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Will they, or Won't they? Examining patients' vaccine intention for flu and COVID-19 using the Health Belief Model

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ABSTRACT

Background: The twindemic of influenza and COVID-19 places pharmacists in a position of high-impact to inform and manage vaccination uptake. Given prior vaccine hesitancy in the US and the current high impact of COVID-19 on the population, it is imperative to understand and address factors that drive perceptions and intention to get vaccinated.

Objectives: The objectives of the study were to 1) determine impact of the COVID-19 pandemic on influenza vaccine uptake, on patient perceptions of vaccinations, vaccine intention, and health behaviors and 2) determine vaccine intention through the Health Belief Model.

Methods: An IRB-approved prospective Qualtrics-based survey was administered online to eligible respondents: non-pregnant panel respondents 18 years or older within the United States who could independently complete the entire questionnaire in English. Data analyses included descriptive statistics, psychometric analyses of the 5C and CoBQ tools, one-way ANOVA to compare demographic groups and vaccine intention items with survey scores, and mapping and path analysis of the HBM with one added domain (Decision Making Determinant, DMD).

Results: 525 respondents completed the survey from October 23–29, 2020. Respondents aged 18–49, making less than \$20,000 or an undisclosed income, and not having anyone close to them directly affected by COVID-19 showed a significant, negative impact of COVID-19 on health behavior and a significantly lower vaccine acceptance. The 5C and CoBQ showed moderately strong reliability. Mapping for the HBM revealed significant correlations between all modifying factors with Individual Perceptions except for Race/Ethnicity. Of the Individual Perceptions, Perceived Benefits (-.114) and Perceived Barriers (.307) significantly predicted DMD and directly impacted Vaccine Intention. DMD was not a significant mediator of Vaccination Intention.

Conclusions: Vaccination messaging should focus on a simple yet balanced view of benefits and risks, targeting those under age 50 and living in low-income households, to motivate uptake of influenza and COVID-19 vaccines.

Introduction

The COVID-19 virus has infected over 13.5 million Americans as of early December 2020 and factored in the deaths in over 268,000.¹ This viral threat is not new, as lower respiratory tract infections remain the most deadly communicable diseases, responsible for 3 million deaths worldwide in 2016.^{2,3} Prior to its vaccine development in the 1940s, the influenza virus caused 40–70 million deaths.⁴ Pharmaceutical companies raced to receive COVID-19 vaccine approval in the United States (US); they sought the Emergency Use Authorization (EUA) and deliberated solutions for access (the ability to fulfill transportation and vaccine storage requirements) as public health officials set up distribution hierarchies for vaccine recipients.⁵ The one vital element in question is the public's acceptance of the COVID-19 vaccine, a factor that has been complicated by mixed messaging regarding the spread of the virus and safety of novel vaccines.^{6–10} In regards to the flu, experience has shown that despite state coverage and relative affordability,

uptake for the influenza vaccine in the US has been markedly low at 48.4%, hitting the lowest mark of 34.2% among 18–49 year-olds as reported in the 2019–2020 season.¹¹

The US population has shown conflicting intention when evaluating their choice to get immunized once the COVID-19 vaccine is available. Reported percentages ranged from 58 to 72% (depending on the poll) and revealed respondent concerns about vaccine side effects and overall effectiveness.^{12–15} To further complicate information, the COVID-19 vaccines closest to dissemination require two doses on different days.^{16–18}

Another factor that comes into play is age; the group with the lowest flu shot uptake (18–49) has reportedly seen more complications as COVID-19 has spread.¹⁹ Additionally, the Centers for Disease Control and Prevention (CDC) and studies reported the disproportionate effect of COVID-19 on certain racial and ethnic groups.^{20–24} In this climate, infectious disease experts [CDC and National Foundation for Infectious Diseases (NFID)] and public health officials have emphasized the need

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for the flu vaccination during a respiratory pandemic like COVID-19, highlighting some evidence of cross immunity against COVID-19.^{25–28} The pharmacy profession has been given the large responsibility in preparing to administer the COVID-19 vaccine and continuing to administer the flu shot; this has been reinforced by health organizations, pharmaceutical companies, and governmental plans.²⁹ Pharmacists will uniquely be involved and in a position to both increase the number of immunizers and reduce barriers associated with disparities in provided immunization services.³⁰ It is imperative that pharmacists and health care providers effectively increase awareness of the need for vaccination while also recognizing the complex mix of pandemic factors during this time.^{31,32} A modification in public acceptance and intention to receive flu and COVID-19 vaccines is needed to significantly prevent spread and to establish herd immunity.^{33,34}

Various health behavior models have been proposed and used to explain vaccination intention, including the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM).^{35,36} HBM was chosen as the model for the current study to determine the likelihood of vaccination in the US due to its design, previous use in vaccination studies to identify behavior relationships, and overall fit with this study.^{37,38} When compared with other models that explain behavior and resulting action, the HBM was specifically developed to focus on preventative health research.^{36–39} The HBM has been modified since its early use in the 1950s to be more inclusive and encourage interventions that improve health behaviors.⁴⁰ The most commonly cited concepts involved in the HBM include Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Cues to Action, and Self-Efficacy. The HBM suggests that Modifying Factors including patient characteristics, demographics, and certain knowledge directly impact individual beliefs and lead to individual intention. In terms of the COVID-19 pandemic and vaccination uptake, the behaviors of importance encompass intention to receive the COVID-19 and flu vaccines. The outside influence on individual behaviors as described by the HBM also includes “Cues to Action,” which could comprise the increased push by health care groups and providers, the media attention, etc. to seek out preventative health during the COVID-19 pandemic.

