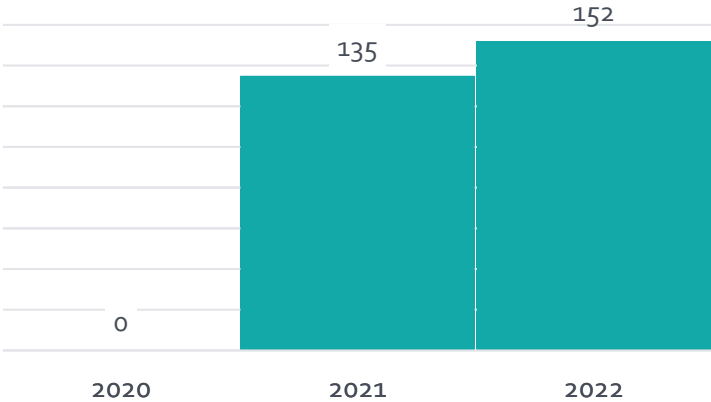
Figure 17: New RADx-UP citations by year (not cumulative) (as of May 5, 2022)

Total RADx-UP Citations by Target Population
(N = 67 Publications)
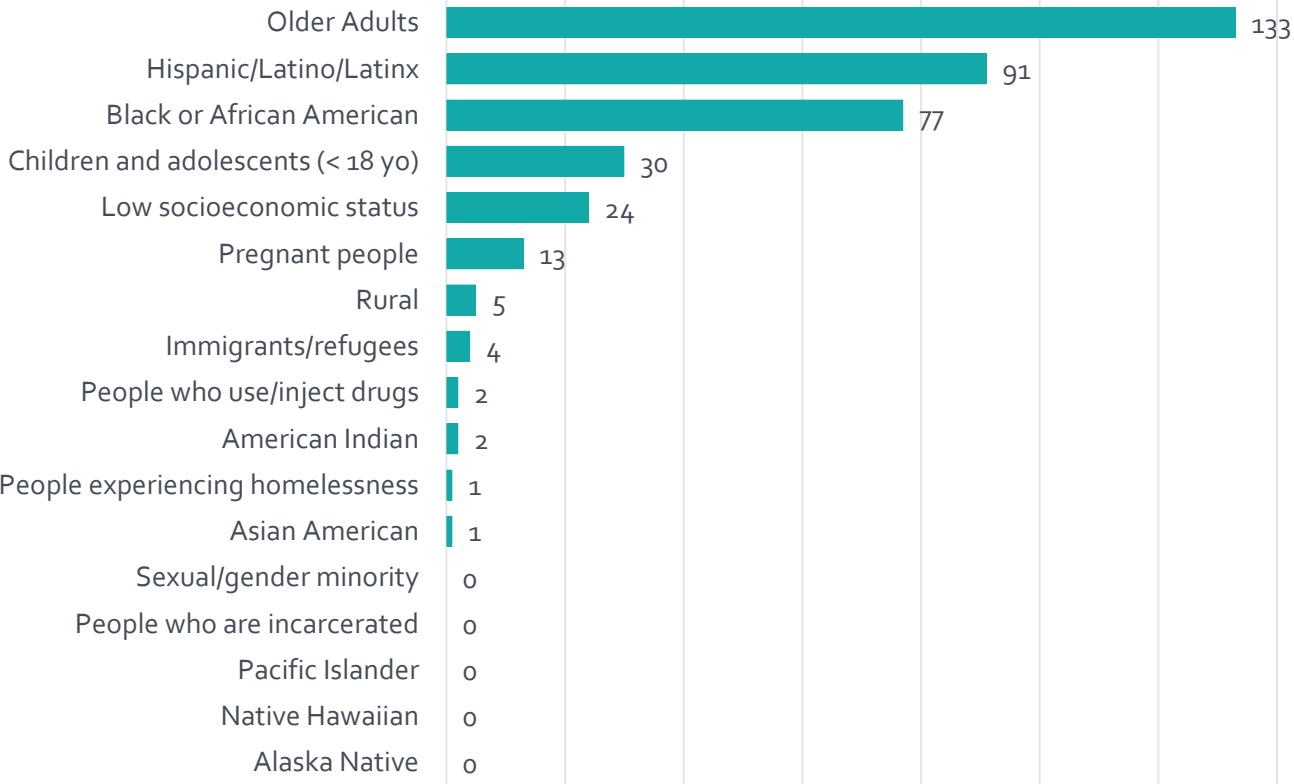
Figure 18: RADx-UP citations by target populations (as of May 5, 2022)

Total RADx-UP Citations by U.S. Region (N = 67 Publications)

