Drivers of Health Disparities and Consequences for COVID-19 Vaccine Choices: Modelling Health Preference Heterogeneity Among Underserved Populations

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ISPOR 2022, May 16

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The authors have no conflicts of interest to report.

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PhRMA Foundation Award Winners — Valuing Diversity: Addressing Health Disparities in Value Assessment

Challenge Award Question:
How can value assessment methods and processes better account for populations that are typically underrepresented in research and drivers of health disparities?

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Published in JMCP: https://www.jmcp.org/pb-assets/Supplements/Supplement9-a-1631902625

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1st Place

The Effect of Unobserved Preferences and Race on Vaccination Hesitancy for COVID-19 Vaccines: Implications for Health Disparities

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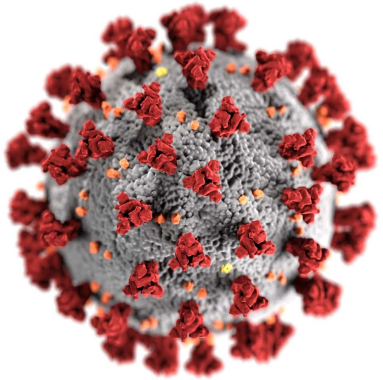
Background



- White residents were being vaccinated at significantly higher rates than Black residents.
- Reducing the extra burden of COVID-19 on people already facing disparities was a national priority for COVID-19 vaccine rollout.
- Public health efforts were targeted to address vaccine hesitancy among Blacks and other minority populations.

Research Objective

To identify key factors underlying the disparities in COVID-19 vaccination

Data

- Primary data from representative sample of population of four largest U.S. states (New York, California, Texas, Florida)
  - sampled from an online Qualtrics panel
  - representative with respect to U.S. population in terms of age, gender and race
  - between August 10 and September 3, 2020
  - N=475 (after exclusion criteria n=452)
- Longitudinal data asking respondents to imagine situation where several vaccines for COVID-19 had been developed.
  - would have undergone all required testing and received regulatory approval for use in humans

Study Design: Discrete Choice Experiment

- Six scenarios (choice tasks) and, in each task, two possible vaccines were described with seven attributes:
  - Risk of infection
  - Risk of serious illness
  - Estimated protection duration
  - Risk of mild side effects
  - Risk of severe side effects
  - Waiting time
  - Fee
- Vaccines also varied by two key population attributes:
  - Population coverage
  - Exemption from international travel restrictions

	Vaccine A	Vaccine B	No vaccine
Risk of infection:	5,000 out of 100,000 people (5%)	1,500 out of 100,000 people (1.5%)	7,500 out of 100,000 people (7.5%)
Risk of serious illness:	6,000 out of 100,000 people (6%)	10,000 out of 100,000 people (10%)	20,000 out of 100,000 people (20%)
Estimated protection duration:	6 months	3 months	
Risk of mild side effects	100 in 100,000 (0.1%)	5,000 in 100,000 (5%)	
Risk of severe side effects:	10 in 100,000 (0.01%)	1 in 100,000 (0.001%)	
Population coverage:	50%		
Extra rights from vaccination:			
Exemption on social distancing outside household	Yes		No
Exemption on wearing face masks for domestic travel	Yes		No
Exemption on quarantine for international travel	No		No

	Vaccine A		Vaccine B		
	Free access	**Paid access**	**Free access**	**Paid access**	**No vaccine**
Waiting time:	3 months		1 month		
Fee:		$100		$200	
Your preferred option:	O	O	O	O	O

Figure 1: Example Stated Choice question

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Analytic Approach of Study: Compare Model Fit

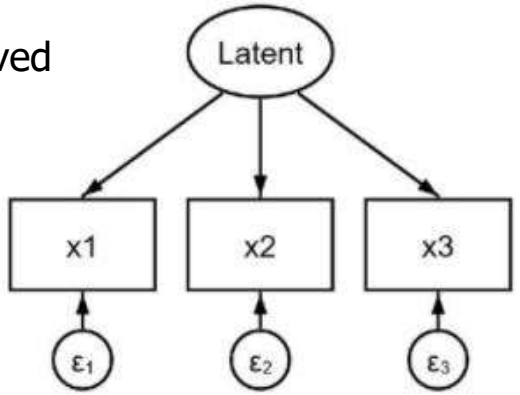
- Estimated five sets of choice models and compared model fit:
  - Simple multinomial logit – using continuous distribution
    - Interaction terms can be used to allow differences in preferences across different groups, where probability of person n choosing option i in task t is given by: $$P_{n,t}(i \mid x_{n,t}, \Omega) = \frac{e^{V_{i,n,t}}}{\sum_{j=1}^{J} e^{V_{j,n,t}}},$$
  - Nested Logit models
  - Mixed Logit models
    - Include observed as well as unobserved preferences such as personality traits, moral values, emotional distress, etc., by allowing for individual-specific intercepts
  - Latent class models (LC) – using discrete distributions
    - Probabilistically segmenting a sample population into different segments
    - Where log-likelihood function uses a weighted average across separate sub-models (one for each class), with the weights given by the class allocation probabilities, such that:

$$LL(x, z, \Omega, \gamma) = \sum_{n=1}^{N} log \sum_{s=1}^{S} \pi_{n,s} \left[\prod_{t=1}^{T} P_{n,t,s}(Y_{n,t} \mid x_{n,t}, \Omega_s)\right]$$

  - LC with socio-demographic effects as in nested logit (NL) models.

