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Survey of Healthcare Professionals to Assess Severe Acute Respiratory Syndrome Coronavirus 2 Vaccination Hesitancy

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Abstract

Introduction: Vaccine hesitancy, the delay in acceptance and/or refusal to vaccinate, is influenced by a number of factors including: complacency, confidence, unmet safety and efficacy concerns. The primary goal of this survey was to identify contributing factors to coronavirus disease 2019 (COVID-19) vaccine hesitancy among healthcare providers in the Western United States. **Methods:** The World Health Organization Strategic Advisory Group of Experts (SAGE) 2014 vaccine hesitancy guidelines informed development of a 22-question vaccine hesitancy survey. The survey was distributed to nurses, pharmacists, physicians, and physician assistants. Descriptive statistics and logistic regression were used to identify factors contributing to COVID-19 vaccine hesitancy, and if factors differed by profession or demographics. **Results:** Healthcare providers responding to the survey (n=212) believed COVID-19 vaccine was important to protect the community, especially those most vulnerable. Physician assistants and physicians were more likely than nurses and pharmacists to believe they may have serious vaccine-related complications (OR=2.93, p=0.003), and were planning to wait and see how the COVID-19 vaccine affected others before they received it (OR=3.29, p<0.001). Males were more less likely to believe the risks of the COVID-19 vaccine would be openly shared (OR=0.30, p<0.001), and that the vaccine would be safe (OR=0.37, p=0.002) and/ or effective (OR=0.30, p<0.001). **Conclusions:** Several factors contributing to vaccine hesitancy are modifiable and strategies could be developed to target and address complacency, confidence, and unmet concerns. Information from this study can be used to reduce COVID-19 vaccine hesitancy and guide efforts to support consistent messaging and resources to healthcare providers.

Introduction

Vaccination in the US has a long, complicated history, highlighting a moral dilemma between autonomy of an individual to make decisions about their healthcare and the greater health of the public, both of which influence vaccine uptake and acceptance [1]. To protect lives and limit COVID-19 spread, measures such as surveillance, strategic communication, quarantine, and vaccination are necessary [2]. However, public health experts indicate that until a safe and effective vaccine is made available to all, all willing individuals receive the vaccine, and 70% of the US population are vaccinated, COVID-19 infections will not be adequately controlled [3].

Vaccine hesitancy, defined as the delay in acceptance or refusal to vaccinate despite availability of services is complex and context specific. Vaccine hesitancy is influenced by a number of factors such as complacency, convenience, and individual vaccine confidence, all of which vary across time and place. Many individuals in the US and worldwide may choose not to be vaccinated due to doubts about safety and efficacy, especially given the expedited vaccine development timeline [4]. In 2014, the World Health Organization (WHO) Strategic Advisory Group of Experts working group created guidelines to help identify and address vaccine hesitancy [5]. However, in 2019, vaccine hesitancy remained one of the top ten threats to global health, ranking above HIV and just below "weak primary healthcare systems" [6].

It is estimated that the roughly 21 million frontline healthcare providers in the US are at a nearly 12-times greater risk of testing positive for COVID-19 compared to the general population [7]. Those healthcare providers with inadequate access to personal protective equipment (PPE), many in rural and underserved communities, have an estimated 23% higher risk of COVID-19 infection [7]. On November 30, 2020, members of the CDC external Advisory Committee on Immunization Practices voted 13 to 1 to vaccinate healthcare providers and long-term care facility residents first, once the COVID-19 vaccine was approved for Emergency Use Authorization (EUA). Despite the increased risk to frontline healthcare providers and current prioritized availability of the COVID-19 vaccines to healthcare providers, some do not plan to be vaccinated in the first phase (1a) of CDC distribution, potentially putting themselves, their patients, and the healthcare systems at risk [8,9]. This work identified a vital gap in current knowledge (Section 6B) -- how does vaccine hesitancy among healthcare professionals impact vaccine acceptance of their patients and population health [5]? Therefore, the primary goal of this survey was to identify factors contributing to COVID-19 vaccine hesitancy among healthcare providers in the Western US.

The secondary goal was to explore differences by health profession (discipline), age group, gender, and political affiliation.

