Introduction

Rural communities are the backbone of U.S. agriculture and hold strong associations for many Americans about the ideal rural life that includes agricultural tourism, small-scale farming, farmers' markets and community-supported agriculture, connecting to nature, and respect and nostalgia for rural livelihoods (Harrington, 2018). Nearly one-fifth of the population in the United States live in rural communities and about 10% of rural Americans contribute to the agricultural and natural resources workforce (United States Census Bureau, 2016; United States Census Bureau, 2021). This considerable portion of the U.S. population experiences many factors that negatively impact the health and well-being of individuals. These factors include a lack of broadband access, limited access to effective healthcare, and an increased rate of chronic health risks, all of which were exacerbated during the COVID-19 pandemic (Centers for Disease Control and Prevention, 2021).

The COVID-19-related death rate in the United States was the highest among rural residents. In fact, the incidence and mortality rates among rural Americans were double that of metropolitan counterparts during the surges that occurred in summer 2020 and winter 2021 (Ullrich & Mueller, 2022). Despite the severe impacts of COVID-19, many rural community members were hesitant to receive the COVID-19 vaccine. According to the de Beaumont Foundation (2020 – says 2021 in refence list), rural Americans were among the most vaccine hesitant groups with 26% of rural Americans indicating they were not "absolutely certain" they would get the vaccine when it was available. As such, the study presented in the current paper sought to investigate effective influences on rural Americans' intentions related to the COVID-19 vaccine.

The health and well-being of rural communities, including vaccine education, disease prevention, nutrition, and health literacy, are formal priorities of Cooperative Extension through the National Framework for Health Equity and Well-Being (Burton et al., 2021). Braun et al. (2014 – says 2018 in reference list) posits that Cooperative Extension has the ability to impact public health just as Cooperative Extension impacted American agriculture more than 100 years ago. As Extension professionals are asked to increase programming related to health equity and well-being, they will need to be equipped with effective communication strategies (Burton et al., 2021). Cooperative Extension is not the only organization prioritizing the health of rural communities. The Centers for Disease Control and Prevention (CDC) has also emphasized a need to focus on the health of individuals living in rural communities and has deployed several initiatives in rural communities to address disease surveillance, public health research, and grant funding. The CDC suggests working with community leaders, advocates, and faith-based and other community-based organizations will increase an understanding of a community's knowledge, needs, barriers, and challenges (CDC, 2021). This understanding could lead to better communication strategies geared toward educating rural communities regarding health and, more specifically, about COVID-19 and the vaccine.

Literature Review and Conceptual Framework

Community-Based Social Marketing (CBSM)

The theoretical framework used for this study is community-based social marketing (CBSM). CBSM focuses on the idea that removing the barriers to an activity and enhancing the

benefits to the activity will increase behavior change related to the activity. CBSM can be used to normalize behaviors in a social system (McKenzie-Mohr, 2011). This framework takes into account the difficulty associated with behavior change and utilizes its five steps to combat that difficulty (McKenzie-Mohr, 2000). This study focuses on three of the steps of CBSM through a model incorporating barriers and benefits, incentives, and social norms of receiving a COVID-19 vaccination. Social norms are developed among a group of individuals, as people observe behaviors of other people and imitate those behaviors as a social reaction (Sherif & Sherif, 1953). Social norms have been extensively studied in disciplines, such as psychology and economics, but is a relatively fresh concept when applied to life science, such as agriculture and health (Reid et al., 2010). Agranov et al. (2021) determined that social norms were a major influential factor related to the COVID-19 vaccine.

CBSM has several steps: select the behavior to promote, identify the barriers and benefits associated with the behavior selected, develop a strategy with behavior-change tools to address the barrier, pilot the plan, and evaluate the plan once implemented (McKenzie-Mohr, 2014 – not in reference list). In the context of this study, the desired behavior is vaccinating against COVID-19. It was essential to select the proper behavior to promote. The behavior must be "an end-state, non-divisible behavior" (McKenzie-Mohr, 2011, p. 43). An end-state, non-divisible behavior is the absolute last step in a behavior.