The objectives of the study were to 1) determine the impact of the COVID-19 pandemic on influenza vaccine uptake, on patient perceptions of vaccinations, vaccine intention, and health behaviors and 2) determine vaccine intention through the Health Belief Model. The authors used the HBM as framework with a combination of survey tools that were available (5C vaccine acceptance tool) and that our team developed (COVID-19 Behavioral Questionnaire or CoBQ).⁴¹

Methods

A prospective Qualtrics-based survey study was designed with four components: vaccination intention items, the 5C vaccination acceptance survey (Betsch et al.), the CoBQ, and demographic items to compare with the former three components. Fig. 1 illustrates the predicted HBM with Modifying Factors, Individual Perceptions, and Action. The Modifying Factors were expected to include the following demographic data collected from the questionnaire: number of prescription medications, gender identification, age group, race/ethnicity, education, and household income. Based on the volume of messaging and news regarding COVID-19, Cues to Action was hypothesized to be a Modifying Factor preceding the Individual Perceptions, rather than its usual role as an Action domain influencing the behavior. The HBM concepts included Individual Perceptions of Perceived Benefits, Perceived Barriers, and Perceived Threat. Perceived Susceptibility and Severity were classified under one umbrella domain of Perceived Threat. A Decision-Making Determinant (DMD) domain was added as a potential mediator between Individual Perceptions and Action.

Patient reported outcomes included overall vaccine intention and vaccination history. Vaccination Intention comprised separate questions asking if the respondent had taken the flu shot in the previous year

(2019–2020), and reasons they would/would not take the flu shot and a possible COVID-19 vaccine this year (2020–2021).¹ Instead of developing an entirely new survey, the authors used the previously validated 5C tool for vaccine factors (nonspecific for any one vaccination) and added components from the CoBQ that were developed in order to cross-walk with the HBM. The 15-item 5C tool was previously validated in Germany and through a translated English online survey. The domains of the 5C-comprised Confidence, Complacency, Constraints, Calculation (referring to an individual’s active interest to search for information), and Collective [Responsibility] (or the willingness to protect others). Each of these domains contained three items. The higher the 5C score (the closer to 4), the more likely the respondent is to accept vaccination. The survey was assessed by the authors for clarity and minor edits were made to the wording to correct any potential misinterpretations.

The CoBQ, developed by the current authors, was designed to have 18 items with four expected domains: General Health (4), Lifestyle (4), Public Awareness (6), and Mental Health (4). To ensure that the CoBQ was clear to its respondents, face and content validity were assessed by four lay people and four health care professionals (not including the authors) before it was sent for IRB approval. In terms of grading and the associated relationships, it was predicted that the higher the CoBQ score (the closer to 4), the greater the negative impact of the COVID-19 pandemic on health behavior. Both the CoBQ and 5C surveys had a four-point Likert Scale with corresponding points (Strongly Disagree-1, Disagree-2, Agree-3, and Strongly Agree-4). The survey items, study, and use of the Qualtrics panel were approved by the IRB prior to administration. (See Appendix for the full questionnaire.)

All eligible participants accessed the abovementioned surveys online via Qualtrics through their membership within the Qualtrics Panel. They were recruited based on the following inclusion criteria: respondents must be at least 18 years of age, able to independently answer questions without assistance, be a member of the Qualtrics panel, consent to participate, reside in the United States, and be able to understand and complete the full questionnaire in English. Recruitment was also based on Qualtrics’ balancing for region, gender, ethnicity, and income from a general US census breakdown. An example of the expected breakdown included the following for ethnicity: Non-Hispanic White ~66%, Non-Hispanic Black ~12%, Hispanic ~12%, and Other~10%. Gender was expected to be balanced between male and female while also allowing for a respondent to choose “non-binary” or “prefer not to disclose”. The first item in the questionnaire was a required agreement to complete the survey and consent to participate in the study, which needed to be checked in order to proceed.

Descriptive statistics for demographic and vaccination intention items were analyzed. One-sample scale reliability of the 5C and CoBQ was tested and measured by Cronbach’s Coefficient alpha. Construct validity was tested through factor analysis with Varimax rotation. Item-item and inter-domain correlations were further examined for validity. Correlational analyses were conducted between the scores from the CoBQ, the 5C, and vaccination intention items. A path analysis was conducted of the model; this included linear regression from Individual Perceptions to DMD, logistic regressions from demographics to Individual Perceptions and from DMD to vaccine intention [for flu and COVID-19 vaccines]. A binary variable was used for the COVID-19 vaccine intention, grouping the two “I will...” responses into “Yes” and the two “I won’t...” responses into “No”, while the intention for flu vaccine required a multinomial logistic regression model to compare “Yes,” “No,” and “Unsure” responses. Goodness-of-fit tests were performed for these two models to assess their ability to fit the distribution of the data, and statistical significance was set at alpha less than 5%. Collinearity between independent variables was analyzed using VIF in each of the models. All data were collected electronically via Qualtrics and transferred to SPSS 26.0 for analysis. Logistic and multinomial

^[1] This study preceded COVID-19 vaccine approval.