Methods

Survey development and validation

For this project, we utilized the WHO SAGE 2014 vaccine hesitancy guidelines, factors contributing to vaccine hesitancy from the media, and data from published vaccine hesitancy studies to identify and develop relevant survey content [5]. The resulting 22-question survey was designed to assess individual needs in: perceived safety and efficacy of the COVID-19 vaccine, general acceptance of the vaccine, anticipated vaccine uptake/vaccination by the respondent, and modifiable and/or influenceable factors contributing to vaccine hesitancy. The final healthcare provider survey was reviewed and approved by all members of the research team. Resulting questions were grouped into three-categories contributing to vaccine hesitancy: contextual influences, individual and group influences, and vaccine-related factors. The survey was distributed using Qualtrics XM (Qualtrics, Provo, UT), an experience management software platform used for survey development, dissemination, and tracking, to four distinct healthcare disciplines responsible for care of patients with COVID-19 (nurses, pharmacists, physicians, and physician assistants) in Washington, Wyoming, Alaska, Montana, and Idaho (the WWAMI region). The decision to include these healthcare disciplines was based on COVID-19 transmission risk.

Participants, distribution, recruitment

For each state, contact information for providers was collected from the primary state professional organization for that discipline, if there was not a primary organization in the state, multiple organizations were contacted. Initially 15-health professional organizations in the five identified states were contacted to participate. Organizations were first emailed a research inquiry with the attached survey on August 28, 2020. Follow-up phone calls were made to each of the organizations to ensure inquiry/survey receipt, answer any questions the organization had about the project, and offer additional support if necessary. No more than four phone calls were made to each organization, and at that point the organization was deemed non-responsive. An additional seven professional health organizations were sent the research inquiry email and survey late September. The survey was closed on November 24, 2020. As an incentive to take the survey, participants were placed in a raffle to win a gift valued at $100.

Data handling and statistical analysis

Responses from participants who started the survey and completed all COVID-19-related questions as well as provided their discipline, age group (millennials, boomers, generation X), and gender were included in survey analysis. Participants who did

not state their political affiliation were retained, and this missing data set to "not reported". Responses to the COVID-19 questions were dichotomized based on the distribution of responses; with "neutral" responses classified with "disagree" apart for most questions

Descriptive statistics were used to characterize the response to each COVID-19 question by provider. Logistic regression was used to determine if healthcare providers' views of the COVID-19 vaccine were significantly predicted by program, age, gender, and political affiliation. The statistical analysis software R (v 4.0.3) was used for all analyses. Due to the number of tests, statistical significance was determined as $p < 0.01$. This study was approved by the University's Institutional Review Board, receiving a waiver of written consent for expedited approval.

Results

Of the 290 participants who started the survey, a total of 212 completed all COVID-19-related questions and provided required demographics and thus were included in our analysis. Survey respondents were primarily female, pharmacists, and millennials (Table 1).

Healthcare Provider Characteristics	N	% of study population
Profession		
-Physician/PA	57	26.9%
-Nursing	56	26.4%
-Pharmacy	99	46.7%
Age Group		
-Baby Boomer	37	17.5%
-Generation X	78	36.8%

	N	
-Millennials	97	45.8%
Gender		
-Male	80	37.7%
-Female	132	62.3%
Political Affiliation		
-Democrat	42	19.8%
-Republican	42	19.8%
-Independent	20	9.4%
- none/other	45	21.2%
-not reported	63	29.7%

Table 1: Study population demographics.

Overall, healthcare providers participating in the survey believed COVID-19 vaccine was important to protect the community and protection of the most vulnerable community was more important than individual protection, demonstrating a significant group influence (Table 2). The majority of respondents to this survey expressed doubts that the government and pharmaceutical companies would be transparent about efficacy of the COVID-19 vaccine and risks posed by vaccine administration. Over half of survey respondents (52.4%) reported that they were concerned about whether vaccination would effectively prevent COVID-19 infection and related complications. However, more respondents (38.4%) agreed that they trusted the efficacy of the vaccine than respondents who distrusted its efficacy (26.9%). The majority of respondents believed that they would not experience serious side effects due to vaccination, and trusted that the vaccine would be safe.

Question#	Response	Pharmacy, N=99, N (%)	Nursing, N=56, N (%)	PA, N=31, N (%)	Medicine, N=26, N (%)	All Providers, N=212, N (%)
Q2-1	Agree/ Strongly Agree	75 (75.8)	17 (30.4)	24 (77.4)	19 (73.1)	135 (63.7)
	Neutral	12 (12.1)	13 (23.2)	5 (16.1)	2 (7.7)	32 (15.1)
	Disagree/ Strongly Disagree	12 (12.1)	26 (46.4)	2 (6.5)	5 (19.2)	45 (21.2)
Q2-2	Agree	77 (77.8)	18 (32.1)	28 (90.3)	22 (84.6)	145 (68.4)
	Neutral	11 (11.1)	16 (28.6)	1 (3.2)	1 (3.8)	29 (13.7)
	Disagree	11 (11.1)	22 (39.3)	2 (6.5)	3 (11.5)	38 (17.9)
Q2-3	Agree	77 (77.8)	21 (37.5)	27 (87.1)	23 (88.5)	148 (69.8)
	Neutral	11 (11.1)	14 (25.0)	2 (6.5)	1 (3.8)	28 (13.2)

