

## ORIGINAL RESEARCH

### COVID-19 vaccine hesitancy among rural Oklahomans

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## ABSTRACT:

**Introduction:** COVID-19 vaccination is widely recommended as a prevention strategy; however, vaccine uptake is disproportionately lower among rural Americans compared to their urban counterparts. Development of public health activities to address the rural–urban vaccine gap requires an understanding of determinants of vaccine hesitation. The present study explores perceptions of and barriers to COVID-19 vaccination among rural Oklahomans.

**Methods:** Between March and May 2021, 222 residents, unvaccinated for COVID-19, within rural Oklahoma counties completed a cross-sectional, online questionnaire to qualitatively assess perceptions, benefits, and concerns regarding getting vaccinated for COVID-19.

**Results:** Approximately two-fifths of rural respondents in the  
**Keywords:**

COVID-19, disparities, prevention, USA, vaccine hesitancy.

present study were hesitant to get vaccinated, even when a vaccine was made available to them. Major factors included limited knowledge and understanding about the vaccine, including potential side-effects and long-term complications, as well as skepticism surrounding COVID-19 vaccine development and efficacy. Among the potential perceived benefits of vaccination were protecting the health of vulnerable individuals and the ability to return to normal day-to-day activities.

**Conclusion:** Increases in COVID-19 cases and deaths in rural areas are expected to continue as new variants are introduced within communities. The present findings highlight the need for the development of culturally tailored vaccine information, to be disseminated by local leaders within rural communities.

## FULL ARTICLE:

### Introduction

The prevalence and fatality rates of COVID-19 have disproportionately affected rural communities across the USA when compared to their urban counterparts. According to the Centers for Disease Control and Prevention (CDC), 7-day case incidence increased at a greater rate in rural communities from August 2020 to December 2020, and the 7-day death rate per 100 000 population in rural communities has been greater most days since 6 August 2020<sup>1</sup>. Further, the cumulative death rate per 100 000 population in the USA among rural residents has been consistently greater than for urban residents since 9 December 2020 and is 13.6% greater as of 1 June 2021<sup>1</sup>. These differences are exacerbated by cultural norms and lack of medical and public health resources<sup>2-5</sup>.

Longstanding systemic health and social inequities have put some rural residents at increased risk of COVID-19 infection<sup>2,6-11</sup>. Rural Americans have higher rates of cigarette smoking, high blood pressure, and obesity, are less likely to have health insurance, and have limited access to medical care services, all of which negatively affect health outcomes<sup>12-16</sup>. Similarly, African Americans, American Indians, and Latinx residents are at increased risk of COVID-19 infection and illness severity in these rural areas<sup>7</sup>.

One way that COVID-19 can be mitigated is through uptake of the currently available vaccines; however, an estimated vaccination rate of at least 70% was required to achieve herd immunity against the Delta variant<sup>17,18</sup>. Vaccine uptake rates among adults in the rural USA and rural Oklahoma are lower than in the urban USA and Oklahoma<sup>19</sup>. Further, 32% of the total rural population of Oklahoma is fully vaccinated, compared to 42% of the total urban population of the state as of 9 August 2021<sup>20</sup>. One possible

explanation for the difference in vaccine uptake between these populations is higher vaccine hesitancy, in general, among rural populations<sup>21</sup>. Vaccine hesitancy is exacerbated within economically marginalized rural communities that lack access to healthcare providers and receive inadequate health education, resulting in more severe disease and lower health literacy<sup>22,23</sup>.

Data from the 2017 National Immunization Survey–Child Survey suggests that a lack of childhood vaccination coverage among uninsured children and living outside of metropolitan statistical areas for diseases (eg measles, mumps, rubella, hepatitis B) could be addressed through increased awareness and use of vaccination programs, eliminating missed vaccination opportunities during healthcare visits, and minimizing health insurance coverage interruptions<sup>24</sup>. Despite being widely recommended and fully covered as a preventive service under the *Affordable Care Act*, data show that the overall rural influenza vaccination rate is suboptimal<sup>25</sup>. Among Medicare enrollees (ie those over the age of 65 years, younger individuals with a disability or diagnosed with end-stage renal disease), county-level flu vaccination rates range from 21% to 62%, with 18 rural Oklahoma counties reporting rates less than 40%<sup>26</sup>. A general public distrust of intrusions on individual liberty, mixed with the loss of confidence in government institutions under current social conditions, and a psychological distance (ie the degree to which people feel removed) from the risk of deadly communicable diseases has lowered US vaccination rates in recent years<sup>27-29</sup>. Further, rural areas of the USA have a higher proportion of individuals with more conservative ideologies who are less likely to accept COVID-19 vaccination<sup>30-34</sup>. Recent findings have further demonstrated that consumption of news from conservative media outlets (eg Fox News, Breitbart News, One America News) are strongly associated with unwillingness to

get the COVID-19 vaccine<sup>32,35</sup>.