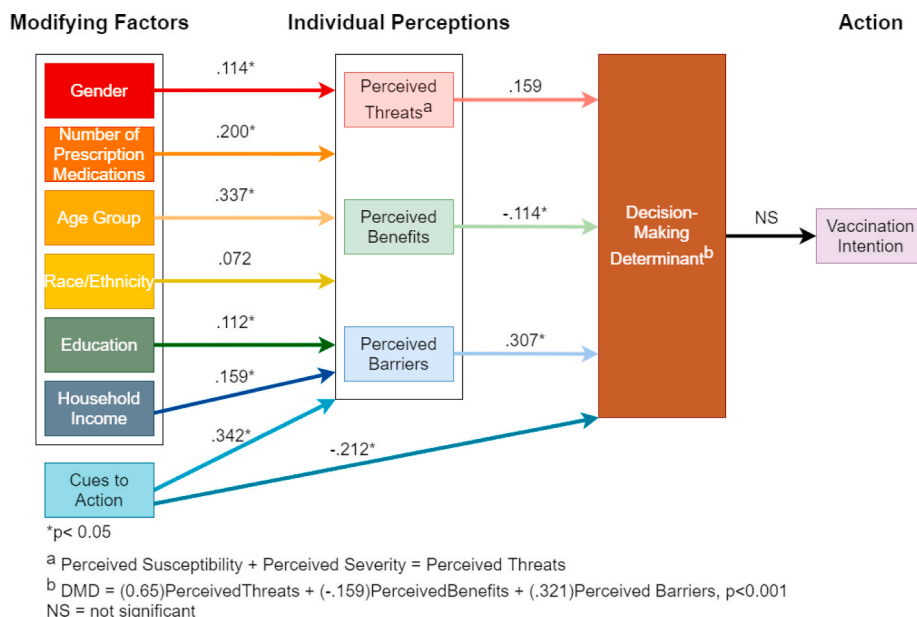


Fig. 1. CoBQ-5C HBM for both flu and COVID-19 vaccination intention with standardized beta coefficient and Spearman’s correlation coefficient.

logistic regressions related to vaccine intention were analyzed through Stata SE 15 (Stata Corp., College Station, TX).

Results

Participant characteristics

Data collection began on October 23, 2020 and concluded on October 29, 2020. Baseline characteristics are shown in Table 1, of which age, gender, and racial proportions were sought to closely match US Census estimates. Of note, approximately 60% of the respondents reported to have some college education or higher.

Vaccination Intention/History

Table 1 also illustrates the respondent-reported results regarding vaccination intention and history. There was an increase from 238 to 278 (a 7.62% improvement) in respondents who stated they received the flu shot last season (2019–2020) and those who planned (or had already received) the flu shot this year (2020–2021). There was a small proportion of respondents who reported ‘still unsure’ about receiving this year’s flu shot (10.29%). The most selected reason respondents intended to vaccinate was their belief that it will help (37.90%). In contrast, a similar percentage of respondents stated that they might not take the flu shot because they do not believe the flu vaccine helps (38.16%). Over half of the respondents (56.19%) stated that no one close to them had been directly impacted by the COVID-19 pandemic. In regards to the COVID-19 vaccine, 66.7% reported willingness to vaccinate. Of the 1/3, 13.71% felt that they did not need the vaccine, while 19.62% were more concerned about the side effects rather than the benefits of getting vaccinated.

Scale reliability

The 30-item combined CoBQ-5C tool showed good reliability as displayed by Cronbach’s alpha of 0.765. During individual tool analysis, the 18-item CoBQ demonstrated moderately good reliability with Cronbach’s alpha = 0.636. Reliability for the 13-item 5C was consistent with its original validation as represented by Cronbach’s alpha = 0.749.⁴¹

Validity of questionnaires

A forced five-factor analysis with Varimax rotation of the 15-item 5C revealed similar results to the original study by Betsch et al.⁴¹ All items loaded onto their hypothesized domains except 38 and 45, and Confidence and Collective Responsibility items merged into one domain. Items 38 and 45 from the 5C were removed before conducting the factor analysis of the CoBQ-5C tool for HBM as seen in Table 3. Item-item correlations were strong within domains and ranged from 0.665 to 0.861.

A factor analysis with Varimax rotation on the CoBQ resulted in four domains. Expected items in Mental Health and Public Awareness loaded as predicted apart from item 15 (from the CoBQ) that split loading between two domains. All item-item correlations within resulting domains ranged from moderate to strong (0.436–0.845).

Comparisons and correlations

As seen in Table 2, One-way ANOVA showed significant differences in both 5C and CoBQ scores within age groups, household income groups, and respondent knowledge of impact of COVID-19 on someone close to them (p < 0.05). Respondents who knew how the flu shot helped (3.04) and thought it was important to protect others (3.01) scored the highest on the vaccine acceptance scale. Elderly patients (70 or older) also had the highest vaccine acceptance score by at least 0.16 points compared to the other age groups (2.94). There was a significant difference in vaccination acceptance between groups with different racial identities and education. The American Indian, Alaska Native, Asian, and South Asian groups scored the highest in vaccine acceptance (2.87–2.89) while Black or African American scored the lowest (2.55). Those with a Bachelor’s degree had the highest vaccine acceptance (2.87) and apart from those who did not want to disclose their education, those with some high school had the lowest score (2.61). The highest vaccine acceptance score in household income was at the \$101k–\$150k level (2.90) and the lowest was the less than \$20k group (2.64).