Identifying barriers is an important step in CBSM, even though program planners often skip this step (Pallack et al., 1980). Factors that are often cited as reasons for skipping this essential step include assuming barriers are already known, funding constraints, and limited time (Pallack et al., 1980). Academic researchers can help fill this gap by studying barriers and providing information to those who are creating communication campaigns. Barriers exist within rural communities related to vaccine hesitancy, particularly the desire to wait and see how others react to and respond to the vaccine (Beleche et al., 2021). Other barriers associated with a willingness to get the vaccine are age, level of education, and political affiliation (Kirzinger et al., 2021). A sense of worry related to the impact of COVID-19 does not exist among rural communities at the same level as it does in more urban communities. Thirty-nine percent of rural residents say they are not worried they or someone in their family will get sick from the virus (Kirzinger et al., 2021). Residents of rural communities feel it is less of their responsibility to the community and more of a personal choice to get vaccinated (Kirzinger et al., 2021).

CBSM Impact on Intentions and Attitudes

Traditionally CBSM has been used in encouraging sustainability practices (Cole & Fieselman, 2013; Fernandez-Haddad et al., 2021; McKenzie-Mohr, 2011). However, CBSM can also be used to foster practices related to human health and well-being. The theory has been used in health campaigns focused on organ donation, influenza, and safe sex (McKenzie-Mohr & Associates, 2022). One campaign in particular called "Flu Ends with U" was a prevention campaign focused on the importance of flu vaccination (DeKalb County Health Department, 2014). The campaign's messaging focused on encouraging vaccination, but also worked to increase awareness and reduce barriers related to vaccine access (DeKalb County Health Department, 2014). The county offered walk-in flu clinics with extended hours on select days of the week and informational resources were provided in both English and Spanish (DeKalb County Health Department, 2014).

In CBSM, identifying the benefits of an end-state behavior is essential. By identifying the benefits, the benefits of an action can be promoted while the barriers can be eliminated (McKenzie-Mohr, 2011). Benefits of receiving the COVID-19 vaccine have been identified

through message testing. For instance, 62% chose messaging with the word's "help", "safe", and "healthy" over words like "right thing to do" (de Beaumont Foundation, 2020). This messaging demonstrates community members willingness to help others and to work to keep the community safe over their willingness to simply do the right thing. Benefits can focus on the personal or community benefits to the end-state behavior while incentives focus on tangible and often monetary rewards for completing the end-state behavior (McKenzie-Mohr, 2011). In flu vaccination research, the benefit of a vaccine being free or covered by insurance was key in people getting vaccinated (Zimmerman et al., 2003). In COVID-19 vaccination campaigns, incentives have included opportunities to win prizes, gift cards, lotteries, and other financial rewards (Law et al., 2022; National Governors' Association, 2021; NYC COVID-19 Information Portal, 2022). The impact of incentives has varied, but anecdotal evidence indicates that for some populations incentives have made them consider their intentions and attitudes related to vaccination.

CBSM also uses commitment techniques to change the intentions of citizens. For instance, when people expressed, they would consider volunteering for a program or giving blood given the opportunity, that intention alone alters attitudes and increases the likelihood that action would occur. Furthermore, future actions would be consistent with the initial commitment. This is supported by self-perception theory (McKenzie-Mohr, 2011). When specifically considering vaccination efforts, a study looking at flu vaccines found that intention was the strongest predictor of vaccination behavior (Zimmerman et al., 2003).

Trust in Science

When exploring effective strategies for educating rural communities about health topics, rural residents' perceptions of science must also be explored. In recent years, science has gained greater trust with urban populations while rural counterparts remain skeptical (Krause et al., 2019). When compared to urban and suburban communities, rural Americans have consistently reported lower levels of trust in science and scientists for more than 30 years (Krause et al., 2019). Efforts to improve trust in science among rural Americans include improving science, technology, engineering, and math (STEM) education at elementary and secondary levels and Extension programming (Harris & Hodges, 2018; Robinson, 2013). Despite these efforts, rural students are significantly less likely to enroll in postsecondary STEM degree programs (Saw & Agger, 2021). Although it has been documented that rural communities distrust science, many crises, such as COVID-19, climate change, water quality, and obesity, not only require scientific knowledge to understand, but also affect rural communities disproportionately (Mueller et al., 2021).