Although advances have been made in identifying individual, interpersonal, and contextual influences on uptake of other infectious disease vaccines, vaccine hesitancy interventions have too often narrowly focused on clinician-initiated interventions (eg clinicians recommend and discuss benefits to vaccination during a medical visit) that are unsuited to rural community norms, health behaviors, and healthcare access. Rural communities in Oklahoma encounter numerous barriers to care despite changes resulting from recent Medicaid expansion<sup>36,37</sup>; 72 of Oklahoma's 77 counties are designated by the Health Resources & Services Administration as Health Professional Shortage Areas for primary care<sup>38</sup>. This leaves many Oklahomans with limited access to clinical services, thereby reducing the potential impact of traditional clinician-initiated vaccine interventions. Consequently, local county outreach is essential for the success of any COVID-19 vaccination intervention. To provide this kind of outreach, nuanced data on the perspectives of rural communities regarding COVID-19 specific vaccines are required.

### Present study

Given the nascent literature surrounding vaccine uptake, specifically concerning COVID-19, within rural communities, the present study sought to explore perceptions regarding COVID-19 vaccination among unvaccinated residents of rural Oklahoma. The present study analyzes responses to open-ended questions evaluating the concerns and perceived benefits of vaccination against COVID-19.

## Methods

### Participant recruitment and data collection

Between March and May 2021, 391 residents within rural Oklahoma counties completed a cross-sectional, online questionnaire to assess health behavior changes during COVID-19. The Index of Relative Rurality (IRR) was utilized to determine the rurality of a participant's residence, with all participants residing in counties with an IRR score greater than 0.40<sup>39</sup>. Participants were recruited through internet-based direct marketing (eg advertisements placed on social media sites), community-based organizations, and peer referral. Participants were eligible if they were aged 18 years or older and a resident of an identified rural Oklahoma county. The online questionnaire took approximately 20 minutes to complete, and participants were offered the opportunity to enter a draw to win one of 65 gift cards valued at US\$50.

As part of this larger study, the authors sought to qualitatively assess perceptions, benefits, and concerns regarding getting vaccinated for COVID-19 among those participants who had not yet been vaccinated ( $n=222$  participants from 22 counties). These counties range in population from 15 553 to 72 454 residents. As shown in Table 1, unvaccinated participants ( $n=222$ ) ranged from age 18 years to 83 years (mean=43.35 years), with most respondents identifying as female (86.0%), and White (87.8%). Additionally, 50% of participants reported typically getting vaccinated for influenza.

**Table 1: Sample demographics ( $n=222$ )**

Characteristic	%	Min	Max	Mean
Age		18	83	43.35
Gender				
Male	13.5			
Female	86.0			
Non-binary	0.5			
Race/ethnicity <sup>†</sup>				
White/Caucasian	87.8			
Hispanic	2.7			
Black/African American	3.2			
American Indian/Native American	26.6			
Usually vaccinated for seasonal influenza				
Yes	50.0			
No	50.0			
Would get COVID-19 vaccine if employer recommended it				
Completely agree	24.2			
Somewhat agree	12.4			
Neutral/no opinion	19.7			
Somewhat disagree	14.6			
Completely disagree	29.2			
Would get COVID-19 vaccine if available				
Completely agree	28.7			
Somewhat agree	13.5			
Neutral/no opinion	19.1			
Somewhat disagree	12.9			
Completely disagree	25.8			
COVID-19 is not so severe that I should get vaccinated				
Completely agree	7.9			
Somewhat agree	9.0			
Neutral/no opinion	34.8			
Somewhat disagree	12.4			
Completely disagree	36.0			

<sup>†</sup> Participants could select more than one category; each group is presented as % of total sample.

### **Online survey**

Unvaccinated participants first responded to two open-ended questions, which qualitatively assessed barriers and benefits to vaccination: 'What are potential benefits to getting vaccinated for COVID-19?' and 'What concerns do you have regarding the COVID-19 vaccine?' Tailoring questions from the Kaiser Family Foundation COVID-19 Vaccine Monitor<sup>21</sup>, the authors quantitatively evaluated participants' tendency to get vaccinated for seasonal influenza (ie 'Do you usually get vaccinated for seasonal influenza?') and potential vaccination determinants (ie 'I would get the COVID-19 vaccine if available', 'I would get the COVID-19 vaccine if my employer recommended it', 'COVID-19 is not so severe that I should get vaccinated').

