



COVID-19 vaccination acceptability and experiences among people who inject drugs in San Diego County

Chad J. Valasek^a, Samantha A. Streuli^a, Heather A. Pines^{a,b}, Maria Luisa Mittal^c, Steffanie A. Strathdee^c, Carlos F. Vera^c, Alicia Harvey-Vera^{c,d,e}, Angela R. Bazzi^{a,f,*}

^a Herbert Wertheim School of Public Health, University of California San Diego, 9500 Gilman Drive, Mail Code 0725, La Jolla, CA 92093-0725, USA

^b School of Public Health, San Diego State University, 5500 Campanile Dr., San Diego, CA, USA

^c School of Medicine, University of California San Diego, 9500 Gilman Drive, Mail Code 0507, La Jolla, CA 92093-0507 USA

^d US-Mexico Border Health Commission, Paseo del centenario #10851, Zona rio, C.P. 22010 Tijuana, Mexico

^e Escuela de Medicina, Campus Tijuana, Universidad Xochicalco, Rampa Yumalinda 4850, Chapultepec Alamar, 22110 Tijuana, Mexico

^f Boston University School of Public Health, 715 Albany Street, Boston, MA 02118, USA

ARTICLE INFO

Keywords:

COVID-19
Vaccinations
Vaccine acceptability
People who inject drugs
Vaccine hesitancy

ABSTRACT

Background: People who inject drugs (PWID) face increased risk of SARS-CoV-2 acquisition and severe disease, yet COVID-19 vaccine uptake has been suboptimal. To inform vaccination interventions tailored for the needs of this population, we explored COVID-19 vaccination acceptability and experiences among PWID in San Diego County, USA.

Methods: From September–November 2021, we conducted qualitative interviews with PWID aged ≥ 18 years who were participating in a prospective study of infectious disease risks in San Diego. Thematic analysis of coded interview transcripts focused on identifying barriers and facilitators to COVID-19 vaccination.

Results: Of 28 participants, 15 reported having had ≥ 1 dose of COVID-19 vaccine, primarily received through community health centers, pharmacies, jails, and homeless shelters. We identified three key barriers to COVID-19 vaccination: (1) low perceived risk of COVID-19 (or belief in natural immunity), (2) institutional distrust (e.g., of pharmaceutical companies and government agencies that “rushed” vaccine development, approval, and distribution), and (3) conflicting information from news, social media, and peers. We also identified three key facilitators of vaccination, including (1) heightened personal and interpersonal safety concerns, (2) health service outreach efforts to make vaccines more accessible, and (3) tailored information delivered by trusted sources (e.g., outreach or community health workers).

Conclusions: Tailored intervention strategies to increase acceptability and uptake of COVID-19 vaccination among PWID should involve efforts to increase vaccine literacy and motivation while decreasing institutional distrust and structural barriers to access.

1. Introduction

People who inject drugs (PWID) are particularly vulnerable to SARS-CoV-2 infection and experience more severe disease than the general population (Strathdee et al., 2021a; Wang et al., 2021). The disproportionate impact of COVID-19 among PWID may be due to structural factors including homelessness, poverty, stigma, and low healthcare access and utilization (Strathdee et al., 2021a), as well as the high prevalence of co-morbidities (Wang et al., 2021; Lim et al., 2022). Addressing structural inequities that increase SARS-CoV-2 transmission

and COVID-19 severity in vulnerable populations affected by substance use is paramount for the health of PWID as well as the general population, particularly as new variants emerge.

While COVID-19 vaccination is a critical strategy for reducing the impacts of the pandemic (Centers for Disease Control and Prevention), some research has shown that COVID-19 vaccine uptake among PWID has lagged behind that of the general population (Menza et al., 2022; Strathdee et al., 2021b), aligning with studies finding low rates of vaccination among PWID for influenza, HPV, and hepatitis B (Price et al., 2021; Sadang et al., 2021; Feinberg and Pearce, 2021). In studies

* Corresponding author at: Herbert Wertheim School of Public Health, University of California, San Diego, 9500 Gilman Drive, MTF 265E (Mail Code 0725), La Jolla, CA 92161, USA.

