

## Case Report

# Implementing a digital system for contact tracing and case investigation during COVID-19 pandemic in San Francisco: a qualitative study

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### ABSTRACT

During the COVID-19 pandemic, many health jurisdictions deployed digital informatics systems to support “manual” case investigation and contact tracing (CICT). This case study evaluates the implementation and use of a digital information system through the experiences of CICT workers in the City and County of San Francisco (CCSF). We conducted semi-structured, 90-min interviews with a sample of the CCSF CICT workforce ( $n = 37$ ). Participants also completed standardized assessments of the digital system using the System Usability Scale (SUS). Qualitative analyses highlighted (1) the importance of digital tools to ensure rapid onboarding and effective data capture in a public health emergency; (2) the use of digital systems to support culturally sensitive care; and (3) the role of digital tools in building supportive work environments. The mean SUS score was 70/100 ( $SD = 17$ ), indicating relative ease of use. In summary, the analysis highlights the importance of digital tools to support manual CICT in the COVID-19 response.

**Key words:** COVID-19, contact tracing, data systems, public health, mobile health

### Lay Summary

During the COVID-19 pandemic, many health departments implemented digital systems to collect, store, and share data for case investigation and contact tracing (CICT). In San Francisco, much of the contact tracing workforce was entirely remote and had little to no public health experience. Given this unique situation, we wanted to understand their experience with the digital system to inform future implementation of digital systems for public health responses. This case study describes how CICT workers in San Francisco experienced and used the digital system and how it could be improved. We conducted semi-structured, 90-min interviews and a short survey with a sample of 37 CICT workers and found that, overall, the digital system was easy to learn and improved workers’ experience of data management during the pandemic. The digital system was also important in fostering a supportive and collaborative work environment. We found that the system could be improved to better support culturally sensitive care and highlight the importance of digital systems in ensuring equitable public health responses.

## INTRODUCTION

The COVID-19 pandemic greatly expanded the use of case investigation and contact tracing (CICT) as an important intervention in limiting community transmission of SARS-CoV-2.<sup>1–3</sup> Despite consensus on the importance of these activities as part of a robust public health COVID-19 response, many jurisdictions in the United States failed to implement effective CICT programs because of lack of resources, leadership, and organizational capacity.<sup>4</sup>

In this context, attention has focused on how digital tools can augment the role of contact tracers (CTs) and case investigators (CIs). While digital tools, including online case management platforms, have been deployed to support contact tracing of other infectious diseases such as Ebola,<sup>5,6</sup> the use of these tools to support COVID-19 “manual” contact tracing (as opposed to Bluetooth-enabled smartphone applications) has not been formally evaluated. Moreover, little attention has focused on the role of these digital tools in support of an entirely remote workforce with limited public health experience. There is a pressing need to understand the experiences of CICTs using the digital tools to inform the implementation of future communicable disease control programs.

In March 2020, in collaboration with the San Francisco Department of Public Health (SFDPH), and University of California, San Francisco (UCSF), and Dimagi, a digital health technology company, rapidly configured a digital case management tool built on Dimagi’s software platform, CommCare, to support COVID-19 response CICT. This study sought to assess the usability of the CommCare digital platform deployed in the City and County of San Francisco (CCSF) to facilitate COVID-19 contact tracing and the experience of CICT workers.

## MATERIALS AND METHODS

### Study design and setting

To assess the experience of CICTs using a digitally enabled contact tracing system, a purposive sample of participants was recruited from CCSF’s CICT program. Eligible participants were “system end users” with experience using the data entry or front-end portion of the digital system, including CTs and CIs, clinicians, and supervisors. Semi-structured interviews were led by 2 study team members trained in qualitative interviewing. An interview guide was developed and used to probe experiences using the digital system and the rapid deployment of digital tools in support of the COVID-19 public health response (see [Supplementary Appendix SIII](#) for interview guide). Participants also completed the 10-item Likert-scaled System Usability Scale (SUS), a validated tool widely used to assess the usability and acceptability of emergent technologies, which scores usability on a scale from 0 to 100, with higher scores indicating greater usability (see [Supplementary Appendix SIV](#) for SUS questions).<sup>7,8</sup> Interviews were conducted remotely in October and November 2020.

