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## COVID-19 vaccination intention and behavior in a large, diverse, U.S. refugee population



Jana Shaw<sup>a,\*</sup>, Kathryn B. Anderson<sup>b,c</sup>, Rachel E. Fabi<sup>d</sup>, Carlie A. Thompson<sup>e</sup>, Megan Harris<sup>e</sup>, Nidaa Aljabbarin<sup>c</sup>, Donna Bolourchi<sup>c</sup>, Nicole Mozo<sup>a</sup>, Daniel Lichtenstein<sup>e</sup>, Christina D. Lupone<sup>c</sup>, David A. Larsen<sup>f</sup>, Andrea V. Shaw<sup>a,b,c</sup>

<sup>a</sup> Department of Pediatrics, SUNY Upstate Medical University Suite 5400, 750 East Adams Street, Syracuse, NY 13210, USA

<sup>b</sup> Department of Internal Medicine, SUNY Upstate Medical University Suite 5142, 750 East Adams Street, Syracuse, NY 13210, USA

<sup>c</sup> Institute for Global Health and Translational Science, SUNY Upstate Medical University Suite 4200, 505 Irving Avenue, Syracuse, NY 13210, USA

<sup>d</sup> Center for Bioethics and Humanities, SUNY Upstate Medical University, 618 Irving Avenue, Syracuse, NY 13210, USA

<sup>e</sup> College of Medicine, SUNY Upstate Medical University, 750 E Adams St, Syracuse, NY 13210, USA

<sup>f</sup> Department of Public Health, 430C White Hall, Syracuse University, Syracuse, NY 13244, USA

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### ABSTRACT

**Introduction:** Refugees often face increased risk of exposure to COVID-19 due to their disproportionate representation in the essential workforce and crowded household conditions. There is a paucity of data about risk factors for under-immunization for COVID-19 among refugees.

**Methods:** Refugees were surveyed in two phases that corresponded to before and after wide availability of COVID-19 vaccines. Participants were asked about their attitudes, and perceptions about COVID-19, previous acceptance of vaccines, sources utilized to obtain trusted health information, and intent to get vaccinated. The overall participant vulnerability was assessed using the social vulnerability index. In-depth semi-structured interviews were completed with key stakeholders through snowball sampling.

**Results:** Of 247 refugees, 244 agreed to participate in the initial survey. Among those, 140 (57.4%) intended to get vaccinated, 43 (17.6%) were unsure, and 61 (25%) did not intend to get vaccinated. In the follow up survey, all 215 who were reached, agreed to provide information about their vaccination status. Among those respondents, 141 (65.6%) were either vaccinated or expressed intent to do so, and 74 (34.4%) remained hesitant. We did not observe any significant correlation between socio-demographic variables, country of origin, and vaccination status/intent. Among those who initially intended to get vaccinated, nearly 1 in 5 changed their mind and decided to forego vaccination, and among those who initially did not plan getting vaccinated, 1 in 3 changed their mind and got vaccinated. Fears related to the vaccine, concerns that the vaccine is religiously prohibited, “wait and see” how others did with the vaccine, communication and transportation barriers were commonly cited as reason not to get vaccinated.

**Conclusions:** Over a third of refugees in our study were hesitant to get vaccinated. Refugees desired additional education about the benefits and safety of vaccines along with easier access to vaccination clinics in their communities.

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**Abbreviations:** RIM, Refugee, immigrant, and migrant populations; SVI, social vulnerability index; CLs, community leaders; HNs, health navigators.

\* Corresponding author.

**E-mail addresses:** [shawja@upstate.edu](mailto:shawja@upstate.edu) (J. Shaw), [AndeKath@upstate.edu](mailto:AndeKath@upstate.edu) (K.B. Anderson), [fabir@upstate.edu](mailto:fabir@upstate.edu) (R.E. Fabi), [ThompCar@upstate.edu](mailto:ThompCar@upstate.edu) (C.A. Thompson), [harrimeg@upstate.edu](mailto:harrimeg@upstate.edu) (M. Harris), [naljab78@gmail.com](mailto:naljab78@gmail.com) (N. Aljabbarin), [MozoN@upstate.edu](mailto:MozoN@upstate.edu) (N. Mozo), [LichtenD@upstate.edu](mailto:LichtenD@upstate.edu) (D. Lichtenstein), [LuponeC@upstate.edu](mailto:LuponeC@upstate.edu) (C.D. Lupone), [dalarsen@syr.edu](mailto:dalarsen@syr.edu) (D.A. Larsen), [ShawAn@upstate.edu](mailto:ShawAn@upstate.edu) (A.V. Shaw).