E-mail address: abazzi@health.ucsd.edu (A.R. Bazzi).

<https://doi.org/10.1016/j.pmedr.2022.101989>

Received 5 July 2022; Received in revised form 13 September 2022; Accepted 17 September 2022

Available online 19 September 2022

2211-3355/© 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

among PWID in diverse settings including the United States, Mexico, and Australia, vaccine hesitancy is a prominent concern that may be tied to socio-economic factors (e.g., education), beliefs about COVID-19 (including COVID-19 disinformation), and concerns about safety and side effects (Strathdee et al., 2021b; Cioffi et al., 2022; Iversen et al., 2021).

Although previous research has provided some insights into COVID-19 vaccine acceptability and hesitancy among PWID, few studies have involved an in-depth examination of vaccination experiences, barriers, and facilitators among both vaccinated and unvaccinated individuals within this population. To inform efforts to increase COVID-19 vaccine uptake among PWID, we conducted in-depth interviews with vaccinated and unvaccinated PWID in San Diego County, CA, USA, to explore COVID-19 vaccination attitudes, experiences, and actual and perceived barriers and facilitators to vaccination.

2. Material and methods

2.1. Study design and sample

We conducted interviews from September 2021 and November 2021 as part of a qualitative study that was nested within the ongoing “La Frontera” cohort study of cross-border drug tourism and overdose and infectious disease outcomes (including HIV, HCV, and SARS-CoV-2) among PWID in San Diego County, USA, and Tijuana, Mexico (Strathdee et al., 2021a). In brief, between October 28, 2020, and September 10, 2021, *La Frontera* staff recruited individuals via street outreach who were eligible if they were ≥ 18 years old, resided in San Diego County or Tijuana, reported past-month injection drug use and spoke English or Spanish. For this qualitative study, we recruited participants residing in San Diego County to participate in one-time qualitative interviews focused on access to and experiences with prevention services, including HIV testing, pre-exposure prophylaxis, and COVID-19 vaccination. As previously described (Bazzi et al., 2022), baseline data were used to purposively sample participants who reported high-risk behaviors for HIV-related outcomes (e.g., condomless sex, receptive syringe sharing). Participants provided verbal informed consent and received \$20 cash compensation for qualitative interviews. The Human Research Protection Program of the University of California San Diego approved all study protocols.

2.2. Data collection

Trained interviewers conducted qualitative interviews in person or via secure video conferencing. Interviews lasted an average of 45 min. Interviews were audio-recorded using a handheld recorder, professionally transcribed, and translated from Spanish to English as necessary by a bilingual, bicultural study team member. Interview topics included participants’ experiences and health-related behaviors during the COVID-19 pandemic, access to health care and HIV prevention services, and attitudes, concerns, and experiences with COVID-19 vaccination. Examples of interview questions included “Can you tell me what you’ve learned about COVID-19 vaccines?”; “What, if any, concerns do you have about the available COVID-19 vaccines?”; and “What is your view on vaccines in general?” Interviewers took detailed interview notes immediately after interviews to record their observations on key topics and potential emergent themes.

2.3. Data analysis

We used a combination of deductive and inductive approaches for this analysis. We developed a preliminary codebook through an iterative, consensus-based process involving five rounds of codebook testing and revision by the lead interviewer (CV) and three investigators (AB, HP, and SA Streuli). We resolved discrepancies through a consensus-based approach (i.e., deliberation and discussion during regular

weekly meetings), leading to a finalized codebook (version five). We began with a number of general, deductive codes including “vaccines” and “vaccine acceptability.” Codes were then refined through an inductive process following participant interviews. The lead interviewer then applied finalized codes to interview transcripts using Nvivo (v12). Through a systematic review of data coded for “COVID knowledge, beliefs,” “COVID Vaccine,” and “Vaccines (general),” we identified key themes regarding COVID-19 vaccine acceptability and uptake. The lead interviewer then selected representative quotes related to each theme. All participant names used in this report are pseudonyms in order to maintain anonymity.