	Disagree	11 (11.1)	21 (37.5)	2 (6.5)	2 (7.7)	36 (17.0)
Q5-1	Agree	46 (46.5)	5 (8.9)	17 (54.8)	9 (34.6)	77 (36.3)
	Neutral	18 (18.2)	6 (10.7)	7 (22.6)	10 (38.5)	41 (19.3)
	Disagree	35 (35.4)	45 (80.4)	7 (22.6)	7 (26.9)	94 (44.3)
Q6-2	Agree	11 (11.1)	28 (50.0)	1 (3.2)	4 (15.4)	44 (20.8)
	Neutral	22 (22.2)	18 (32.1)	6 (19.4)	4 (15.4)	50 (23.6)
	Disagree	66 (66.7)	10 (17.9)	24 (77.4)	18 (69.2)	118 (55.7)
Q9-1	Agree	60 (60.6)	3 (5.4)	19 (61.3)	18 (69.2)	100 (47.2)
	Neutral	20 (20.2)	18 (32.1)	10 (32.3)	3 (11.5)	51 (24.1)
	Disagree	19 (19.2)	35 (62.5)	2 (6.5)	5 (19.2)	61 (28.8)
Q6-3	Agree	44 (44.4)	40 (71.4)	14 (45.2)	13 (50.0)	111 (52.4)
	Neutral	25 (25.3)	11 (19.6)	13 (41.9)	5 (19.2)	54 (25.5)
	Disagree	30 (30.3)	5 (8.9)	4 (12.9)	8 (30.8)	47 (22.2)
Q9-2	Agree	48 (48.5)	3 (5.4)	15 (48.4)	16 (61.5)	82 (38.7)
	Neutral	30 (30.3)	24 (42.9)	13 (41.9)	6 (23.1)	73 (34.4)
	Disagree	21 (21.2)	29 (51.8)	3 (9.7)	4 (15.4)	57 (26.9)

Table 2: Survey Results.

The logistic regression results suggest significant differences between demographics and vaccine hesitancy (Table 3). Compared to respondents in pharmacy and nursing programs, respondents who were physician assistants and physicians were more likely to believe they may have serious vaccine-related complications (odds ratio [OR]=2.93, P=0.003), and plan to wait and see how the COVID-19 vaccine affected others before they get it (OR=3.29, P<0.001). Physician assistants and respondents in medicine were also less likely to believe they would have a positive COVID-19 vaccine experience (OR=0.32, P=0.002), that it was important to be vaccinated to protect those who could not get vaccinated (OR=0.24, P=0.002), that the pharmaceutical industry would provide a safe and effective COVID-19 vaccine (OR=0.38, P=0.006), and that the medical professionals in charge of COVID-19 had their best interests in mind (OR=0.30, P=0.004).

	Q1_1 "My experiences with other vaccines were positive, therefore I expect my experience with the COVID-19 vaccine will also be positive"			Q1_2 "I believe that it is better to develop immunity by getting the vaccine than by getting COVID-19"			Q2_1 "I believe that it is important to get the COVID-19 vaccine so that I can stay healthy"		
Characteristic	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Program									
Pharmacy/ Nursing	Ref			Ref			Ref		
PA/ Medicine	0.32	0.15, 0.65	**0.002**	0.4	0.14, 0.82	**0.021**	0.6	0.28, 1.20	0.15
Age									
Millennials	Ref			Ref			Ref		
Boomer	1.21	0.53, 2.81	0.654	0.5	0.15, 1.20	0.128	0.5	0.18, 1.06	0.076
Generation X	0.68	0.34, 1.33	0.257	0.8	0.40, 1.74	0.647	0.5	0.26, 1.04	0.067
Gender									

Characteristic	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Female	Ref						Ref		
Male	0.73	0.38, 1.39	0.335	0.7	0.32, 1.42	0.316	0.5	0.24, 0.92	**0.029**
Political									
Republican	Ref			Ref			Ref		
Democratic	0.83	0.31, 2.25	0.712	0.7	0.21, 2.05	0.47	0.5	0.19, 1.52	0.245
Independent	2.15	0.69, 6.92	0.192	0.7	0.15, 2.44	0.543	1.2	0.37, 3.84	0.76
None/other	1.17	0.46, 3.05	0.74	0.9	0.31, 2.79	0.899	1.2	0.45, 3.13	0.736
Not reported	2.15	0.89, 5.38	0.094	2	0.76, 5.30	0.174	1.3	0.52, 3.19	0.602

