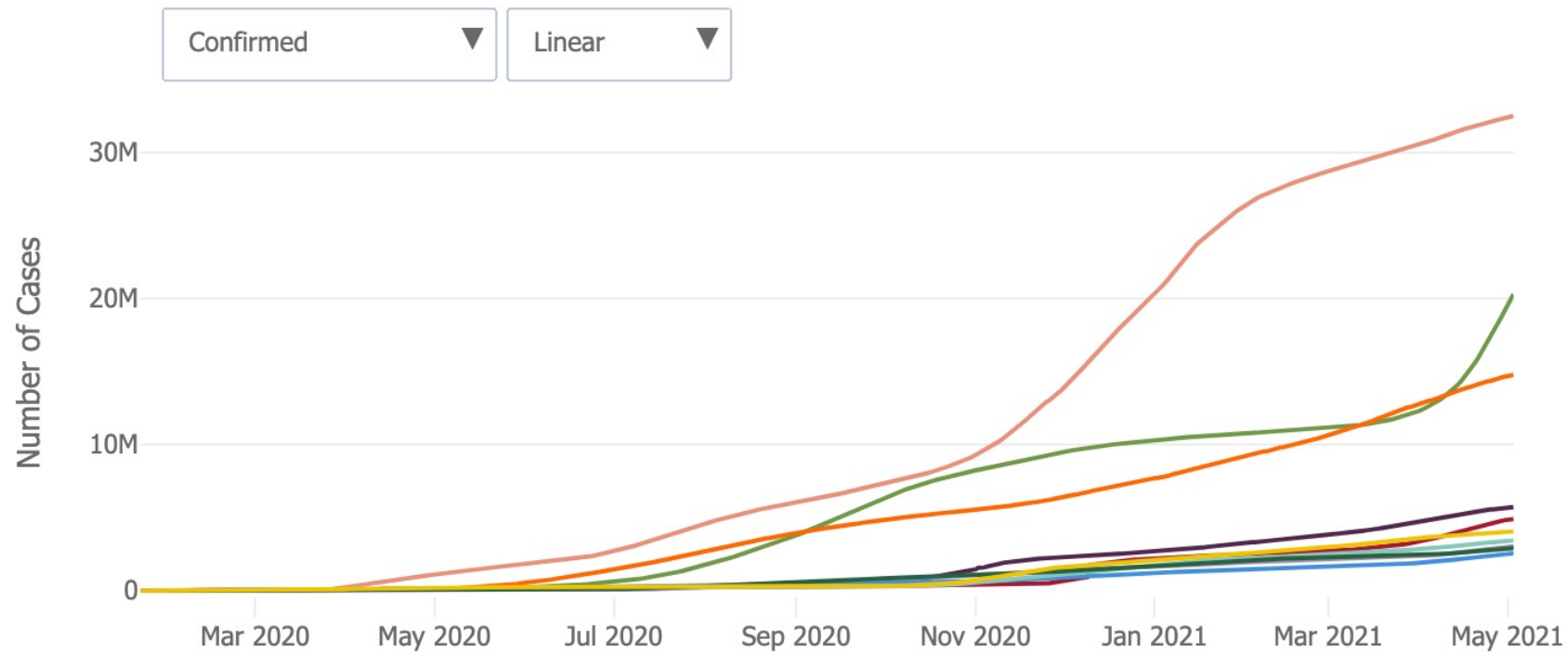# Using a Survey of End User Perceptions to Develop COVID-19 Digital Contact Tracing Mobile Phone Application Guidelines

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Introduction

DAILY CONFIRMED NEW CASES (7-DAY MOVING AVERAGE)

Outbreak evolution for the current 10 most affected countries

(Johns Hopkins, 2021)

Introduction

► The CDC, WHO, NIH and other organizations are all working to prevent the spread of COVID-19 and mitigate its significant effects

► Implications of COVID-19:
 — Physical health
 — Mental health
 — Financial costs

► Prevention is key

Problem Statement

- **Problem** (clinical): An increasing number of COVID-19 cases in the United States and no clear guidelines for COVID-19 digital contact tracing.

- **Current Practice**: Contact tracers contact positive individuals by phone and ask questions about where they have been recently and who they may have been in close contact with.
  - Relies on large workforce
  - Phone communication
  - Memory of the individual with COVID-19

- Identified by clinical staff at a medical practice working to develop a mobile contact tracing application during the COVID-19 pandemic.

- This problem affects organizations that remain open during the COVID-19 pandemic

Purpose and Objectives

► **Purpose**:
— to develop guidelines for digital contact tracing of COVID-19 when using mobile applications in the US for people identified as positive in an area for risk of community transmission, considering the perceptions of the community.

► **Objectives**:
— (1) Identified a team for development of a contact tracing phone application at On-Site Medical by June 15, 2020.
— (2) Conducted a literature review on recommendations on COVID-19 contact tracing mobile applications by February 1, 2020.
— (3) Identified and analyze acceptability, perceptions and barriers to using a digital contact tracing app with organizational leaders who perform COVID-19 testing by April 4, 2021.
— (4) Updated contact tracing mobile application guidelines with new evidence and suggestions from survey results by April 25, 2021 that outline ethics, privacy, and clinical aspects.

Background

► On-Site Medical Services has been developing a mobile contact tracing phone application to augment traditional contact tracing in schools and organizations in New England.
  — Located in Newport, NH
  — Team of nurse practitioner, law student, developers, graphic designers, and sales people.
  — Performs large scale COVID-19 testing in New England and delivers results and guidance.

► Guidelines for contact tracing mobile applications are needed:
  —Increasing number of COVID-19 cases, substantiating a need for augmenting traditional contact tracing
  —Frequent updates in COVID-19 research
  —Americans are suspicious of contact tracing efforts

Concepts

► **COVID-19** refers to coronavirus disease 2019, which is caused by severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2)

► **Guidelines:** "an indication or outline of policy or conduct" (Merriam-Webster, n.d.c)

► **Mobile application**: a program that performs a specific task or set of tasks downloaded to a cell phone, tablet, or wearable device, such as a watch (Merriam-Webster, n.d.a)

► **Contact tracing**: "the practice of identifying and monitoring individuals who may have had contact with an infectious person as a means of controlling the spread of a communicable disease" (Merriam-Webster, n.d.b)

Concepts (cont.)

► **Isolation:** "separates sick people with a contagious disease from people who are not sick" (CDC, 2020)

► **Quarantine:** "separates and restricts the movement of people who were exposed to a contagious disease to see if they become sick" (CDC, 2020)

► **Perception:** "a belief or opinion, often held by many people and based on how things seem" (Cambridge Dictionary, n.d.b)

► **Barrier:** "something that prevents something else from happening or makes it more difficult" (Cambridge Dictionary, n.d.a)

Framework

► Sociotechnical Theory

— the interaction of social and technical factors that can create or impede the conditions for successful performance (Walker, Stanton, Salmon, & Jenkins, 2008)

— optimization of each aspect alone increases the quantity of unpredictable relationships and relationships that are harmful to the system's performance (Walker et al., 2008)

Technology

Needs of the app

• Method to accurately determine positive COVID-19 case
• Method to accurately and quickly identify and notify close contacts
• Sufficient information to perform these functions

Needs of the users

• Adequate privacy
• Easy to use
• Convenient to use
• Ability for administrators to have access to information to keep organization safe
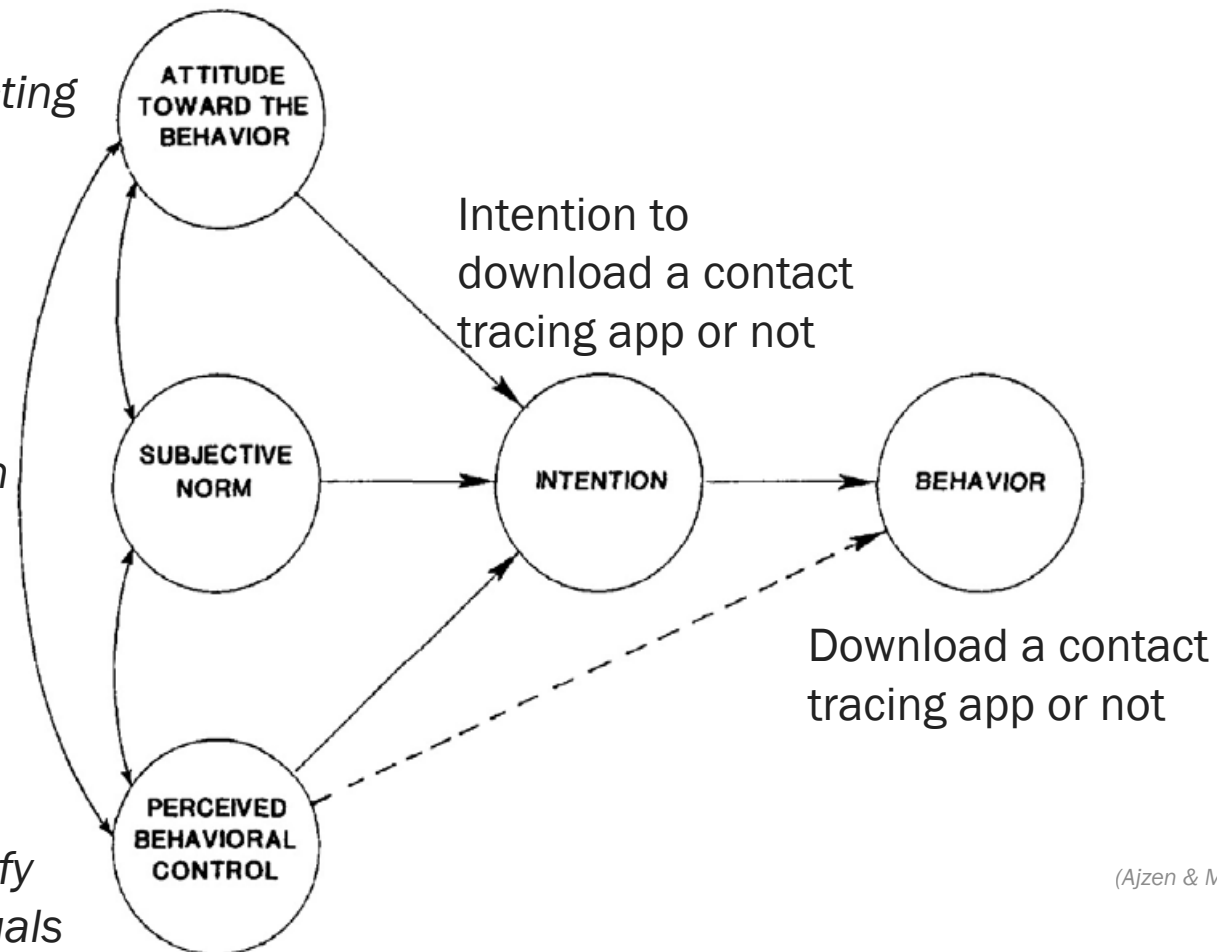• Quick notifications

People

Framework

► Theory of Planned Behavior

"[The app] would give me a sense of acting responsibly for the wider community."
"I would not benefit from the app"

"I would be more likely to download it if a large amount of people in my organization downloaded it"

"The app will be too much hassle to download."