West	2
Midwest	6
Northeast	32
Southwest	3
Southeast	51
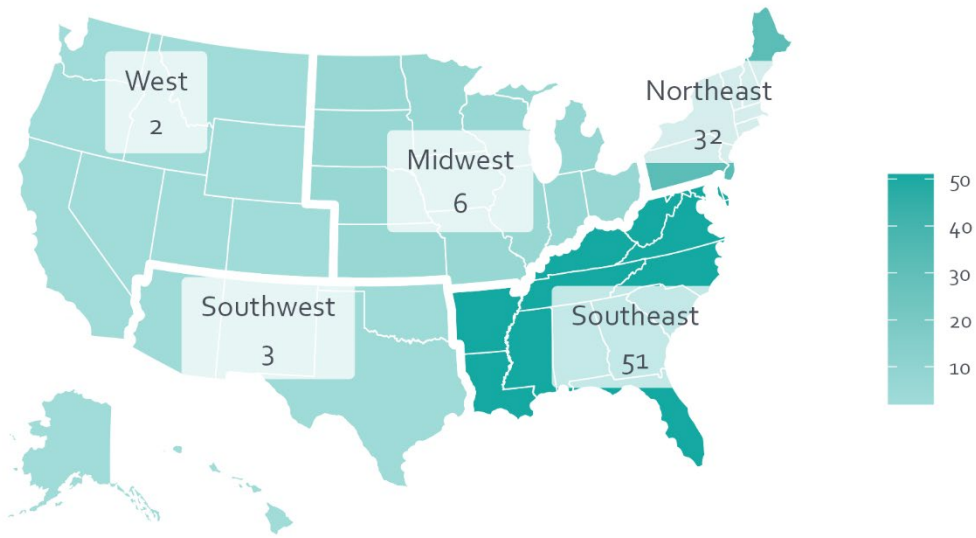
Figure 19: RADx-UP citations by region of the United States (as of May 5, 2022)

Total RADx-UP Citations by Study Approach (N = 67 Publications)

Study Approach	Citations
Quantitative	177
Qualitative	52
Review	36
Editorial	16
Mixed-methods	3
Clinical case study	2
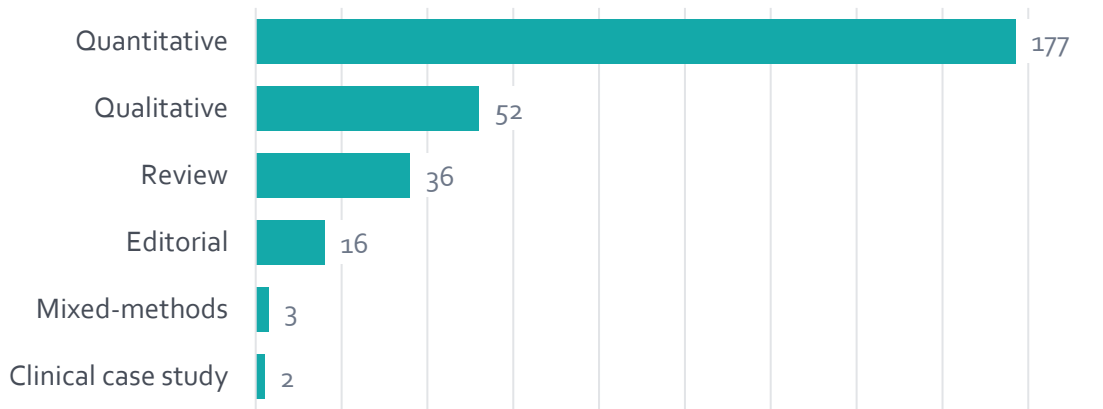
Figure 20: RADx-UP citations by study approach (as of May 5, 2022)

Publication Count and Citation Count by Study Approach

Legend:
- ■ Article Count (N=70 publications)
- ■ Citation Count (N=67 publications)

Study Approach	Article Count	Citation Count
Clinical Case Study	1	2
Qualitative	4	52
Mixed Methods	5	3
Review	6	36
Editorial	8	16
Quantitative	44	177
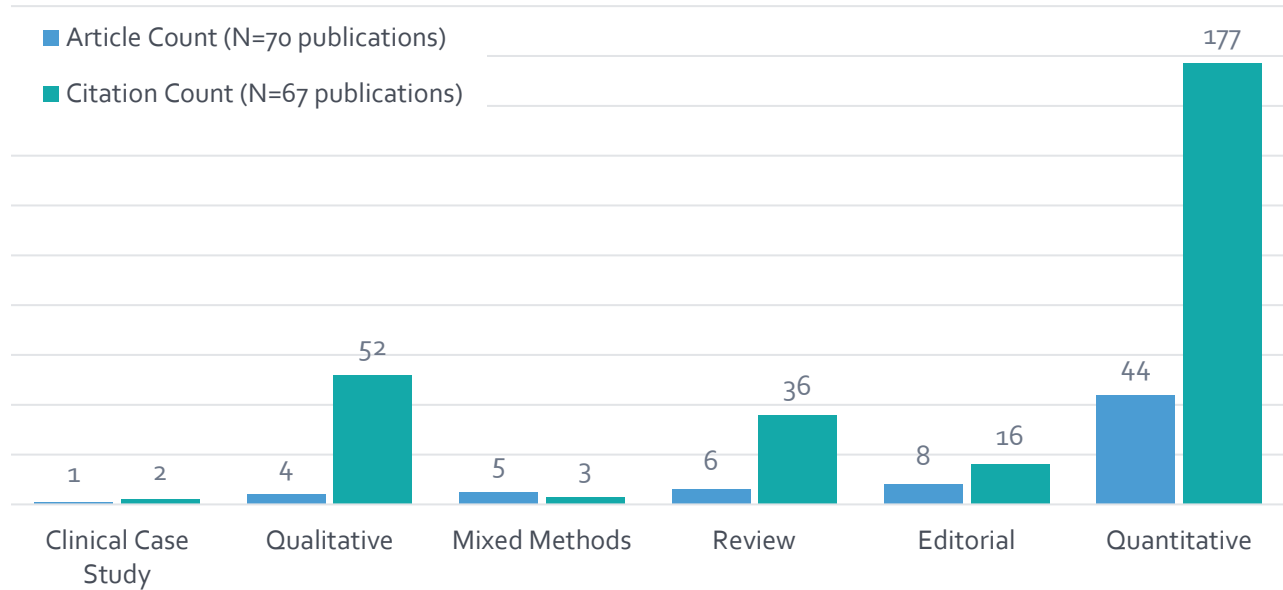
Figure 21: RADx-UP citations and publications by study approach (as of May 5, 2022)