	Q4_1 "I am hesitant to get the COVID-19 vaccine because of my negative past experiences(s) with vaccines?"			Q5_1 "I believe the risks of the COVID-19 vaccine will be openly shared by the government and/or pharmaceutical companies, with the public"			Q5_2 I believe that my work will consider my risks when deciding to require the COVID-19 vaccine		
Characteristic	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Program									
Pharmacy/ Nursing	Ref			Ref			Ref		
PA/ Medicine	4.9	1.57, 21.7	**0.014**	0.75	0.38, 1.49	0.404	0.5	0.25, 0.99	**0.047**
Age									
Millennials	Ref			Ref			Ref		
Boomer	0.46	0.17, 1.29	0.132	0.93	0.39, 2.32	0.879	1.01	0.44, 2.41	0.977
Generation X	1.1	0.43, 2.95	0.84	0.57	0.29, 1.12	0.104	0.44	0.22, 0.64	**0.016**
Gender									
Female	Ref						Ref		
Male	1.12	0.45, 2.89	0.804	0.3	0.15, 0.58	**<0.001**	0.34	0.17, 0.64	**0.001**
Political									
Republican	Ref			Ref			Ref		
Democratic	1.56	0.40, 6.39	0.519	0.64	0.24, 1.70	0.374	0.622	0.23, 1.65	0.339
Independent	4.02	0.61, 79.8	.217	0.98	0.31, 3.20	0.969	0.93	0.29, 3.02	0.908
None/other	0.95	0.27, 3.30	0.939	1.57	0.61, 4.10	0.35	0.54	0.21, 1.37	0.199
Not reported	0.7	0.21, 2.17	0.548	1.22	0.49, 3.03	0.665	0.98	0.40, 2.41	0.971

	Q6_2 I believe that I may have serious vaccine-related complications if I receive the COVID 19 vaccine			Q6_3 I am concerned that the Covid-19 vaccine might not prevent COVID-19 Infections			Q7_1 I trust information from the media and social media about COVID-19 vaccine		
Characteristic	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Program									
Pharmacy/ Nursing	Ref			Ref			Ref		
PA/ Medicine	2.93	1.47, 6.12	**0.003**	1.22	0.62, 2.38	0.564	0.5	0.23, 1.09	0.08
Age									

Millennials	Ref			Ref			Ref		
Boomer	0.45	0.19, 1.04	0.064	1.39	0.61, 3.19	0.43	0.37	0.14, 0.99	**0.047**
Generation X	0.73	0.37, 1.42	0.355	1.05	0.54, 2.03	0.876	0.45	0.19, 1.04	0.066
Gender									
Female	Ref						Ref		
Male	1.69	0.89, 3.25	0.109	2.35	1.25, 4.49	**0.009**	0.7	0.32, 1.51	0.36
Political									
Republican	Ref			Ref			Ref		
Democratic	0.93	0.35, 2.46	0.891	1.7	0.66, 4.47	0.272	0.33	0.11, 0.93	**0.04**
Independent	0.64	0.20, 2.00	0.439	1.03	0.34, 3.21	0.957	2.2	0.49, 15.7	0.353
None/other	0.77	0.30, 1.96	0.591	0.49	0.19, 1.19	0.117	0.75	0.27, 2.08	0.585
Not reported	0.6	0.24, 1.45	0.261	0.48	0.20, 1.13	0.094	2.44	0.78, 8.17	0.132
	Q7_2 "I trust the government is making decisions in my best interest with respect to the COVID-19 vaccine"			**Q7_3 "I believe that the pharmaceutical industry will provide a safe and effective COVID-19 vaccine"**			**Q7_4 "I agree with my work's requirement of the COVID-19 vaccine"**		
Characteristic	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Program									
Pharmacy/ Nursing	Ref			Ref			Ref		
PA/ Medicine	0.5	0.23, 1.09	0.08	0.38	0.18, 0.75	**0.006**	0.5	0.25, 0.96	**0.039**
Age									
Millennials	Ref			Ref			Ref		
Boomer	0.37	0.14, 0.99	**0.047**	1.27	0.54, 3.12	0.59	0.81	0.35, 1.89	0.62
Generation X	0.45	0.19, 1.04	0.066	0.78	0.40, 1.54	0.479	0.84	0.42, 1.66	0.614
Gender									
Female	Ref						Ref		
Male	0.7	0.32, 1.51	0.36	0.27	0.14, 0.51	**<.001**	0.5	0.26, 0.96	**0.038**
Political									
Republican	Ref			Ref			Ref		
Democratic	0.33	0.11, 0.93	**0.04**	0.87	0.32, 2.33	0.782	0.65	0.25, 1.66	0.367
Independent	2.2	0.49, 15.7	0.353	1.44	0.44, 4.78	0.546	3.83	1.03, 18.8	0.062
None/other	0.75	0.27, 2.08	0.585	2.3	0.89, 6.08	0.087	0.86	0.35, 2.12	0.746
Not reported	2.44	0.78, 8.17	0.132	1.64	0.66, 4.11	0.288	1.32	0.54, 3.19	0.537
	Q8_1 "I plan to wait and see how the COVID-19 vaccine affects others before I get it, because it is so new"			**Q8_2 "I believe in general medical professionals in charge of the COVID 19 vaccine have my best interest at heart"**			**Q9_1 "I trust the COVID-19 vaccine will be safe"**		
Characteristic	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**