Analytic Approach (2)

- Final model specification "subgroup analysis": LC model with three classes, where in each class, we estimated a NL model, nesting together four vaccine options given in survey.
  - Determined heterogeneous treatment effects within classes
  - Also defines subgroup "membership" by both observed and unobserved



Rationale for LCA

- Typical value assessment methods in health, including cost-effectiveness and health outcomes, generally account for health disparities by using observed differences between most advantaged groups in a given category (income, race, etc.) and disadvantaged groups.
- Standard analysis of a "representative" sample – including underrepresented populations – yields average effects across the entire population.
  - Subtler problem is inclusion of unobserved preferences.
  - Mixed Logit models rely on using continuous statistical distributions to represent unobserved heterogeneity.
- Different approach is to use discrete (rather than continuous) distributions and probabilistically segmenting a sample population into different segments, such as Latent Class Analysis (LCA).
  - Actual class allocation is not observed deterministically, and LC structure consequently uses class allocation model where respondent belongs to class with a certain probability that we can estimate.
  - These class allocation probabilities can vary across individual decision-makers as a function of their observed characteristics.

Principal Findings

- Individuals who identify as Black had lower rates of vaccine hesitancy than those who identify as White.
  - True overall, by latent class and within latent class
  - Contrary to what is being reported, Blacks are not universally more vaccine hesitant.
- Combining respondents who would not consider a vaccine (17%) with those who would consider one but ultimately choose not to vaccinate (11%), more than 1 in 4 (28%) people will not be willing to vaccinate.
- No-vaccine rate is highest in Whites and lowest in Blacks.

Principal Findings (cont.)

- Latent class modeling found participants tended to cluster into three classes, which we termed:
  - "Anxious"
  - "Evaluative"
  - "Cost-Conscious"

	Latent Class Difference from Sample Mean (Posterior Estimation)		
	Class 1: Anxious	Class 2: Evaluative	Class 3: Cost-conscious
No Vaccine	1.2%	51.5%	4.1%
Wait for free vaccine	36.8%	36.2%	89.3%
Pay for Immediate Access	61.8%	12.3%	6.6%

Principal Findings (cont.)

- Stated reasons for seeking vaccination varied by race, with trust in public officials and physicians being the highest (comparatively) among White and lowest among Black Americans, respectively.

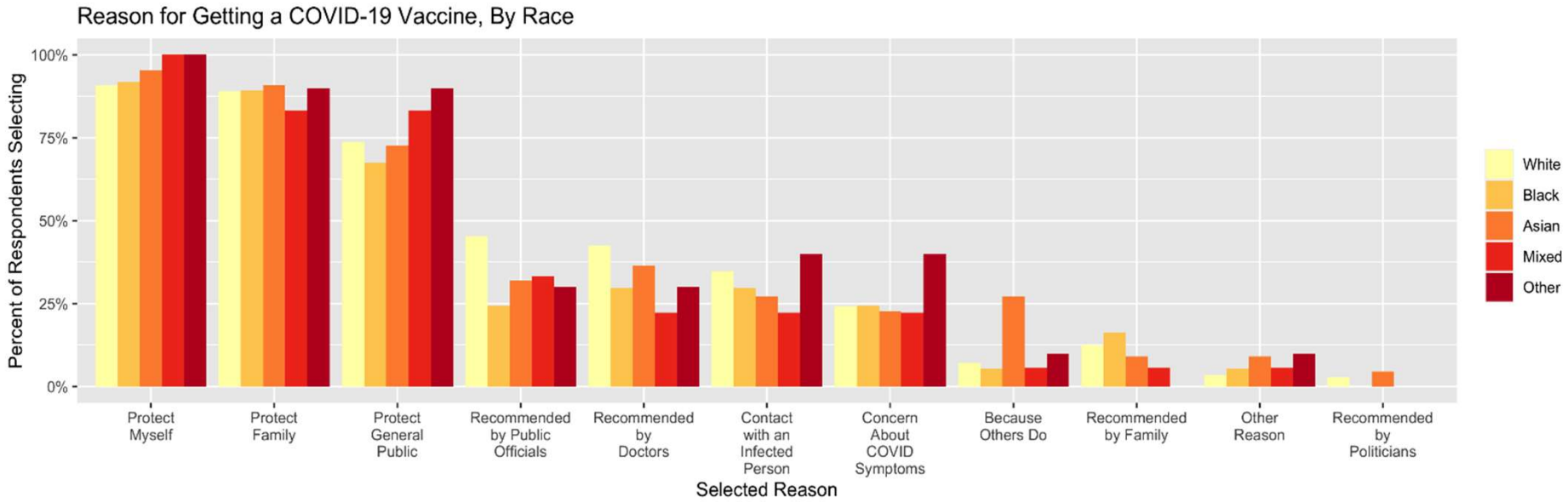


Figure 2: Reasons for getting vaccinated

Principal Findings (cont.)