### **Data analysis**

Two research team members independently open-coded participant responses. Consistency checks were conducted to assess reliability among the coders. Responses were analyzed separately for each question using an inductive approach, assessing observations to detect patterns and regularities, to identify and interpret concepts and themes that emerged from these data. Concepts were the most basic unit of meaning from which results developed. Related concepts were grouped together to form overarching themes. The Statistical Package for the Social Sciences v24 (IBM; <http://www.spss.com>) to analyze demographic characteristics and descriptive statistics.

### **Ethics approval**

All protocols were approved by the institutional review board at Oklahoma State University Center for Health Sciences (#2020025), and each study participant completed an informed consent process.

### **Results**

Several factors were identified that could affect the acceptability of the COVID-19 vaccine. The identified themes and illustrative quotes are provided in Tables 2 and 3.

#### **Perceived barriers to COVID-19 vaccination**

Participants viewed there to be a lack of scientifically accurate COVID-19 information being disseminated within their communities, which led some to make vaccine decisions based on commonly disseminated disinformation and misinformation

(Table 2).

**Rapid vaccine development, efficacy, and lack of long-term data:** Lack of research and of long-term safety studies were the most frequently identified concerns related to receiving the COVID-19 vaccine. This included skepticism related to long-term potential outcomes, the use of mRNA technology in an expedited manner, and a lack of clarity as to why the vaccine was only approved under the Emergency Use Authorization of the US Food and Drug Administration (FDA). In rare instances, such concerns were exacerbated by vaccine misinformation and conspiracies, for example that the use of mRNA technology would ultimately alter the genetic make-up of vaccinated individuals. Respondents noted that their medical providers (eg physicians, nurses) shared their own concerns about the vaccine, ultimately decreasing the participants' willingness to schedule a vaccine appointment at a local site.

Efficacy was noted by participants as a driving factor in their COVID-19 vaccination decision. Among these participants, there was a tendency to perceive the vaccine as less efficacious than reported by government agencies and even more so against emerging new strains. Similarly, participants viewed the COVID-19 vaccine as comparable to the seasonal influenza vaccine in which yearly shots or potential boosters would be required. Respondents noted decreasing vaccine protection over time would require semi-annual or annual shots, which they thought could lead to further vaccine complications.

**Vaccine complications:** Participants noted that potential adverse reactions and side-effects from vaccination limited their intention. Concerns ranged from missing work due to feeling unwell after receiving a dose to fearing an anaphylactic reaction. Most notably, respondents expressed the potential for adverse long-term side-effects yet to be discovered within current clinical trials. Relatively few participants mentioned a pre-existing condition and possible complications as a barrier to vaccine uptake, with most expressing concern about potential interactions with their prescribed medications or limited data on how vaccination could impact their health condition.

**Vaccine availability:** Fewer than 20 participants perceived lack of availability of COVID-19 vaccines within rural communities to be a barrier. In these instances, individuals noted the need to drive longer distances to receive vaccination or viewed themselves, at the time of responding, as not yet eligible for vaccination.

**Table 2: Perceived barriers to COVID-19 vaccination**

Theme and subthemes	Illustrative quote(s)
Limited knowledge about the vaccine	
Rapid vaccine development	<i>Made too quickly. Already a stop on one type of vaccine and the others have not be on the market long enough to see lasting side-effects. It's not an approved vaccine and mRNA has never been given before. Way too many unknowns with it.</i>
Lack of long-term data	<i>Hasn't been around long enough for me to want to put in my body, they came up with it to quick, I believe the risk is greater than the reward at the moment. I am worried because it is still so new and no long-term data are available.</i>
Vaccine efficacy	<i>It's effectiveness, especially with new variants.</i>
Vaccine complications	<i>Everyone I know across the country who has been vaccinated had difficulties with the second dose. I am concerned about losing workdays due to feeling unwell after the second dose. The adverse reactions and the possibility of my children becoming unable to have children of their own if they get the vaccination. I know they say it won't make you infertile but I'm still nervous about that potentially coming from the vaccine.</i>
Vaccine availability	<i>Timing – seems like I maybe the very last group in OK [Oklahoma] eligible, and we are traveling overseas in august plus kids in school ... they are incompetent in getting them out quick so I don't know that I will be able to get before August.</i>
Pre-existing health issues	<i>I had 3 surgeries in Oct 2020 that I am still having many complications from, in addition to my other autoimmune diseases. Several of my docs have been changing many meds every week or two, some with nasty side-effects. I can't add anything else new until we get this under better control. I've been off work (and working from home) mostly since Sept 2020 because of my existing health issues.</i>

**Perceived benefits of COVID-19 vaccination**

**Individual level prevention of COVID-19:** The most commonly reported benefit of COVID-19 vaccination was to lower the risk of acquiring COVID-19 (Table 3). Several respondents also mentioned decreased severity of symptoms if they were to contract COVID-19 in the future. On a few occasions, respondents indicated that higher risk populations could benefit from vaccination (eg elderly, immunosuppressed), although they did not specifically mention themselves as a candidate for vaccination.

