

Perceived Usefulness of COVID-19 Mobile Applications for Vaccination in New York State (NYS)

DeeDee Bennett Gayle
University at Albany,
SUNY
dmbennett@albany.edu

Yvonne Dadson
University at Albany,
SUNY
ydadson@albany.edu

Mahsa Goodarzi
University at Albany,
SUNY
mgoodarzi@albany.edu

Xiaojun Yuan
University at Albany,
SUNY
xyuan@albany.edu

Abstract

This study investigates the acceptance and perceptions of COVID-19 mobile applications, particularly the Excelsior Pass for proof of vaccination in New York State (NYS). Employing the Antecedent Privacy Concerns Outcomes (APCO) methodology, a two-stage research approach was conducted, involving an online survey of 249 NYS residents and focus group interviews with 63 participants. The study explored the perceived usefulness of the apps and the influence of privacy and security concerns on their adoption, considering differences by race and age. Results showed that the Excelsior Pass was generally regarded as beneficial, with slight variations based on the task it was used for. While age and race had a minimal association, political affiliation proved more significant. Despite the apps' promise, their measured adoption emphasizes the need for targeted outreach and policy refinements to maximize their public health impact.

Keywords: Mobile applications, COVID-19, New York State, mixed method, vaccination mobile app

1. Introduction

Vaccines emerged as a valuable strategy for COVID-19 prevention. By July 2020, the global SARS-CoV-2 vaccine landscape included 158 vaccine candidates (Kaur and Gupta 2020; Kuter et al. 2021). In December 2020, the United Kingdom became the first country to implement a clinically approved vaccine (Smith, 2020). Billions of doses had been administered globally by mid-2021, with 24% of the world population having received at least one dose (Mathieu et al. 2021). The United States (US) was among the many countries that vaccinated at least half of their citizens against COVID-19 by mid-2021.

In the US, nationwide proof of vaccination was 'low tech.' Individuals receiving the COVID-19 vaccine were provided a vaccination card that included handwritten information about the vaccination dates, manufacturer, lot number, and location. Subsequent booster shots were also added to the same card and shared with the state health departments. Though the cards were branded as the Centers for Disease Control and Prevention (CDC), the CDC did not provide the card directly to people nor maintain the records (Canning et al. 2022; Kelly 2021; National Center for Immunization and Respiratory Diseases [NCIRD] (U.S.) 2022).

This CDC card was widely criticized as easily forged, lost or damaged (Frenkel 2021; Hanna 2021). Though a federal digital vaccination system was not feasible (Hecht-Felella 2021; Holmes et al. 2021), agencies like the Transportation Security Administration (TSA) accepted the card for travel requirements (Canning et al. 2022; NCIRD, 2022). Technology companies and states made efforts to align digital credentials into an interoperable national framework, such as the SMART Health Card (Jackson 2021). The importance of verifiable proof increased due to policies that exempted fully vaccinated individuals who remained asymptomatic after exposure from quarantine (without need for further testing). However, inconsistencies on the CDC cards, such as the absence of full names or birthdates, sometimes lead to verification issues (NCIRD, 2022).

The use of mobile apps for infectious disease outbreaks is not disease specific. While COVID-19 is on the rise again in parts of the US (Green, 2024), so too are other infectious diseases globally, including Mpox and an Ebola-like tick infection (Guy, 2024; Reardon, 2024). In fact, there is a correlation between climate change impacts and the spread of infectious diseases (Yehya, 2024). Therefore, there is an

increasing need to understand the best ways to secure adoption and acceptance of proof of vaccination apps in case they are needed again. Furthermore, requiring digital proof raised privacy and equity concerns, as it may have excluded marginalized people due to digital divide issues (Gostin et al. 2021; Zeinalipour-Yazti and Claramunt 2020).