Trust in Science Impact on Intentions and Attitudes

The public is often asked to make decisions related to scientific breakthroughs, such as the choice to buy genetically modified foods or receive a vaccine (Litva et al., 2002). Given the complexity of some scientific topics, people will rely on their trust in science, rather than knowledge, when developing intentions and attitudes related to scientific topics (Hendriks et al., 2016). Trust in science can influence how people respond to and embrace or reject scientific discoveries (Nadelson et al., 2014). Trust can be a muddled concept as it includes many factors related to knowledge, credibility, access, values, beliefs, and perceptions. In 2014, Nadelson et

al. developed a scale to measure trust in science and scientists in an effort to quantify this difficult construct.

Research shows rural citizens are more trusting of local influences and base their understanding of scientific phenomena on local observations (Avery, 2013). Additionally, Americans indicate more variability of trust in science related to controversial topics, such as climate change or vaccines (Funk, 2017). A recent study showed the primary cause of COVID-19 vaccine hesitancy among rural Americans was the distrust in the system evaluating the vaccine (Lennon et al., 2022). These same respondents were distrustful regarding the speed of the development of the vaccine and had mistrust in the approval process (Lennon et al., 2022). Sailer et al. (2021) posited that trust in science aided the public's decision in complying with prevention guidelines associated with COVID-19. However, with the United States boasting a high COVID-19 infection rate, Carter (2020) begs the question - is trust in science enough?

People's attitudes have long been documented as guiding people's behavior (Fazio, 1986). Many issues surround the formation of attitudes including feelings and beliefs (Zanna & Rempel, 2008). Polarization of contentious issues can also contribute to the formation of attitudes around a particular behavior, and sociodemographics, like rural residency, are often a contributing factor (Miller et al., 1993). Causal analysis in contemporary research suggests that people's behavior is influenced by their beliefs and attitudes about a specific action (Ajzen & Fishbein, 2005), like the decision to receive a vaccine. When scientific issues are extremely complex, the formation of attitudes becomes more complicated, particularly when people need to make a decision related to their personal behavior like in the cases of fracking (Choma et al., 2016), stem cells (Ipsos MORI, 2011), and vaccines (Zimmerman et al., 2003). When thinking about how to change personal attitudes toward behaviors, a key factor in people being vaccinated against the flu was an attitude that being vaccinated was a wise decision (Zimmerman, 2003). Additionally, interpersonal conversations and storytelling tend to be more effective than mass media (Kalla & Broockman, 2020), and the belief that important individuals thinking a behavior is positive can lead to positive attitudes about the behavior, resulting in action toward completing the behavior (Zimmerman et al., 2003). These factors may offer evidence for a connection between CBSM, attitude formation, and behavior change.

Purpose & Hypotheses

As Cooperative Extension professionals and agricultural communicators work to address complex environmental and health challenges, they will need to implement strategic communication tactics to influence personal behaviors. The purpose of this study was to understand the role of community-based social marketing (CBSM) concepts and trust in science on Americans' intentions and attitudes toward the COVID-19 vaccine. Based on the literature review, rural residents are generally less accepting of vaccines and scientific knowledge (de Beaumont Foundation, 2020; Krause, 2019). To ensure the applicability and plausibility of the proposed model, we first needed to confirm variable differences in this study among Americans living in different regions. Previous work has indicated differences in rural and urban Americans related to trust in science (Krause, 2019; Lennon et al., 2022) and vaccine attitudes (de Beaumont Foundation, 2020; Krause, 2019). However, previous work has not documented differences in CBSM principles between rural and urban Americans; but, there is evidence that rural communities trust heavily on social norms and their community culture (Avery, 2013), which could suggest differences between rural and urban Americans on this concept.

Researchers hypothesize there will be significant differences between rural and urban Americans on all study variables.

H1: Differences will exist between rural Americans and urban Americans' trust in science, intention to get the COVID-19 vaccine, and CBSM principles.