### 1. Introduction

Refugee, immigrant, and migrant populations (RIM) represent more than 40 million people in the US [1]. They often face increased risk of exposure to COVID-19 due to their disproportionate representation in the essential workforce and crowded household conditions. RIM populations face unique challenges compared to the general US population, including: lower immunization rates cultural and language barriers, distrust of authorities including

medical doctors, lower health and vaccine literacy, underinsured health status, and limited health care access [2–6].

Two-dose mRNA COVID-19 vaccines from Pfizer-BioNTech and Moderna became available to the US public in December 2020, and a single dose viral vector vaccine from Janssen [Johnson & Johnson] vaccine became available in March 2021. The COVID-19 vaccination program in New York State initially prioritized groups at the highest risk for severe disease (older adults, those with comorbidities, healthcare workers, etc.) without consideration of immigration status. As of October 29, 2021, vaccines are available to all people 5 years and older [7].

In spite of wide-spread availability, approximately 27% of adults across the US are hesitant about COVID-19 vaccination as of August 2021 [8]. The remaining 63% have either initiated, completed, or intend to get vaccinated. Vaccine hesitancy persists across racial and ethnic groups. Among those who want to “wait and see,” 14% were Black, 27% were Hispanic, and 50% were White. Among those who definitely will not get vaccinated, 13% were Black, 13% were Hispanic, and 65% were White [8]. Commonly suggested reasons for vaccine hesitancy included concerns about side effects, long term safety, perceived rushed development of vaccines, and concerns that the vaccine will be mandated even if people don't want it.

Before practical approaches to facilitate high vaccination coverage among RIM communities are employed, it is essential to understand their knowledge, attitudes, and perceptions about COVID-19 severity and the benefits of vaccination, as well as the access barriers to vaccination they may experience. Pro-vaccine messages do not always work as intended, as they are dependent on pre-existing vaccine beliefs and attitudes [9]. The quality and content of vaccine communication can either enhance vaccine acceptance or affirm anti-vaccination stances. Therefore, it is critically important to understand RIM populations' unique vaccine information needs as anticipatory guidance about COVID-19 vaccination will require communication and support, tailored to the individual's intentions and beliefs. There is a paucity of data about key risk factors for under-immunization for COVID-19 in RIM communities that are vulnerable to misinformation due to language barriers, fear of legal persecution due to their immigration status, and a lack of access to vaccination sites, among others. Using two waves of survey data before and after widespread vaccine availability, as well as semi-structured interviews with key stakeholders, we examined vaccination attitudes, needs, and barriers among resettled refugees in the highest per capita refugee resettlement site in the state [10]. Here we summarize our findings and offer insight into RIM communities and their attitudes, and perceptions of COVID-19 vaccination and the barriers they face in accessing it.

## 2. Methods

A community-clinical partnership was established between Catholic Charities Refugee Resettlement Services and SUNY Upstate Medical University to offer weekly voluntary SARS-CoV-2 saliva PCR testing to all ages, regardless of immigration or health insurance status, for households with at least one foreign-born adult. An Upstate Medical University research team provided the weekly saliva PCR testing as a way to improve community access to COVID-19 testing. Seven refugee peer navigators from Catholic Charities, speaking greater than 20 languages fluently, participated in regular outreach to the culturally and linguistically congruent community to dispel myths and share verified COVID-19 information. The community-clinical team met weekly to share information from the community outreach, and to support the at-risk households that came for screening.

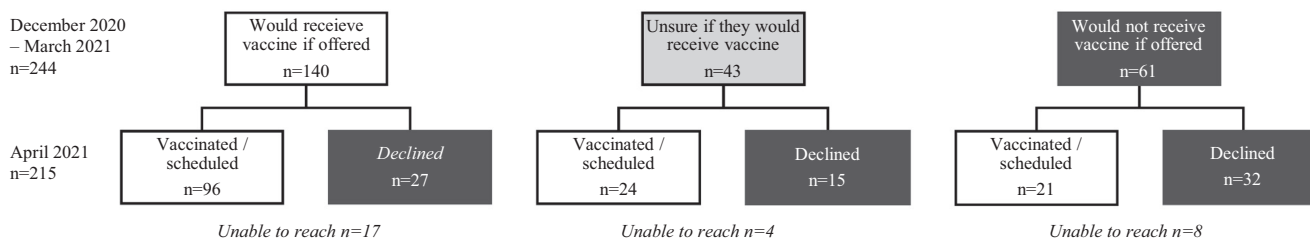
Foreign-born adults who presented for COVID-19 testing between December 2020 through March 2021 were invited to participate in the study. Participants completed an initial survey that was verbally translated at the time of testing. We surveyed their attitudes, and perceptions about COVID-19, previous acceptance of vaccines, sources utilized to obtain trusted health information and intent to get vaccinated against COVID-19, Fig. 1. Additionally, we collected information on participants' sex, age, education, employment, household size, country of origin, language, year of arrival in the United States, and reasons for seeking testing. A follow-up survey was conducted in April 2021 once COVID-19 vaccines became widely. Peer navigators contacted all those who participated in the initial survey to inquire about their COVID-19 vaccination status. Those who intended to get vaccinated were registered and transported to the vaccination site. Those who were just interested but not ready to make an appointment, were unsure, or did not want to get vaccinated were classified as “declinedg” (Fig. 1).