3. Results

3.1. Overview of study sample and key findings

Among 28 participants, ages ranged from 21 to 65 years (median: 40 years) and about two-thirds (64%) identified as male of “Mixed” or “Other” race (64%) and “Hispanic or Latino” ethnicity as (64%; Table 1). Most participants also reported an educational attainment of high school or less. At the time of qualitative interviews (September–November 2021), 15 (53.6%) reported having had a least one COVID-19 vaccine dose, while 13 (46.4%) had not.

Thematic analysis of qualitative data identified three key considerations that influenced COVID-19 vaccination attitudes and experiences, including: (1) low perceived risk of SARS-CoV-2 infection or complications, (2) institutional distrust, and (3) conflicting information. We also identified experienced or suggested facilitators of COVID-19 vaccination, including: (1) personal and interpersonal safety concerns, (2) health service outreach, and (3) trusted sources of information.

3.2. Low perceived risk of COVID-19 infection or complications

Many participants, especially those who were unvaccinated, had low perceived risk of acquiring SARS-CoV-2 or experiencing complications from the virus. As Juan (55 year-old unvaccinated man), who generally did not like or feel that he “needed” vaccines, stated, “I’ve always been in pretty good health.” Another participant, Kurt (27 year-old unvaccinated man), explained, “If I were to get COVID, it’s going to be very mild, so to put something extra in my body isn’t worth it, [because] this flu [or] SARS thing isn’t going to be that detrimental to me.” Similarly, Jessica (26 year-old unvaccinated woman) believed her risk of SARS-CoV-2 acquisition or death was low, stating, “I’m not high risk of not being able to survive COVID-19 if I were to catch it.” Some participants provided explanations for their low risk, as Kurt said, “I usually work out every day and eat really good and stuff.” Others, like Chris (46 year-old

Table 1

Sample characteristics: people who inject drugs in San Diego County (n = 28).

Age in years: median (interquartile range; IQR)	40 (32–53)
Hispanic or Latino	18 (64%)
Racial identity:	
White	9 (32%)
Black or African American	1 (4%)
Mixed	8 (29%)
Other	10 (36%)
Gender identity:	
Cisgender man	18 (64%)
Cisgender woman	10 (36%)
Educational attainment	
Less than high school	2 (7%)
Some high school	6 (21%)
Completed high school or GED	8 (29%)
Completed trade school	3 (11%)
Some college	4 (14%)
Completed college	5 (18%)
Vaccinated	15 (53.6%)
Unvaccinated	13 (46.4%)

unvaccinated man), cited specific precautionary behaviors (i.e., wearing a mask in public) as sufficient to protect him from COVID-19 infection: "Because, basically, I wear a mask, everywhere I go."

Of note, several participants' low perceived risk of COVID-19 was related to their beliefs that their current lifestyle or behaviors provided them with "natural immunity" that protected them from COVID-19 symptoms or severe disease. Specifically, a few participants credited their experiences of homelessness or drug use with helping them "build up immunity." Linda (40 year-old unvaccinated woman) reported being curious if she had already had COVID-19 because, "I feel like everybody in the little drug world didn't get it or didn't suffer from it." When asked why she believed that people who use drugs have this immunity, she explained, "Okay, there was one time a doctor said [that] my friend would have died from [COVID-19] had she not been so high on crystal meth, and so sometimes I think that whatever the drugs have, or whatever they do...because I never get sick either." Daniel (59 year-old vaccinated man) also stated, "I haven't gotten COVID because of crystal [meth]."

3.3. Institutional distrust

Participants expressed distrust of institutions as driving their COVID-19 vaccine hesitancy and avoidance, in part due to their previous negative experiences with governmental and medical institutions. This distrust includes pharmaceutical companies and government agencies involved in vaccine development, approval, and distribution. First, many participants, including one vaccinated participant, criticized the profit motivations of pharmaceutical companies. For example, Kurt was wary of vaccine safety and efficacy because, "It just sounds to me like it was just a money kind of thing...greed." Relatedly, several participants viewed the COVID-19 vaccine development and approval process as overly "rushed," increasing risks of side effects or safety and efficacy problems. While some participants were highly skeptical and even believed that COVID-19 vaccines were "fake" for these reasons, others simply expressed reduced confidence and felt unable to judge the potential risks because the vaccines were so new; as Jessica stated in October 2021, "They don't know the side effects from it yet." Even participants who perceived a real threat from COVID-19 were hesitant to get vaccinated because of these concerns. For example, even though Chris viewed the vaccine development and testing process as "something that's been rushed" and wondered if the vaccines were "actually just fake," he "definitely" wore masks to avoid acquiring or spreading SARS-CoV-2.