**Community-level prevention of COVID-19 transmission:** Respondents emphasized that vaccination would lead to decreased COVID-19 transmission. Some mentioned

protecting family, 'loved ones', and vulnerable populations, especially older adults, as potential motivators. Others provided a more general reference to preventing spread within the community, with several indicating achieving herd immunity could be a prospective benefit of vaccination.

**Return to normal:** For many participants, vaccine uptake within their community was related to the desire to 'return to normal', in which an incentive to being vaccinated was the ability to engage in activities enjoyed pre-pandemic. Specific activities mentioned included traveling, returning to work, attending events, and not having to adhere to COVID-19 precautions, such as wearing masks or quarantining.

**Table 3: Perceived benefits of COVID-19 vaccination**

Theme	Subtheme	Illustrative quote(s)
Individual-level prevention of COVID-19	Decreased risk of acquiring COVID-19	<i>Vaccination will reduce the risk of infection with covid-19, which is more conducive to our health. Reduces the chances of me getting it again--wouldn't wish it on anyone. I am waiting to donate plasma or I would have already been vaccinated.</i>
	High-risk populations should be vaccinated	<i>For the older population, it may be necessary to keep them from contracting the virus and suffering from any related complications.</i>
	Decrease severity of symptoms	<i>During this time of increased infection in the community I will be less susceptible. If I do get it I hope to have a less severe infection.</i>
Community-level prevention of COVID-19 transmission	Slowing or stopping the spread	<i>The fact that my risk of severe symptoms is greatly reduced if I were to still become infected. The hope that I will hopefully protect someone who isn't able to get the vaccine. Vaccination helps slow the spread, decrease the likelihood of mutations, and builds herd immunity. Protect my elderly family and friends</i>
Return to normal		<i>Returning to almost all normal activities with less worries (returning to work, visit friends and family, finally go on a vacation or trip). Can travel and go to events where vaccination is mandatory. Also, might be needed for certain jobs.</i>

**Discussion**

The present study investigates people's perceptions regarding

vaccination against COVID-19 in rural Oklahoma between March and May 2021. These results suggest that the general, unvaccinated, adult population of rural Oklahomans have mixed

reactions regarding vaccination against COVID-19 despite three vaccines (Pfizer and BioNTech, Moderna, and Johnson & Johnson) having emergency use authorizations in the USA at the time of the study.

Individual- and community-level prevention of COVID-19 transmission and returning to normal were the most commonly reported perceived benefits of vaccination. These findings are consistent with the motivating factors reported by other studies. In a survey of hospital employees, Kuter and colleagues<sup>40</sup> found that protection of one's self and family were the most perceived benefits of vaccination. A swift return to normal was also highlighted by Geana and colleagues<sup>41</sup>, who found that women leaving jails thought that vaccination would help life return to normal within a year. These findings suggest that there is a fraction of the population that believes vaccination against COVID-19 is beneficial, but they are still hesitant to receive the vaccination themselves.

The desire to protect others and return to normalcy has been shared by government organizations, companies, politicians, universities, celebrities, and individuals across social and traditional media to boost an array of COVID-19 mitigation behaviors (eg mask-wearing, physical distancing, vaccination)<sup>3,42-44</sup>. Despite the plethora of public health campaigns to increase COVID-19 vaccination<sup>45-47</sup>, and the majority of adults in the USA having received at least one dose of the vaccine<sup>1</sup>, many are still hesitant<sup>21</sup>. Potential adverse reactions and side-effects following vaccination were a concern among vaccine-hesitant participants in the present study. Individuals may have more of an emotional response to the potential of having adverse reactions even though there may be a greater benefit from vaccination<sup>48</sup>. Only half (48.4%) of participants in the present study believed that COVID-19 is so severe that they should get vaccinated. This is particularly concerning among populations with comorbid conditions. Recent work has noted such populations are ambivalent to vaccination despite being at higher risk of severe infection<sup>49</sup>.