"An app like this would make it easy to notify people if they are close contacts of individuals infected with COVID-19."

Intention to download a contact tracing app or not

Download a contact tracing app or not

(Ajzen & Madden, 1986)

Synthesis of the Evidence 1: Evidence Search

► **PICOT Question**: In individuals who test positive for COVID-19 or other infectious diseases (P), does the use of digital contact tracing modalities in addition to traditional contact tracing using trained professionals (I) increase the timeliness and number of exposed individuals who are able to be contacted and subsequently decrease the number of cases of COVID-19 or other infectious diseases in a community (O) compared with traditional contact tracing alone (C)?

Synthesis of the Evidence 1: Evidence Search

► **Databases:** PubMed and Embase

► **Search Terms:** "contact tracing" AND ("telephone" OR "digital" OR "mobile "OR "mobile applications" OR "real-time")

► **Inclusion criteria:** English language, full text, research articles, and a published date of 2015 or later
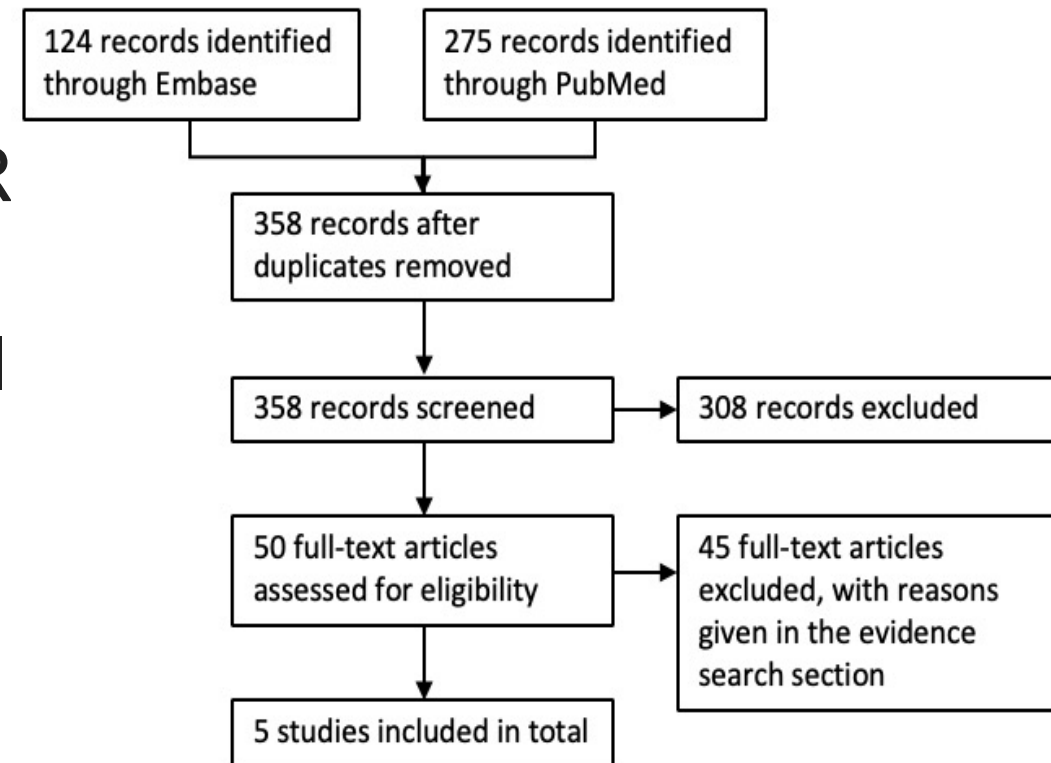
Synthesis of the Evidence 1

Characteristic	Anglemyer et al., 2020	Chen et al., 2020	Danquah et al., 2019	Hellmich et al., 2017	Ho et al., 2020
Study Design	Systematic review of cohort studies	Cohort study	Clustered RCT	Cohort study	Cohort study
Country Study Performed in	Various	Taiwan	Sierra Leone	United States	Singapore
Infectious Disease Studied	COVID-19	COVID-19	Ebola	Pertussis	COVID-19
Study Subjects & Characteristics	not specified; studies: 6 cohort studies and 6 modelling studies	convenience sample of passengers on a cruise ship, who had been exposed to SARS-CoV-2 (n=3,000)	26 contact tracing coordinators and 86 contact tracers with 25 Ebola cases	all employees working in an emergency and radiology department	employees of the National Centre for Infectious Diseases in Singapore working during the 2-day period

Synthesis of the Evidence 1 (cont.)

Characteristic	Anglemyer et al., 2020	Chen et al., 2020	Danquah et al., 2019	Hellmich et al., 2017	Ho et al., 2020
Comparison Modality	Summary of modelling studies and interventions (comparisons within studies varied)	# of cases of pneumonia and respiratory syndrome in those asked to quarantine compared with the general public in Taiwan	Phone app to digitize coordination of contact tracers vs paper based system	RTLS in a hospital vs EHR records	RTLS in a hospital vs EHR records
Major Findings	Modelling studies suggest DCT can reduce the # of secondary cases when used with public health measures	Contract tracing with mobile position data followed by self-quarantine and isolation may help prevent COVID-19 transmission	App had improved data completeness, storage and accuracy	RTLS identified significantly more contacts than the EMR review and was quicker.	More contacts identified by EMR, but the sensitivity and specificity of the EMR was lower than the RTLS; RTLS was quicker.

Synthesis of the Evidence 1 (cont.)

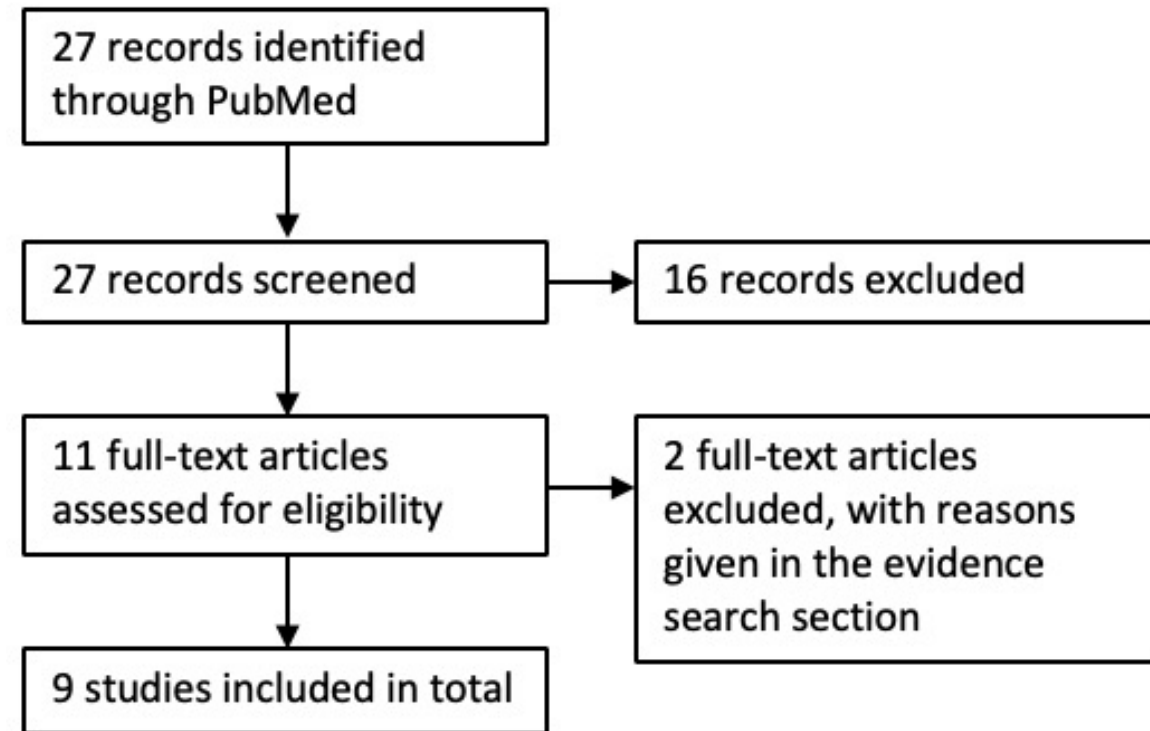| Characteristic	Anglemyer et al., 2020	Chen et al., 2020	Danquah et al., 2019	Hellmich et al., 2017	Ho et al., 2020
Strengths	Combination of modelling and cohort studies; systematic review	Large sample size	Large sample size	Study design	Able to determine sensitivity and specificity based on interviews
Weaknesses	strong primary research on the effectiveness of contact tracing technologies is lacking	Did not address privacy concerns; outcomes not directly related to research question	Poor cell phone service and access to charging location	errors in staff members using the RTLS tags	possible inaccuracy of interviews with potential contacts about their locations
Assessment of Quality	II, good	II, good	I, high	II, good	II, high

Synthesis of the Evidence 1 (cont.)

► Level of Evidence: Level II, Good Quality based on the *Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide* (Johns Hopkins University, n.d.)

► No direct evidence evaluating digital contact tracing versus manual contact tracing

— RTLS research suggests that this form of contact tracing is quick and accurate when identifying contacts versus contact tracing using EMR documentation.

— Automated text messages may reduce the time needed to advise all potential contacts to quarantine.

— Utilizing technology for contact tracers to coordinate efforts may improve accuracy and completeness of work.

► Limitations of the studies:

— errors in utilizing the technologies

— inequity in those without access to digital technologies

— privacy concerns

► Strengths:

— large sample sizes

— diverse populations and settings

— various methods of digital contact tracing

► Research suggests that digital contact tracing combined with manual contact tracing may increase the speed of contacts initiating quarantine, and therefore mitigate the spread of infectious diseases, such as COVID-19, if the technology is accepted by users.