The group that obtained the highest CoBQ score, and therefore reported the most negative effects on their behavior from the COVID-19 pandemic, included respondents who did not know if someone close to them was directly impacted by the COVID-19 pandemic (2.41), identified as non-binary (2.57), mixed race (2.44), did not want to disclose their household family members (2.43) or their education

Table 1
Baseline characteristics.

	# and (%) (n = 525)
<u>I got the flu vaccine last year</u>	
Yes	238 (45.33%)
No	271 (51.62%)
I don't remember	16 (3.05%)
<u>I plan to get (or have already received) the flu shot this year (2020–2021)</u>	
Yes	278 (52.95%)
No	193 (36.76%)
Unsure	54 (10.29%)
<u>(For those who responded “Yes” to “I plan to get the flu shot...”)</u>	
<u>I will get (or have already received) the flu vaccine this year because (select ALL that apply)*</u>	
It is mandatory for my work	35 (7.06%)
I believe it will help	188 (37.90%)
I know how it helps	127 (25.60%)
I think it is important to protect others	146 (29.44%)
<u>(For those who responded “No” to “I plan to get the flu shot...”)</u>	
<u>I may not take the flu vaccine this year because (select ALL that apply)*</u>	
It will give me the flu	62 (20.39%)
I do not believe it helps	116 (38.16%)
I do not know how it helps	66 (21.71%)
I won't be interacting with others	60 (19.74%)
<u>Has anyone close to you been directly impacted by the COVID-19 Pandemic?</u>	
Yes	204 (38.86%)
No	295 (56.19%)
I don't know	26 (4.95%)
<u>If the COVID-19 vaccine becomes available, select one of the following statements that best fits your opinion:</u>	
I will get the COVID vaccine immediately when it is available	128 (24.38%)
I will get the COVID vaccine only when it has been out for a few months	222 (42.49%)
I will not get the COVID vaccine because I don't want to have side effects	103 (19.62%)
I will not get the COVID vaccine because I don't need it	72 (13.71%)
<u>Prescription Medications Taken On a Regular Basis?</u>	
No	237 (45.14%)
Yes, 1–2 prescriptions	138 (26.29%)
Yes, 3–5 prescriptions	109 (20.76%)
Yes, 6 or more	41 (7.81%)
<u>Gender Identity</u>	
Male	263 (50.10%)
Female	257 (48.95%)
Non-binary	4 (0.76%)
I do not want to disclose	1 (0.19%)
<u>Age Group</u>	
18–29	110 (20.95%)
30–49	172 (32.76%)
50–69	168 (32.00%)
70 or older	74 (14.10%)
I do not want to disclose	1 (0.19%)
<u>Race Identity</u>	
American Indian or Alaska Native	7 (1.33%)
Asian	19 (3.62%)
South Asian	3 (0.57%)
Black or African American	63 (12.00%)
Native Hawaiian or Other Pacific Islander	1 (0.19%)
Hispanic or Latinx	63 (12.00%)
White	347 (66.10%)
Mixed Race	18 (3.43%)
Chose not to disclose	4 (0.76%)
<u>Highest Education</u>	
Some high school	24 (4.57%)
High school diploma	143 (27.24%)
Some college	143 (27.24%)
Associate degree (e.g., AA, AS)	50 (9.52%)
Bachelor's degree (e.g., BA, BS)	105 (20.00%)
Master's degree or higher (e.g., MA, MS, PhD)	56 (10.67%)
I do not want to disclose	4 (0.76%)
<u>Household Members other than self*</u>	
At least 1 baby 0–3 years old	34 (5.26%)
At least 1 child 4–17 years old	123 (19.01%)
At least 1 adult 65 years or older	75 (11.59%)
At least 1 adult 18 years or older	266 (41.11%)
There are no others in my household	126 (19.47%)
I do not want to disclose	23 (3.55%)
<u>Household Income</u>	
Less than \$20,000	168 (32.00%)
\$21,000 to \$50,000	185 (35.24%)
\$51,000 to \$100,000	109 (20.76%)
\$101,000 to \$150,000	24 (4.57%)
Greater than \$150,000	24 (4.57%)
I do not want to disclose	15 (2.86%)

*n ≠ 525.

Table 2
Average survey scores based on demographic characteristics or vaccination intention/history and ANOVA^a.