While previous research primarily focused on the development and efficacy of COVID-19 vaccines (Kaur and Gupta 2020; Kuter et al. 2021) and the global progress of vaccination efforts (Mathieu et al. 2021), there was a lack of comprehensive analysis on the challenges and opportunities in the US associated with implementing a secure and equitable proof of vaccination system.

This study examines the landscape for proof of vaccination during COVID-19 in the US, identifying key barriers to the adoption, and proposing solutions to ensure the integrity and accessibility. By conducting a critical review of existing literature, analyzing case studies of successful implementations, and engaging with stakeholders, this research contributes to the development of a more robust and inclusive approach to verify vaccination status in the US and tests the Antecedents Privacy Concerns Outcomes (APCO) model.

2. Previous Work

Most research on digital health passports for vaccination, focused on personal data privacy (Eisenstadt et al. 2020; Frederiksen 2021; Kamin-Friedman and Peled Raz 2021; Spitale et al. 2022; Waitzberg et al. 2021). This focus centered around issues of public trust, vaccine hesitancy, privacy, and security concerns. Numerous studies examined how these factors influenced the adoption and effectiveness of technologies that supported the COVID-19 vaccination efforts (Ajana et al. 2023; Bardosh et al. 2022; Samha et al. 2022; Towett et al. 2023). These studies were primarily conducted abroad (Davis 2021; Karopoulos et al. 2021; Lee et al. 2021). State-level bans created challenges for the nationwide adoption and interoperability of digital health passport systems in the US (Karopoulos et al. 2021; Towett et al. 2023).

Nevertheless, some states, such as New York, implemented digital vaccine credential systems like the Excelsior Pass (Governor Kathy Hochul 2021). Bechtel (2022) evaluated the effectiveness of the Excelsior Pass and found that it facilitated the safe reopening of businesses and events while providing a secure and convenient way to manage vaccination records. However, the study acknowledged potential privacy concerns and the need for robust data

protection measures as potential data breaches or unauthorized access could undermine user trust and adoption (Becker et al. 2014; Esmailzadeh 2020; Mbunge et al. 2021). As mentioned by Karopoulos et al. (2021), the Excelsior Pass required sensitive permissions such as camera and external storage, likely for QR code scanning and verification purposes.

Previous evidence suggested mandatory digital passports could increase vaccine hesitancy (Burki 2022; Porat et al. 2021). Despite initial interest, users lost motivation or encountered usability issues, leading to decreased engagement and abandonment of the app (Mustafa et al. 2022; Towett et al. 2023). Some studies found willingness to adopt COVID-19 countermeasures like passports were impacted by political ideologies, trust in public health authorities, and sociodemographic factors like age and race/ethnicity (Esmailzadeh 2020; Waitzberg et al. 2021). Further research on the digital divide and its impact on the adoption of digital health tools is crucial to ensure equitable access to these technologies. Studies showed that individuals from lower socioeconomic backgrounds, racial and ethnic minorities, and those with limited digital literacy may face greater barriers in accessing and using digital health tools (Badr et al., 2024; Hargittai et al., 2019; Neter and Brainin 2019; Saeed and Masters, 2021; Wilson et al., 2016).

This study employs a mixed-method approach, analyzing quantitative survey data and qualitative focus group data. The survey and focus group instruments were based on the APCO framework. Survey questions were developed using Qualtrics and administered through Amazon Mechanical Turk. Focus group and survey participants received a comparative incentive. The mixed method protocol was approved by the University of Albany Institute Review Board, #22X036.

Several studies using the APCO framework employed a survey design (Dinev and Hart 2006; Lankton and Tripp 2013). Each adjusted the design to include specific elements unique to their device of investigation. The unique adjustment to this study was the use of the app for the specific purposes of a health-related emergency, COVID-19. Variables included experiences with mobile and vaccination apps, demographics, privacy and security concerns, and privacy awareness¹.