Synthesis of the Evidence 2: Evidence Search

► **PICOT Question**: What are the barriers, perceptions and attitudes (O) of leaders who organize the COVID-19 responses in their organizations and members of the public (P), in high-resource countries similar to the United States, towards using a digital contact tracing mobile phone application (I)?

Synthesis of the Evidence 2: Evidence Search

► **Database:** PubMed

► **Search Terms:** "contact tracing" AND ("telephone" OR "digital" OR "mobile "OR "mobile applications" OR "real-time") AND ("wuhan" AND "coronavirus"[MeSH Terms] OR "2019-nCoV" OR "2019nCoV" OR "COVID-19" OR "SARS-CoV-2") AND ("perspectives" OR "attitudes" OR "barriers") **Inclusion criteria:** English language and a published date of 2019 or more recent

27 records identified through PubMed

↓

27 records screened → 16 records excluded

↓

11 full-text articles assessed for eligibility → 2 full-text articles excluded, with reasons given in the evidence search section

↓

9 studies included in total

Synthesis of the Evidence 2

Characteristic	Altmann et al., 2020	Camacho-Rivera et al., 2020	Guillon & Kergall, 2020	Maytin et al., 2021	O'Callaghan et al., 2020	Thomas et al., 2020	Williams et al., 2020	Wnuk et al., 2020	Zhang et al., 2020
n	5,995	10,760	1,909	513	8,088	1,500	27	2,726	1,964
Study Subjects & Characteristics	representative	Representative; self-reported history of chronic conditions	Reweighted to be representative of France	18-24 years old; representative	Representative; 18 y/o+	18 y/o+, excluded healthcare workers and hx of COVID-19	18 y/o+, most <50 y/o	18 y/o+, more women and young adults	Representative
Country	Various	US	France	US	Ireland	Australia	UK	Poland	US
Study Design	Cross-sectional	Cross-sectional	Cross-sectional	Cross-sectional	Cross-sectional	Cross-sectional	Qualitative	Cross-sectional	Cross-sectional

Synthesis of the Evidence 2 (cont.)

Charac-teristic	Altmann et al., 2020	Camacho-Rivera et al., 2020	Guillon & Kergall, 2020	Maytin et al., 2021	O'Callaghan et al., 2020	Thomas et al., 2020	Williams et al., 2020	Wnuk et al., 2020	Zhang et al., 2020
Data Collection Instruments	Survey	Survey	Survey	Survey	Survey of app that was about to roll out	Survey of app that was already rolled out	Video interviews	Survey	Survey
Major Findings	68%+ supportive; No ass'n with COVID-19 mortality rates	24.1% very likely to download; + ass'n: mental health and respiratory conditions	38.4% supportive; + ass'n: COVID-19 health risk -ass'n: impulsivity	33.4% supportive	82% supportive	37.7% did 18.7% intended to	5 themes: mis-conceptions, privacy, stigma, uptake, greater good	+ ass'n: ideological view	42% supportive; Inves-tigated features of apps

Synthesis of the Evidence 2 (cont.)

Characteristic	Altmann et al., 2020	Camacho-Rivera et al., 2020	Guillon & Kergall, 2020	Maytin et al., 2021	O'Callaghan et al., 2020	Thomas et al., 2020	Williams et al., 2020	Wnuk et al., 2020	Zhang et al., 2020
Strengths	Large sample size, 5 countries	Large sample size, bilingual	Large sample size	Large, representative sample	Large, representative sample	Able to assess app use (not hypothetical); large sample size	Helps to understand beliefs	Large sample size	Large, representative sample
Weaknesses	May have higher digital literacy; hypothetical	Self-report of dx; hypothetical	Not representative sample	Perspectives may have changed in the US	Hypothetical	English only; not inclusive of natives	Small sample size; few participants >50 y/o	Not a representative sample	Perspectives may have changed in the US; hypothetical
Quality	III, high quality	III, high quality	III, good quality	III, high quality	III, high quality	III, high quality	III, good quality	III, good quality	III, high quality

Synthesis of the Evidence 2 (cont.)

► Level of Evidence:

— Level III (cross-sectional studies), High or Good Quality based on the *Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide* (Johns Hopkins University, n.d.)

► The estimated acceptance and uptake of COVID-19 contact tracing apps vary, but common themes exist:

— Barriers to using digital contact tracing app:
  — Privacy concerns
  — Security concerns
  — Government distrust
  — Technology concerns
  — Effectiveness of the app

— Reasons to use digital contact tracing app:
  — Feeling susceptible to COVID-19
  — Helping to prevent the spread of COVID-19

► Strengths of the studies:

— Generally representative samples
— Large sample sizes

► Limitations of the studies:

— Changing COVID-19 environment
— High digital literacy of respondents
— Responding in socially desirable way

Methods

- **Project Design**
  - Quality improvement using the PDSA cycle to make improvements to the guidelines with input from surveys and new research
  - Translating evidence into practice – updates were made to guidelines as new evidence accrued
- **Setting**
  - This project will survey leaders of the COVID-19 responses at organizations that have utilized On-Site Medical Services for testing for COVID-19 from August 2020 through February 2021. Organizations include boarding schools, colleges, and businesses in Massachusetts, New Hampshire, and Vermont.
  - The sizes and locations of these organizations vary, located in rural and suburban towns with about 50 staff to over 1,000 students.

Methods (cont.)

► **Participants**

— Participants included human resources personnel, medical staff, members of the school administrative staff, and others involved in the COVID-19 response.

— They received e-mails with a link to the REDCap survey.

► **Recruitment/Selection Process**

— The members of organizations that utilized On-Site for COVID-19 testing who lead their COVID-19 responses were asked to participate in the survey by email

— These members utilized COVID-19 testing services from the company and the author coordinated results reporting with them

Sent email	After 1 week	After 2 weeks	At the end of 2 weeks
• Asked participant to complete survey	• First email reminder	• Second email reminder	• Phone call to anyone who did not complete survey

Methods (cont.)

Act
- Update guidelines for digital contact tracing based on surveys and new evidence

Plan
- Conduct literature review
- Prepare initial guidelines based on current evidence

Study
- Administer surveys to participants
- Revise literature review and summary of COVID-19 knowledge

Do
- Implement the contact tracing app in organizations
- Updated digital contact tracing guidelines

Survey

► Goal: understand perceptions, attitudes and barriers of organization members to download a contact tracing app and features that are important to them

► About 5 minutes to complete

► 3 Parts
— Part 1: perceived susceptibility to COVID-19
— Part 2: description of contact tracing app with questions about the likelihood of them downloading it and reasons they would or would not download it
— Adapted from Altmann et al. (2020) and O'Callaghan et al. (2020)
— Part 3: features that would make it more likely for the participant to download the app
— Select all that apply

Guideline Development

► **Objective:** To create a clinical practice guideline (CPG) for selecting and implementing digital contact tracing mobile phone applications (apps) or features of the apps for COVID-19 based on current literature and analysis of opinions from organizations testing for COVID-19.

► **Clinical Question:** What factors must be considered when selecting an effective and secure digital contact tracing mobile phone application to mitigate the spread of COVID-19?

► **Target Populations:** This guideline is intended for use by public health workers and organizations interested in utilizing a digital contact tracing mobile phone application for COVID-19.

► **Stakeholder Involvement:**

— Guidelines from CDC, WHO, Johns Hopkins University

— Survey results from organizations in New Hampshire, Massachusetts, and Vermont

— Reviewed by several experts in the field

Guideline Development (cont.)

► **Literature Review:**
— 8 papers identified to include in CPG

► **Sections**
— General Recommendations
— Initial Sign Up
— Important Features
— Evaluation