A lack of accurate information disseminated within local communities regarding COVID-19 vaccination remains a driver of vaccine hesitancy among unvaccinated rural Oklahomans. This gap has exacerbated skepticism over the development and use of mRNA vaccines, instilled distrust in government agencies including the CDC and the FDA, and led to ideologically disparate groups coming together around their shared skepticism, which is further spreading inaccurate information<sup>49-51</sup>. Similarly, healthcare providers in these rural communities are not immune to their own skepticisms and ideologies and may share these with their patients. Future research should further examine the role rural providers play in spreading vaccine misinformation.

### **Implications**

The present study's findings indicate that new and modified interventions responsive to rural communities must be developed

to address vaccine hesitancy. For example, efficacy and side-effect concerns can be addressed by local health clinics providing historical information about vaccine side-effects and the science behind mRNA vaccines. Such approaches have been utilized to educate parents when considering COVID-19 vaccination for their children<sup>52</sup>. Similarly, transitioning away from government-led vaccination clinics to offering the COVID-19 vaccine at rural health clinics and through primary care providers may facilitate discussion of vaccine concerns with a local and trusted provider<sup>48,53,54</sup>.

Rural communities often comprised small populations and tightly knit social structures<sup>55,56</sup>. Rural social networks are critical to supporting behavior change. The Popular Opinion Leader model, utilized to promote HIV risk reduction, posits that behavior change is achieved when new risk-reducing methods are disseminated by opinion leaders through personal contacts in their social network<sup>57</sup>. In response to the COVID-19 pandemic, rural community influencers should be trained and given resources to reduce disease stigma, increase perceived disease severity, discuss the benefits of vaccination, and provide accurate, up-to-date epidemiologic information in their area<sup>58-60</sup>. Faith leaders are one such group that have been shown to effectively disseminate public health information in rural communities<sup>61-63</sup>. Adapting the Popular Opinion Leader model to enhance vaccine uptake is one example of adapting existing interventions to complement other public health efforts during the COVID-19 pandemic.

### **Limitations**

The present study is not without limitation. First, participation was voluntary and focused largely on health concerns and perceived needs within Oklahoma. The views of those volunteering to complete the online questionnaire may not reflect the larger rural population in Oklahoma. Second, the sample largely comprised rural White and American Indian individuals, thus limiting the authors' ability to evaluate vaccine hesitancy concerns specific to various racial/ethnic groups. Third, as all data were collected using online methodologies, these findings may not include rural residents with limited or no internet service. Lastly, as an exploratory study, the findings may not be representative of the larger rural population in Oklahoma.

### **Conclusion**

COVID-19 vaccination is a preventive strategy that reduces disease transmission and decreases mortality. Despite this, vaccine uptake varies widely by geography and rurality. The present study highlights key determinants of vaccination hesitancy among a population disproportionately impacted by the pandemic. This is particularly concerning as COVID-19 rates are increasing due to new predominant variants (eg Delta). Public health activities and health messaging campaigns should engage local rural community leaders while focusing on the unique strengths and assets of rural communities.