In contrast, the Technology Acceptance Model (TAM) primarily focuses on the perceived usefulness and perceived ease of use as determinants of technology adoption (Davis 1989; Venkatesh and Davis 2000). While TAM has been widely applied in various contexts, it does not explicitly address the role of privacy concerns, which are crucial in digital health

¹ [The Complete Survey & Focus Group Questions Based on APCO Framework](#)

tools (Angst and Agarwal 2009; Bansal et al. 2010). Given the sensitive nature of personal health information and the potential risks associated with data breaches or misuse, the APCO model provided a more comprehensive and relevant theoretical lens for understanding the factors influencing the adoption and perception (Dinev et al. 2016; Xu et al. 2010).

Throughout the pandemic, questions regarding the seriousness of the virus consumed the news media, politics, and familial discussions (Esmailzadeh 2022). Due to this unique consideration, investigators hypothesized that individuals who questioned the seriousness of the pandemic would be less likely to adopt the vaccination app, regardless of digital literacy or security concerns. Given the connection between the perceived seriousness of the pandemic and political affiliation, investigators included demographic questions related to the political party's support.

3. Methodology

Collectively, there were 312 individuals in our study: 249 survey respondents and 63 focus group participants. The demographic information for both the survey respondents and focus group participants is shown in Table 1. The following sections explain the specific procedures for the survey and focus group designs. The initial research questions explored were: 1) How does the perceived usefulness of mobile apps for COVID-19 vaccination differ by race and age in NYS? 2) How do privacy and security concerns influence the adoption of COVID19 vaccination mobile apps (are there differences by race and age)?

3.1. Survey Design

Amazon Mechanical Turk was used to locate respondents who lived in New York State and were willing to take the (10-minute) survey. Several academic papers have used the Amazon Mechanical Turk platform to conduct scholarly research (Mason and Suri 2012; Mortensen and Hughes 2018). Amazon Turk has been proved to be a valid inexpensive tool to conduct experimental research, however, the users of Amazon Turk are often young and more ideologically liberal compared to the general public, which can affect suitability and create bias findings (Berinsky, Huber & Lenz, 2012).

Most of the survey respondents were between the ages of 25 and 45 (over 70%). Similarly, over 70% of the respondents self-identified as White. A little over 50% of the respondents self-identified as men, see Table 1.

Table 1: Demographic information for participants

Categories	Response Options	Focus Groups		Survey	
		N	%	N	%
Age	18-24	27	42.9%	13	5.2%
	25-34	12	19%	100	40.2%
	35-44	16	25.4%	77	30.9%
	45-54	3	4.8%	31	12.5%
	55-64	5	7.9%	24	9.6%
	65-84	0		4	1.6%
Race/ Ethnicity	African American	22	34.9%	30	12.1%
	White	11	17.5%	176	70.7%
	Asian	13	20.6%	33	13.3%
	Hispanic/Latino	15	23.8%	37	14.9%
	Other ethnicity	2	3.2%	10	4.0%
Gender	Female	24	38.1%	110	44.2%
	Male	24	38.1%	135	54.2%
	Gender non-binary	2	3.2%	2	0.8%
	Transgender or transsexual	1	1.6%	0	0%
	Unassigned	12	19%	2	0.8%
	Education	Associate degree	6	9.5%	14
Bachelor's degree		17	26.9%	140	56.2%
Completed some college		13	20.6%	26	10.4%
Completed some postgraduate		4	6.3%	5	2.0%
Completed some High School				2	0.8%
High school graduate		4	6.3%	13	5.2%
Master's degree		2	3.2%	41	16.5%
Ph.D., law, or medical degree		5	7.9%	2	0.8%
Other advanced degrees beyond a master's degree		1	1.6%	6	2.4%
Unassigned		11	17.5%	0	0%
Income	Less than \$25,000	9	14.3%	30	12.1%
	\$25K to \$34,999	4	6.3%	23	9.2%
	\$35K to \$49,999	11	17.5%	41	16.5%
	\$50K to \$74,999	7	11.1%	65	26.1%
	\$75K to \$99,999	5	7.9%	39	15.7%
	\$100K to \$149,999	8	12.7%	35	14.1%
	150,000 or more	5	7.9%	15	6.0%
	Unknown	14	22.2%	1	0.4%
Personal Political Affiliation	Democrat	28	44.4%	140	56.2%
	Independent	12	19%	56	22.5%
	Republican	6	9.5%	41	16.5%
	Other	3	4.8%	7	2.8%
	Unsure	4	6.3%	4	1.6%
	Unknown	10	15.9%	1	0.4
COVID-19 Political Party Support	Democrats	25	39.7%	147	59.0%
	Republican	3	4.8%	49	19.7%
	Others	3	4.8%	5	2%
	Does not support any party	12	19%	36	14.5%
	Unknown party support	20	31.7%	12	4.8%