► **Procedure for Updating Guideline:**
— This guideline will be updated as new evidence on contact tracing applications becomes available and based on analysis of survey results.
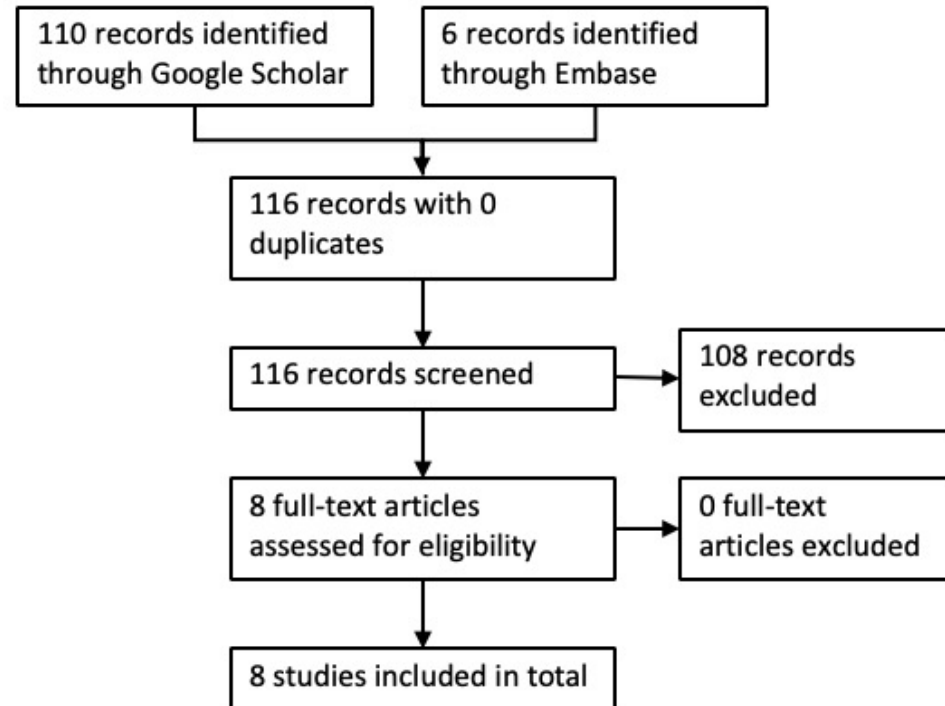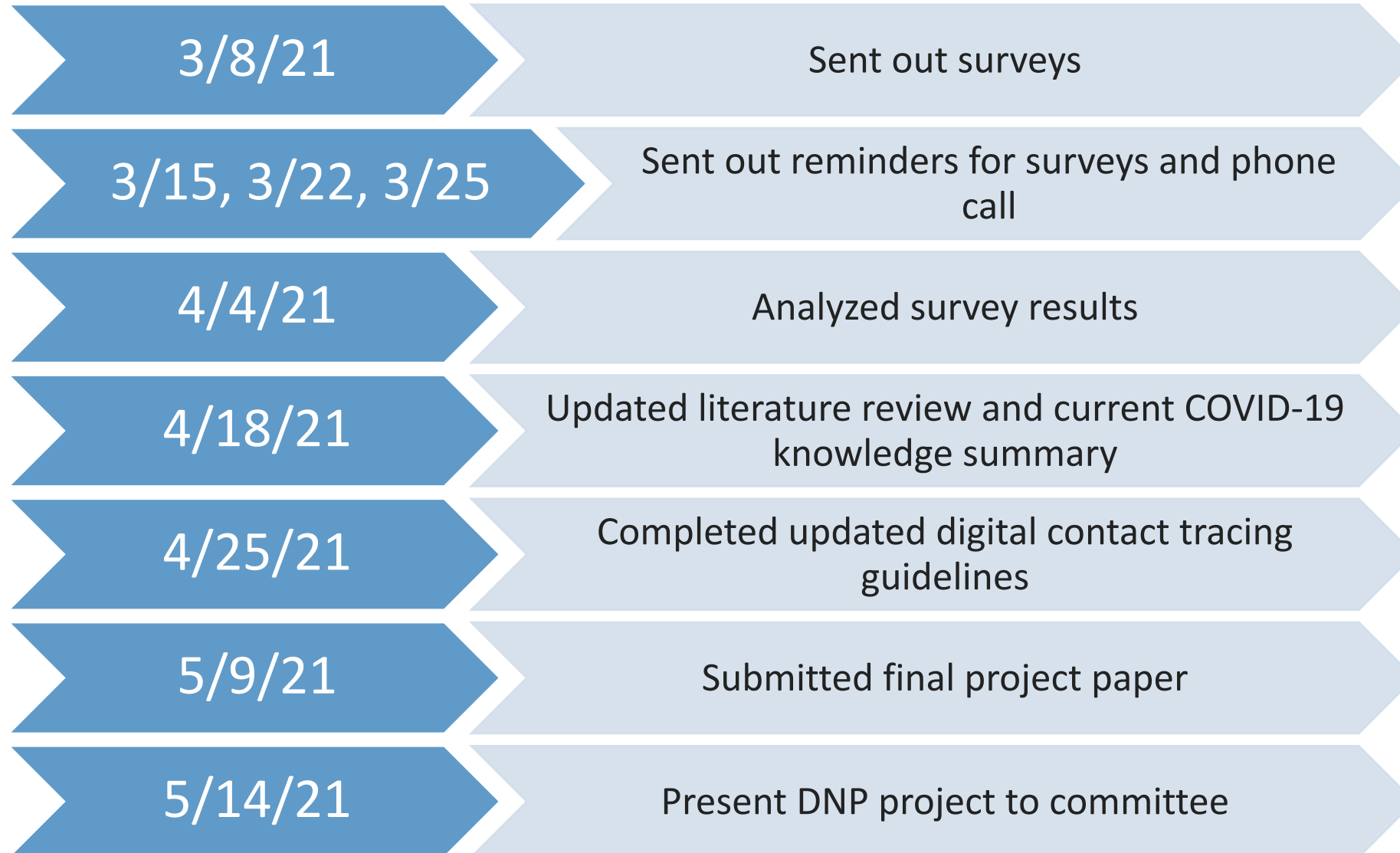
Analysis

- ► Survey Questions
  - — Qualitative and quantitative data collected through REDCap and downloaded on to Excel spreadsheet.
  - — Qualitative data was used to describe sample characteristics and for open-ended suggestions for improvement
    - — Sample characteristics:
      - — Role within the organization and regarding COVID-19
    - — Qualitative data for other open-ended questions
      - — Analyzed for common themes to improve CPG or better understand perceptions and barriers to a contact tracing app
  - — Quantitative data was analyzed using Excel:
    - — Mean
   - — Median
    - — Standard deviation

Timeline of Project

3/8/21	Sent out surveys
3/15, 3/22, 3/25	Sent out reminders for surveys and phone call
4/4/21	Analyzed survey results
4/18/21	Updated literature review and current COVID-19 knowledge summary
4/25/21	Completed updated digital contact tracing guidelines
5/9/21	Submitted final project paper
5/14/21	Present DNP project to committee

Budget

► Expenses involved with the development, evaluation, and modification of the app were covered by the employer (On-Site Medical Services).

► Access to peer reviewed articles and databases were provided by Vanderbilt University School of Nursing through tuition.
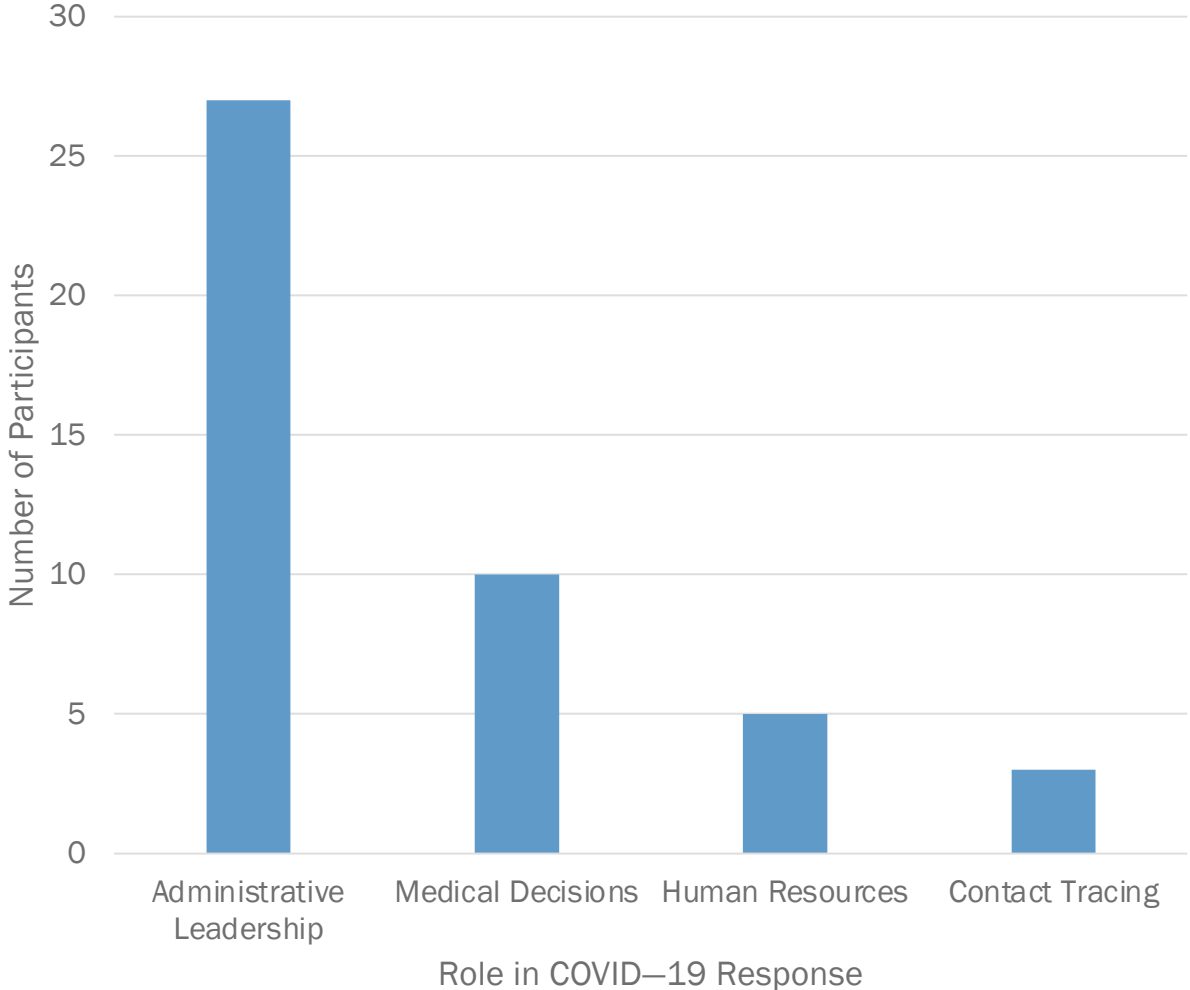
► There were no additional costs.
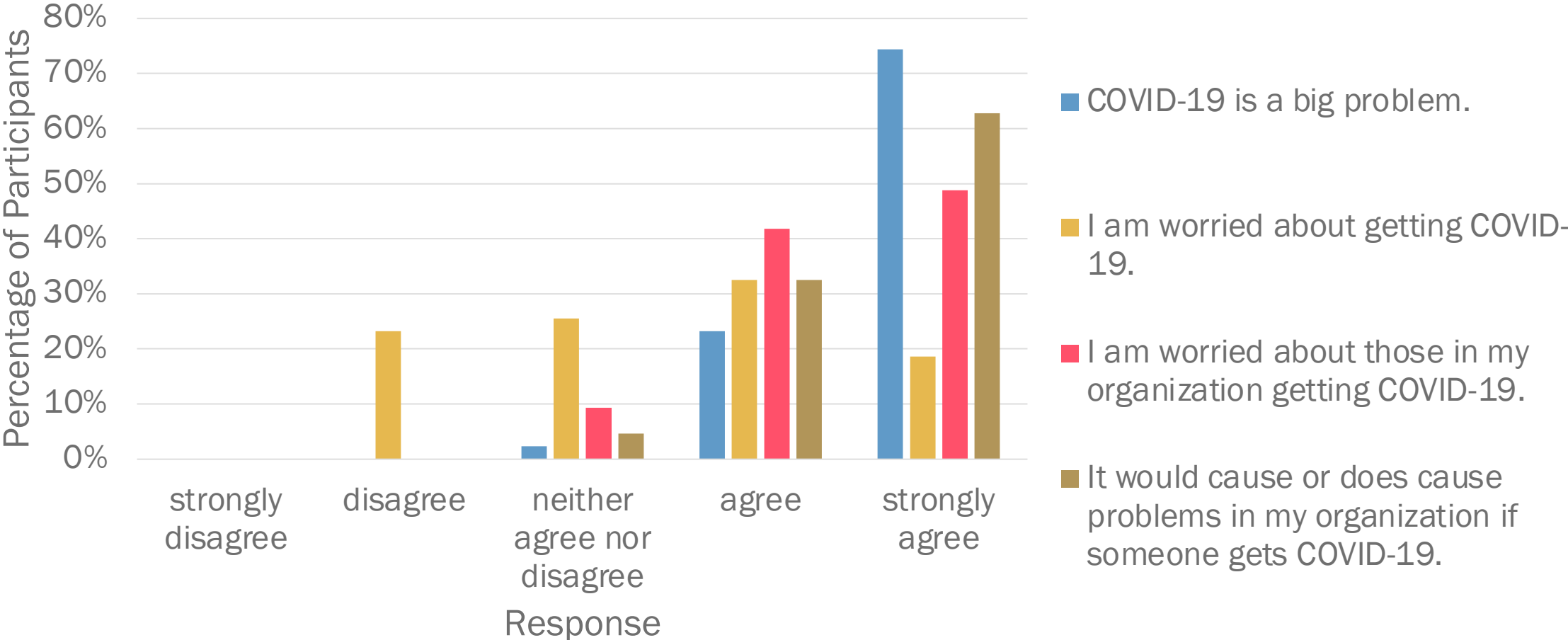
Results - Demographics