	Mean 5C Score + SD	Mean CoBQ Score + SD
<u>I got the flu vaccine last year</u>		
Yes	2.89 + 0.44	2.27 + 0.37
No	2.59 + 0.36	2.29 + 0.32
I don't remember	2.48 + 0.30	2.36 + 0.27
	ANOVA p < 0.05 between groups	
<u>I plan to get (or have already received) the flu shot this year (2020–2021)</u>		
Yes	2.88 + 0.43	2.27 + 0.36
No	2.50 + 0.34	2.30 + 0.32
Unsure	2.70 + 0.30	2.30 + 0.31
	ANOVA p < 0.05 between groups	
<u>(For those who responded "Yes" to "I plan to get the flu shot...")</u>		
<u>I will get (or have already received) the flu vaccine this year because (select ALL that apply)</u>		
It is mandatory for my work	2.69 + 0.43	2.38 + 0.33
I believe it will help	2.89 + 0.43	2.28 + 0.36
I know how it helps	3.04 + 0.44	2.23 + 0.39
I think it is important to protect others	3.01 + 0.40	2.21 + 0.37
<u>(For those who responded "No" to "I plan to get the flu shot...")</u>		
<u>I may not take the flu vaccine this year because (select ALL that apply)</u>		
It will give me the flu	2.53 + 0.34	2.34 + 0.34
I do not believe it helps	2.47 + 0.38	2.31 + 0.34
I do not know how it helps	2.58 + 0.30	2.20 + 0.29
I won't be interacting with others	2.59 + 0.35	2.28 + 0.32
<u>Has anyone close to you been directly impacted by the COVID-19 Pandemic?^b</u>		
Yes	2.79 + 0.44	2.34 + 0.33
No	2.68 + 0.42	2.23 + 0.34
I don't know	2.69 + 0.33	2.41 + 0.31
	ANOVA p < 0.05 between groups	ANOVA p < 0.05 between groups
<u>If the COVID-19 vaccine becomes available, select one of the following statements that best fits your opinion:</u>		
I will get the COVID vaccine immediately when it is available	2.87 + 0.47	2.32 + 0.31
I will get the COVID vaccine only when it has been out for a few months	2.85 + 0.37	2.24 + 0.36
I will not get the COVID vaccine because I don't want to have side effects	2.50 + 0.30	2.31 + 0.32
I will not get the COVID vaccine because I don't need it	2.40 + 0.36	2.32 + 0.34
	ANOVA p < 0.05 between groups	
<u>Prescription Medications Taken On a Regular Basis?</u>		
No	2.63 + 0.38	2.28 + 0.35
Yes, 1–2 prescriptions	2.77 + 0.43	2.27 + 0.30
Yes, 3–5 prescriptions	2.83 + 0.45	2.29 + 0.37
Yes, 6 or more	2.86 + 0.46	2.31 + 0.32
	ANOVA p < 0.05 between groups	
<u>Gender Identity</u>		
Male	2.69 + 0.42	2.31 + 0.32
Female	2.75 + 0.44	2.25 + 0.35
Non-binary	2.88 + 0.31	2.57 + 0.22
I do not want to disclose	N/A	N/A
<u>Age Group,^b</u>		
18-29	2.62 + 0.38	2.37 + 0.31
30-49	2.63 + 0.42	2.31 + 0.33
50-69	2.78 + 0.43	2.22 + 0.35
70 or older	2.94 + 0.40	2.22 + 0.33
I do not want to disclose	N/A	N/A
	ANOVA p < 0.05 between groups	
<u>Race Identity</u>		
American Indian or Alaska Native	2.89 + 0.48	2.38 + 0.19
Asian	2.88 + 0.59	2.24 + 0.36
South Asian	2.87 + 0.19	2.18 + 0.46
Black or African American	2.55 + 0.39	2.24 + 0.35
Native Hawaiian or Other Pacific Islander	N/A	N/A
Hispanic or Latinx	2.68 + 0.38	2.25 + 0.36
White	2.75 + 0.42	2.29 + 0.33
Mixed Race	2.79 + 0.45	2.44 + 0.36
Chose not to disclose	2.54 + 0.31	2.26 + 0.50
	ANOVA p < 0.05 between groups	
<u>Highest Education</u>		
Some high school	2.61 + 0.37	2.39 + 0.26
High school diploma	2.66 + 0.36	2.28 + 0.32
Some college	2.72 + 0.42	2.30 + 0.32
Associate degree (e.g., AA, AS)	2.69 + 0.43	2.27 + 0.41
Bachelor's degree (e.g., BA, BS)	2.87 + 0.44	2.25 + 0.38
Master's degree or higher (e.g., MA, MS, PhD)	2.71 + 0.51	2.26 + 0.31
I do not want to disclose	2.40 + 0.26	2.55 + 0.31
	ANOVA: p < 0.05 between groups	
<u>Household Members other than self^c</u>		
At least 1 baby 0–3 years old	2.57 + 0.31	2.31 + 0.29
At least 1 child 4–17 years old	2.69 + 0.41	2.30 + 0.33

(continued on next page)

Table 2 (continued)

	Mean 5C Score + SD	Mean CoBQ Score + SD
At least 1 adult 65 years or older	2.78 + 0.43	2.19 + 0.34
At least 1 adult 18 years or older	2.77 + 0.42	2.26 + 0.34
There are no others in my household	2.75 + 0.45	2.31 + 0.36
I do not want to disclose	2.64 + 0.35	2.43 + 0.25
Household Income^b		
Less than \$20,000	2.64 + 0.37	2.35 + 0.32
\$21,000 to \$50,000	2.72 + 0.41	2.27 + 0.34
\$51,000 to \$100,000	2.82 + 0.46	2.24 + 0.33
\$101,000 to \$150,000	2.90 + 0.53	2.24 + 0.41
Greater than \$150,000	2.77 + 0.51	2.17 + 0.35
I do not want to disclose	2.66 + 0.35	2.31 + 0.47
	ANOVA $p < 0.05$ between groups	ANOVA $p < 0.05$ between groups

^a Scores were not compared if group's $n < 2$.