Additional demographic information was requested of respondents, including education, income, and two questions on their political party influences: 1) the respondents' party affiliation and 2) which party they supported to handle the pandemic. As shown in Table 1, there is a slight variation in the two political questions, for a small portion of the respondents the political party better suited to handle the pandemic differed from the respondents' personal political affiliation. Each demographic category includes the number of participants who did not respond to the demographic questions, labeled as unassigned. For the responses related to COVID-19 party support, participants who did not respond to the question and those who responded unsure were combined into one category: unknown party support.

3.2. Focus Group Design

To select focus group participants a convenience approach was used to send recruitment information to several locations in NYS, including universities, community organizations, and social media groups, which then led to a snowball effect.

Participants were required to be adults (aged 18 or older) and fluent in English. While both the survey and focus group data focused on NY residents, focus group participants had to live, work, or physically go to school within NYS. This slight variation was applied to capture all individuals in NY who would have been subject to any Excelsior pass mandates.

Each session was designed for 6-8 participants, and alternates were selected in case of cancellations. Confirmed participants were provided with a date, time, and invite for the session and asked to complete a demographic questionnaire, which requested additional information regarding educational attainment, income range, gender, and politicization. The sessions were segmented by race and age to aid in the analysis of results. Segmentation has long been used to encourage group discussion and to ensure all participants feel comfortable enough to contribute (Morgan et al. 1998; Morgan and Krueger 1993).

In this paper, data from the focus group sessions was used to provide context for the survey results. The focus group data exposed possible reasons why people used the apps (or not) and if there were nuanced considerations for certain populations. The demographic questionnaire and interview instrument were aligned with the survey questionnaire.

All sessions were held using Zoom video conferencing software, since the sessions were held at the tail end of NYS pandemic restrictions and in-person were discouraged by university IRB. During each session, three members of the investigator team

were present for a hour-long group interview. One member served as the interview moderator (to read consent and ask questions), a second as a note-taker (to record general themes and non-verbal cues), and a third as the Zoom moderator (to handle online waitlists and monitor chat comments by participants).

4. Results

Within this section, the results of the survey and focus groups are presented. Each includes subsections related to the findings on perceived usefulness, privacy and security, and trust.

4.1. Survey Results

The validity (KMO=.842) and reliability ($\alpha=.795$) of the survey results were tested before performing the statistical analyses. The normality and homogeneity of the data distribution was verified before conducting the analysis of variance tests. Chi-squared test of independence was also performed to ensure the independence of demographic categories.

4.1.1. Perceived Usefulness. An ANOVA was performed to understand the relationship between the perceived usefulness of vaccination apps for work, education, and recreation activities. The results show a slight significant difference between racial groups based on where the apps were used; for education engagement ($F=2.156, p<0.05$) or recreational activities ($F=2.408, p<0.05$). However, there was no significance using the apps for work.

The results also show a slight significance among age groups in the use of apps for education ($F=2.275, p=.048$), the difference is evident between 18–24-year-olds and 35–44-year-olds in terms of perception. There was no significance among age groups in their perceived usefulness of apps for work activities or recreation activities ($p=0.194$). Additionally, no statistically significant interaction between differences age and racial groups was found.