Total RADx-UP Citations by Quantitative Methodology
(N = 49 Quantitative Publications)

Methodology	Citations
Observational	154
Evaluation	15
Experimental	5
Formative/Exploratory	3
Simulation	3
Cost-benefit	0
Dissemination & implementation	0
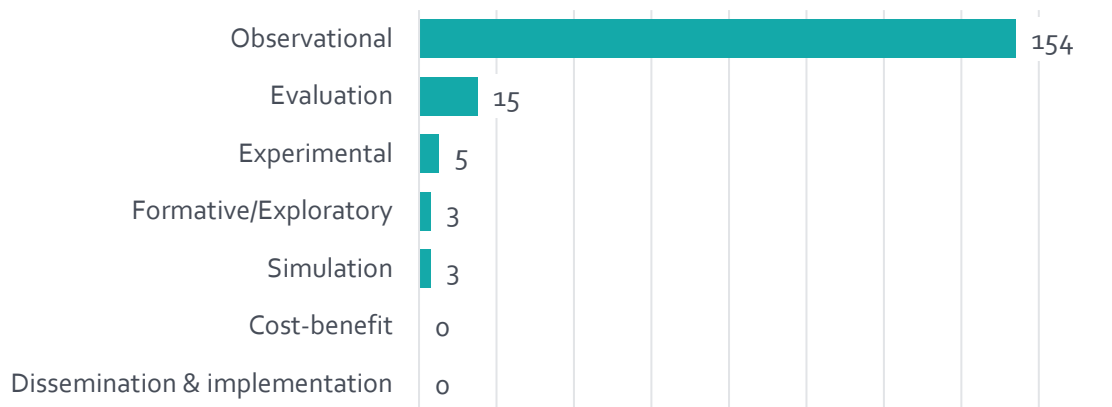
Figure 22: RADx-UP citations by quantitative methodology (as of May 5, 2022)

Total RADx-UP Citations by Study Setting
(N = 67 Publications)

Setting	Value
Residential care facility	153
School	16
Community health center	16
Hospital	13
In-home	7
Prison/jail	0
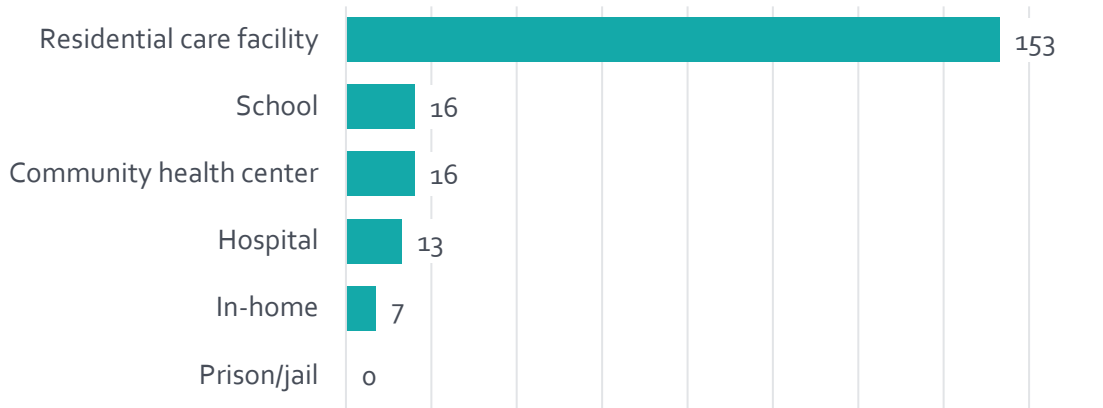
Figure 23: RADx-UP citations by study setting (as of May 5, 2022)

Total RADx-UP Citations by Minority-Serving Institution Type
(N = 67 Publications)