Once differences between rural and urban Americans were confirmed, the next step was to focus on understanding rural Americans' influences on intention to vaccinate for COVID-19. Researchers proposed testing the hypothesized model in H2 to address the purpose of understanding what influences rural American's intention to vaccinate for COVID-19. The hypothesized model in Figure 1 is comprised of five hypotheses:

H2$_a$: CBSM principles will significantly impact rural Americans COVID-19 vaccine attitudes (Agranov et al., 2021; Beleche et al., 2021).

H2$_b$: Trust in science will significantly impact rural Americans COVID-19 vaccine attitudes (Krause et al., 2019).

H2$_c$: CBSM will significantly impact rural Americans' intention to get the COVID-19 vaccine (McKenzie-Mohr, 2011).

H2$_d$: Trust in science will significantly impact rural Americans' intention to get the COVID-19 vaccine (Lennon et al., 2022).

H2$_e$: COVID-19 vaccine attitudes will significantly impact rural Americans' intention to get the COVID-19 vaccine (Ajzen & Fishbein, 2005; Fazio, 1986; Zimmerman et al., 2003).

The hypothesized model for H2$_{a-e}$ is visualized in Figure 1.

Figure 1

Hypothesized Model of Rural Americans Relationship between Community Based Social Marketing (CBSM) Principles, Trust in Science, Attitude Toward COVID-19 Vaccines, and Intention of Getting the COVID-19 Vaccination
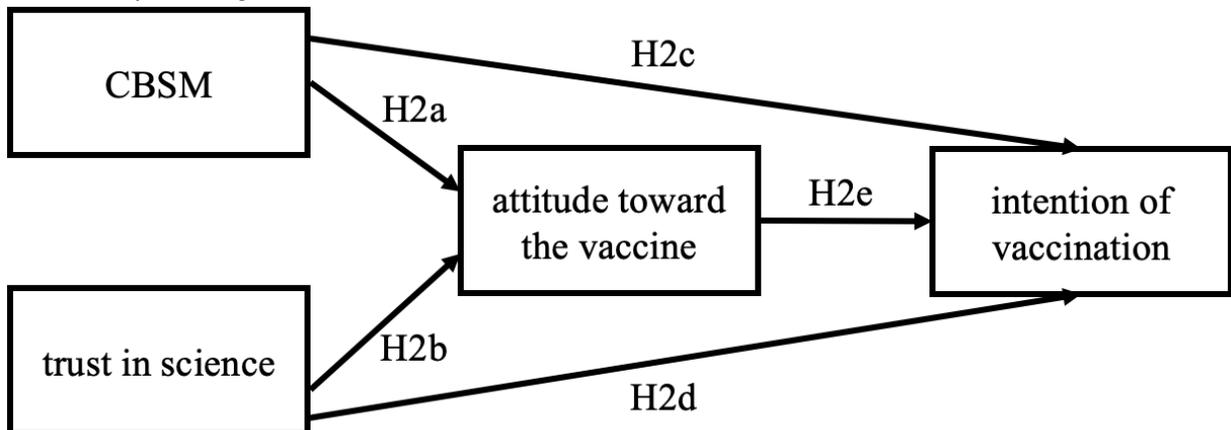
Note. This figure is a visual representation of the hypothesized relationship between study variables for rural Americans.

Methods

This study aimed to develop a better understanding of how to effectively increase rural Americans' intentions of vaccination against COVID-19 during the pandemic. An online survey research design was utilized to address this purpose. A third-party company, Qualtrics, was consulted to obtain a non-probability opt-in sample of U.S. residents 18 years of age or older sampled to match U.S. Census characteristics for age, region of the U.S., race, gender, and ethnicity. Non-probability sampling is an approach commonly used to make population estimates (Baker et al., 2013) particularly in research examining public opinion of emerging issues because of increased access to the internet, the relatively low cost of online surveys, and higher response rates compared to past probability-based methods (e.g., random digit dialing of landline numbers). This method also has an overall greater ease of reaching members of the population of interest (Lamm & Lamm, 2019). In the past, a lack of broadband access in rural areas resulted in a study limitation when trying to reach rural Americans for online surveys. However, 80% of rural Americans have access to or own smartphones with Internet access and 99% of rural Americans have access to high-speed mobile networks (CTIA, 2016; Vogels, 2021).