Workplace of Participants
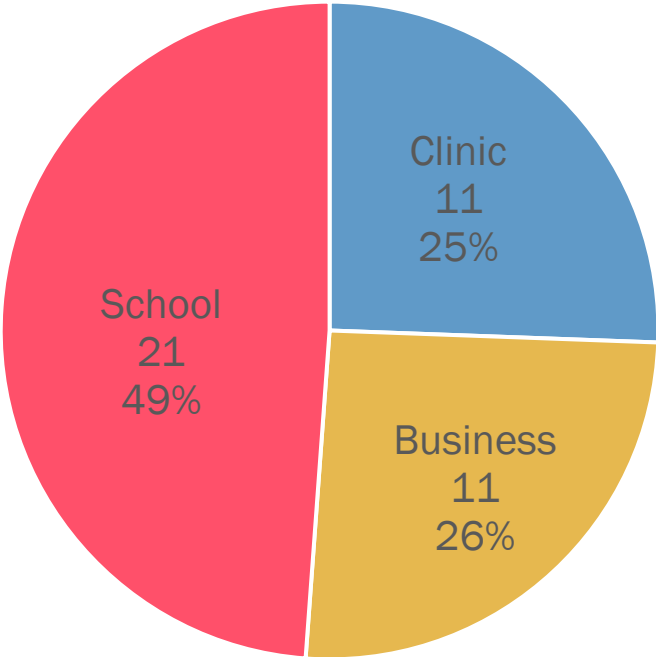
Role of Participants in COVID-19 Response
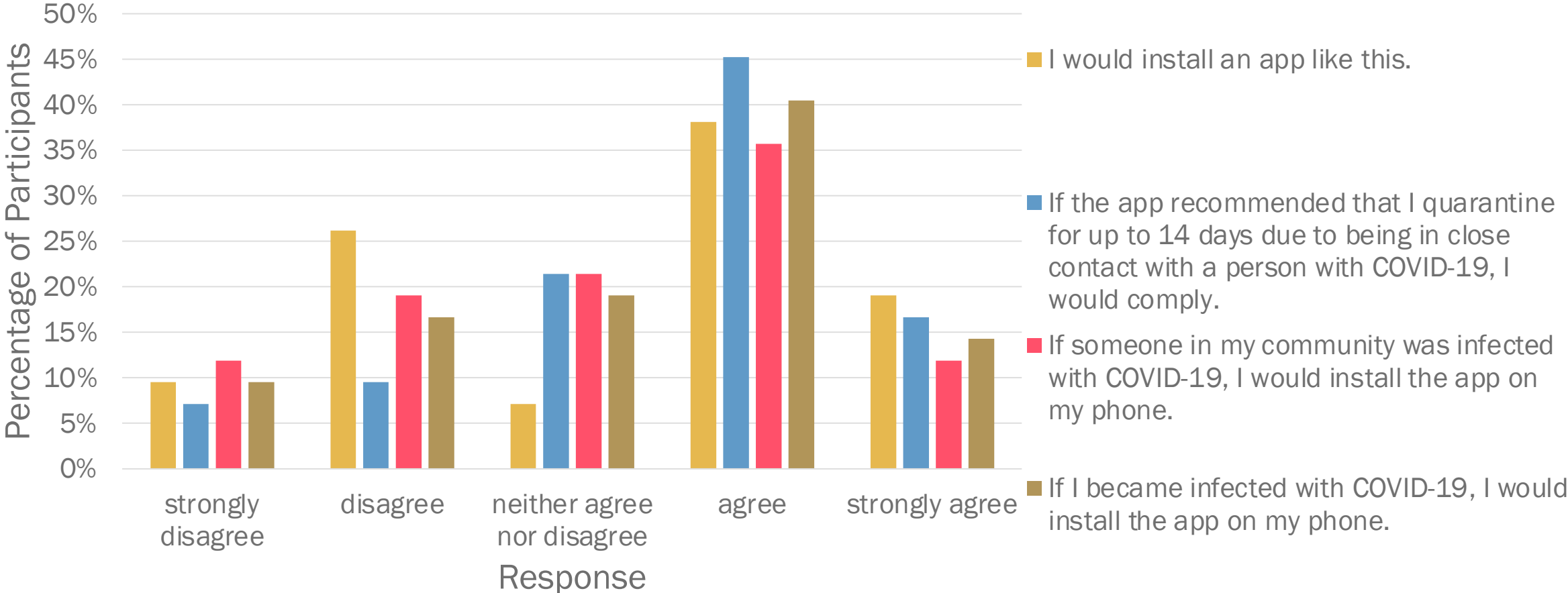
Results – Perceptions of COVID-19

Results – Perceptions of Contact Tracing Apps

Perceptions of COVID-19 Contact Tracing Apps

Results – Organizational Perceptions
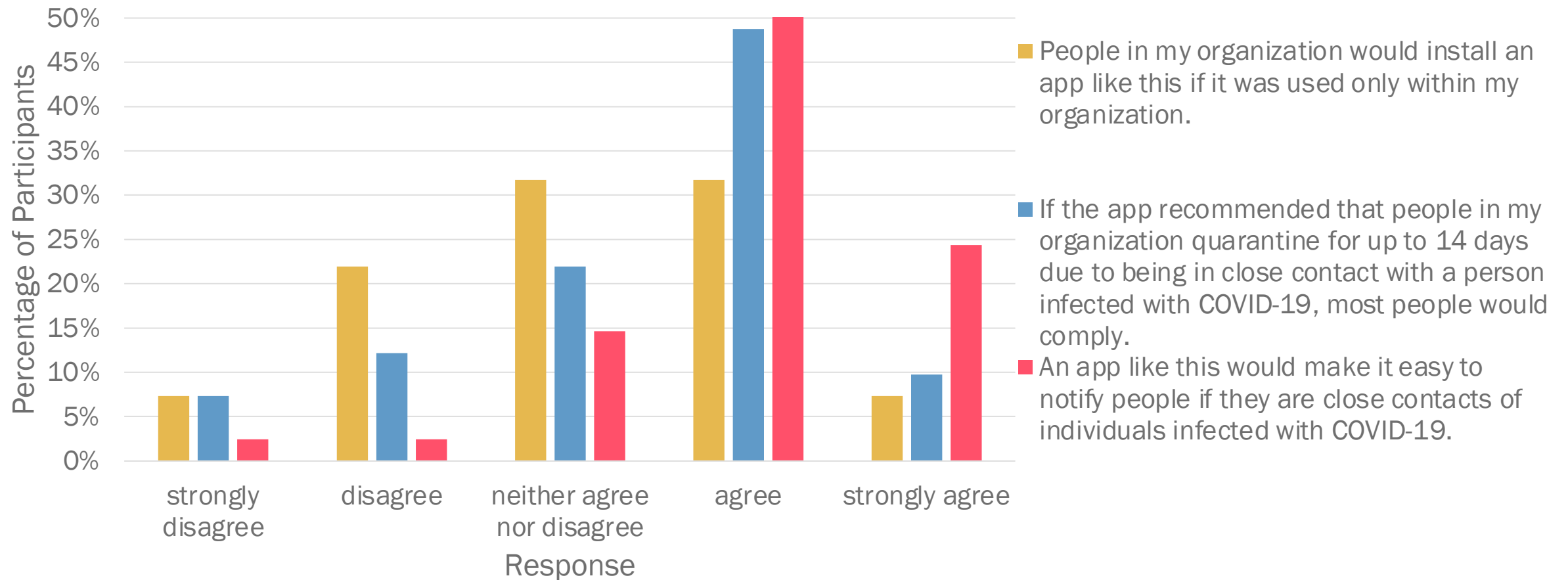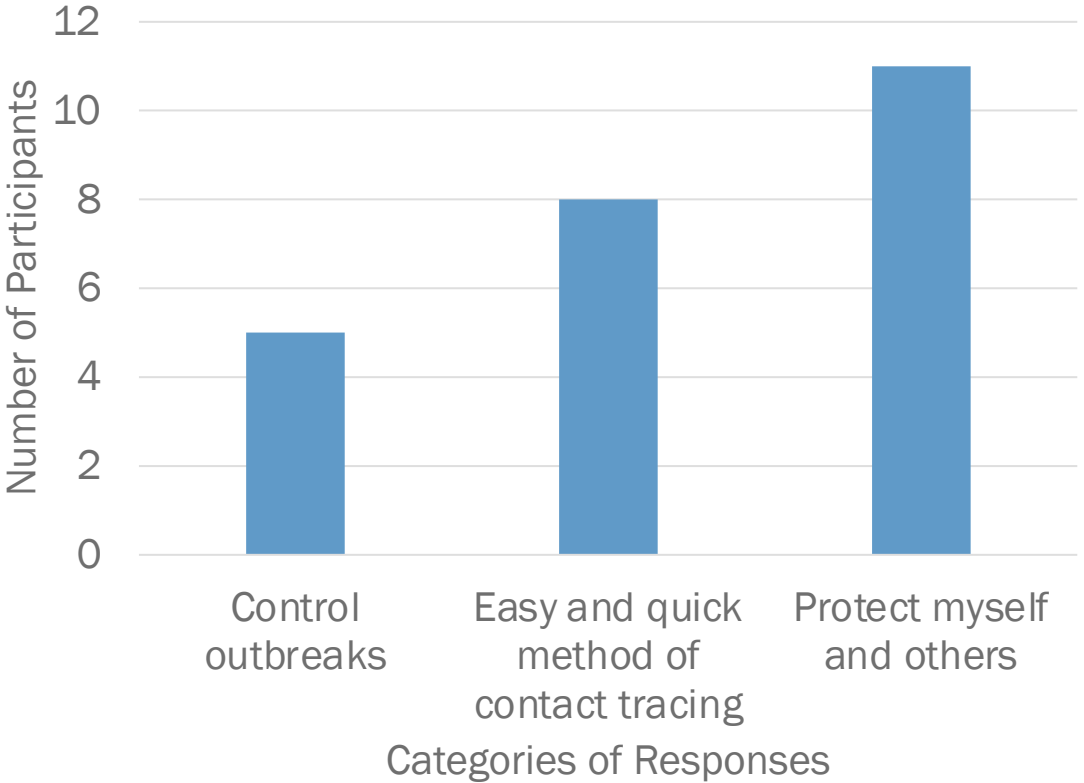