Data from the initial survey was gathered on paper forms entered in REDCap software by trained study personnel. Participants were eligible for inclusion in quantitative analyses as long as they answered the question about their vaccination intent. We examined descriptive statistics of vaccine attitudes, beliefs, and trusted sources of information and performed stratified analyses of these variables by demographic variables (i.e. age, gender, highest educational level achieved, region of origin, and years in the United States). Differences in proportions were assessed via  $\chi^2$  or Fisher's exact tests, and differences in means across response categories were assessed via analysis of variance (ANOVA). All quantitative analyses were performed using SPSS version 27.

We assessed the relative deprivations of the RIM participants using the social vulnerability index (SVI). The SVI was developed by the US Centers for Disease Control to better understand potential impacts of natural disasters on diverse communities. The SVI combines fifteen measures from the U.S. Census including measures of socio-economic status and household density into a single index. The SVI is associated with increased COVID-19 risk [11], and more vulnerable counties had lower vaccination coverage at least until March of 2021 [12]. We matched geocoded households to census tracts and compared the SVI among vaccine hesitant and vaccine accepting participants using R version 4.0.3 [13]. We then conducted an analysis of variance of the SVI by vaccine intent group.

In addition to these quantitative analyses, we also conducted in-depth semi-structured interviews with key stakeholders, including seven refugee health navigators (HNs) involved with the COVID-19 testing site and six community leaders (CLs) engaged in COVID-19 outreach efforts who were identified through snowball sampling – all HNs and CLs are themselves refugees, and belong to the communities with which they work. The six CLs who were interviewed represented 12 different language/ethnic groups, and many of them were members of the New American Forum, a community-based organization led by refugees that works to address community needs and uplift the voices of new Americans. Interview domains included vaccine acceptance, vaccine access, and media literacy, as well as the impact of the COVID-19 pandemic on the community. Analysis of the interviews was performed using an iterative emergent thematic coding scheme. Researchers used NVivo software to identify and organize themes into a hierarchical codebook that was applied to all interview transcripts. Researcher bias was mitigated through personal memos, member checking, and triangulation with quantitative data.

The study was approved by the SUNY Upstate Medical University Institutional Review Board (IRB) (Project 1607447-2), and Western IRB (Study Number 1284593).



**Fig. 1.** Change of vaccination intent and readiness between December 2020–April 2021. Participants were approached for survey participation during self-reported COVID-19 testing. The initial survey included 244 participants. Follow up survey took place when COVID-19 vaccines became widely available in April 2021. Out of 244, we were able to reach 215 refugees for a follow up survey.

### 3. Results

#### 3.1. Demographic characteristics

We approached 247 foreign-born adults who presented for COVID-19 testing. Three declined to answer question about vaccination intent, hence 244 survey participants were included, 109 males (44.7%) and 135 females (55.3%). The mean age was 38.5 years (SD 12.8); 62 (26.8%) reported university education, and 80 (34.6%) had secondary or high school education, with the remaining participants reporting no formal schooling, primary school or preferred not to disclose, Table 1. The majority of participants, 188 (77.0%), arrived from four regions: Central and East Africa, Southeast Asia, and the Middle East, and 93 (40%) have been in the US < 5 years (Table 1).

#### 3.2. Vaccination intent by socio-demographic factors and other variables

Among 244 participants of the initial survey, 140 (57.4%) intended to get vaccinated, 43 (17.6%) were unsure, and 61 (25%) did not intend to get vaccinated. We did not observe any significant correlation between socio-demographic variables and vaccination status/intent (Table 1). Vaccination acceptance declined with increased household size as 83.3% of single person households accepted vaccination compared to 47.3% among households with 6 and more members,  $p = 0.04$ . The majority of participants (92%) had never previously declined a vaccine for themselves or their child. Those who declined vaccines in the past were more likely to decline COVID-19 vaccines compared to those who never declined vaccination, 8 (42.1%) versus 52 (24%), respectively,  $p = 0.01$ . Trusted sources for health decisions varied by vaccination intent with doctor's office, news outlets and social media being significantly different between each group (Table 2). "My doctor/doctor's office" was the most common source of trusted information among all groups.