^b There is a significant difference between groups ($p < 0.05$) in both 5C and CoBQ scores.

^c $n > 525$ due to multiple responses allowed. This characteristic was not tested for correlation between groups.

(2.55).

Crosswalk to HBM

Factor analysis with Varimax rotation of the combined CoBQ-5C was conducted for fit to the HBM (Fig. 1). Seven domains clearly emerged from the factor analysis mapping the HBM. Analysis of Modifying Factors revealed that all included demographic factors except race/ethnicity were significantly related to the domain of Individual Perceptions ($p < 0.05$). The number of household members was excluded because multiple responses were possible which could have confounded the analysis. Age group had the greatest correlation with Individual Perceptions (.337). Cues to Action was significantly related to both the Individual Perception (.342) and DMD (-.212) components. The inner DMD regression model was significant at an R^2 of 0.127; where 13% of variance in DMD was significantly explained by Perceived Benefits (30.7%, $p < 0.001$) and Perceived Barriers (-11.4%, $p < 0.001$), with a very low multicollinearity ($VIF \sim 1.1$). DMD did not have a significant mediating impact on vaccine intention although crude (unadjusted) logistic regression demonstrated a significant association between two of the three DMD items and Vaccine Intention. A one-unit increase in item 28 (Table 3) was significantly associated with a 13% increase in the odds of COVID-19 vaccine intention. Similarly, a one-unit increase in item 30 was significantly associated with a 34% increase in the odds of COVID-19 vaccine intention. For the flu vaccine, neither the DMD nor its domain items significantly predicted intention. Crude logistic regression showed that Perceived Barriers and Perceived Benefits (but not Perceived Threat) were independently significantly associated with both flu vaccine and COVID-19 vaccine intention ($p < 0.001$).

Discussion

This study was the first to test, validate, and utilize a COVID-19 specific tool describing the pandemic's impact on respondent health behavior. Additionally, this study demonstrated the different facets involved in vaccination acceptance and intention using the HBM. Results of this study could inform future measures that might improve the health care system's understanding of its populations, identify those groups who may have concerns about the vaccines, and suggest a strong strategy for vaccine administrations based on significant associations within the predicted HBM.

Vaccination Intention/History

The items assessing vaccination intention supported the notion that a greater majority of respondents would be willing to receive the flu shot compared to last year. This is preliminarily confirmed by reports that

suggest a doubling in flu vaccine uptake in chain pharmacies compared to last year (e.g., one store reported administration of 2,621 flu vaccines by December compared to the previous season's 1,770).⁴² The respondents who were unsure (10.29%) or would not consider this year's flu shot present an opportunity for pharmacists to recognize the reasons used to avoid receiving a flu shot and address these notions using motivational interviewing. The commonly reported answers (21.71% of respondents stating that they do not know how it will help, 38.16% believing that it will not help, and 20.39% reporting that it will give them the flu), illustrate that as health care providers, there is still much to be done to make patients comfortable with vaccines while acknowledging their concerns. New interventions and approaches may be needed to promote vaccination and combat any false and damaging claims.^{8,43} Further, there was a 12.3% difference between respondents who believed the flu shot would help versus those who knew how it helps, which may indicate that those who do receive the flu shot may also not be adequately informed. In addition, the almost equal proportion of respondents who said they would or would not get the flu vaccination may be a result of mixed messages regarding the virus and vaccines.⁶

It was interesting to note that despite more than half of the respondents (56.1%) reporting that no one close to them had been directly impacted by COVID-19, approximately 2/3 stated that they would receive the COVID-19 vaccine if it were to become available. There have been influenza pandemics in the past and information from health care providers about the seriousness of the flu and need to receive the vaccine. Still, only this year during the novel COVID-19 pandemic did flu vaccine supply and demand compound from previous years.⁴⁴ Messaging about vaccinations have centered around herd immunity and getting the nation "back to normal," yet only 29.44% of those who stated they will receive or have received the flu shot this season were motivated by the idea to protect others.⁴⁵⁻⁴⁷ This finding may point to the need for a discussion of individual benefits rather than a population approach when encouraging flu shot uptake.

A majority of the patients reported that they would get the COVID vaccine (66.87%) with 24.38% responding that they would get it immediately. When compared with the Gallup Panel within a week of this study's data collection, this proportion exceeds the 58% who would agree to be vaccinated against COVID-19.¹² Tracking willingness to vaccinate against COVID-19 may be impacted by the mounting spread, amount of knowledge provided to the patients and overall vaccine beliefs as exemplified in the flu vaccine items.

5C

The 5C domains held up well in comparison to its previous testing.⁴¹ For two items, the interpretations by participants may have been

Table 3
CoBQ-5C factor loading with Varimax rotation and corresponding HBM components^a.