Perceptions of COVID-19 contact tracing apps within organization

Legend:
- People in my organization would install an app like this if it was used only within my organization.
- If the app recommended that people in my organization quarantine for up to 14 days due to being in close contact with a person infected with COVID-19, most people would comply.
- An app like this would make it easy to notify people if they are close contacts of individuals infected with COVID-19.
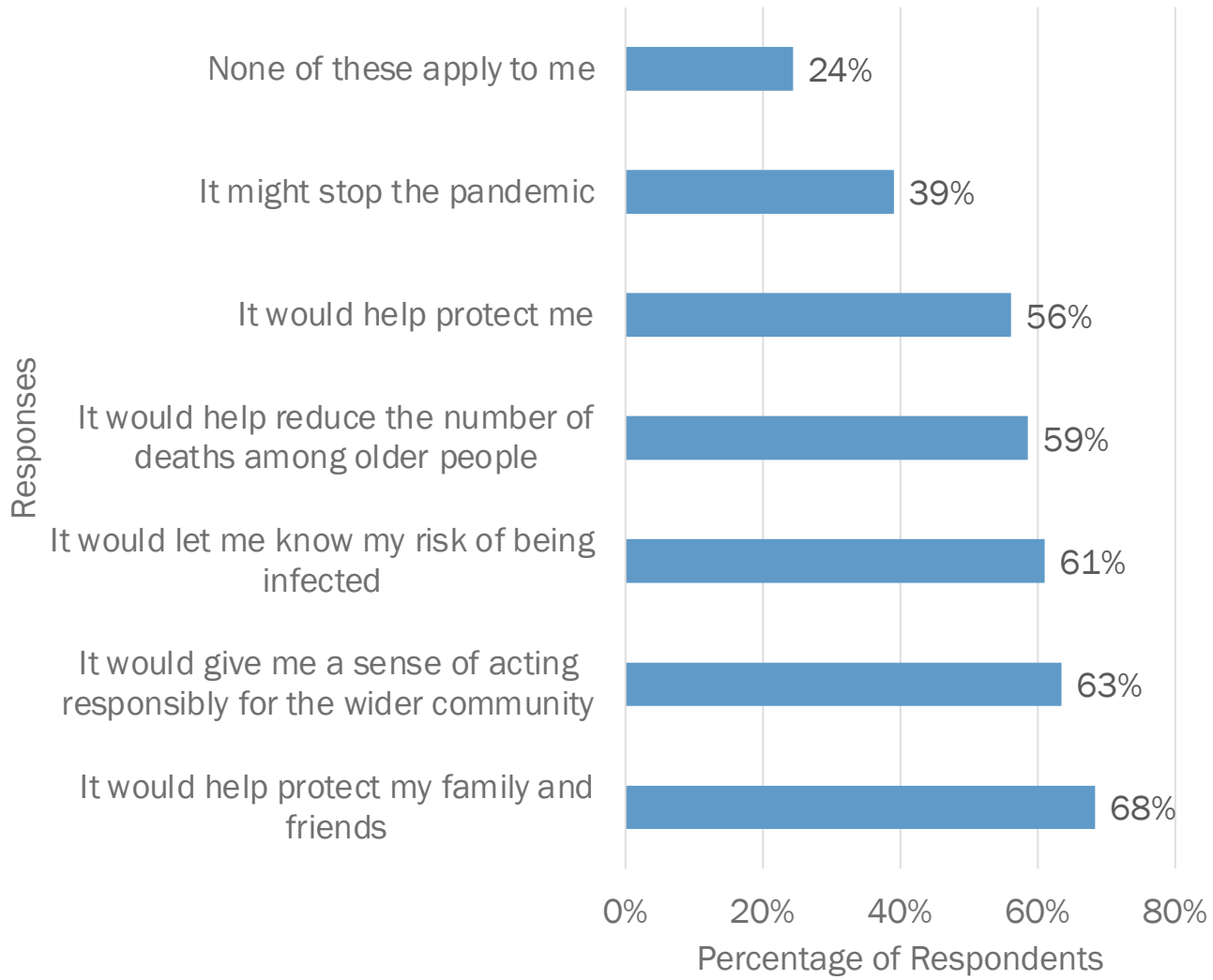
Results – Reasons to Install

What is the main reason, if any, you would install such an app?

Reasons that it would make it more likely to install an app like this

Results – Qualitative

What are the reasons, if any, people in your organization would install such an app?

Results – Reasons Not to Install

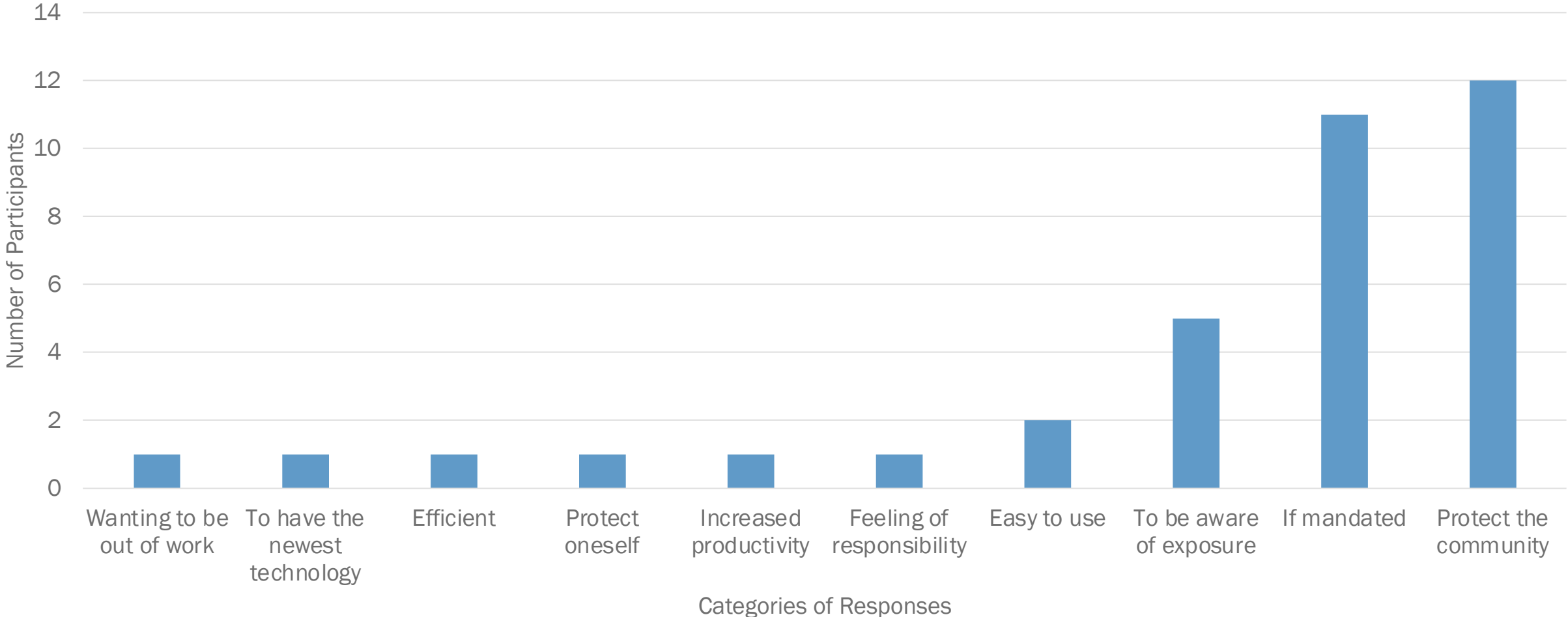What is the main reason, if any, you would NOT install such an app?

Reasons that would make it less likely to install an app like this
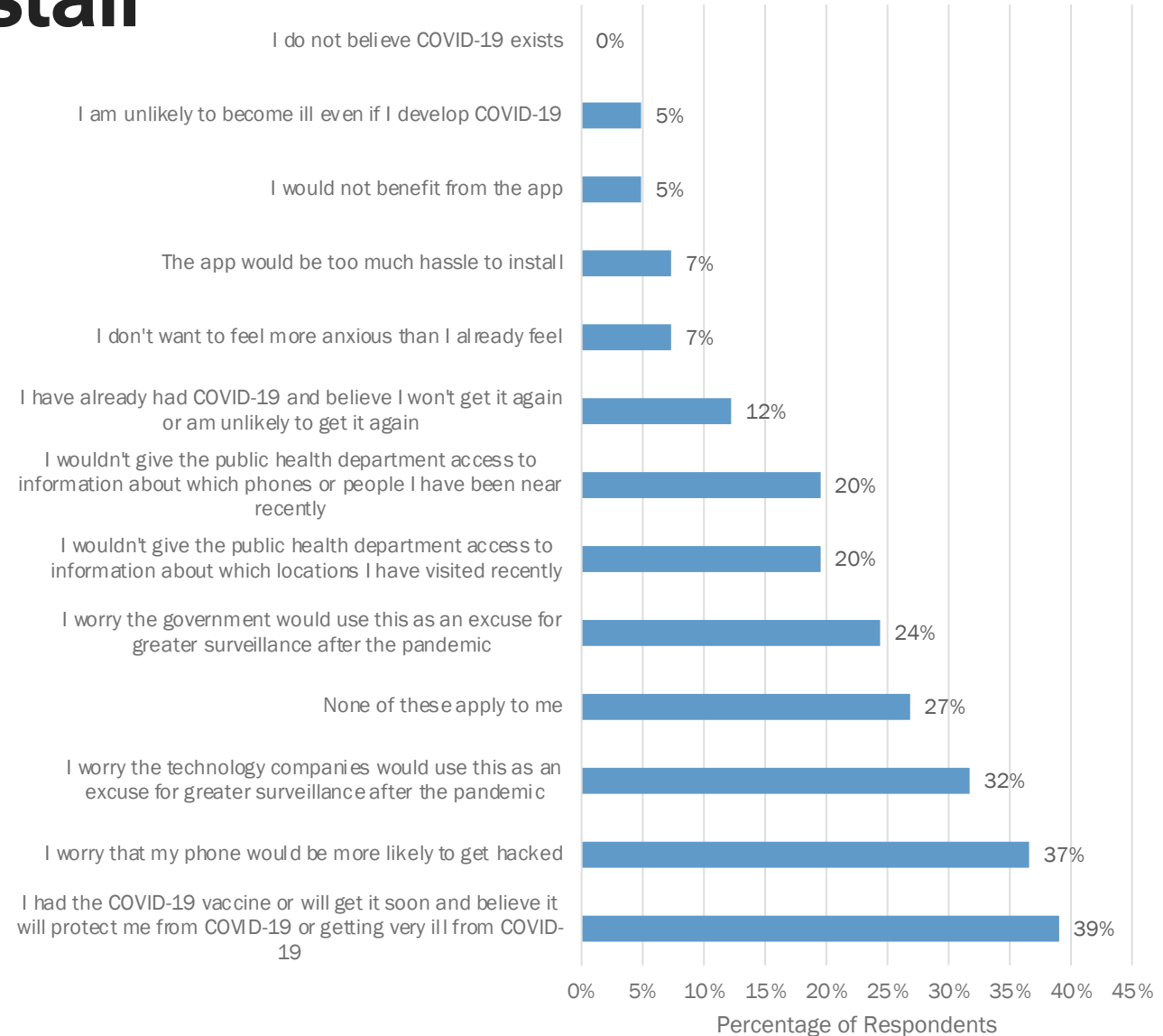
Results – Qualitative