## **REFERENCES:**

- 1** Centers for Disease Control and Prevention. *COVID Data Tracker 2021*. 2021. Available: [web link](#) (Accessed 9 August 2021).
- 2** Pro G, Hubach R, Wheeler D, Camplain R, Haberstroh S, Giano Z, et al. Differences in US COVID-19 case rates and case fatality rates across the urban-rural continuum. *Rural and Remote Health* 2020; **20(3)**: 6074. DOI link, PMID:32811154
- 3** Pro G, Schumacher K, Hubach R, Zaller N, Giano Z, Camplain R, et al. US trends in mask wearing during the COVID-19 pandemic depend on rurality. *Rural and Remote Health* 2021; **21(3)**: 6596. DOI link, PMID:34252284
- 4** Patel L, Elliott A, Storlie E, Kethireddy R, Goodman K, Dickey W. Ethical and legal challenges during the COVID-19 pandemic: are we thinking about rural hospitals? *Journal of Rural Health* 2020; **37(1)**: 175-178. DOI link, PMID:32282953
- 5** Kirby JB, Yabroff KR. Rural-urban differences in access to primary care: beyond the usual source of care provider. *American Journal of Preventive Medicine* 2020; **58(1)**: 89-96. DOI link, PMID:31862103
- 6** Ameh GG, Njoku A, Inungu J, Younis M. Rural America and coronavirus epidemic: challenges and solutions. *European Journal of Environment and Public Health* 2020; **4(2)**: em0040. DOI link
- 7** Cheng KJG, Sun Y, Monnat SM. COVID-19 death rates are higher in rural counties with larger shares of Blacks and Hispanics. *The Journal of Rural Health* 2020; **36(4)**: 602-608. DOI link, PMID:32894612
- 8** Haischer MH, Beilfuss R, Hart MR, Opielinski L, Wrucke D, Zirgaitis G, et al. Who is wearing a mask? Gender-, age-, and location-related differences during the COVID-19 pandemic. *PLoS One* 2020; **15(10)**: e0240785. DOI link, PMID:33057375
- 9** Paul R, Arif AA, Adeyemi O, Ghosh S, Han D. Progression of COVID-19 from urban to rural areas in the United States: a spatiotemporal analysis of prevalence rates. *The Journal of Rural Health* 2020; **36(4)**: 591-601. DOI link, PMID:32602983
- 10** Peters DJ. Community susceptibility and resiliency to COVID-19 across the rural-urban continuum in the United States. *The Journal of Rural Health* 2020; **36(3)**: 446-456. DOI link, PMID:32543751
- 11** Ranscombe P. Rural areas at risk during COVID-19 pandemic. *The Lancet Infectious Diseases* 2020; **20(5)**: 545. DOI link
- 12** Garcia MC, Faul M, Massetti G, Thomas CC, Hong Y, Bauer UE, et al. Reducing potentially excess deaths from the five leading causes of death in the rural United States. *MMWR Surveillance Summaries* 2017; **66(2)**: 1. DOI link
- 13** Leider JP, Meit M, McCullough JM, Resnick B, Dekker D, Alfonso YN, et al. The state of rural public health: enduring needs in a new decade. *American Journal of Public Health* 2020; **110(9)**: 1283-1290. DOI link, PMID:32673103
- 14** James W, Cossman JS. Long-term trends in Black and White mortality in the rural United States: evidence of a race-specific rural mortality penalty. *The Journal of Rural Health* 2017; **33(1)**: 21-31. DOI link, PMID:27062224
- 15** Anderson TJ, Saman DM, Lipsky MS, Lutfiyya MN. A cross-sectional study on health differences between rural and non-rural US counties using the County Health Rankings. *BMC Health Services Research* 2015; **15(1)**: 441. DOI link, PMID:26423746
- 16** Gong G, Phillips SG, Hudson C, Curti D, Philips BU. Higher US rural mortality rates linked to socioeconomic status, physician shortages, and lack of health insurance. *Health Affairs* 2019; **38(12)**: 2003-2010. DOI link, PMID:31794316
- 17** Dong M, He F, Deng Y. How to understand herd immunity in the context of COVID-19. *Viral Immunology* 2021; **34(3)**: 174-181. DOI link, PMID:33351708
- 18** Omer SB, Yildirim I, Forman HP. Herd immunity and implications for SARS-CoV-2 control. *JAMA* 2020; **324(20)**: 2095-2096. DOI link, PMID:33074293
- 19** Murthy BP, Sterrett N, Weller D, Zell E, Reynolds L, Toblin RL, et al. Disparities in COVID-19 vaccination coverage between urban and rural Counties – United States, December 14, 2020 – April 10, 2021. *Morbidity and Mortality Weekly Report* 2021; **70(20)**: 759. DOI link, PMID:34014911
- 20** Landgraf C. *Rural Oklahoma COVID-19 dashboard*. 2021. Available: [web link](#) (Accessed 10 August 2021).
- 21** Kaiser Family Foundation. *KFF COVID-19 vaccine monitor 2021*. Available: [web link](#) (Accessed 10 August 2021).
- 22** Mical R, Martin-Velez J, Blackstone T, Derouin A. Vaccine hesitancy in rural pediatric primary care. *Journal of Pediatric Health Care* 2021; **35(1)**: 16-22. DOI link, PMID:33010996
- 23** Hausman BL, Lawrence HY, Marmagas SW, Fortenberry L, Dannenberg CJ. H1N1 vaccination and health beliefs in a rural community in the Southeastern United States: lessons learned. *Critical Public Health* 2020; **30(2)**: 245-251. DOI link
- 24** Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kang Y. Vaccination coverage among children aged 19-35 months – United States, 2017. *Morbidity and Mortality Weekly Report* 2018; **67(40)**: 1123. DOI link, PMID:30307907
- 25** Centers of Disease Control and Prevention. *Flu vaccination coverage, United States, 2019-20 Influenza Season 2020*. Available: [web link](#) (Accessed 9 August 2021).
- 26** UW Population Health Institute. *Oklahoma: flu vaccinations 2020*. Available: [web link](#) (Accessed 9 August 2021).
- 27** Jacobson RM, Sauver JLS, Rutten LJF. Vaccine hesitancy. *Mayo Clinic Proceedings* 2015; **90(11)**: 1562-1568. DOI link, PMID:26541249
- 28** Larson HJ, De Figueiredo A, Xiahong Z, Schulz WS, Verger P, Johnston IG, et al. The state of vaccine confidence 2016: global insights through a 67-country survey. *EBioMedicine* 2016; **12**: 295-301. DOI link, PMID:27658738
- 29** Larson HJ, Schulz WS, Tucker JD, Smith DM. Measuring vaccine confidence: introducing a global vaccine confidence index. *PLoS Currents* 2015; **7**: 25. DOI link
- 30** Kreps S, Prasad S, Brownstein JS, Hswen Y, Garibaldi BT, Zhang B, et al. Factors associated with US adults' likelihood of accepting COVID-19 vaccination. *JAMA Network Open* 2020; **3(10)**: e2025594. DOI link, PMID:33079199