Outside of age and race, a strong significance in perceived usefulness was found between groups that support different political parties' handling of the pandemic based on where the apps were used; for work ($F=5.923, p<0.001$) and recreation ($F=4.948, p<0.001$). There was a mean difference between Democrats and those who don't support any party; for work ($t=1.24, p<.001$) and for recreation ($t=1.22, p<.001$). However, there was no statistically significant difference between subjects on the perceived usefulness for education activities.

4.1.2. Privacy and Security. No significant difference was found regarding the concern for privacy and security among racial groups ($F=1.821,$

p=.095) or age groups (F=.264, p=.932). Additionally, there was no statistically significant interaction between race and age regarding privacy and security concerns (F=1.201, p=.271). However, again, there was a difference between groups that support different political parties' handling of pandemic (F=5.663, p<.001). The difference was between those who support Republicans and Democrats (t=1.25, p=.002) and between those who support Republicans and those who don't know which party handles the pandemic better (t=2.24, p=.007).

4.1.3. Trust. There was a significant positive relationship between trust in the NYS government and the respondents' pandemic experience with their perceived usefulness of the vaccination app for work, education, and recreation, see Table 2. A linear regression was fitted to the combined power of race/ethnicity, age, party support, trust in the New York State government, pandemic experience, and privacy and security concerns in predicting the perceived usefulness of vaccination applications.

Table 2: Predicting perceived usefulness with demographic information, trust, and experiences

	Work		Education		Recreation	
	Coeff	t (p)	Coeff	t (p)	Coeff	t (p)
Trust	.357	7.175 (<.001)	.404	8.467 (<.001)	.368	6.781 (<.001)
Experience	.349	5.307 (<.001)	.322	5.086 (<.001)	.413	5.748 (<.001)
Adj. R ²	.348		.404		.350	

4.1.4. Vaccination App Experiences. A linear regression fitted to explore the combined power of comfort, pandemic experience, trust in the New York State Government, and privacy and security concerns in predicting the perceived usefulness of vaccination applications was performed. The results show a significant positive relationship between comfort, pandemic experience, trust, and privacy/security concerns for the use of the apps for work, education, and recreation. The details are showcased in Table 3.

Table 3: Predicting perceived usefulness with comfort, trust, experiences, and privacy concerns

	Work		Education		Recreation	
	Coeff	t (p)	Coeff	t (p)	Coeff	t (p)
Trust	.195	3.469 (<.001)	.293	5.122 (<.001)	.163	2.990 (<.001)
Experience	.190	3.192 (<.001)	.177	3.286 (<.001)	.189	3.661 (<.001)
Comfort	.480	7.977 (<.001)	.346	5.641 (<.001)	.505	8.612 (<.001)
Concern	.145	4.331 (<.001)	.253	5.267 (<.001)	.192	4.174 (<.001)
Adj. R ²	.471		.450		.496	

4.2. Focus Group Results

The perceived usefulness of the vaccination apps varied among focus group participants. While the app was well received among all races, there was a mixed response among middle-aged participants. Furthermore, we uncovered barriers to use within NYS based commuters from or to other states. Quoted italicized participant comments are included with demographic information in square brackets, as follows: [*Pseudonym, Age, Race, COVID-19 Party Support*].

Several participants felt the Excelsior Pass was useful, specifically in reducing fraud. At least one concluded that using the app could also help to reduce mental anxiety. One participant thought the app would be useful to manage employees.

Having a digital record is less prone to being lost or being urged being stolen, stolen by someone who's doing you know the fake, the fake cards. [Mavis, 55 years old (yo), African American, No party support]

However, some participants noted that enforcement was imperative. Many of the mixed responses were notably from a specific age group (35 - 54). At least one participant was concerned about the use of an app for privacy reasons, indicating that it is not useful and only a mandate would increase its use among the population.