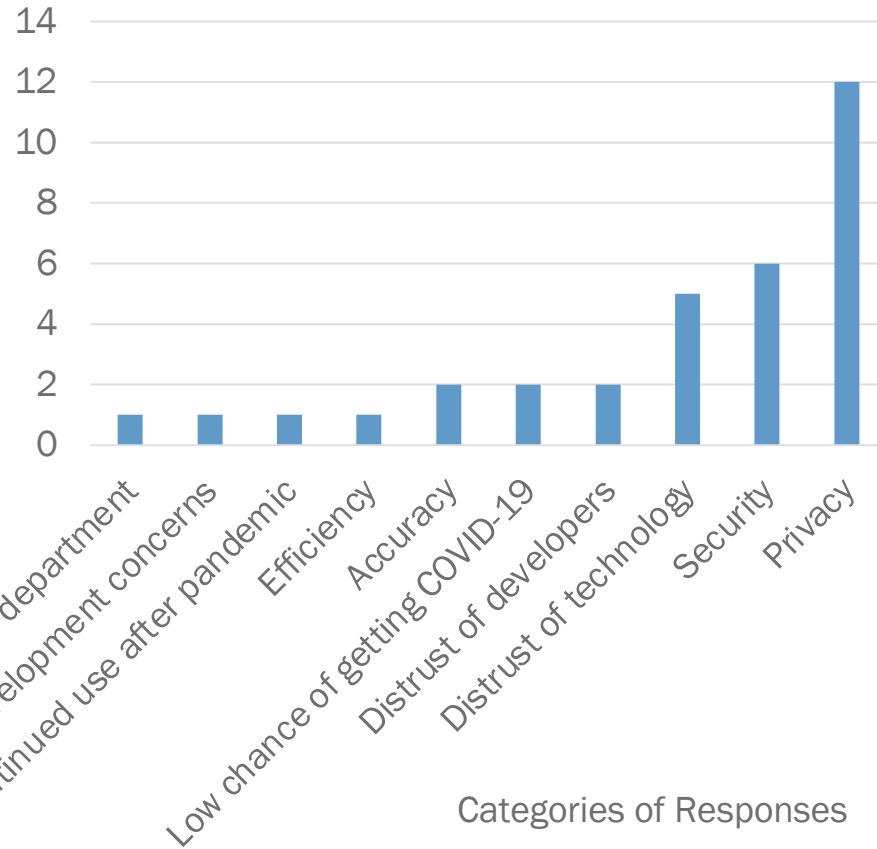What are the reasons, if any, people in your organization would not install such an app?

Results – Features

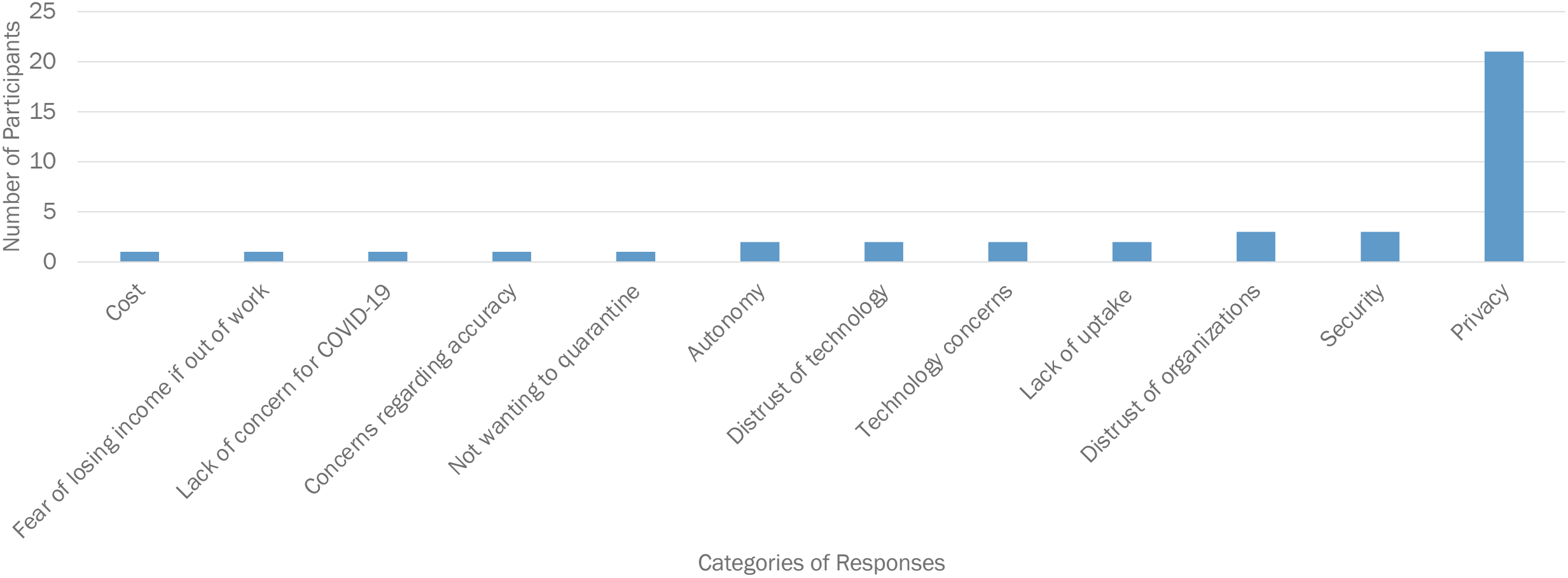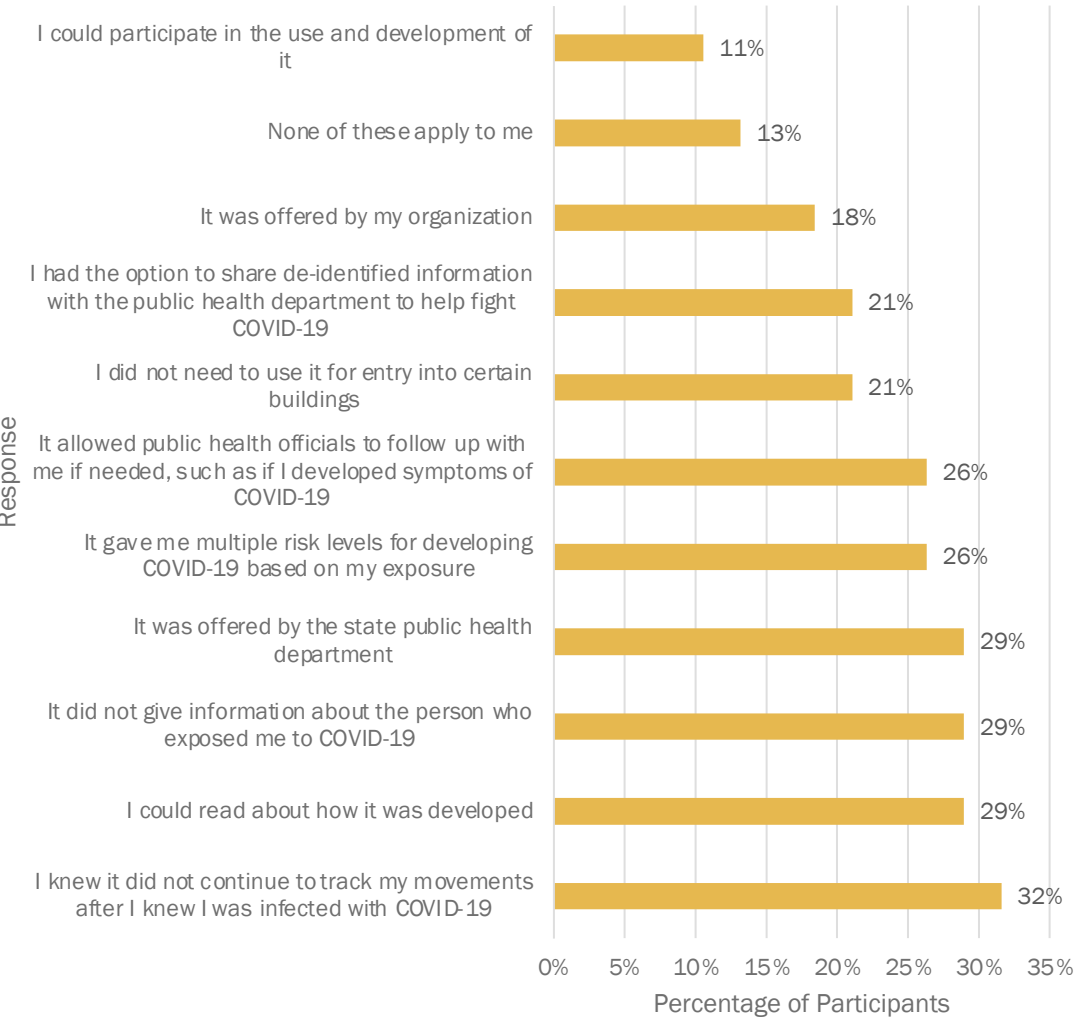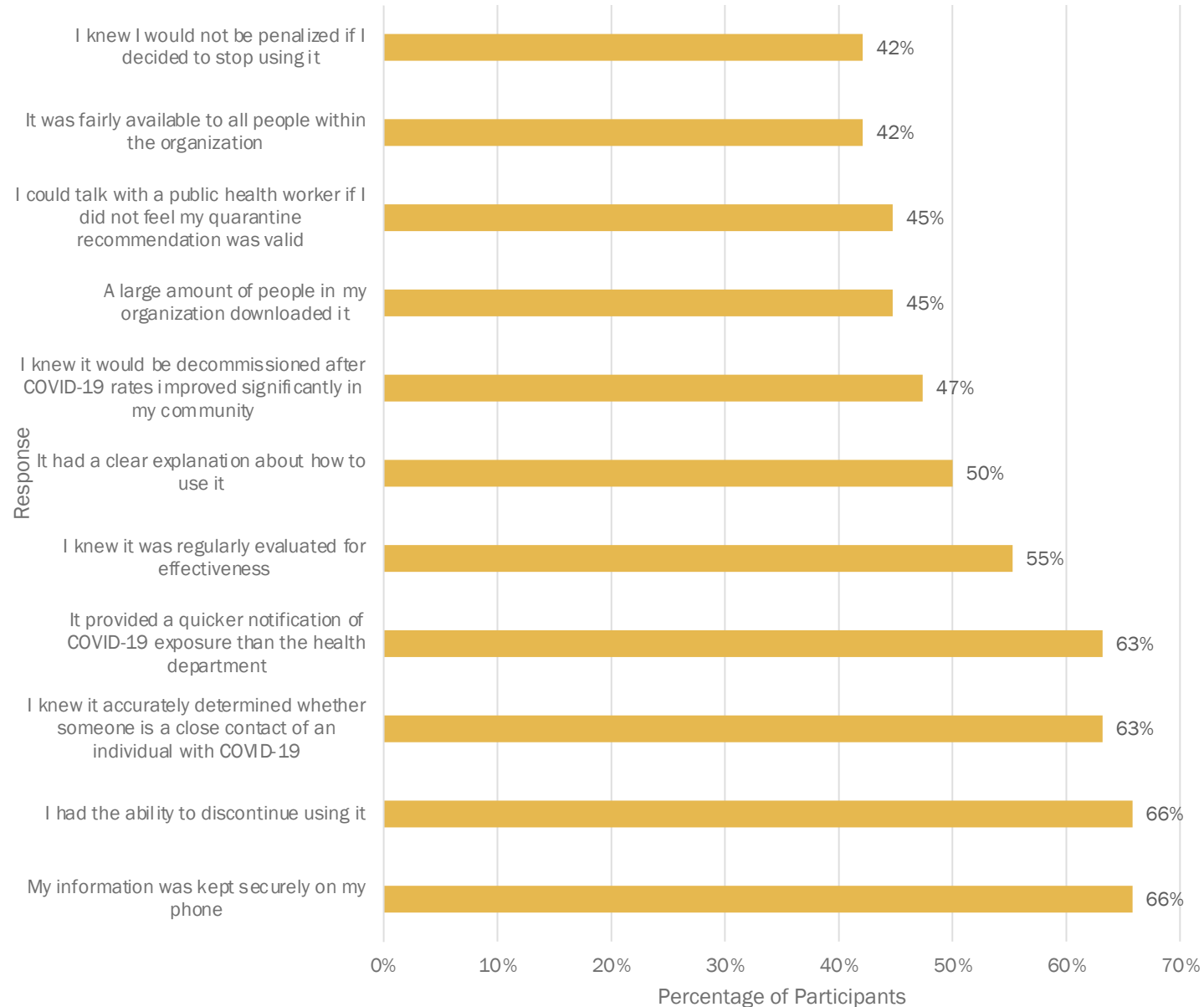Features that would make it more likely for participants to install an app like this