Program									
Pharmacy/ Nursing	Ref			Ref			Ref		
PA/ Medicine	3.29	1.67, 6.62	**<0.001**	0.3	0.13, 0.66	**0.004**	0.47	0.23, 0.92	**0.029**
Age									
Millennials	Ref			Ref			Ref		
Boomer	0.78	0.31, 1.88	0.592	1.9	0.81, 4.51	0.143	1.18	0.51, 2.83	0.704
Generation X	0.99	0.49, 1.99	0.981	0.96	0.47, 1.94	0.899	0.6	0.30, 1.17	0.132
Gender									
Female	Ref			Ref			Ref		
Male	1.31	0.68, 2.53	0.418	0.48	0.23, 0.95	**0.039**	0.37	0.19, 0.70	**0.002**
Political									
Republican	Ref			Ref			Ref		
Democratic	0.66	0.25, 1.73	0.402	0.92	0.33, 2.60	0.874	1.33	0.50, 3.55	0.566
Independent	0.62	0.19, 1.95	0.422	1.5	0.45, 4.98	0.505	2.34	0.74, 7.80	0.154
None/other	0.55	0.21, 1.36	0.198	0.95	0.34, 2.64	0.917	1.57	0.62, 4.06	0.342
Not reported	0.26	0.10, 0.65	**0.005**	1.52	0.60, 3.98	0.381	2.37	0.97, 5.95	0.6
	Q9_2" I trust the COVID-19 vaccine will be effective"								
Characteristic	**OR**	**95% CI**	**p-value**						
Program									
Pharmacy/ Nursing	Ref								
PA/ Medicine	0.5	0.25, 0.99	**0.047**						
Age									
Millennials	Ref								
Boomer	0.82	0.34, 2.00	0.651						
Generation X	0.63	0.32, 1.26	0.191						
Gender									
Female	Ref								
Male	0.3	0.15, 0.57	**<0.001**						
Political									
Republican	Ref								
Democratic	1.04	0.39, 2.76	0.935						
Independent	1.53	0.48, 5.06	0.473						
None/other	2.25	0.88, 5.88	0.092						
Not reported	2.46	0.99, 6.23	0.055						

Table 3: Model Results.

Compared to females, males were more vaccine hesitant. Males were less likely to believe the risks of the COVID-19 would be openly shared (OR=0.30, P<0.001), that their workplace would consider their own risks when deciding to require the COVID-19 vaccine (OR=0.34, P=0.001), and that the pharmaceutical industry would provide a safe and effective vaccine (OR=0.27, P<0.001). Males were also less likely than females to believe that the vaccine would be safe (OR=0.37, P=0.002) and effective (OR=0.30, P<0.001).

Participants who self-reported as democratic (vs. republican) were more likely to believe that the government was making decisions in their best interest with respect to the COVID-19 vaccine (OR=4.09, P=0.007). Participants who did not provide their political affiliation were significantly less likely to plan and wait and see how the COVID-19 vaccine affected others (OR=0.26, P=0.005).

Discussion/Conclusions

Vaccine hesitancy and confidence are influenced by a number of factors, including but not limited to: complacency (low perceived disease risk, low perceived vaccine benefit), confidence (distrust of those manufacturing, administering, or promoting vaccine); and concerns (vaccine safety and efficacy) [10].

Complacency

The Health Belief Model proposes that people are most likely to take preventative action if they believe the threat of a health risk to be serious and apply to them [11,12]. In the case of COVID-19 the individual must believe that: COVID-19 places them at risk and/or places others in their community at risk; risk of infection is greater than the risk of receiving the vaccine; and that other management strategies cannot mitigate risk of infection [13]. Complacency, a feeling of contentment, satisfaction, and/ or security, is often associated with an unawareness of danger, trouble, or controversy [14,15]. Many uncertainties remain about COVID-19 infection, sequelae, and the vaccine. Vaccination complacency exists when perceived risks of vaccine-preventable diseases are low, vaccination is not deemed a necessary preventative action, and/or risks of vaccination are greater than risks of infection [16]. Education and information gaps can influence both patient and healthcare provider complacency. Patients and providers need time to mentally prepare for the information they receive (when), information that is meaningful to their current needs (why), and access resources that support the need for transparent, tailored information and messaging (how).