Institution Type	Value
Hispanic-Serving Institution	35
Asian American and Pacific Islander...	21
Tribally Controlled Institution	0
Historically Black College and University	0

Figure 24: RADx-UP citations by study setting (as of May 5, 2022)

NIH iCite Relative Citation Ratio (RCR)

We found all 70 (100%) in the RADx-UP publication set in iCite. Due to the brief time since publications of these papers, however, **only 22 of the 70 publications** were assigned RCR values as of May 13, 2022.The 22 publications assigned RCR values include one scholarly publication published in 2020 and 21 scholarly publications published in 2021 with five citations or more.[2]

The average (mean) RCR score for the 22 RADx-UP publications with RCRs is 4.33. This RCR value indicates that, on average, at the time of this analysis, these RADx-UP publications had received more than four times as many citations per year as a typical (median) NIH-funded publication from the same field and publication year. Similarly, the median RCR score for the RADx-UP publi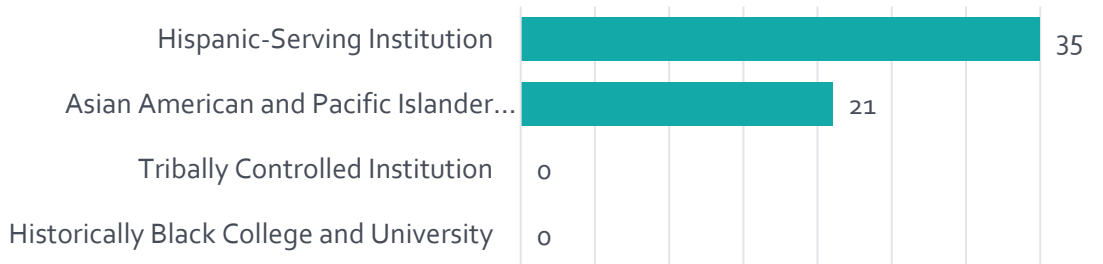cations is 2.66. This indicates that the accrual of citations per year for the median RADx-UP paper is more than twice that of a typical (median) NIH-funded publication in the same field and publication year. These RCR measures are subject to change as more publications in this data set receive RCR values as citations accrue over time. At the same time, the initial RCR data indicate the RADx-UP publications have a greater-than-typical citation rate compared to NIH-funded papers in the same field and year. This citation-based metric in turn indicates greater-than-typical scientific influence of these publications, compared to that of the NIH-funded paper cohort.

Table 2: Relative Citation Ratio Data from iCite

Relative Citation Ratio (RCR) Data	Value
Number of 70 RADx-UP publications with assigned RCR values	**22** (of 70) publications
Average (Mean) RCR	4.33
Median RCR	2.66
Maximum RCR	10.61
Minimum RCR	1.42

---

[2] "Relative Citation Ratio is not available for papers published last fiscal year, since, in general, not enough time has passed for citation statistics to meaningfully accrue in that period. An exception is made for papers with 5 or more citations since publication, as these are deemed to be accruing citations quickly enough for reliable calculations. The current year in the database increments with the NIH Fiscal Year every October. For example, in June 2019 (NIH Fiscal Year 2019), papers from 2018 receive provisional RCRs if they have 5 citations or more, and all papers from 2017 receive provisional RCRs. In October 2019 (the start of NIH Fiscal Year 2020), papers from 2019 receive provisional RCRs if they have 5 citations or more, and all papers from 2018 receive provisional RCRs" (National Institutes of Health Office of Portfolio Analysis, n.d.).
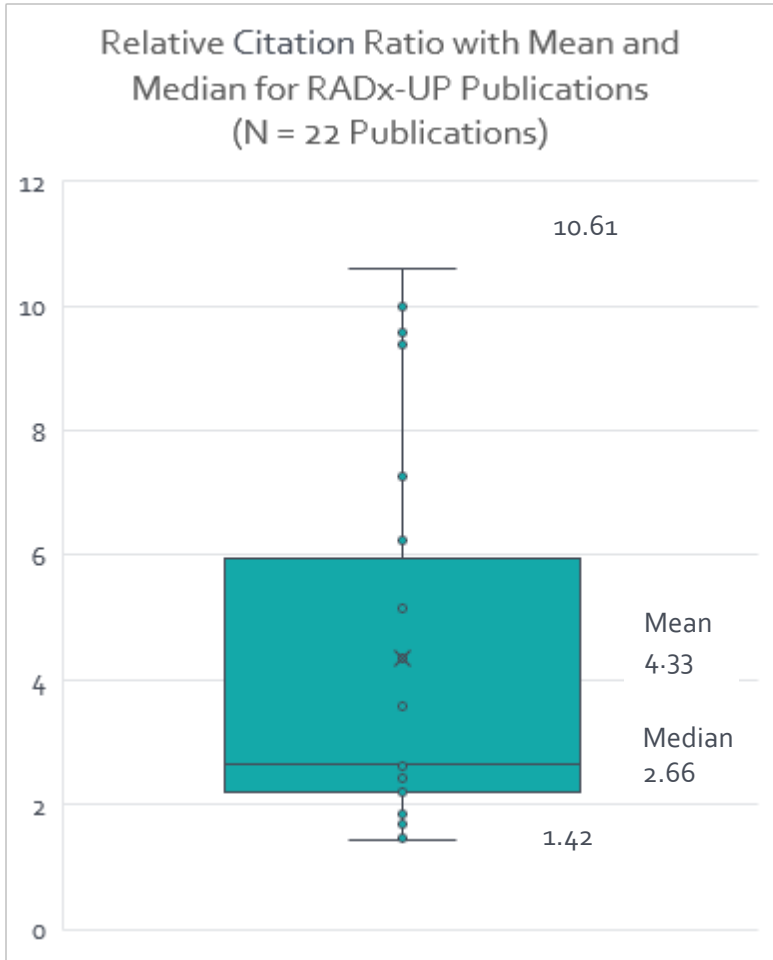
Relative Citation Ratio with Mean and Median for RADx-UP Publications (N = 22 Publications)