Left chart — Response vs. Percentage of Participants:

- I could participate in the use and development of it — 11%
- None of these apply to me — 13%
- It was offered by my organization — 18%
- I had the option to share de-identified information with the public health department to help fight COVID-19 — 21%
- I did not need to use it for entry into certain buildings — 21%
- It allowed public health officials to follow up with me if needed, such as if I developed symptoms of COVID-19 — 26%
- It gave me multiple risk levels for developing COVID-19 based on my exposure — 26%
- It was offered by the state public health department — 29%
- It did not give information about the person who exposed me to COVID-19 — 29%
- I could read about how it was developed — 29%
- I knew it did not continue to track my movements after I knew I was infected with COVID-19 — 32%

Right chart — Response vs. Percentage of Participants:

- I knew I would not be penalized if I decided to stop using it — 42%
- It was fairly available to all people within the organization — 42%
- I could talk with a public health worker if I did not feel my quarantine recommendation was valid — 45%
- A large amount of people in my organization downloaded it — 45%
- I knew it would be decommissioned after COVID-19 rates improved significantly in my community — 47%
- It had a clear explanation about how to use it — 50%
- I knew it was regularly evaluated for effectiveness — 55%
- It provided a quicker notification of COVID-19 exposure than the health department — 63%
- I knew it accurately determined whether someone is a close contact of an individual with COVID-19 — 63%
- I had the ability to discontinue using it — 66%
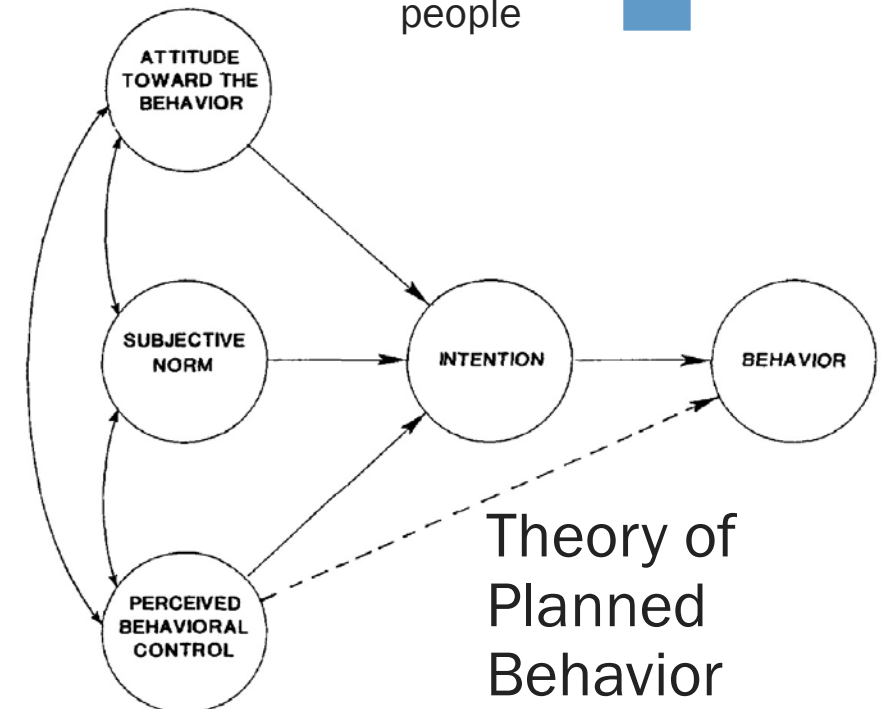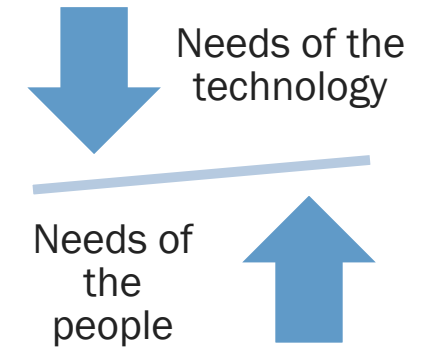- My information was kept securely on my phone — 66%

Results – Updates to CPG

► Added new column to CPG that ranks importance of each aspect
— Important to at least 50% of local organization leaders
— Important to 25-49% of local organization leaders
— Important to less than 25% of organization leaders

► Added another section on personalization of the app
— Updates on COVID-19 regulations
— Locations of nearby COVID-19 testing and vaccination sites
— Notifications if in close contact with an individual

Discussion - Aim

► Aims:

— to identify and analyze acceptability, perceptions, and barriers to using a digital contact tracing app with organizational leaders who perform COVID-19 testing and then use these results plus an updated literature review to update the digital contact tracing guidelines

— to create a clinical practice guideline (CPG) for selecting and implementing digital contact tracing mobile phone apps or features of the apps for COVID-19 based on current literature and analysis of opinions from organizations testing for COVID-19

Sociotechnical Theory

Needs of the technology

Needs of the people

ATTITUDE TOWARD THE BEHAVIOR

SUBJECTIVE NORM

PERCEIVED BEHAVIORAL CONTROL

INTENTION

BEHAVIOR

Theory of Planned Behavior

Discussion – Relation to Literature

► Similarities:
— 57% would download the app
— Most were felt COVID-19 was a big problem
— Main reasons to download:
— Altruism
— Main reasons not to download:
— Privacy/security concerns

► Unique Aspects:
— 23% not worried about getting COVID-19
— 17% would not quarantine
— 39% would not download app due to being vaccinated
— 31% wrote in that people in their organization would download the app if mandated

Discussion – Strengths and Limitations

- ► Strengths:
  - — Variety of organization leaders (schools and companies throughout New Hampshire, Massachusetts, and Vermont)
  - — High response rate of 81% (43/53)

- ► Limitations:
  - — Not surveying organization members
  - — Sample may have higher digital literacy
  - — Unclear reasoning due to quantitative questions

Discussion - Implications

- ► Completion of updated CPG on digital contact tracing
- ► Organizations and public health departments can use this CPG to choose a digital contact tracing app

Discussion – Future Innovation

► Vaccination considerations

► Surveying organization members and developing a training for them prior to app rollout

Conclusion

► Digital contact tracing guidelines needed

► Concerns:
— Privacy and security
— Accuracy
— Efficiency
— Ease of Use
— Distrust of Government and Technology Companies

► 57% of organizational leaders would download an contact tracing app

► Motivating Factors:
— Protection of themselves and the community (altruism)
— An easy and efficient app

References

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