- 31** Latkin C, Dayton L, Yi G, Jaleel A, Nwosu C, Limaye R. COVID-19 vaccine delay: an examination of United States residents' intention to delay vaccine uptake. *Human Vaccines & Immunotherapeutics* 2021; **17(9)**: 2903-2913. DOI link, PMID:34014130
- 32** Viswanath K, Bekalu M, Dhawan D, Pinnamaneni R, Lang J, McCloud R. Individual and social determinants of COVID-19 vaccine uptake. *BMC Public Health* 2021; **21(1)**: 1-10. DOI link, PMID:33910558
- 33** Omer SB, Benjamin RM, Brewer NT, Bутtenheim AM, Callaghan T, Caplan A, et al. Promoting COVID-19 vaccine acceptance: recommendations from the Lancet Commission on Vaccine Refusal, Acceptance, and Demand in the USA. *The Lancet* 2021; **398(10317)**: 2186-2192. DOI link
- 34** Latkin C, Dayton LA, Yi G, Konstantopoulos A, Park J, Maulsby C, et al. COVID-19 vaccine intentions in the United States, a social-ecological framework. *Vaccine* 2021; **39(16)**: 2288-2294. DOI link, PMID:33771392
- 35** Latkin CA, Dayton L, Miller JR, Yi G, Jaleel A, Nwosu CC, et al. Behavioral and attitudinal correlates of trusted sources of COVID-19 vaccine information in the US. *Behavioral Sciences* 2021; **11(4)**: 56. DOI link, PMID:33924118
- 36** Chen X, Orom H, Hay JL, Waters EA, Schofield E, Li Y, et al. Differences in rural and urban health information access and use. *The Journal of Rural Health* 2019; **35(3)**: 405-417. DOI link, PMID:30444935
- 37** Aljassim N, Ostini R. Health literacy in rural and urban populations: a systematic review. *Patient Education and Counseling* 2020; **103(10)**: 2142-2154. DOI link, PMID:32601042
- 38** Health Resources & Services Administration. *HPSA Find 2020*. Available: [web link](#) (Accessed 9 August 2021).
- 39** Waldorf B, Kim A, editors. *Defining and measuring rurality in the US: from typologies to continuous indices*. Commissioned paper presented at the Workshop on Rationalizing Rural Area Classifications. Washington, DC, 2015.
- 40** Kuter BJ, Browne S, Momplaisir FM, Feemster KA, Shen AK, Green-McKenzie J, et al. Perspectives on the receipt of a COVID-19 vaccine: a survey of employees in two large hospitals in Philadelphia. *Vaccine* 2021; **39(12)**: 1693-1700. DOI link, PMID:33632563
- 41** Geana MV, Anderson S, Ramaswamy M. COVID-19 vaccine hesitancy among women leaving jails: a qualitative study. *Public Health Nursing* 2021; **38(5)**: 892-896. DOI link, PMID:33973268
- 42** Owens C, Struble N, Currin JM, Giano Z, Hubach RD. Beliefs about social distancing during COVID-19 stay-at-home orders: a theory-based salient belief elicitation. *Health Behavior Research* 2021; **4(1)**: 6. DOI link
- 43** Malecki KM, Keating JA, Safdar N. Crisis communication and public perception of COVID-19 risk in the era of social media. *Clinical Infectious Diseases* 2021; **72(4)**: 697-702. DOI link, PMID:32544242
- 44** Kamiński M, Szymańska C, Nowak JK. Whose tweets on COVID-19 gain the most attention: celebrities, political, or scientific authorities? *Cyberpsychology, Behavior, and Social Networking* 2021; **24(2)**: 123-128. DOI link, PMID:32986469
- 45** Tewarson H, Greene K, Fraser MR. State strategies for addressing barriers during the early US COVID-19 vaccination campaign. *American Public Health Association* 2021; 5 May. DOI link, PMID:33950715
- 46** Bagcchi S. The world's largest COVID-19 vaccination campaign. *The Lancet Infectious Diseases* 2021; **21(3)**: 323. DOI link
- 47** Benjamin-Chung J, Reingold A. Measuring the success of the US COVID-19 Vaccine campaign – it's time to invest in and strengthen immunization information systems. *American Public Health Association* 2021; 5 May. DOI link, PMID:33600253
- 48** Rosenbaum L. Escaping catch-22 – overcoming covid vaccine hesitancy. *New England Journal of Medicine* 2021; **384**: 1367-1371. DOI link, PMID:33577150
- 49** Vallis M, Glazer S. Protecting individuals living with overweight and obesity: attitudes and concerns towards COVID-19 vaccination in Canada. *Obesity* 2021; **29(7)**: 1128-1137. DOI link, PMID:33774916
- 50** Van Scoy LJ, Snyder B, Miller EL, Toyobo O, Grewel A, Ha G, et al. Public anxiety and distrust due to perceived politicization and media sensationalism during early COVID-19 media messaging. *Journal of Communication in Healthcare* 2021; **14(3)**: 193-205. DOI link
- 51** Latkin CA, Dayton L, Yi G, Konstantopoulos A, Boodram B. Trust in a COVID-19 vaccine in the US: a social-ecological perspective. *Social Science & Medicine (1982)* 2021; **270**: 113684. DOI link, PMID:33485008
- 52** Children's Hospital of Philadelphia. *Long-term side effects of COVID-19 vaccine? What we know*. Available: [web link](#) (Accessed 1 August 2021).
- 53** Ratzan S, Schneider EC, Hatch H, Cacchione J. Missing the point – how primary care can overcome Covid-19 vaccine "hesitancy". *New England Journal of Medicine* 2021; 384:e100. DOI link, PMID:33951377
- 54** Centers for Disease Control and Prevention. *Expanding COVID-19 vaccine distribution to primary care providers to address disparities in immunization: guide for jurisdictions*. Atlanta, GA: Centers for Disease Control and Prevention, 2021.
- 55** Banyard VL, Edwards KM, Moschella EA, Seavey KM. "Everybody's really close-knit": disconnections between helping victims of intimate partner violence and more general helping in rural communities. *Violence Against Women* 2019; **25(3)**: 337-358. DOI link, PMID:29890921
- 56** Glendinning A, Nuttall M, Hendry L, Kloep M, Wood S. Rural communities and well-being: a good place to grow up? *The Sociological Review* 2003; **51(1)**: 129-156. DOI link
- 57** Kelly JA. Popular opinion leaders and HIV prevention peer education: resolving discrepant findings, and implications for the development of effective community programmes. *AIDS Care* 2004; **16(2)**: 139-150. DOI link, PMID:14676020