Data Collection

Through Qualtrics, respondents are recruited using traditional, actively managed market research panels and social media platforms. To help exclude duplication and ensure validity, Qualtrics also employs digital fingerprinting technology and internet protocol (IP) address checks (Qualtrics, 2019). Attention filters (e.g., "select 'strongly agree' for this answer") were used to identify respondents not paying attention. Respondents who did not complete all items or who did not select the appropriate answer to attention filters were excluded from analyses. Data were collected from January 8 to 21, 2021, from 1,549 adults.

The questionnaire design was divided into the following parts. First, based on the literature on community-based social marketing (McKenzie-Mohr, 2000; 2011) and research related to benefits, barriers, and social norms (Agranov et al., 2021; Reid et al., 2010; Zimmerman et al., 2003) researchers designed a 13 question CBSM scale. The scale was used to examine what can increase participants' willingness to be vaccinated through a variety of factors that may occur in daily life and included concepts related to barriers and benefits, incentives, and social norms. After factor analysis, researchers kept seven questions in this CBSM scale, including "Getting a gift card to a store for getting the vaccine in the store pharmacy influences my decision to get a COVID-19 vaccine", "Having my insurance pay" for 100% of the cost influences my decision to get a COVID-19 vaccine", "Having my employer pay 100% of the cost influences my decision to get a COVID-19 vaccine", "Having the vaccine available at my place of employment influences my decision to get a COVID-19 vaccine", "Hearing the reactions or testimonies of others who have received the vaccine influences my decision to get a COVID-19 vaccine", "When it comes to getting a COVID-19 vaccine, I want to do what my family members think I should do", and "When it comes to getting a COVID-19 vaccine, I want to do what my friends think I should do" ($\alpha = .87$, $M = 3.49$, $SD = 1.31$).

The second part was trust in science. The design of the questionnaire was based on Nadelson et al.'s (2014) 21-item research scale. The scale has been used to analyze how much the respondents trust in science and scientists, and to explore people's positive and negative attitudes from different perspectives. One of the questions in Nadelson's scale "People who understand science more have more trust in science" was removed because it was far from the purpose of this research. The remaining 20 questions were kept, 12 of these were reverse coded (after reversed; $\alpha = .92$, $M = 3.34$, $SD = .72$). The general questions asked participants to judge their trust and positive attitude toward science or scientists with simple narrative sentences, such as "people should trust the work of scientists". On the contrary, the reverse-coded proposition questions emphasized negative attitudes toward these, such as believing scientific theories are weak explanations. In the first two parts of survey, participants were asked to respond using a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Each question in the questionnaire was answered with a single-choice scale, and unanswered ones were set as missing values.

In addition, participants' attitudes toward COVID-19 vaccination were asked with a 7-point Likert scale. Higher scores indicated they held more positive attitudes toward the vaccine, such as "good", "safe", "useful", "desirable", "wise", and "beneficial". In contrast, lower scores indicated relatively negative attitudes toward the vaccine, such as "bad", "dangerous", "useless", "undesirable", "foolish", and "harmful" ($\alpha = .98$, $M = 5.20$, $SD = 2.00$).

Vaccine intention was operationalized by asking participants' degree of agreement with the statement "I will get the COVID-19 vaccine when it becomes available to me". Responses were recorded on a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree ($M = 5.00$, $SD = 2.17$).

Since this study focused primarily on rural residents, participants were also asked to select the option that best describes the place where they live. Five choices were presented: a farm in a rural area ($n = 54$), rural area, not a farm ($n = 285$), urban or suburban area outside of the city limits ($n = 775$), subdivision in a town or city ($n = 316$), and downtown area in a city or town ($n = 119$). Participants who chose the first two were defined as living in rural areas for the purpose of this study, while the other three choices were defined as living in non-rural areas. Basic data such as age, income, highest educational level, and political alignments were also collected and controlled in this research because prior research indicated there were differences in vaccine attitudes and intentions based on these variables (Kirzinger et al., 2021; Miller et al., 1993; Padamsee et al., 2022), and the present study wanted to make sure we only measured the effects of the variables of interest within this study.