Risk communication principles vital during a pandemic dictate that information must be fast, right, and credible; however, it is difficult to balance these principles with ever changing health information. It is important to understand the mental models' individuals use to assess risk and benefits of COVID-19 infection and vaccination. It has been demonstrated in the media that a large number of patients and healthcare providers across the US have low perceived risk of COVID-19 infection, believe misinformation about the COVID-19 infection and/or vaccine [17-19]. There is limited healthcare providers' knowledge about vaccinations under development. Information is available about other mRNA vaccines, and could be leveraged to alleviate patient and provider safety and efficacy concerns; however, this vital and necessary targeted health information has not been provided to healthcare providers contributing to safety and efficacy concerns as well as complacency.

Most healthcare providers that participated in our study believe vaccinations are important to protect individuals, the general community, and our most vulnerable populations (Question (Q)2a-c). However, many healthcare workers are planning to "wait and see" before getting the vaccine themselves (Q8.1). Physicians and physician assistants in our study were less likely than nurses and pharmacists to believe that it was important to be vaccinated to protect those who could not get vaccinated (OR=0.24, P=0.002). This was consistent with other vaccine studies where many healthcare providers were hesitant to vaccinate themselves, their family, and their patients in the first phase of vaccine distribution; suggesting a lower perceived risk, lower perceived susceptibility, and higher vaccine risk [20-22]. Many providers felt they could protect their patients through robust infection-control practices which may account for the sub-optimal vaccination compliance index scores (<80%) seen with other vaccines, irrespective of discipline [23].

Confidence

There are a number of factors that contribute to the low confidence reported for the COVID-19 vaccine: distrust of the development, administration, and promotion of the vaccine [4,24,25]. The majority of respondents to our survey expressed doubts that the government and pharmaceutical companies will be transparent about COVID-19 vaccination risks and vaccine efficacy. A great number of participants trusted the efficacy of the COVID-19 vaccine but believed they will experience serious side effects due to the vaccination, demonstrating a residual trust that the vaccine will not be safe. These findings are consistent with reports in the US and abroad that distrust is leading to alarming vaccine skepticism, decreased vaccine confidence, and increased vaccine hesitancy including a "wait and see" response [13,26,27].

One of the biggest confidence hurdles to overcome is the concern that vaccines and the development and review process has been politicized, eroding trust in the pending and currently available COVID-19 vaccines similar eroded trust in vaccines seen with H1N1 pandemic [28,29]. Disparate media coverage has widened the divide, impacting the perceived safety and efficacy of the vaccine by US residents [30,31]. The media, especially in the

US, is giving the public politically-driven, mixed message as to the safety and efficacy of the COVID-19 vaccine [30,31]. In our study, the majority of respondents (77.8%) either strongly disagreed or disagreed that they can trust media/ social media messages about COVID-19 (Q7.1). Interestingly, respondents who self-reported as democratic were more likely to believe that the government was making decisions in their best interest and participants who did not provide their political affiliation were significantly less likely to plan to and "wait and see" than others; the federal government was under republican leadership at the time of our survey administration.

Another potential factor that could be contributing to distrust both in the development, administration, and promotion of the COVID-19 vaccine could be trust in the medical profession and healthcare system(s); both by healthcare providers and by the general public [32]. In our study, a greater number of male healthcare providers believed that decisions made by healthcare systems would place them at increased risk, requiring them to receive potentially risky vaccines, suggesting that healthcare systems consider healthcare system risk above employee risk(s). This may have been reinforced by personal protective equipment shortages, which persisted for nine-months during the pandemic, placing staff at unnecessary risks and further degrading trust of healthcare providers in the healthcare system [33]. While the CDC only recommends vaccinations for healthcare workers during the initial COVID-19 vaccine distribution phase, individual states are given the power to determine whether mandatory vaccinations will be required for different industries such as healthcare and education.

Lastly, it is especially crucial that healthcare providers "practice what they preach" to maintain public confidence in the healthcare system, especially when it comes to health promotion and practicing a healthy lifestyle. Empiric evidence suggests that nothing kills credibility, degrades trust, or underscores the value of health messaging faster than healthcare workers not practicing what they preach, including recommendations to immunize [32,34-36].