10.61

Mean 4.33

Median 2.66

1.42

Figure 25: RCR Distribution, Mean and Median for RADx-UP publications (as of May 13, 2022)

Evaluating the dissemination of the results of RADx-UP beyond scholarly audiences meets the sixth evaluation objective of understanding **critical knowledge advancement to address COVID-19 disparities**. Understanding how often RADx-UP work is mentioned in news, social media, and policy documents can indicate the knowledge advancement beyond scholarly communities. We used PlumX metrics tool in Scopus to capture seven altmetrics. 66 of 67 publications indexed in Scopus had PlumX Metrics associated with them. A table of the metrics follows with counts of altmetric indicators for these 66 publications, with a more detailed exploration of the policy documents citing RADx-UP scholarly work. Policy documents citing RADx-UP publications can indicate an explicit translation from research to public decision-making.

Table 3: PlumX metrics for RADx-UP scholarly publications

PlumX Metric		Total Altmetric Counts for RADx-UP Publications (N=66 Publications)
Capture		**2170**
Reader Count		2170
Policy Citation Count		**8**
Mention		**166**
All Blog Count		7
News Count		159
Social Media		**2339**
Facebook Count		574
Tweet Count		1765
Usage		**39**
Abstract Views		39

Policy Citations

Policy citations include government documents and policy advocacy documents. Two policy advocacy groups have argued for reducing prison populations, based on the findings in a RADx-UP article titled "Effectiveness of interventions to reduce COVID-19 transmission in a large urban jail: A model-based analysis" (Malloy, Puglisi, Brandeau, Harvey, & Wang, 2021) . A media modeling update from Michigan cites "Community SARS-CoV-2 surge and within-school transmission" (Zimmerman, et al., 2021) as evidence for the possible safety of schools with appropriate safety measures. The Centers for Disease Control circulated a brief on primary and secondary school COVID-19 safety from National Center for Immunization and Respiratory Diseases, which cited two RADx-UP articles: 1) "Quarantine Elimination for K–12 Students With Mask-on-Mask Exposure to SARS-CoV-2" (Boutzoukas, et al., 2022) and 2) "Secondary Transmission of COVID-19 in K-12 Schools: Findings From 2 States" (Boutzoukas, et al., 2022).

**RADx-UP PlumX Metric Counts
(N = 66 Publications)**

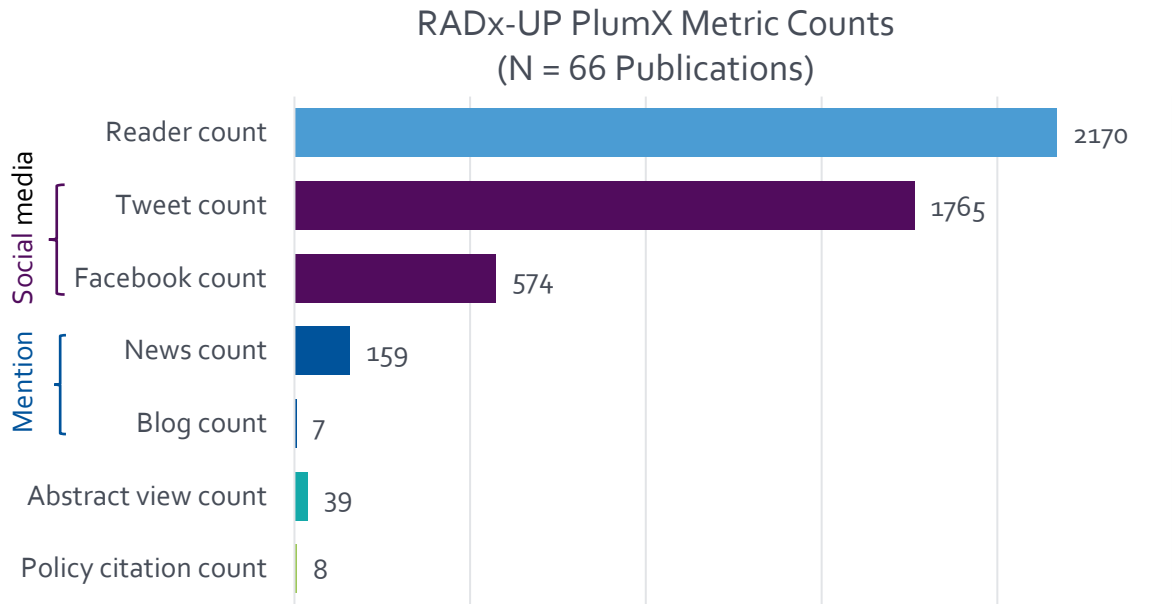| Metric	Count
Reader count	2170
Tweet count	1765
Facebook count	574
News count	159
Blog count	7
Abstract view count	39
Policy citation count	8