#### 3.3. Vaccination intent after broad COVID-19 vaccine availability

Among 244 initial survey participants, 140 (57.3%) said they would get vaccinated, 43 (17.6%) were unsure, and 61 (25%) stated they would not get vaccinated. Out of 244 participants, we were able to reach 215, all of them agreed to participate in a follow up survey. Among those participants, 141 (65.6%) were either vaccinated or expressed intent to do so, and 74 (34.4%) remained hesitant. Of the initial 140 who said they would get vaccinated, 96 (68.6%) were vaccinated or registered to get vaccinated, and 27 (19.3%) decided not to get vaccinated. Similarly, of the initial 43 who were unsure about getting vaccinated, 24 (55.8%) were vaccinated or registered, and 15 (34.9%) changed their mind not to get vaccinated. Interestingly, among 61 of those who initially said they

would not get vaccinated, 21 (34.4%) did, and 32 (52.5%) still chose not to (Fig. 1).

#### 3.4. Social deprivation index and vaccination intent

The RIM participants lived in neighborhoods of high social vulnerability, with a median of 0.87 on a scale of 0 to 1 (Fig. 2). Individuals who were vaccine-accepting in the follow up survey generally had lower levels of social vulnerability than individuals who were hesitant or unsure, ANOVA F-test = 6.36,  $p = 0.0124$  (Fig. 3).

#### 3.5. Vaccination intent by the country of origin

The distribution of respondents' vaccination intent by the country of origin before after COVID-19 vaccines became widely available is summarized in Fig. 4. There were no significant differences in vaccination intent noted,  $p = 0.08$ .

#### 3.6. Community stakeholder interviews

##### 3.6.1. Major themes

We found that many refugees held fears about COVID-19 vaccination founded, in part, on historical mistrust and online disinformation. Refugees also face significant, modifiable systemic barriers to vaccine access. The primary themes that emerged from our qualitative analysis include: (1) Personal barriers, (2) Access-related barriers, and (3) Potential solutions to increase vaccination. While several other themes were also identified, we limited our analysis to these three in order to focus on their relationship to our quantitative findings. Some quotations below have been slightly edited for clarity.

##### 3.6.2. Personal barriers

Personal barriers that were commonly discussed by HNs and CLs included: (1a) Fears related to the vaccine, (1b) Concerns that the vaccine is religiously prohibited, and (1c) Plans to "wait and see" how others did with the vaccine. A Burmese HN explained that rumors about the potential side effects of the vaccine were quite common and traveled quickly, saying "The bad news goes very fast that the vaccine will cause death or the vaccine will cause this symptom, the vaccine will make you sick, the vaccine will not cure the virus. So those kinds of things I often hear all the time in the community. So, it is challenging for us" (HN1). Most other interviewees reiterated this concern, noting that many such rumors were spread through social media. Because of the prevalence of these rumors, several HNs and CLs indicated that many members of their community intended to take a "wait and see" approach with the vaccine. An Arabic-speaking HN described how "I think a lot of them are just in the waiting period where they want to watch how other people are taking the vaccine and they want to watch that and how the implications are with the frontline workers and

**Table 1**  
Vaccination intent by select sociodemographic characteristics among 244 participants between December 2020 and March 2021.