Concerns: Safety & Efficacy

One of the main influences of vaccination acceptance by healthcare workers is safety and efficacy of the vaccine, which also influences vaccine hesitancy [37,38]. Our data is in agreement with other work on this subject. Gaps in vaccine knowledge and understanding are known drivers of hesitancy; bringing into question both the safety and efficacy of the vaccine [5,39]. Historically, vaccine development takes years and employs rigorous laboratory and clinical trials weakening or killing the virus to determine both safety and efficacy [40]. Traditionally a slow process, the expedited COVID-19 vaccine development and clinical trial processes have been made possible through governmental subsidization,

use of established processes, overlapping steps in development and assessment, and streamlined data-recording utilizing social media platforms [41]. A key determinant in improving vaccine acceptance by healthcare workers will be through efforts that will increase the knowledge and awareness of the safety and efficacy of the COVID-19 vaccine [38].

Factors contributing to COVID-19 vaccine hesitancy among healthcare providers may differ from those noted with other vaccines including who provides the vaccine, where it is provided and anticipated safety risks associated with administration setting [42-44]. Group influences, including personal experience of the patient and provider, have also been shown to impact vaccine hesitancy [5]. Our data showed differences in vaccine trust (safety and efficacy) by healthcare provider type. In our study, respondents did not trust the safety and or efficacy of the COVID-19 vaccine (Q9.1, 9.2). Physicians and physician assistants were less likely to believe that the pharmaceutical industry would provide a safe and effective COVID-19 vaccine, more likely to believe COVID-19 vaccine use may be associated with have serious vaccine-related complications (Q6.2), might not protect against COVID-19 infections and/or complications, and plan to wait and see how the COVID-19 vaccine affected others before they received and/or recommended it. Males in our study were also less likely than females to believe that the vaccine would be safe and effective. We hypothesize that one factor in these differences is due to provider personal experience with vaccines/vaccination, which is evolving for each profession.

A majority of US adults (57%) reported they would trust scientific research findings more if researchers made their data publicly available [45,46]. Accelerated vaccine development programs must gain public and healthcare provider trust, demonstrating they are not compromising efficacy or safety by more openly sharing safety and efficacy data, especially with prescribing healthcare providers. Previous data has demonstrated that empowering healthcare providers and the public with knowledge leads to increased confidence in the vaccine resulting in an uptake in vaccination and recommendation for vaccination [47,48].

Limitations

Limitations of our study include but are not limited to survey distribution channels; time of survey distribution; and sample size. The decision to use professional organizations for each state rather than licensing boards was made primarily based on data acquisition costs. However, we hoped that the ease of survey access through the online platform and incentive helped increase participation. Lastly, we had only 26-physicians respond to our survey. Due to the small sample size, we combined their responses with those of physician's assistants to create a large enough sample size to assess contribution of gender, age, role in healthcare system, and political

ideation. Incomplete surveys and what appeared to be intentional skipping of the political ideation question may indicate distrust and frustration with the politicization of the COVID-19 pandemic; however, it is difficult to draw conclusions from one survey.

Conclusion

It is important to quantify and address factors contributing to vaccine hesitancy in healthcare professionals to prevent spread of the COVID-19. A number of contributing factors are modifiable and strategies could be tailored to address complacency and healthcare provider education needs, increase confidence, and alleviate distrust. Information garnered from this study can be used to inform and guide efforts to support consistent messaging that support state and federal vaccination efforts; reducing vaccine hesitancy and spread of SARS-CoV-2.

References

1. Hendrix KS, Sturm LA, Zimet GD, Meslin EM (2016) Ethics and Childhood Vaccination Policy in the United States. Am J Public Health 106: 273-278.

2. CDC (2020) Sharing and Shifting Tasks to Maintain Essential Healthcare During COVID-19 in Low Resource, non-US settings.

3. Mayo Clinic (2020) Herd immunity and COVID-19 (coronavirus): What you need to know.

4. Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, et al. (2020) Vaccine hesitancy: the next challenge in the fight against COVID-19. Eur J Epidemiol 35: 775-779.

5. Sage Working Group on Vaccine Hesitancy (2014) Report of the Sage Working Group on Vaccine Hesitancy.

6. US News (2019) WHO Names Vaccine Hesitancy as Top World Threat in 2019. National News.

7. Nguyen LH, Drew DA, Joshi AD, Guo CG, Ma W, et al. (2020) Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study. medRxiv.

8. Dooling K (2020) Phase 1 allocation COVID-19 vaccine: Work Group considerations.

9. (2020) Some health care workers hesitant to take COVID vaccine.

10. Blasi F, Aliberti S, Mantero M, Centanni S (2012) Compliance with anti-H1N1 vaccine among healthcare workers and general population. Clin Microbiol Infect 18: 37-41.

11. Corace KM, Srigley JA, Hargadon DP, Yu D, MacDonald TK, et al. (2016) Using behavior change frameworks to improve healthcare worker influenza vaccination rates: A systematic review. Vaccine 34: 3235-3242.