Data Analysis

After collecting the data, independent sample t-tests, correlation, and regression were performed using SPSS version 27. To answer the hypotheses in this study, the participants were first divided into two groups, rural and non-rural Americans. H1 was assessed through t-test analysis, to determine whether Americans living in different areas have differences in trust in science, CBSM principles, attitudes toward the COVID-19 vaccine, and intention to vaccinate. To assess H2a-e, the 339 respondents from rural areas were isolated to determine the influence of CBSM and trust in science on COVID-19 vaccine attitudes and intention to get vaccinated. Hierarchical Linear Regression was used to test the hypothesized model in Figure 1.

<div align="center">**Results**</div>

Rural and Urban Differences

To answer H1, researchers first explored whether rural and non-rural Americans differed significantly in their perspectives on science and in attitudes and intentions to get COVID-19 vaccinations. The results indicated that rural Americans had significantly lower scores on all four variables (the CBSM, trust in science, attitude toward vaccination, and intention of vaccination; $p < .001$). Table 1 shows rural and non-rural Americans' attitude of science and intention of vaccination. Therefore, researchers rejected the null hypothesis and confirmed differences in attitudes and intentions toward vaccines between rural and urban participants. This allowed researchers to move forward focused on the sample of rural Americans ($n = 339$) to test H2a-e.

Table 1

Rural and Non-rural Americans' Attitude of Science and Intention of Vaccination

	Rural Americans		Non-rural Americans		t	p-value	Cohen's d
	M	*SD*	*M*	*SD*			
CBSM	3.09	1.32	3.61	1.28	-6.54	.000**	1.29
Trust in Science	3.22	.78	3.37	.70	-3.57	.000**	.72
Attitude toward Vaccine	4.71	2.14	5.33	1.94	-4.78	.000**	1.98
Intention of Vaccination	4.45	2.37	5.15	2.08	-4.96	.000**	2.15

*Note. * $p < .05$, ** $p < .01$

The first step in testing H2a-e was to examine the correlations between study variables (Table 2). We found that CBSM and trust in science are substantially and moderately related to attitudes toward vaccines and intention to administer COVID vaccines ($p < .001$), and people's attitudes toward vaccines were highly correlated to their intention of getting vaccinations ($p < .001$). In addition, researchers found that age, income, political beliefs and alignments, and educational level may all be associated with the main variables. Thus, we controlled the said demographic variables in the regression model. Table 2 shows the main variables and control variables in this study.

Table 2

Correlation of Main Variables of COVID Vaccine and Demographic Variables

Variable	1	2	3	4	5	6	7	8	9
1. Intention of Vaccination	-								
2. Attitude toward Vaccine	.78**	-							
3. CBSM	.57**	.56**	-						
4. Trust in Science	.43**	.45**	.16**	-					
5. Age	.16**	.16**	-.12**	.14**	-				
6. Income	.26**	.24**	.24**	.08**	-.00	-			
7. Political Belief	-.17*	-.19**	-.18**	-.23**	.13**	-.02	-		
8. Political Alignment	-.11*	-.05*	-.11**	.01	-.12**	-.16**	-.16**	-	
9. Education Level	.26**	.26**	.20**	.13**	.07**	.53**	-.06*	-.11**	-

Note. * $p < .05$, ** $p < .01$
Strength of relationships (Davis, 1971): .01–.09 = *Negligible*, .10–.29 = *Low*, .30–.49 = *Moderate*, .50–.69 = *Substantial*, > .70 = *Very strong*.

In H2$_a$ and H2$_b$, researchers attempted to explore the relationship of CBSM and trust in science to attitude. A hierarchical linear regression revealed a significant positive relationship between CBSM and participant's attitude toward vaccination, $\beta = .50$, $t(330) = 12.80$, $p < .001$. Besides, trust in science also showed a significant positive effect on their attitude, $\beta = .35$, $t(330) = 8.72$, $p < .001$. Thus, H2$_a$ and H2$_b$ were both valid (Table 3). For rural Americans, CBSM has relatively higher explanatory power and influence than trust in science.