CoBQ-5C Domains	Public Awareness	Confidence and Collective Responsibility	Complacency and Constraints	Mental Health	General Health Habits	Perspective/Attitudes	Calculation
HBM Domains	Cues to Action	Perceived Benefits	Perceived Barriers	Perceived Threats (Perceived Susceptibility + Perceived Severity)		Decision-Making Determinant	
1) I avoid crowds as much as possible to prevent my risk of getting COVID-19.	.804	.123	.036	-.055	-.037	.025	-.087
2) Since the COVID-19 pandemic, I have seen my extended family or friends less often than usual.	.627	-.004	.140	-.124	-.176	.160	-.139
3) I always wear a mask when outside of my home or around other people.	.789	.205	.058	.013	.004	.001	.014
4) I am concerned that people who do not follow the rules will get others sick.	.798	.232	.018	-.076	-.008	-.042	-.099
5) I think that all who follow quarantine lower the risk of getting COVID-19.	.713	.328	-.043	-.027	.020	-.017	-.036
6) Going out and participating in large gatherings (more than 15 people) puts everyone at risk.	.673	.231	.114	-.127	-.053	.038	-.107
7) During the COVID-19 pandemic, I have been seeing my doctor only for emergencies, not for regular care. ^R	-.176	.018	.220	.043	.419	-.256	-.104
8) Avoiding COVID-19 risk is more important than taking care of my chronic health issues. ^R	-.282	-.141	.442	-.080	.365	-.030	-.151
9) It has gotten more difficult to take care of myself since the COVID-19 pandemic. ^R	-.023	-.021	.180	.363	.601	.041	-.030
10) I have not been eating healthy during the COVID-19 pandemic. ^R	.059	-.043	.154	.173	.752	.010	.014
11) I have not exercised as much during the COVID-19 pandemic. ^R	-.059	-.068	-.043	.069	.792	.088	.150
12) I have developed some poor habits during the COVID-19 pandemic (e.g., poor sleep patterns, smoking, drinking more alcohol). ^R	-.026	-.052	.096	.470	.496	.046	.140
13) I have become sad or angry more often since the COVID-19 pandemic. ^R	-.155	-.020	.139	.790	.119	.076	.053
14) Since the COVID-19 pandemic, I have had less energy to do things. ^R	-.139	-.129	.096	.726	.311	.018	.040
15) The level of social interaction during the COVID-19 pandemic has impacted me negatively. ^R	-.027	-.152	.046	.784	.084	-.070	.067
16) The COVID-19 pandemic has had some positive effects on my daily life (e.g., reduced stress, time-spent commuting, expenses).	.163	.032	-.099	-.077	.004	.741	.047
17) Overall, my physical/social/mental health has remained fairly stable during the COVID-19 pandemic.	.216	.041	-.053	.247	.163	.648	-.053
18) Vaccinations are effective.	.211	.788	.152	-.065	-.099	.048	-.023
19) I am completely confident that vaccines are safe	.133	.830	.029	-.052	-.057	.024	.094
20) I am confident that public authorities decide in the best interest of the community.	.163	.784	-.156	-.010	.041	.041	-.025
21) I get vaccinated because I can also protect people with a weaker immune system.	.246	.653	.217	-.158	-.040	.048	-.091
22) Vaccination is a collective action to prevent the spread of diseases.	.336	.625	.192	-.111	-.075	.010	-.123
23) My immune system is so strong, it also protects me against diseases.	.258	-.236	.326	.016	-.108	-.409	.246
24) Vaccine-preventable diseases are not so severe that I should get vaccinated. ^R	.235	.006	.527	-.090	.073	-.269	.322
25) For me, it is inconvenient to receive vaccinations. ^R	.125	.258	.710	.069	.095	-.127	.185
26) Visiting the doctor's makes me feel uncomfortable, this keeps me from getting vaccinated. ^R	.076	.112	.764	.135	.149	-.042	.096
27) Everyday stress prevents me from getting vaccinated. ^R	.070	.064	.771	.268	.110	.017	.034
28) For each and every vaccination, I closely consider whether it is useful for me. ^R	-.062	-.005	.312	.030	.039	-.090	.649
29) It is important for me to fully understand the topic of vaccination, before I get vaccinated. ^R	-.150	-.075	-.032	.088	.106	-.029	.798
30) When I think about getting vaccinated, I weigh benefits and risks to make the best decision possible. ^R	-.153	-.007	.092	.076	-.035	.019	.783

^RRecoded Item.

^a Items 1–17 belong to the CoBQ and items 18–30 belong to the 5C.

different given the current COVID-19 pandemic environment: (Item 38: Vaccination is unnecessary because vaccine-preventable diseases are not common anymore and Item 45: When everyone is vaccinated, I don't have to get vaccinated too). When fitting the 5C items to the HBM, the authors chose to remove these two items before further analyses.

CoBQ

Psychometric testing of the 18-item CoBQ revealed a moderately reliable and valid tool that measures the impact of the COVID-19 pandemic on respondent behavior. The domains of Mental Health and Public Awareness loaded as expected. Through analysis of factor loading, two domains were renamed: "Lifestyle" to "Perspective/Attitude" and "General Health" to "General Health Habits."