12. Donadiki EM, Jiménez-García R, Hernández-Barrera V, Sourtzi P, Carrasco-Garrido P, et al. (2014) Health Belief Model applied to non-compliance with HPV vaccine among female university students. Public Health 128: 268-273.

13. Gasmi A, Noor S, Tippairote T, Dadar M, Menzel A, et al. (2020) Individual risk management strategy and potential therapeutic options for the COVID-19 pandemic. Clin Immunol 215: 108409.

14. Dictionary by Merriam-Webster: America's most-trusted online dictionary.

15. Dictionary, Encyclopedia and Thesaurus - The Free Dictionary.

16. https://ec.europa.eu/health/sites/health/files/vaccination/docs/glossary_en.pdf

17. The New York Times (2020) Coronavirus Doctors Battle Another Scourge: Misinformation.

18. MedPage Today (2020) COVID Patients' Crackpot Theories Take Toll on Healthcare Workers.

19. AP News (2020) Video contains a litany of false claims about COVID-19 and vaccines.

20. Paoli S, Lorini C, Puggelli F, Sala A, Grazzini M, et al. (2019) Assessing Vaccine Hesitancy among Healthcare Workers: A Cross-Sectional Study at an Italian Paediatric Hospital and the Development of a Healthcare Worker's Vaccination Compliance Index. Vaccines (Basel) 7: 201.

21. Barrière J, Vanjak D, Kriegel I, Otto J, Peyrade F, et al. (2010) Acceptance of the 2009 A(H1N1) influenza vaccine among hospital workers in two French cancer centers. Vaccine 28: 7030-7034.

22. Maconachie M, Lewendon G (2004) Immunising Children in Primary Care in the UK - What are the Concerns of Principal Immunisers? Health Education Journal 63: 40-49.

23. American Medical Association (2020) Are physicians obliged to get vaccinated against COVID-19?

24. Opel DJ, Salmon DA, Marcuse EK (2020) Building Trust to Achieve Confidence in COVID-19 Vaccines. JAMA Netw Open 3: e2025672.

25. American Psychological Association (2020) Building Community Trust to Improve Participation in COVID-19 Testing and Contact Tracing.

26. The New York Times (2020) Covid Vaccines Are Coming. A Divided and Distrustful America Awaits.

27. The Independent (2020) Distrust of government leading to 'alarming' vaccine scepticism, poll finds.

28. YaleNews (2020) Politics affect public buy-in on COVID-19 vaccine, study shows.

29. Freimuth VS, Musa D, Hilyard K, Quinn SC, Kim K (2014) Trust during the early stages of the 2009 H1N1 pandemic. J Health Commun 19: 321-339.

30. The Baltimore Sun (2020) Tucker Carlson tells viewers to be nervous about COVID vaccine.

31. CNN (2020) US coronavirus news: Experts know more about the coronavirus vaccines than any other in history.

32. Armstrong K, Rose A, Peters N, Long JA, McMurphy S, et al. (2006) Distrust of the health care system and self-reported health in the United States. J Gen Intern Med 21: 292-297.

33. NPR (2020) PPE Shortages Persist Nearly 9 Months into the Coronavirus Pandemic.

34. Daily Nurse (2020) Practice What You Preach: The Value of Healthy Nurses.

35. Physician's Weekly (2020) Practicing What We Preach?

36. Wick JY (2016) When it Comes to FLu Shots, Do Pharmacists Practice What they Preach?

37. O'Keefe SM (2020) One in Three Americans Would Not Get COVID-19 Vaccine.

38. Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, et al. (2016) Vaccine hesitancy and healthcare providers. Vaccine 34: 6700-6706.

39. World Health Organization (2020) WHO SAGE values framework for the allocation and prioritization of COVID-19 vaccination.

40. CDC (2020) Vaccine Testing and Approval Process.

41. CDC (2020) How CDC Is Making COVID-19 Vaccine Recommendations.

42. Quartz (2020) Ten years ago, H1N1 swine flu ushered in drug-store flu shots.

43. CDC (2020) National and State-Level Place of Flu Vaccination among Vaccinated Adults in the United States, 2014-15 Flu Season.

44. CDC (2011) Place of Influenza Vaccination among Adults --- United States, 2010—11.

45. Pew Research Center (2020) How Americans view research and findings.

46. Pew Research Center (2020) Intent to Get a COVID-19 Vaccine Rises to 60% as Confidence in Research and Development Process Increases.

47. Junqueira L (2020) Information: Empowering Healthcare Professionals in Fostering Safe Systems.

48. Sibbitt S (2020) Empowering Physicians to Become Stewards.