	Total N [%]	Vaccine Intent N [%]			Statistics p-value
		Accepting	Unsure	Not accepting	
<b>All</b>	244 [100]	140 [57.4]	43 [17.6]	61 [25.0]	
<b>Sex</b>					.518 <sup>a</sup>
Female	135 [55.3]	73 [54.1]	26 [19.2]	36 [26.7]	
Male	109 [44.7]	67 [61.5]	17 [15.6]	25 [22.9]	
<b>Age</b>					.284 <sup>b</sup>
18–39 years	139 [57.0]	76 [54.7]	23 [16.5]	40 [28.8]	
40–64 years	95 [38.9]	58 [61.1]	17 [17.9]	20 [21.0]	
65+ years	10 [4.1]	6 [60.0]	3 [30.0]	1 [10.0]	
<b>Mean (SD)</b>	38.5 [12.8]	39.2 [13.4]	39.2 [13.4]	36.2 [10.9]	
<b>Educational Attainment<sup>c,d</sup></b>					.679 <sup>a</sup>
No formal schooling	41 [17.7]	20 [48.8]	9 [22.0]	12 [29.3]	
Primary school	48 [20.8]	27 [56.3]	8 [16.7]	13 [27.1]	
Secondary school / High school	80 [34.6]	48 [60.0]	10 [12.5]	22 [27.5]	
University	62 [26.8]	34 [54.8]	15 [24.2]	13 [21.0]	
<b>Region of Origin</b>					.168 <sup>e</sup>
Central Africa	45 [18.4]	27 [60.0]	5 [11.1]	13 [28.9]	
East Africa	46 [18.9]	25 [54.3]	10 [21.7]	11 [23.9]	
North Africa	12 [4.9]	5 [41.7]	4 [33.3]	3 [25.0]	
South Africa	1 [0.4]	0 [0.0]	1 [100.0]	0 [0.0]	
Central Asia	4 [1.6]	3 [75.0]	1 [25.0]	0 [0.0]	
East/ Southeast Asia	59 [24.2]	31 [52.5]	8 [13.6]	20 [33.9]	
South Asia	11 [4.5]	10 [90.9]	1 [9.1]	0 [0.0]	
Eastern Europe	4 [1.6]	4 [100.0]	0 [0.0]	0 [0.0]	
Latin America	19 [7.8]	14 [73.7]	2 [10.5]	3 [15.8]	
Middle East	41 [16.8]	19 [46.3]	11 [26.8]	11 [26.8]	
North America	2 [0.8]	2 [100.0]	0 [0.0]	0 [0.0]	
<b>Years since U.S. arrival<sup>f</sup></b>					.581 <sup>b</sup>
<1	9 (3.9)	6 [66.7]	1 [11.1]	2 [22.2]	
1–5	84 (36.5)	47 [56.0]	16 [19.0]	21 [25.0]	
6–10	55 (27.8)	31 [56.4]	10 [18.2]	14 [25.5]	
10+	82 (31.7)	47 [57.3]	16 [19.5]	19 [23.2]	
<b>Mean (SD)</b>	8.6 (6.8)	8.9 [7.3]	8.7 [6.6]	7.8 [5.5]	
<b>Household size<sup>g</sup></b>					.042 <sup>a</sup>
1	12 (5.3)	10 [83.3]	1 [8.3]	1 [8.3]	
2–5	125 (54.1)	80 [64.0]	20 [16.0]	25 [20.0]	
6+	91 (39.9)	43 [47.3]	18 [19.8]	30 [33.0]	
<b>Mean (SD)</b>	5.0 (2.4)	4.6 [2.5]	5.1 [2.1]	5.8 [2.3]	

<sup>a</sup> Pearson Chi-Square.

<sup>b</sup> Analysis of Variance.

<sup>c</sup> Refers to highest level of educational attainment *began*, as reported by participants >=18 years.

<sup>d</sup> n = 231 because some participants did not answer this question.

<sup>e</sup> Fisher's exact.

<sup>f</sup> n = 230 because some participants did not answer this question.

<sup>g</sup> n = 228 because some participants did not answer this question.

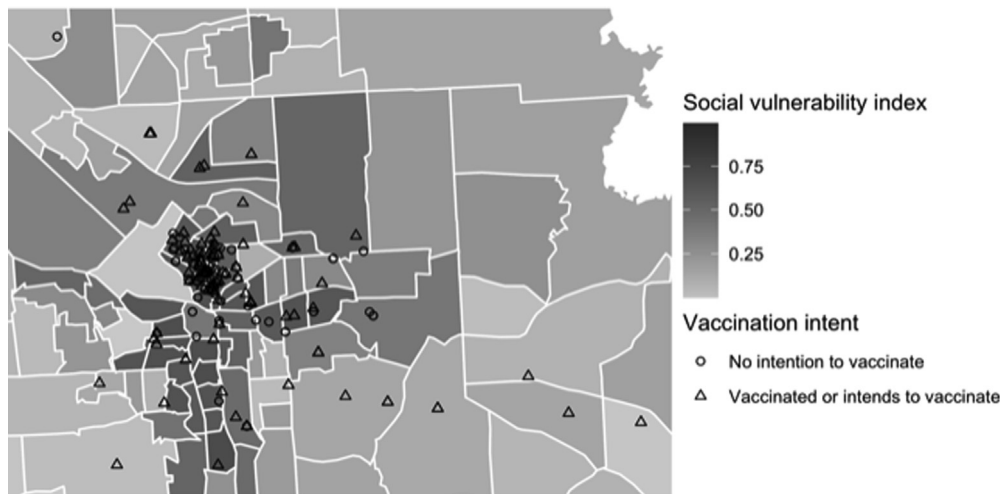
**Table 2**  
Trusted sources of information among 238 refugees by vaccination intent between December 2020 through March 2021.