Table 3

Best-fit Hierarchical Linear Regression Model of CBSM and Trust in Science to Attitude toward Vaccination

Independent Variables	$t(330)$	Std. β	p
CBSM	12.80	.50	.000**
Trust in Science	8.72	.35	.000**

Note. Dependent Variables: Attitude toward Vaccination; Age, income, political beliefs and alignments, and educational level were all controlled
* $p < .05$, ** $p < .01$, $R^2 = .55$ ($F = 60.79$, $p < .001$)

In addition, we used the same linear regression method to test H2$_c$, H2$_d$, and H2$_e$ to explore the effects of CBSM, trust in science, and attitude toward vaccination on the intention of vaccination respectively. The results indicated that a significant positive relationship existed between CBSM and the intention, $\beta = .20$, $t(330) = 4.64$, $p < .001$, and H2$_c$ was supported. By comparison, the relationship between trust in science to the vaccine intention was non-significant, $\beta = .05$, $t(330) = 1.22$, $p = .23$, and H2$_d$ was rejected. At last, the results revealed that the attitude toward vaccination of rural Americans can strongly affect their willingness to receive COVID-19 vaccines, $\beta = .55$, $t(330) = 11.05$, $p < .001$, H2$_e$ was valid (Table 4).

Table 4

Best-fit Hierarchical Linear Regression Model of Attitude toward Vaccine to the Intention of Vaccination

	$t(330)$	Std. β	p
CBSM	4.64	.20	.000**
Trust in Science	1.22	.05	.23
Attitude toward Vaccination	11.05	.55	.000**

Note. Dependent Variables: Intention of vaccination; age, income, political beliefs and alignments, and educational level were all controlled
* $p < .05$, ** $p < .01$, $R^2 = .64$ ($F = 74.57$, $p < .001$)

Conclusions & Discussion

Results of this study add to the understanding of perspectives of rural Americans related to trust in science and CBSM principles and the impact of these variables on vaccine attitudes and intentions. Rural Americans in this study had significantly lower scores in trust in science, CBSM principles, COVID-19 attitudes, and COVID-19 vaccine intentions than those living in urban areas. This confirms previous work that showed rural Americans were less likely to get the COVID-19 vaccine (de Beaumont Foundation, 2020; Lennon et al., 2022) and that rural Americans have less trust in science and scientists than urban Americans (Avery, 2013). This study adds new knowledge in the area of CBSM principles and the differences between rural and urban Americans in this context. Rural Americans had significantly lower scores in the CBSM principles measured in this study than urban Americans. However, the CBSM principles still had significant explanatory power in the final model for rural residents, which indicates that while for this topic these principles were not as important to rural residents as urban, the value of CBSM in vaccine science campaigns can still be high in rural communities.

In the final model in this study (Figure 2), CBSM principles and trust in science both significantly contributed to rural Americans attitudes toward the COVID-19 vaccine (H2a-e), but the relationships between CBSM and rural Americans' attitudes toward vaccines was stronger than that between trust in science and their attitudes toward vaccines. CBSM also has a direct positive impact on people's intentions toward vaccines (H2c). Rural Americans attitude toward the COVID-19 vaccine significantly impacted their intention to get the COVID-19 vaccine (He). However, rural Americans' trust in science did not significantly impact their intention to get the vaccine directly (Hd). Since attitudes toward vaccines have directly affected behavioral intentions in previous work (Zimmerman et al., 2003) and, in the present study, it is important to continue to work to change rural residents' attitudes through health education. While CBSM was more impactful than trust in science in this study, both are vital when it comes to influencing rural Americans' attitude toward COVID-19 vaccines and should be considered when working with rural communities.