Social media
Mention

Figure 26: RADx-UP PlumX metric counts by altmetric type (as of May 13, 2022)

Conclusions

This bibliographic analysis of the initial, small set of research publications produced by the RADx-UP Program focuses on assessing indicators of the program's research performance at a very early stage. We used traditional bibliometric measures (e.g., publication and citation counts); the new, improved field- and time-normalized RCR measure developed by NIH iCite; and PlumX altmetric data from Scopus to assess RADx-UP scholarly articles published from 2020 into 2022 that Scopus indexed as of March 15, 2022. Given the relatively small publication set (i.e., 70 publications) and the short amount of time since publication, this analysis provides a preliminary indication of the RADx-UP Program's research productivity and influence, as well as of public engagement with the research, demonstrated by PlumX data.

Based on the early bibliometric measures outlined in this report, the RADx-UP Program shows initial signs for strong productivity, influence, and public engagement with the research.

- Research productivity as measured by scholarly publication output per year indicates a substantial upward trend, supported at least in part by the growth in the number of RADx-UP research projects from 69 in 2020 to 125 as of March 15, 2022. One article published in 2020 grew to 44 articles published in 2021, and 25 articles published within the first 3 months into 2022. We expect the number of 2022 publications to surpass 2021 output by the end of the year.
- Research influence as indicated by citations counts is also notable. Citation count data were available from Scopus for 67 articles of the 70 total RADx-UP scholarly publications. Those 67 articles had a combined total of 287 citations (self-citations included) that had accrued since the articles' publication. Three of the 2021 articles (Klonoff et al., 2021; Berry et al., 2021; White et al., 2021) had received more than 20 citations each, indicating significant research influence on the research community.
- Research influence as measured by time- and field- normalized RCR scores indicate the RADx-UP publications have a greater-than-typical citation rate compared to NIH-funded papers in the same field and year. This in, turn, indicates greater-than-typical scientific influence of these publications, compared to that benchmark group of papers.
- Public engagement, as indicated by PlumX altmetric data, indicates significant engagement with RADx-UP publications. Most notably in terms of impact, 8 policy documents have cited RADx-UP articles. State and national policymakers are including RADx-UP findings in disseminations to the public and scientific audiences. Additionally, advocacy groups are using RADx-UP findings to identify how to improve COVID-19 outcomes for underserved target populations, like people who are incarcerated.

Through the bibliometrics analysis, we can understand how the RADx-UP Program meets the evaluation objectives of **Understanding of the Social, Ethical, and Behavioral Implications (SEBI) of COVID-19 testing and vaccination in target population** and **Critical knowledge advancement to address COVID-19 disparities**. Though we are still at an early stage of bibliometrics reporting, the initial RCR scores show strong uptake of RADx-UP publications in scholarly communities, improving our understanding of COVID-19 testing and vaccination among underserved populations. Combining publication content analysis data with bibliometric data shows that RADx-UP publications are improving the understanding of testing and vaccination in most target populations funded through the grant. Altmetric data like mentions and citations in news, social media, and policy also indicate that RADx-UP findings are translating beyond scholarly communities. Policy citations in particular demonstrate that the social, ethical, and behavioral implications of COVID-19 testing and vaccination from the RADx-UP Program are relevant for government decision-making.

Early Recommendations & Implications

The RADx-UP CDCC will continue to monitor the scholarly production of projects and should provide support to projects working with target populations and geographic areas that do not yet have many publications. The CDCC should consider which target populations do not have many publications or citations when facilitating and evaluating proposals to use consortial data. Additionally, RADx-UP Projects and the CDCC can work to

increase awareness of RADx-UP publications and raise the profile of RADx-UP Projects in scholarly communities and the general public through continuing to promote existing resources and services and considering expanding those resources:

- Continue to promote RADx-UP work on social media and the public RADx-UP site
- Create more lay summaries for more RADx-UP publications
- Educate RADx-UP projects about how to promote their own scholarly work

Greater citation and altmetric impact would demonstrate engagement with RADx-UP research.