Second, several participants, including some who were vaccinated, expressed views of distrust directed towards the U.S. government, which several participants viewed with suspicion for its role in backing or being "behind" COVID-19 vaccine development efforts. Juan could not explain the specific reasons for this distrust but explained that there was "something there" causing him to feel nervous: "I don't like [vaccines]. Like I said, I don't trust the government. I know that's probably stupid and just sounds paranoid, but it's in my mind...I don't know why...I really don't. It's just something there, you know?" Kurt provided more specific reasoning behind his distrust of the government:

I hear that there's something about mRNA in your DNA, or something like that, and I don't really know what's up with that. I don't know if they have some kind of hidden agenda or something, like trying to put a patent on us or something like that, because they're altering our DNA.

Other participants viewed COVID-19 vaccines as representing more paternalistic and authoritative government policies. For example, Kate (39 year-old vaccinated woman) asked the interviewer, "At first, it seemed like it was some kind of government-controlled thing, you know?" For Josh (35 year-old unvaccinated man), the way vaccines were being promoted could justify their social exclusion. He explained, "I feel like this is potentially a trap, that whole, 'Oh, well I don't want

him in the grocery store unless he's got his vaccine,' you know?"

3.4. Conflicting information

For many participants, conflicting facts about COVID-19 vaccines from news, social media, and social networks were pervasive and increased their vaccine hesitancy. Several of these participants mentioned difficulty assessing information on COVID-19 vaccines, as Carol (46 year-old vaccinated woman) explained, "I wouldn't even know where to go [to] research [vaccines]...I can look up things online, but there are so many different places." The multitude of "facts" available caused confusion for participants and their peers, as Kate described, "All the information leaked out and people say all this crazy stuff about the government [and] it just spreads...And you don't know what's true and what's not."

Many unvaccinated (and two vaccinated) participants reported coming across disinformation about COVID-19 vaccines. Some of these sources reported increased likelihood of death from the vaccines. Linda described receiving a video sent from a friend: "Okay. This [video] even made me not want to [get vaccinated] even more. Because I got so scared. But I [understand], like, it is meant to scare you and stuff. [They're] doing it on purpose. But this is the information I got. And it did scare me." Similarly, Kate accessed information on the Internet that included "a lot of conspiracy theories...videos of people telling on the government, how the government made COVID-19 for population control; they're just trying to kill us off, the old and the sick."

3.5. Experienced or suggested facilitators of vaccination

Facilitators of COVID-19 vaccination that participants experienced or suggested included tailored education and outreach efforts to increase vaccine motivation and access. Specifically, those related to (1) personal and interpersonal safety concerns, (2) health service outreach efforts to make vaccines more accessible, and (3) trusted sources of information.

First, among the 15 vaccinated participants, several aspects of risk assessment, including perceptions of their personal and interpersonal safety, appeared to support their decisions to get vaccinated. Many of the vaccinated participants decided to do so because they believed in the efficacy of available vaccines to protect against severe SARS-CoV-2 symptoms, as Gabriel (55 year-old vaccinated man) explained, "they do protect a little, but I still have to be careful...you can still get sick, but it won't be so strong." Moreover, vaccinated participants' perceptions of the health consequences of SARS-CoV-2 supported beliefs that it was a real threat requiring prevention measures, as David (35 year-old vaccinated man) explained, "The disease is real, dangerous, and we have to take any medication or vaccine to prevent it." Finally, some participants explained that relationships with family motivated their decisions to get vaccinated, as Steven (44 year-old vaccinated man) explained, "I want to see my parents and my nieces and nephews, and I can't see them unless I'm vaccinated." This potential facilitator, while based on subjective perception, can help inform vaccination outreach efforts focused on informing unvaccinated individuals that COVID-19 carries personal risks in addition to risks posed to others.