- With exception of increased hesitancy by Whites, predicted uptake for the three vaccine options was not found to vary dramatically by race alone.
- Variation along racial and socioeconomic lines emerged during latent class analysis.

Vaccine Uptake	No Vaccine	Wait for free vaccine	Pay for Immediate Access
LCA all data	10.6%	59.9%	29.5%
By race			
White	11.8%	59.2%	28.9%
Black	7.6%	62.6%	29.8%
Asian	7.6%	62.4%	30.0%
Mixed	7.5%	62.4%	30.1%
Other	12.0%	58.6%	29.4%*

Principal Findings (cont.)

- Class 2 ("Evaluative" – highest "No Vaccine" class) membership is higher among:
  - Ages 41 to 60
  - Lower income (under $20k per year)
  - Lower levels of education
- Lower actual rates of vaccine hesitancy among Blacks may reflect differences in preferences by income and education that cut across races, with Black Americans more likely to be in low SES groups
  - Potentially due to structural racism

Demographic Group	Class 1: Anxious	Class 2: Evaluative	Class 3: Cost-conscious
Race			
White	0%	7%	-2%
Black	8%	-2%	-5%
Asian	-10%	-42%	24%
Mixed	-10%	-8%	11%
Other	1%	-33%	11%
Prefer not to say / missing	41%	-97%	3%
Income (USD)			
Less than $20K	13%	21%	-18%
$20K - $40K	40%	-31%	-21%
$40K - $75K	-19%	-21%	23%
More than $75K	-14%	17%	5%
Prefer not to say / missing	--	--	--
Education			
None	--	--	--
Less than high school	-96%	193%	5%
High school graduate / GED	14%	-11%	-7%
Associate's degree	2%	4%	-3%
Bachelor's degree	-1%	-10%	5%
Professional / graduate degree	-26%	25%	11%

Conclusions

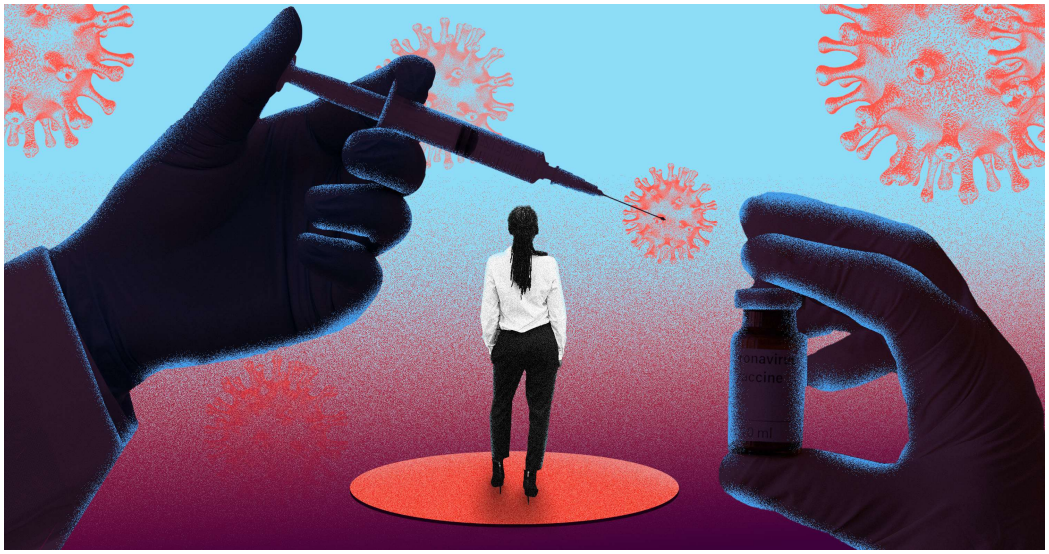
- Lower rates of vaccination among Black Americans do not reflect lower rates of racially motivated vaccine hesitancy.
- Instead, these lower rates reflect a higher proportion of Blacks among groups with vaccine hesitancy – lower income and lower educated individuals.
- To reduce racial disparities in vaccination rates, it will be necessary to address vaccine hesitancy more broadly in disadvantaged populations.

Value of LC Models in Health Preferences Research

- Subgroups will be homogeneous in response, but possible to also allow for further heterogeneity within class
- In our study: membership in subgroup may differ by health disparities
  - Example: could be a subgroup of individuals who are hesitant to receive a COVID-19 vaccine – group will act similarly – not based on health disparities – but membership within the group could be more likely for disadvantaged populations
- Application of these methods in health can be valuable to support policy development and clinical practice, especially to account for individual drivers of health disparities.

Policy Implications

- Public health efforts were being targeted to address vaccine hesitancy among Blacks and other minority populations.
- Our model results helped point the way to more effective differentiated policies.



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