- 58** Berry SD, Johnson KS, Myles L, Herndon L, Montoya A, Fashaw S, et al. Lessons learned from frontline skilled nursing facility staff regarding COVID-19 vaccine hesitancy. *Journal of the American Geriatrics Society* 2021; **69(5)**: 1140-1146. DOI link, PMID:33764497
- 59** Al-Metwali BZ, Al-Jumaili AA, Al-Alag ZA, Sorofman B. Exploring the acceptance of COVID-19 vaccine among healthcare workers and general population using health belief model. *Journal of Evaluation in Clinical Practice* 2021; **27(5)**: 1112-1122. DOI link, PMID:33960582
- 60** Quinn SC, Andrasik MP. Addressing vaccine hesitancy in BIPOC Communities-Toward trustworthiness, partnership, and reciprocity. *New England Journal of Medicine* 2021; **385**: 97-100. DOI link, PMID:33789007
- 61** Taylor B, Croff JM, Story CR, Hubach RD. Recovering from an epidemic of teen pregnancy: the role of rural faith leaders in building community resilience. *Journal of Religion and Health* 2019; 1-15. DOI link, PMID:31190274
- 62** Harr CR, Yancey GI. Social work collaboration with faith leaders and faith groups serving families in rural areas. *Journal of Religion & Spirituality in Social Work: Social Thought* 2014; **33(2)**: 148-162. DOI link
- 63** Aholou TM, Cooks E, Murray A, Sutton MY, Gaul Z, Gaskins S, et al. "Wake up! HIV is at your door": African American faith leaders in the rural South and HIV perceptions: a qualitative analysis. *Journal of Religion and Health* 2016; **55(6)**: 1968-1979. DOI link, PMID:26883229

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