	Vaccine Intent			p-value
	Accepting	Unsure	Not accepting	
<b>Total</b>	182 N [%]	44 N [%]	77 N [%]	
<b>Trusted sources<sup>a</sup></b>				
My doctor/doctor's office	43 [23.6]	26 [59.1]	25 [32.4]	.002 <sup>b</sup>
News outlets/television	42 [23.1]	4 [9.1]	14 [18.2]	.021 <sup>b</sup>
Friends/family	27 [14.8]	5 [11.4]	9 [11.7]	.444 <sup>b</sup>
Other	26 [14.3]	4 [9.1]	7 [9.1]	.217 <sup>b</sup>
Social media	17 [9.3]	0 [0]	11 [14.3]	.016 <sup>b</sup>
Doctors in general/hospital	15 [8.2]	2 [4.5]	5 [6.5]	.553 <sup>c</sup>
Religious community	5 [2.7]	0 [0]	1 [1.3]	.624 <sup>c</sup>
CDC/WHO news/updates	4 [2.2]	3 [6.8]	1 [1.3]	.365 <sup>c</sup>
Catholic Youth Organization	3 [1.6]	0 [0]	4 [5.2]	.157 <sup>c</sup>

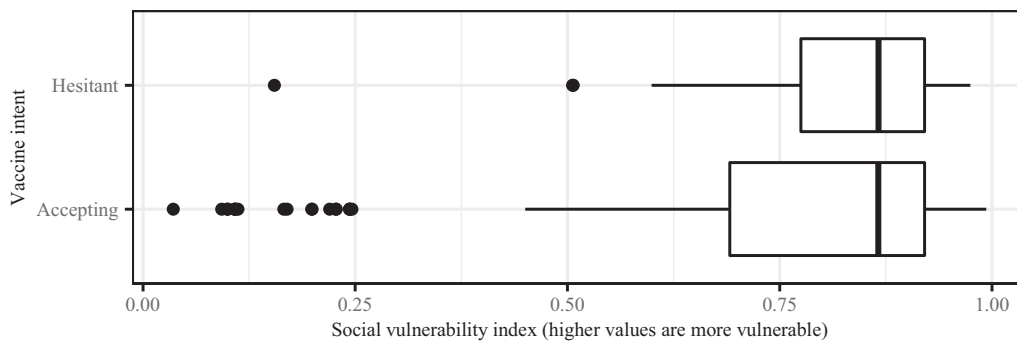
<sup>a</sup> N = 303, multiple answers could be selected, not mutually exclusive; n = 303.

<sup>b</sup> Pearson Chi-Square.

<sup>c</sup> Fisher's exact test.



**Fig. 2.** Map of social vulnerability index among survey respondents and their vaccination status/intent Syracuse area, New York. The social vulnerability index ranges from 0 to 1, with higher values indicating a community is more vulnerable. The SVI was previously associated with increased COVID-19 risk, and more vulnerable counties had lower vaccine coverage. The SVI combines fifteen measures from the US Census including measures of socio-economic status and household density into a single index. Geocoded households were matched to census tracts and compared the SVI among vaccine hesitant and vaccine accepting participants using R version 4.0.3. We then conducted an analysis of variance of the SVI by vaccination intent in April of 2021 showing that vaccine hesitant refugees lived in more socially vulnerable neighborhoods than their accepting counterparts.



**Fig. 3.** Social vulnerability of survey respondents by their vaccination intent/status. The social vulnerability index ranges from 0 to 1, with higher values indicating a community is more vulnerable. The SVI was previously associated with increased COVID-19 risk, and more vulnerable counties had lower vaccine coverage. The SVI combines fifteen measures from the US Census including measures of socio-economic status and household density into a single index. Geocoded households were matched to census tracts and compared the SVI among vaccine hesitant and vaccine accepting participants using R version 4.0.3. We then conducted an analysis of variance of the SVI by vaccination intent in April 2021 showing that vaccine hesitant refugees lived in more socially vulnerable neighborhoods than their accepting counterparts.

other members of the community, and then they’ll make a decision” (HN2).