I think the enforcement is the key part of this.... but also, with all of these mandates and vaccine requirements being lifted across the state, I think that the efficacy of this app might be waning. I wish it weren't. But I think that's kind of the direction right now [Victor, 35 - 54 yo, White, Democrat]

Other participants indicated a flaw in the system: the State-based system created a barrier for non-state residents who work or attended school in NY. Similarly, those who traveled out of the state could not always rely on the app being accepted. One commented that the app may have been developed and disseminated too late.

So, it's only New York State. As a result, a lot of other states don't have a centralized vaccine database. And therefore, there's really no way to confirm whether the vaccine info they're uploading is accurate. So, if I go to New Hampshire, or Maine, I have no idea of whether the proof of vaccinations I'm seeing are correct. If I go to South Dakota, is the COVID Excelsior Pass going to work? Because I'm not in New York. I think it's probably one of the reasons I haven't gone back to using this because I do travel out of state enough that probably not going to be effective for me anyway. [Xyla, 35 - 54 yo, White, Democrat]

A few participants did not find the app useful because they did not see the need to duplicate the CDC card issued. After all, you could create a digital version of it on your phone via the camera feature. *It's probably not useful anymore. Because it's my first time to hearing about this app. ...you know, even for us, we aren't clear, you know, ... So, if you just show the vaccine record, we work at, I mean, safer? I think this may be useful for certain scenarios. But we're not sure, yeah. [Williams, 35- 54 yo, Asian, No party support]*

Two respondents were unaware of the app prior to the focus group session. During the session, two main topics emerged: mandates and inconsistencies in government communication about the virus.

This is my first time actually seeing this or hearing about this. And I really think it wouldn't really be impactful as much with the mandates being lifted and stopping in NYC right now... But I haven't I haven't ever seen this app before. [Yosef, 35- 54 yo African American, No party support]

4.2.1. Privacy and Security. Opinions regarding privacy concerns of the Excelsior Pass ranged from worries about personal data exposure, citing location tracking, hacking, misuse of information, and a desire for transparent permissions within the app. On occasion, these concerns differed by race. For instance, younger African American participants were particularly concerned about location tracking and data mining, given their high app use. Hispanics/Latino participants expressed concerns about hacking and misuse of information but accepted necessary data sharing with the government. White participants focused on potentially fraudulent use but were comfortable storing primary vaccine data.

Yes. I have location privacy concerns [Kay, 18- 24 yo, African American, Democrat]

However, some were indifferent to privacy concerns, trusting the security of a government platform and accepting necessary data-sharing tradeoffs. Asian participants saw vaccine information as already shared. Individuals from other races such as Alaska Native, Asian, and Pacific Islander origins were indifferent about if information is stolen.

I'm not sure if I would I think if it's sort of New York state sponsored I'd like to think that I'm New York state already kind of has my information that I put on here. But I guess minimal to no risk. I'd not be worried about my privacy on this app. [Quist, 18- 34 yo, H/L, Democrat]

A third group was uncertain, wanting more details on what data is collected and how it is protected before assessing the risks. Their concern depended on factors like whether social security numbers or addresses are included. Here, we found a difference in the responses

based on age. Young adult participants were uncertain about the data collected and feared tracking and hacking. Middle-aged participants wanted transparent permissions and data practices. Older participants were largely unworried, trusting the government's security protections.

I will be kind of afraid of using the app because I'm not sure of the (inaudible) in my private information [Derek, 35- 54 yo, African American, unknown party support]

4.2.2. Trust. Young Asian and Hispanic/Latino adults expressed general trust in the app despite minor concerns on faking. Middle-aged adults, including those of Asian and African American backgrounds, were more doubtful and hesitant about fully trusting the app technology or digital apps. The development of the app by the government versus private sources mattered to some. Older African American adults conveyed greater trust and openness to responsible app use. While young African American and White participants trusted the app mainly for convenience rather than full confidence. Only a couple of participants indicated they would not trust the app.