Second, most participants, regardless of vaccination status, believed that health service outreach efforts were needed to make vaccines more accessible for PWID, particularly for those experiencing homelessness. As Ana (31 year-old vaccinated woman) recommended, "If they were out there in the street, like here, for people from here...that'll make it a lot easier." Finally, several participants reported that vaccine programs should include incentives, such as small amounts of cash or nonmonetary items like food. Mike (30 year-old unvaccinated man) was confident that such incentives would help increase COVID-19 vaccination, saying, "Oh, there's no secret, the power behind that [money]."

Lastly, participants called for enhanced distribution of accurate information and enhanced educational outreach by trusted sources, particularly in areas where PWID live and congregate. Tailored

educational materials could include flyers, pamphlets, and posters that could help individuals feel “more comfortable.” Such tailored messaging, according to a number of our participants, should include health information in accessible language and visuals that include details on risks specific for PWID and people experiencing homelessness. To encourage individuals to take the time to read printed educational materials, participants suggested providing food, coffee, a comfortable space, and clothes or other resources. Beyond these suggestions, participants noted that the information must be shared from trusted sources, such as primary providers, outreach health workers, syringe service program (SSP) staff, and peers, in order to facilitate higher vaccination rates for PWID. For instance, when Tom (52 year-old vaccinated man) was asked what helped him get vaccinated, he reported: “Uh, the people at the family clinic. Regular doctor.” Frank (65 year-old vaccinated man) reported that he was briefed on the vaccine by outreach workers at a shelter before receiving the vaccine. Several participants reported feeling more at ease about the vaccine after talking to peers who have already been vaccinated. This led a couple of participants to suggest including vaccinated peers or trusted service providers (e.g., outreach or community health workers) as part of vaccine educational efforts. As Natalie (21 year-old unvaccinated woman) recommended, “Have someone like us [say] that it did actually help.” Similarly, Kurt explained, “The more people that I see [who] have a good head on their shoulders...that got the vaccine, [will] make me more likely to get [it].”

4. Discussion

Individuals with substance use disorders may be more likely to contract COVID-19 and experience more severe disease, hospitalization, and death (Wang et al., 2021). Understanding the barriers and facilitators to vaccination amongst PWID is thus particularly important. Through our analysis of qualitative interview data, we identified three challenges to COVID-19 vaccination among PWID, including low perceived risk of infection or complications, institutional distrust, and conflicting information.

One of the most common concerns when participants in our sample were weighing the risks of COVID-19 vaccination was the novelty of COVID-19 vaccines. Many participants shared concerns specific to COVID-19 vaccines rather than vaccines more generally. These anxieties included how “rushed” the vaccine development and approval processes had been, which then related to some participants’ anxieties around motivations of governmental institutions and pharmaceutical companies to control or profit off of the population (Troiano and Nardi, 2021; Romer and Jamieson, 2020). Common concerns about vaccine safety in our sample align with previous studies finding that PWID, like a sizable segment of the general U.S. population (The Henry J. Kaiser Family Foundation), harbor concerns that COVID-19 vaccines are unsafe and have been insufficiently tested (Kumari et al., 2021).

As with many other marginalized populations, participants in our study expressed institutional distrust, specifically involving medical and governmental institutions, as a significant barrier to vaccination (Best et al., 2021). This distrust included concerns about profit motivations for companies developing COVID-19 vaccines, and these concerns acted as noteworthy barriers to vaccination. Conversely, some participants trusted medical providers, which facilitated their vaccination, confirming research with the general population showing that people tend to trust their primary care providers for COVID-19 vaccination information (Liu and Chu, 2022).