Comparisons and Correlations

The significant differences in 5C and CoBQ scores within age groups and household income groups highlight some findings: respondents age 18–49 with the highest CoBQ scores, (indicating the most negative behavioral impacts from COVID-19) are also part of the age group with the lowest flu vaccination uptake in the United States.¹¹ Additionally, the lowest income group reported the highest CoBQ score when compared with all other household incomes. Respondent behaviors directly influence their willingness to vaccinate.⁴⁸ Identifying these groups before another wave of the COVID-19 pandemic occurs, or before another twindemic season with influenza, would have the potential to improve vaccine uptake and to address patient concerns.

The questionnaires were conducted before vaccination trial results were made public and the flu season hit its peak, which may influence current and future responses. The authors are continuing to test the full questionnaire in pharmacy and clinic settings. Future results may be able to distinguish a difference in acceptance, behavior, and intention based on when the questionnaire was completed. A change in leadership and the management of the COVID-19 pandemic in the US might also influence participant responses, particularly the items in the CoBQ in the Perspective/Attitude domain and Vaccination Intention items. Further testing of the CoBQ will be conducted to confirm its psychometric properties in other settings. Additional use of the combined questionnaire to assess patient groups at the highest risk of missed opportunities for vaccine uptake will continue to prove useful. Current results provide a snapshot within the COVID-19 pandemic that could prove useful for future comparisons.

HBM

The results of HBM from this study differ slightly from similar uses of the HBM in predicting vaccine intention or acceptance. Previous studies have examined determinants as a predictor of vaccine intention using concepts such as Self-Determination Theory and Willingness to Pay (WTP). In this study, Cues to Action and Perceived Benefits domains showed significant negative correlations with DMD. These results have unclear effects due to the non-significant relationship between the DMD domain and vaccine intention, although individual items from this domain did show significant relationships to vaccine intention.^{49–50} One study conducted before the COVID-19 pandemic noted the significant associations between Perceived Threat or Risk, Barriers, and Cues to Action when determining flu or H1N1 vaccine intention, while another study focused on domains related to knowledge and attitudes towards the flu vaccine.^{51–53} A recent study testing HBM with willingness to receive COVID-19 vaccine displayed that Perceived Benefits were significantly related to a "definite intention."⁵⁰ Our study confirmed the role of Perceived Benefits and Perceived Barriers on the Vaccine Intention for both flu and COVID-19 vaccines. One published study used the HBM for vaccine intention among students for A/H1N1 influenza and reported that with similar predictors to this study, a calculated pseudo

R^2 of 0.475 was significantly explained by Perceived Risk, Susceptibility, Seriousness, Barriers, and number of flu shots in the last 5 years.⁵² Recently, Clark et al. adapted the HBM to predict international COVID-19 voluntary compliance behaviors of rule following, taking health advice, and taking health precautions; through individual regressions of each behavior, the authors showed that the domain of health precautions ($R^2 = 0.54$) was the most effective domain.⁵⁴

While there have been several polls regarding potential vaccine uptake and some previously published studies with surveys based on previous pandemic questionnaires, this study was specifically created to address the COVID-19 pandemic through a health behavior framework and validated tool.^{12–15,55} A comparison of respondents who completed the questionnaire at the end of the flu season and later months of the COVID-19 pandemic versus the October group could illustrate a difference due to factors such as newfound hope with the vaccine news or a normalized COVID-19 lifestyle.

Key findings

Being within the age group 18–49, having a household income of \$20,000 or less, and knowing someone affected by the COVID-19 pandemic significantly affected respondents' vaccine acceptance and negatively impacted health behavior. Public health organizations have campaigned and marketed messages about COVID-19, this study's results indicate that Cues to Action (Table 3, items 1–6) do significantly impact vaccine intention. Finally, the results indicate that people in the US may make decisions based on perceived individual benefits and risks rather than the population threat of infection and its dire consequences. The above findings point to the need for a message that relays simple, straightforward, and evidence-based information (e.g., "take the COVID-19 vaccine available in your community and be sure to return for the second dose), while presenting a balanced view of the vaccination outcomes to individuals.⁵⁶ Pharmacists may be the best and most accessible health care professionals to utilize this information and improve flu and COVID-19 vaccine uptake.³⁰

Limitations

The study of 525 respondents was designed to be representative of the US population. However, this approach could have limited the ability to discover opportunities in underserved communities and minorities, both due to an online panel as well as potential language limitations. Focused studies in particular areas and demographics of interest would better suit an analysis of differences within a group or region. The authors have obtained certified translations of the full questionnaire in various languages and are in the process of data collection at various pharmacy sites. Inclusion of languages other than English would increase the generalizability of the study as well as help to ensure that any future results will not underrepresent any one patient group. There was also a potential for selection bias if the participation in a Qualtrics panel is indicative of higher engagement and stronger opinions.

Conclusion

The vaccination questionnaire provides reliable and valid tools that measure vaccination acceptance and the COVID-19 pandemic's impact on behavior. Study results indicate respondents could be disproportionately negatively impacted by the pandemic and less likely to accept vaccinations if they are in the 18–49 age group, have a household income less than \$20,000, and do not know anyone directly impacted by the COVID-19 pandemic. Pharmacists and public health groups could potentially improve flu vaccine uptake and contribute to high COVID-19 vaccine acceptance through education and outreach focused on individual perceived benefits of and barriers to the vaccine.

Author statement

This research paper being submitted to RSAP has not been considered for publication elsewhere.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.sapharm.2020.12.012>.

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