No, I won't say I trust this app. I'm just saying it's doing nothing. [Xavier, 35- 54 yo, Asian, unknown party support]

Most of the participants trusted the app. Either because of the entity that developed that app, the potential usefulness of the app, or because another institution (namely a university) promoted its use.

Yeah, I trust it too. I feel like it's from the state, it's probably something at least decent. [Mike 18- 34yo, Asian, unknown party support]

4.2.3. Vaccination App Experiences. Over 80% of our participants had used either the NYS Excelsior Pass or the NYS Excelsior Pass Plus vaccination apps. This was across all races and ages. Middle-aged adults (35 –54 years old) expressed a mix of experiences, with some reporting occasional app usage or intentions to use it in the future once vaccinated.

Yes, I use it all the time. Because I don't like to carry my vaccine card physically. I do have a picture of it on my phone. But some places prefer that Excelsior pass itself. That way, you know, it's not a fake or a copy of somebody else's vaccine card. [Barbara, 18 – 34 yo, Asian, Democrat]

Others in this age group preferred the CDC cards and questioned the usefulness or benefits of the digital verification app. Young adults (18 – 34 years) showed a range of perspectives. Some found the app helpful when they lacked their physical vaccine cards, while others in this age group defaulted to using their cards instead of the app. Older adults faced technical issues and limitations when using the digital verification apps. Across races, African Americans referenced

successfully using the app when their physical vaccine cards were unavailable, such as when traveling.

But from my experience in New York City, I noticed that most places are okay and do accept a picture of your vaccination card if you don't have it with you physically. So that's what I've been using to get around places... I didn't see a need in having an app, if, by showing a picture I could just get in [Nina, 18-34 yo, Asian, No party support]

Hispanic/Latino participants reported occasional app usage in certain situations. Asian adults were more skeptical, doubting the app's usefulness than physical documentation or questioning its advantages over vaccine cards. White participants expressed a preference for relying on their original vaccine cards. Those of other races discussed plans to use the app in the future, such as if mandated by employers.

I have no experience with this but I'm just wondering what the difference between this with me is bring a physical copy of my vaccine card with me in my wallet? Umm, except this is probably more convenient, if I don't [have] the physical card. Is there any additional benefit of having this? [Vince, 35 – 54 yo, Asian, unknown party support]

4.2.3. Other Interesting Findings. Some of the issues raised across age and race were the issues of short expiration timelines, resulting in users still needing to carry documentation, limiting usefulness. Some participants objected to showing proof, though they appreciated the accessibility and convenience of using the apps. The low patronage and usage of the apps were discussed during the interviews and highlighted that there were hot spot areas in NYS where the Excelsior pass (or Excelsior pass plus) was mandated.

Yeah, I've used both the Excelsior Pass and Excelsior Pass Plus. Well, I have had troubles with the Excelsior Pass Plus. Once I got boosted, it wouldn't acknowledge that I was a real person, or that I was born when I was born. So, I've stopped using that one. But [early] in the pandemic, I was using the Excelsior pass. So, I just use the paper card instead, which is falling apart at this point. [Victor, 35 - 54 yo, White, Democrat]

6. Discussion

Where the vaccination apps were used (and for what purpose) influenced perception on usefulness, work, recreation, or education mattered. While only slight significance was found among age and race/ethnicity of survey respondents regarding use for education and recreation, focus group interviews provided a different picture.

The apps were well received by all, however, there was a notable mixed response among middle-

aged participants. As a useful tool, some thought the app could reduce fraud, minimize anxiety, and help manage employees. The few that mentioned negative perceptions were concerned about privacy/security and barriers when used by commuters, which were similar in other studies (Becker et al. 2014; Esmailzadeh 2020; Mbunge et al. 2021).