Many participants stated that they had received conflicting information about COVID-19 vaccines, which impacted their vaccine-related decision making. While access to clear and trusted information was a facilitator of COVID-19 vaccination, participants also stated that disinformation campaigns and difficulty determining the trustworthiness of various available information sources acted as barriers to vaccination. Disinformation has been prevalent throughout the COVID-19 pandemic, creating what some scholars refer to as an “infodemic” (Patwa et al.,

2021). This proliferation of “fake news” surrounding the SARS-CoV-2 virus, including false ideas about its etiology and potential “cures,” has made it particularly difficult for individuals to determine the veracity of COVID-related information they encounter in daily life (Ball, 2020). Our study confirms other research findings, including an association between PWID vaccine hesitancy and accessing COVID information via social media, suggesting that disinformation has impacted PWID, including those who support the use of vaccines who have often been exposed to vaccine myths and conspiracy theories (Strathdee et al., 2021b; Wilson and Wiysonge, 2020). Similarly, our findings closely align with those in the emerging literature on hesitant adopters of COVID-19 vaccination in the United States. For instance, our findings regarding concerns about personal safety align with previously-identified “intrinsic motivations” in the general population (Moore et al., 2022) and our findings regarding institutional distrust and knowledge limitations mirrors findings from a larger quantitative study on COVID-19 vaccine hesitancy among PWID in Baltimore, MD (Cepeda et al., 2022).

Participants shared a number of suggestions for specific intervention targets that provide avenues for improving COVID-19 vaccination knowledge, motivation, and uptake among PWID. Previous literature has proposed general interventions to increase vaccine uptake involving education, building knowledge and trust of vaccine development processes, addressing concerns about medication interactions and side-effects, and increasing personalized perceived risk of COVID-19 (Shen and Dubey, 2019). Suggestions from participants in our sample also overlap with other previous research findings, including suggestions that interventions be delivered by trusted sources of health information and support, such as outreach workers, peers, or staff from SSPs or other trusted service agencies (Knight et al., 2022; Strathdee et al., 2021b). While providing clear, up-to-date, information on vaccines is important (Benham et al., 2021), our findings suggest that, without more structural supports such as transportation assistance, financial incentives, and increased vaccine accessibility in areas where PWID live and congregate, vaccine uptake in this population may remain suboptimal (Aronson et al., 2022).

There were several limitations to our study. First, findings from our sample may not generalize to PWID in other contexts or populations. As we did not sample based on COVID-19 vaccination status, future studies should more systematically compare vaccinated and unvaccinated PWID to confirm or expand upon our findings. Second, due to the nature of the overall study from which these data were obtained, participants were purposively sampled based on their HIV-related risks (Bazzi et al., 2022), which were not necessarily COVID-19 risk pathways. Third, we relied on self-report and recall of vaccination beliefs and behaviors, which may change over time and could have been subject to socially desirable responses. Fourth, since this study was conducted prior to the widespread availability or guidance regarding COVID-19 vaccine booster doses, additional research is needed to explore beliefs and experiences with additional vaccine doses and related intervention needs. Future intervention research and longitudinal studies are needed to understand the efficacy of the facilitators identified here and identify implementation strategies to support their widespread adoption by agencies that successfully engage PWID in prevention services (e.g., SSPs). Nevertheless, despite these limitations, our study provides valuable insights into COVID-19 vaccination barriers and facilitators among PWID and has the potential to inform vaccination interventions for this population.

5. Conclusions

In this in-depth study of COVID-19 vaccination acceptability and experiences among PWID, we identified several key barriers to vaccination. Some of these barriers involved concerns that may be unique to this population and reflect the numerous structural barriers that PWID routinely encounter, while other concerns (e.g., disinformation) may be

similar to those identified in the U.S. general population (The Henry J. Kaiser Family Foundation). Our data suggest that efforts to increase vaccine literacy and motivation while addressing structural barriers to access (e.g., through mobile vaccination sites and community outreach) may help increase COVID-19 vaccination acceptability and uptake in this marginalized population.

Author disclosures

Role of funding source: This work was supported by the San Diego Center for AIDS Research (NIH/National Institute of Allergy and Infectious Diseases grant P30AI036214), the NIH/National Institute on Drug Abuse (grants K01DA043412, R01DA049644-S1, R01DA049644-02S2, and T32DA023356), and the UC San Diego Altman Clinical and Translational Research Institute SUSTAIN program (NIH/NCATS 1KL2TR001444). The funding sources did not have a role in study design, in the collection, analysis and interpretation of data, or in the decision to submit the paper for publication.