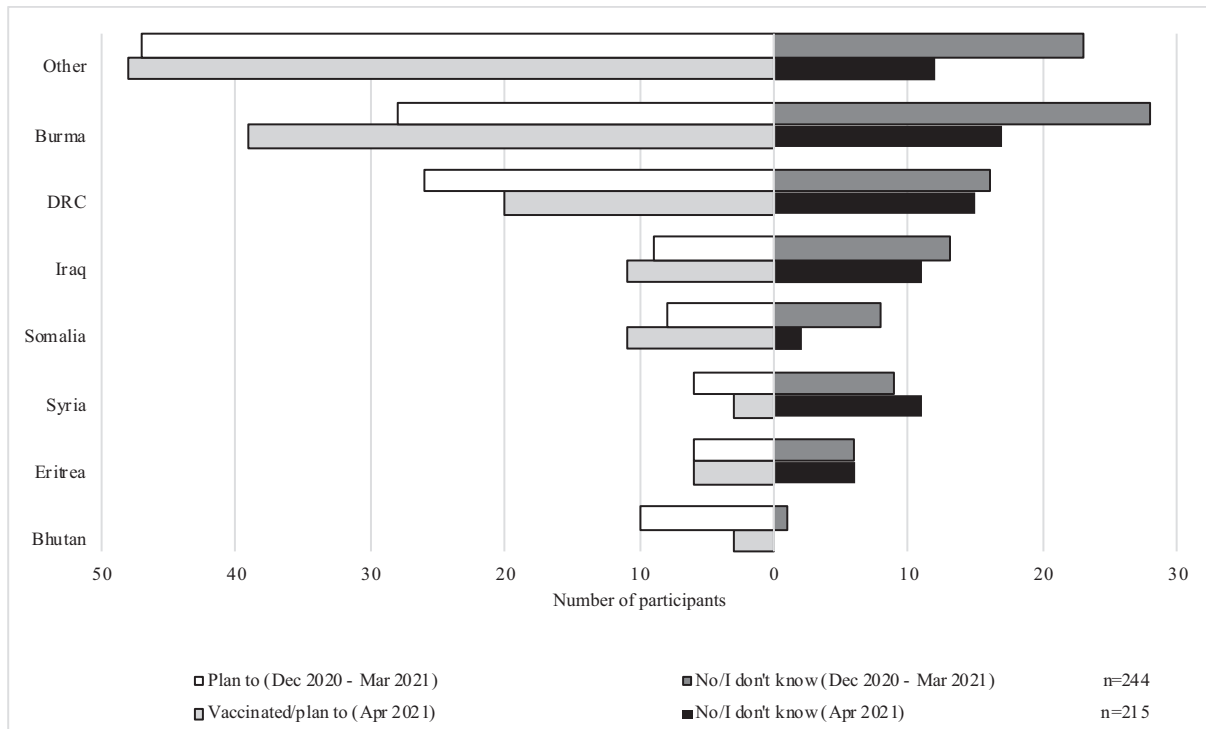
3.6.3. Access to vaccination as a barrier

Refugees also expressed a concern that those who wanted to be vaccinated would not be able to access vaccines. The access-specific barriers described by participants included (2a) communication barriers, and (2b) transportation barriers. These concerns were particularly common in the interviews with CLs who described the challenges faced by the members of their communities. One Bhutanese CL described the communication challenges as being both related to language and information access, saying “Much of [the refugee population] is illiterate, and they don’t have internet access at home. Even if the internet is there, they don’t have cable news, or they don’t know how to access the news through internet. So, this became a big challenge for us, informing the community about the guidelines about the safety precautions” (CL1). Another commonly described barrier was the issue of transportation to vaccination sites. As one CL put it, “It is very hard for us because there is no extra resources and funding for these people to transport to the [state-run vaccination site out of the city], or

any other sites, so if any would be on the north side, where mostly folks live, they can get to the [refugee resettlement agency site in the city] easily” (CL1).

3.7. Community perspectives on effective interventions to increase COVID-19 vaccine acceptance

Both HN and CL respondents offered a variety of potential interventions or suggestions for how to increase vaccine uptake among refugees. These included (3a) Using a trusted source to communicate about the vaccine; (3b) Providing education to the community; and (3c) Offering a vaccine clinic in the community. The most commonly described potential intervention was to engage trusted CLs to communicate about vaccination. One South Sudanese CL suggested that “If you guys talk to the [community] President, explained to him how [the vaccine] is, what it is, all that stuff, then he will take it to the community members, and then it will be coming from him from you guys” (CL5). Many other CLs shared this suggestion, noting that members of various refugee communities are much more likely to trust information that comes directly from people they already know and trust. Several respon-



**Fig. 4.** Vaccination intent/status among respondents by country of origin before and after wide COVID-19 vaccines availability. Initial survey included 244 foreign-born adults who presented for COVID-19 testing between December 2020 through March 2021. A follow-up survey was conducted in April 2021 among 215 initial participants to inquire about their COVID-19 vaccination status. There were no significant differences at the country level and vaccination intent ( $p = 0.08$ , Fisher exact test).

dents also suggested having educational sessions with the community hosted by doctors or other health professionals who speak the same language as the community. A Syrian CL suggested that “You can solve these fears, this problem with families, to educate them about the vaccine, they need to trust with this vaccine. . . They can make a session with many families and talk in person, and when you have this session, I suggest to have doctors from the hospital, I need a doctor in front of me, I need to ask him, and I need him to answer me. Because I have many, many questions” (CL6).