Politics seem to play a much bigger role in the perception of the vaccination apps like simulation research that considered political ideologies as a factor influencing adoption (Esmailzadeh 2020; Waitzberg et al. 2021; Trein & Varone, 2024). Those who favored the democratic party to handle the pandemic were more likely to positively perceive the usefulness of the vaccination apps. While the focus group study was skewed with more who favored the democratic party, our findings show that even those who did not support either party did find some perceived usefulness of the apps, especially if enforced.

The survey suggested there was no statistically significant variation among racial or age groups regarding their privacy and security. However, there was a clear difference in how privacy and security were discussed among focus group participants, with variation by race and age. The types of privacy/security concerns included a wide range of issues: personal data exposure, location tracking, hacking, misuse of information, data sharing with the government, and fraudulent use. Trust in the entity developing the app played a significant role in the level of concern. Our focus group findings tracked with the previous studies indicating that demographic factors may be associated with willingness to adopt these apps because of trust, privacy, and security (Becker et al. 2014; Esmailzadeh 2020; Mbunge et al. 2021; Waitzberg et al. 2021).

Both the survey and focus group results found a relationship between age, race, and trust. According to our survey, trust in the NYS government was directly related to the use of the app for work, education, and recreation. Most skeptical responses came from middle-aged participants across all race/ethnic backgrounds, exclusively. The regression indicates a moderate influence on the perceived usefulness of the app for work, education, and recreation based on trust and pandemic experience.

Comfort, app familiarity, pandemic experience, trust, and privacy/security concerns were significantly and positively related to the use of the apps for work, education, and recreation. In terms of predictability, our model indicates these variables are better influences for perceived usefulness. While other studies highlighted the variation between older and younger adults, we found a difference among the middle-aged participants. Some participants had

problems accessing the app during the rollout of the Excelsior Pass Plus and questioned the advantage over the CDC cards, while others objected to the proof of vaccination requirement. These problems with access and adoption may have contributed to low use (Mustafa et al. 2022; Towett et al. 2023).

6.1. Limitations

This mixed-method study answers questions on the acceptance and perception using an Amazon Mechanical Turk survey and focus group interviews. The small survey and focus group methodology are not generalizable. Amazon Turk may lead to biased findings because of the younger age of its subjects (Berinsky, Huber & Lenz, 2012). Furthermore, having focus group participants who were respondents from the survey or vice versa would have been beneficial. Additionally, recruiting older adults was challenging.

7. Conclusion

This paper examined the acceptance and perceptions the Excelsior Pass for vaccination proof in New York State (NYS). Results indicated politics may have played a role in the perception of the usefulness of the app. Future research endeavors should examine variances in local-level mandates nationwide. Though most of the participants found the app useful, they expressed dissatisfaction centered on the app's limited utility for commuters. These findings offer valuable insights for government agencies interested in launching apps for purposes of mitigating various hazards. Officials should note their influence on the public regarding proper preparedness and mitigation measures.

Practitioners should be prepared to address disparities through targeted outreach, user-centered design, and inclusive policies essential for maximizing the public health benefits of digital vaccination systems (Badr et al., 2024; Saeed and Masters, 2021; Wilson et al., 2016; Yao et al., 2022). Developing clear guidelines and frameworks for the responsible collection, use, and sharing of personal health information is crucial to build public trust and ensure individual rights (Brall et al. 2019; Fahey and Hino 2020; Kassam et al., 2023).

Scholars should consider how the perception of the situation for which the certain ICTs are used (such as a pandemic), may influence theoretical models of ICT adoption. The push to liken the results of similar apps in the same geographic location during COVID, may produce erroneous results. For example, previous research regarding COVID-19 contact tracing apps in NYS shows different results. Future research may benefit from assessing vaccination apps across

different states and compare findings from varied studies conducted in distinct geographical regions. Future research should also explore the potential unintended consequences of these apps, like the exacerbation of existing social inequalities or the erosion of personal autonomy (Bardosh et al., 2022; ÓhAiseadha et al., 2023).

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9. References

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