CRedit authorship contribution statement

Chad J. Valasek: Software, Validation, Data curation, Formal analysis, Writing – original draft, Investigation, Writing – review & editing. **Samantha A. Streuli:** Conceptualization, Methodology, Supervision, Funding acquisition. **Heather A. Pines:** Conceptualization, Methodology, Supervision, Funding acquisition, Writing – review & editing. **Maria Luisa Mittal:** . **Steffanie A. Strathdee:** Formal analysis, Writing – original draft, Resources, Project administration, Writing – review & editing. **Carlos F. Vera:** Resources, Project administration, Writing – review & editing. **Alicia Harvey-Vera:** Resources, Project administration, Writing – review & editing. **Angela R. Bazzi:** Conceptualization, Methodology, Supervision, Funding acquisition, Investigation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

- Aronson, I.D., Bennett, A.S., Ardouin-Guerrier, M.A., Rivera-Castellar, G., Gibson, B., Santoscoy, S., Vargas-Estrella, B., 2022. How vaccine ambivalence can lead people who inject drugs to decline COVID-19 vaccination and ways this can be addressed: qualitative study. *JMIR Formative Research* 6 (3), e35066.
- Ball, P., 2020. Anti-vaccine movement could undermine efforts to end coronavirus pandemic, researchers warn. *Nature* 581 (7808), 251–252.
- Bazzi, A.R., Valasek, C.J., Streuli, S.A., Vera, C.F., Harvey-Vera, A., Philbin, M.M., Biello, K.B., Roth, A.M., Strathdee, S.A., Pines, H.A., 2022. Long-acting injectable HIV pre-exposure prophylaxis preferred over other modalities among people who inject drugs: findings from a qualitative study in California. *AIDS Patient Care & STDs* 36 (7), 254–262.
- Benham, J.L., Lang, R., Kovacs Burns, K., MacKean, G., Léveillé, T., McCormack, B., Sheikh, H., Fullerton, M.M., Tang, T., Boucher, J.-C., Constantinescu, C., Mourali, M., Oxoby, R.J., Manns, B.J., Hu, J., Marshall, D.A., Capraro, V., 2021. Attitudes, current behaviours and barriers to public health measures that reduce COVID-19 transmission: A qualitative study to inform public health messaging. *PLoS ONE* 16 (2), e0246941.
- Best, A.L., Fletcher, F.E., Kadono, M., Warren, R.C., 2021. Institutional distrust among African Americans and building trustworthiness in the COVID-19 response: implications for ethical public health practice. *J. Health Care Poor Underserved* 32 (1), 90–98.
- Cepeda, J.A., Feder, K.A., Astemborski, J., Schluth, C., Kirk, G.D., Mehta, S.H., Genberg, B.L., 2022. COVID-19 Vaccine Hesitancy and Vaccination Status in a Community-Based Cohort of People Who Inject Drugs in Baltimore, Maryland, March–June 2021. *Public Health Rep.* 137 (5), 1031–1040.
- Cioffi, C.C., Kosty, D., Nachbar, S., Capron, C.G., Mauricio, A.M., Tavalire, H.F., 2022. COVID-19 vaccine deliberation among people who inject drugs. *Drug Alcohol Dependence Reports* 3, 100046.
- Feinberg, J., Pearce, S., 2021. Opportunities for hepatitis B vaccination by SUD treatment programs. *Alcohol. Drug Abuse Weekly* 33 (21), 5–6.
- Iversen, J., Peacock, A., Price, O., Byrne, J., Dunlop, A., Maher, L., 2021. COVID-19 vaccination among people who inject drugs: Leaving no one behind. *Drug Alcohol Rev.* 40 (4), 517–520.
- Knight, K.R., Duke, M.R., Carey, C.A., Pruss, G., Garcia, C.M., Lightfoot, M., Imbert, E., Kushel, M., 2022. COVID-19 testing and vaccine acceptability among homeless-experienced adults: qualitative data from two samples. *J. General Intern. Med.* 37 (4), 823–829.