Limitations

Early Stage of Scholarly Production

While such an early analysis provides preliminary signals about research productivity, influence and engagement, the analysis and resulting assessment is limited by the absence of citation data and RCR values that take time to accrue. Future analysis rounds will include other data acquisition and cleaning steps in order to obtain additional comparative citation measures excluded from this initial bibliometric analysis (i.e., Citation Benchmarking measures and Field-Weighted Citation Indicators from Scopus). As the body of research outputs grows from a relatively small set of scholarly articles (published in the first year or two of the research projects) and those outputs have time to accrue citation-based measures (e.g., citation counts and RCR values), future bibliometric analyses will have more measures data available to assess program's research performance more clearly.

Measures Not Included

We could not retrieve and examine the following comparative citation measures for this citation data set, because primary RADx-UP institutions do not maintain institutional access to these metrics in an easily retrievable manner. We evaluated possible web-scraping tools and data cleaning methods as an alternative means to obtain these values from Scopus and found these were not efficient.

- **Field-Weighted Citation Impact (FWCI):** The FWCI measure is the **ratio** of the total citations received by a Scopus document to the average number of citations received by all similar Scopus documents over a three-year window (Elsevier, 2019). This comparative citation measure shows how frequently other publications cite the document compared to documents published in the same year, of the same document type, and in the same discipline(s) as represented by the Scopus journal classification system. Each discipline contributes equally to the metric, which eliminates differences in researcher citation behavior. An FWCI value greater than 1.00 means the document is more cited than expected, according to the average citation count for similar documents. For example, a document with an FWCI of 1.5 indicates the document has been cited 50% more times than expected. The FWCI values in Scopus align with SciVal and while viewable in individual Scopus scholarly publication records are not accessible via the Scopus API but only via the SciVal API.
- **Citation Benchmarking (CB):** The CB value is based on SciVal's field-weighted version of the Outputs in Top Citation Percentiles metric (Elsevier, 2019). It compares scholarly publications within a three-year window that are of the same document time and in the same discipline and displays as a **citation rank percentile**. The 99th percentile is high, and indicates a document is in the top 1% of similar documents globally.

These Scopus comparative citation measures would provide additional benchmarks for RADx-UP publications' citation impact to the RCR metric, which compares RADx-UP publications citation impact to that of the population of NIH-funded publications indexed in iCite. Two separate sources of comparative citation indicators (e.g., iCite and Scopus) would provide additional data on which to base early assessments of citation impact or influence of RADx-UP publications (Elsevier, 2019).

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Appendix

Table 4: Project, scholarly publication, and citation counts by characteristic

Characteristic	Project Count (N=125)	Publication Count (N=70)	Citation Count (N=67)
Target Population			
Alaska Native	8	0	0
American Indian	29	4	2
Asian American	37	2	1
Black or African American	77	16	77
Children or adolescents	36	14	30
Hispanic/Latino/Latinx	88	19	91
Native Hawaiian	11	0	0
Older Adults	55	10	133
Pacific Islander	16	0	0
People who are incarcerated	2	1	0
Pregnant people	26	1	13
Region			
Midwest	29	8	6
Northeast	25	9	32
Southeast	45	23	51
Southwest	18	4	3
U.S. Territories	6	0	0
West	38	4	2
Minority Serving Institution Type			
Asian American and Pacific Islander Serving Institution	12	7	21
Hispanic-Serving Institution	10	11	35
Historically Black College and University	4	1	0
Tribally Controlled Institution	1	0	0

We identified target populations covered in the seventy RADx-UP scholarly publications through scholarly publication content analysis. In nine instances, we identified "Other" target populations. Below is a listing of those "Other" target populations and the number of scholarly publications that focus on these populations:

Table 5: RADx-UP Publication Count by Additional Target Populations

Additional Target Population	Publication Count
Children with intellectual and developmental disabilities	2
Children with medical complexity	1