Figure 2

Final model of Rural Americans Relationship between Community Based Social Marketing (CBSM) Principles, Trust in Science, Attitude Toward COVID-19 Vaccines, and Intention of Getting the COVID-19 Vaccination
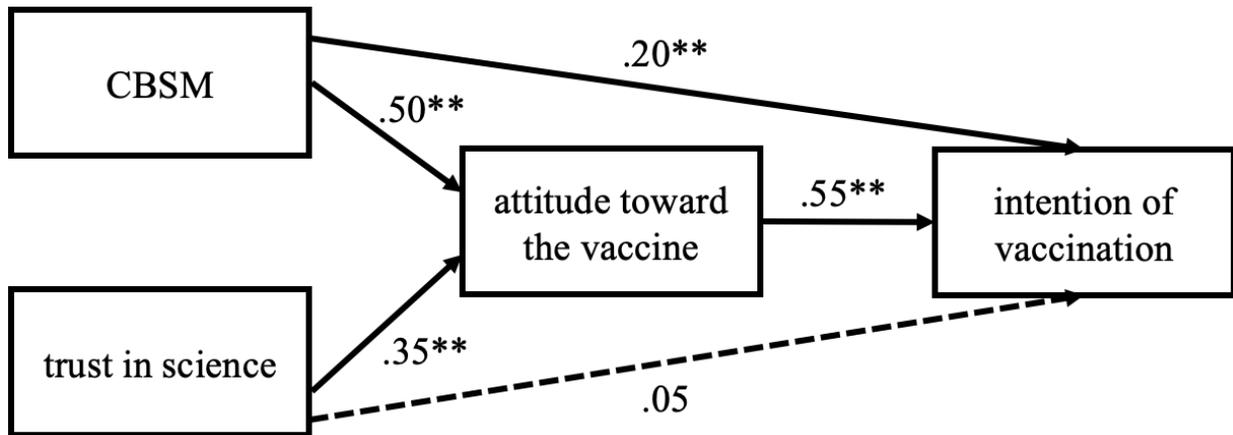
Note. Solid lines indicate significant relationships between variables, while the dashed line indicates the relationship was not significant.

Recommendations

Conclusions derived from this study should be considered by researchers and practitioners. The logical next step for future research is to test the model applied in this study in relation to the end-state behavior of receiving the COVID-19 vaccine. This study focused on intentions and attitudes related to the COVID-19 vaccine, which can be predictive of actions (Fazio, 1986) but should be confirmed in this context through further research. Future research should also apply the model tested in this study to other health and well-being topics prioritized by Cooperative Extension, such as nutrition or disease prevention. Additionally, future research should test how specific community based social marketing campaigns related to COVID-19 vaccines impacted vaccine uptake, particularly in rural communities. Future research should also determine how trust in science and CBSM impact health decisions made by other underrepresented groups that face similar health disparities as rural communities, including racial and ethnic minorities and low socio-economic communities.

Practical implications from this study lend themselves to recommendations for practice. Extension professionals and agricultural communicators should continue to work to improve rural Americans' trust in science, but should prioritize CBSM principles when developing communication campaigns. Communication campaigns utilize CBSM concepts, particularly those concepts included in this study including barriers and benefits, incentives, and social norms, may be most effective when educating rural communities to influence health behaviors. Specifically, as communicators develop campaigns to encourage rural Americans to receive recommended vaccines, influencing attitudes will be an important first step. Cultivating positive attitudes toward vaccines in rural communities is vital, particularly as Americans may be encouraged to receive future vaccines to address emerging infectious diseases. Agricultural

communicators and Extension professionals should collaborate with health organizations to ensure messages related to vaccines are appropriate and effective for rural communities.

Extension communicators should work to increase trust in science in rural communities on a regular basis. By working to educate rural communities about science processes and implications, Extension will be seen as a reliable and trusted source of science information before a public health or other crisis hits. Efforts should continue to provide STEM education in rural communities (Harris & Hodges, 2018; Robinson, 2013). Extension is uniquely positioned in rural communities across the country and are in prime positions to be experts in communicating science in real time and providing local observations (Avery, 2013) to change community social norms through interpersonal conversations and storytelling, which have been seen as more effective (Kalla & Broockman, 2020).

To truly redeem rural America and improve disparities in the effects of climate change, water quality, obesity, and COVID-19 (Mueller et al., 2021), a unified effort in improving trust in science and open communication with scientists and rural residents will be required. This study offers a model for beginning to improve attitudes toward vaccines in an effort to increase vaccination rates in rural communities. But this is only one step in reviving rural communities and preparing rural residents to be resilient in the face of future challenges that can only be solved through complex scientific solutions.

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