- Kumari, A., Ranjan, P., Chopra, S., Kaur, D., Kaur, T., Upadhyay, A.D., Isaac, J.A., Kasiraj, R., Prakash, B., Kumar, P., Dwivedi, S.N., Vikram, N.K., 2021. Knowledge, barriers and facilitators regarding COVID-19 vaccine and vaccination programme among the general population: A cross-sectional survey from one thousand two hundred and forty-nine participants. *Diab. Metab. Syndr.: Clin. Res. Rev.* 15 (3), 987–992.
- Lim, J., Pavalagantharajah, S., Verschoor, C.P., Lentz, E., Loeb, M., Levine, M., Smieja, M., Mbuagbaw, L., Kalina, D., Tarride, J.-E., O’Shea, T., Cvetkovic, A., van Gaalen, S., Findlater, A.R., Lennox, R., Bassim, C., Lokker, C., Alvarez, E., Saw, Y.M., 2022. Infectious diseases, comorbidities and outcomes in hospitalized people who inject drugs (PWID) infections in persons who inject drugs. *PLoS ONE* 17 (4), e0266663.
- Liu, S., Chu, H., 2022. Examining the direct and indirect effects of trust in motivating COVID-19 vaccine uptake. *Patient Educ. Couns.* S0738–3991 (22), 00081–00087.
- Menza, T.W., Capizzi, J., Zlot, A.I., Barber, M., Bush, L., 2022. COVID-19 vaccine uptake among people living with HIV. *AIDS Behav.* 1–5.
- Moore, R., Purvis, R.S., Hallgren, E., Willis, D., Hall, S., Reece, S., et al., 2022. Motivations to vaccinate among hesitant adopters of the COVID-19 vaccine. *J. Community Health* 47, 237–245.
- Patwa, P., Sharma, S., Pykl, S., Guptha, V., Kumari, G., Akhtar, M. S., et al., 2021. Fighting an infodemic: COVID-19 fake news dataset. In: Chakraborty T, Shu K, Bernard HR, Liu H, Akhtar MS (Eds.) *Combating online hostile posts in regional languages during emergency situation. CONSTRAINT 2021. Communications in Computer and Information Science*, vol 1402. Springer, Cham, 21–29.
- Price, O., Dietze, P., Sullivan, S.G., Salom, C., Peacock, A., 2021. Uptake, barriers and correlates of influenza vaccination among people who inject drugs in Australia. *Drug Alcohol Depend.* 226, 108882.
- Romer, D., Jamieson, K.H., 2020. Conspiracy theories as barriers to controlling the spread of COVID-19 in the US. *Soc. Sci. Med.* 263, 113356.
- Sadang, K.G., Miller, D., Veloso, D., Lin, J., McFarland, W., 2021. Unmet health and social welfare needs of women who inject drugs in San Francisco. *J. Health Care Poor Underserved* 32 (1), 204–219.
- Shen, S., Dubey, V., 2019. Addressing vaccine hesitancy. *Can Fam Physician* 65 (3), 175–181.
- Strathdee, S.A., Abramovitz, D., Harvey-Vera, A., et al., 2021a. Prevalence and correlates of SARS-CoV-2 seropositivity among people who inject drugs in the San Diego-Tijuana border region. Page K, ed. *PLoS ONE*, 16(11), e0260286.
- Strathdee, S.A., Abramovitz, D., Harvey-Vera A.Y., et al., 2021b. Correlates of COVID-19 Vaccine Hesitancy among People Who Inject Drugs in the San Diego-Tijuana Border Region. *Clinical Infectious Diseases*, ciab975.
- Troiano, G., Nardi, A., 2021. Vaccine hesitancy in the era of COVID-19. *Public health* 194, 245–251.
- Wang, Q.Q., Kaelber, D.C., Xu, R., Volkow, N.D., 2021. COVID-19 risk and outcomes in patients with substance use disorders: analyses from electronic health records in the United States. *Mol. Psychiatry* 26 (1), 30–39.
- Wilson, S.L., Wiysonge, C., 2020. Social media and vaccine hesitancy. *BMJ Global Health* 5 (10), e004206.