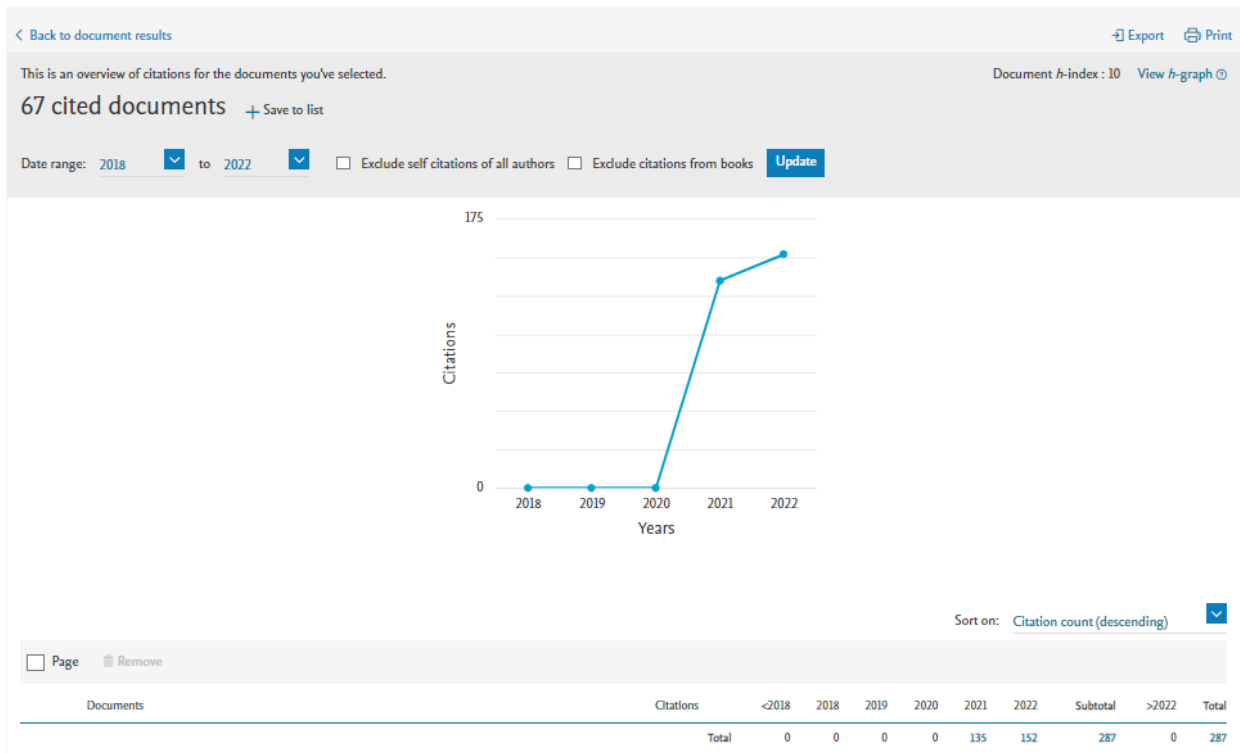|	
Health care workers	1
Medically vulnerable population	1
People living with HIV/AIDs or at risk of HIV infection	3
People with disabilities	1

Citation overview

Figure 27: Scopus Citation Overview for 67 RADx-UP Publications Indexed in Scopus, Self-Citations Included (as of May 5, 2022)
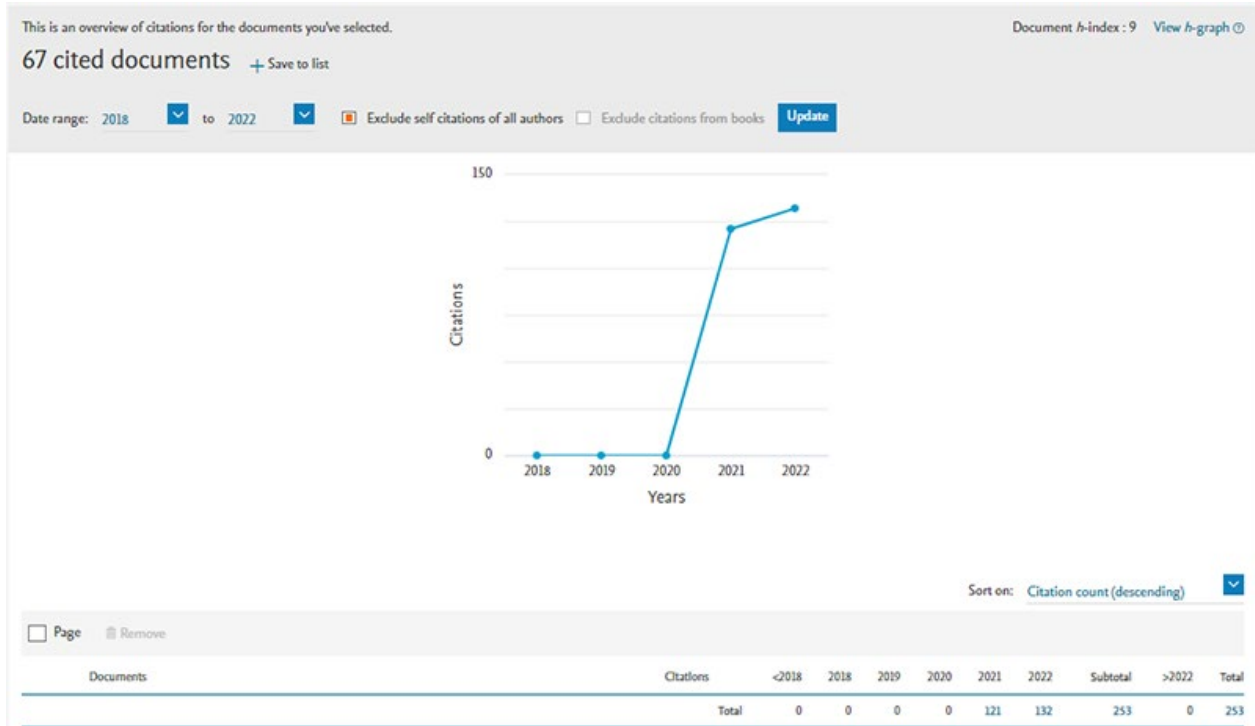
Figure 28: Scopus Citation Overview for 67 RADx-UP Publications Indexed in Scopus, Self-Citations Excluded (as of May 5, 2022)