#### 4. Discussion

We report a high level of vaccine hesitancy, as 34.4% of refugees declined or were unsure about getting vaccinated once COVID-19 vaccines became widely available. This low vaccination intent is especially concerning because refugees are at a greater risk for SARS-CoV-2 infection due to their crowded living conditions, occupational exposure, barriers to COVID-19 testing or health care. This level of hesitancy is similar to the general US population. In April 2021, 64% of adults said that they have gotten at least one dose of a vaccine or intend to do so as soon as possible [14]. We further observed a high degree of fluidity between vaccination intent and behavior. Among those who initially intended to get vaccinated, nearly 1 in 5 changed their mind and decided to forego vaccination, and among those who initially did not plan getting vaccinated, 1 in 3 changed their mind and got vaccinated. The attitude change is not surprising, as widespread misinformation about COVID-19 remains an important factor behind hesitancy [15]. Misinformation spreads faster and reaches broader audiences than correct information [16], and it has been identified as one of the main threats to our society [17]. In our population, 41% of those not accepting vaccines used TV, news, and social media as a trusted source of vaccine and health information. Although reasons behind vaccination decisions among refugee population are largely unknown, this

is not the first time that misinformation has reduced vaccine coverage in refugee populations. For example, misinformation about MMR vaccine and fears of autism resulted in a decline of vaccination and an eventual outbreak of measles among a Somali-American community in 2017 [18].

Trusted sources of information varied among refugees with personal doctors and office staff being the most trusted regardless of the refugee’s vaccination intent. Ensuring refugees have primary care homes with doctors and staff ready to promote vaccines may be of benefit. We further need to ensure primary care homes have COVID-19 vaccines in stock and can deliver vaccines in a trusted, culturally sensitive and competent environment. The rapid spread of misinformation reaches a broader audience quickly and will increase a demand on a primary care provider to engage in an *individually tailored* discussion with a hesitant patient. One on one, in a refugee medical home, the experience of the vaccine hesitant is more contemplative than definitive (personal communication). For example, when a patient cites misinformation as a reason not to get vaccinated, deconstructing misinformation with a trusted source such as a health care provider can be a very effective way to help patients understand the benefits of vaccines and accept them.

Similar to the general public, *refugee CLs and HNs* indicated that an effective strategy to increase vaccine uptake would involve enlisting trusted voices as messengers in support of vaccination [19]. CLs and HNs expressed a desire for additional education about the benefits and safety of vaccines and easy access to vaccination clinics near refugee communities. Structural barriers to vaccination emerged as a serious challenge for refugees, given that some experience internet access and language barriers that can make trustworthy information less accessible. CLs and HNs reported that online registration was challenging during the early phases of the vaccination program, and that long waits to make appointments by phone due to high demand were also a barrier. To reduce this

barrier, vaccination could be accomplished through coordination between resettlement agencies and local departments of health. Pop-up clinics, mobile vans, or vaccination at sites where refugees gather are likely to improve the vaccination rate among those who lack transportation or the ability to register online but who want to be vaccinated. Community-responsive vaccine-related educational interventions to combat vaccine misinformation implemented in clinical and community settings, along with individual- and community-level interventions that maximize vaccine access, uptake, and series completion are most likely to achieve desirable rates of vaccination to achieve community immunity.

We have shown that some of the barriers to vaccination (i.e. access) are modifiable and could be readily employed with community support and commitment. There is also a need for more targeted public health information to reach refugee communities [20,21], including specific guidance on how to personalize and deliver vaccine information using trusted community sources.

Our findings are limited by the inclusion of a convenience sample of refugees over a period of 5 months, who voluntarily agreed to have COVID-19 testing. Selection bias of those who opted for testing may have skewed our findings towards participants who had a better understanding of COVID-19 or were more concerned about the virus. Sample size limited our interpretation of the impact of certain categories on vaccination intent (i.e. trusted sources, country of origin). In addition, social desirability bias could have influenced self-reported vaccination intents, which could overinflate willingness to get vaccinated and influence responses among HNs and CLs who were aware that the team was interested in developing interventions to increase community vaccine uptake. For the qualitative interviews, although almost all HNs who worked with Catholic Charities on the COVID-19 testing project were interviewed, the sample of CLs was snowball-sampled, as CLs recommended additional people to speak with. It could be the case that the interviewed CLs therefore held similar beliefs to one another, and not all community leader views are fully represented in the data.

#### 4.1. Conclusions

We report that over a third of refugees in our study were hesitant to get vaccinated. Many participants expressed trust in health care providers and someone they know who already received the vaccine as sources of vaccine information. They also desire additional education about the benefits and safety of vaccines along with easier access to vaccination clinics in their communities.

#### Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jana Shaw reports a relationship with Pfizer Inc that includes: speaking and lecture fees. Kathryn B Anderson reports a relationship with AstraZeneca that includes: board membership. Kathryn B Anderson reports a relationship with Pfizer Inc that includes.

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