### Digital CICT system

San Francisco identified its first case of COVID-19 on March 5, 2020 and by April 15, a digitally enabled contact tracing program was fully implemented.<sup>9,10</sup> This system was designed collaboratively by SFDPH, UCSF, and Dimagi and was used in CCSF between April 15 and November 18, 2020, after which CCSF adopted a statewide CICT system. A CICT tool built on CommCare enabled data collection and tracking of cases and contacts, and all data were securely stored on encrypted servers compliant with the Health Insurance Portability and Accountability Act (HIPAA). CICTs also used a soft-

phone application to make calls while capturing data using the case management tool and simultaneously linking clients to services. Communication between CICT workers was facilitated by the use of a web-based conferencing software (eg, Zoom) and an encrypted online chat platform (eg, Microsoft Teams).

### Data collection and analysis

All interviews were audio-recorded and transcribed with participants’ consent. Deidentified transcripts were coded and analyzed by 2 qualitative researchers on the study team using Dedoose qualitative coding software.<sup>11</sup> Researchers met frequently and reviewed selections of each other’s work to ensure coding concordance and iteratively developed the codebook, including several a priori codes. Researchers utilized applied thematic analysis to identify themes, generate codes, and quantify code occurrence.<sup>12</sup> All study activities were reviewed and approved by the New England Institutional Review Board (IRB) and the IRB at UCSF.

## RESULTS

Of the 37 participants interviewed, 68% ( $n=25$ ) identified as women; 24% ( $n=9$ ) as men; and 5% ( $n=2$ ) as transgender (3 participants declined to answer). Twenty-four (65%) participants were people of color and 41% of participants identified as Latinx. The average age was 43 years. Participants represented 3 CICT workforce categories: (1) trained public health workers and clinicians employed by SFDPH ( $n=7$ ); (2) redirected state and city employees, serving as “disaster service workers” ( $n=21$ ); and (3) staff from community-based organizations ( $n=9$ ). Those in the latter 2 groups had limited or no prior public health experience (see [Supplementary Appendix SI](#) for participant demographics).

A total of 35 qualitative codes were developed reflecting topics discussed in the interviews. Codes fell into 2 general categories that were directly probed—(1) Usability and (2) Work Processes—and 2 emergent categories—(3) Workplace Support and (4) Rapport-building. See [Table 1](#) for select excerpts from qualitative interviews and [Supplementary Appendix SII](#) for code occurrence frequencies.

### Usability

Among 37 respondents, the mean SUS score was 70 ( $SD=17$ ; see [Supplementary Appendix SI](#) for individual SUS scores). Participants noted the digital tools’ role in facilitating CICT workflows, including looking up records and completing calls, writing case notes, and conducting follow-up. When asked how to improve the system, several reported integrating the case management system with other digital applications (eg, softphone, Zoom, MS Teams;  $n=7$ ), and navigation improvements within the system ( $n=12$ ).

Several participants ( $n=13$ ) highlighted the need for additional training and improvements in the digital platform to enable greater cultural and language compatibility, including matching clients to CICTs from same race, ethnicity, neighborhood, or language.

### Work processes

Eleven participants described feeling overwhelmed by CICT work due to using several digital applications concurrently and frequent updates to CICT guidelines (see [Figure 1](#)). Moreover, frequent modifications were made to the software to ensure that functionality matched evolving epidemiology and policies.

Despite frequent changes and a host of related platforms, most respondents noted that work processes were facilitated

**Table 1.** Select excerpts from interviews under each coding category

Usability
<p>I was extremely excited when I was able to just get through call quicker because I'm able to enter the information. . . I was able to navigate through these different functions to really lay out my speaking points, lay out my approach. It just became secondhand. (10)</p> <p>It's not like a terrifying beast of a database. It's very clear, like this is the question. And I liked that the script is embedded in it. I really liked that about it. I think that's helpful, especially when you're beginning and you're like, I don't know what to say, you know? (11)</p>
Work processes
<p>There's so much like, you know, we do Zoom, we do [MS] Teams. . . We had to like set up our browsers in a certain way. . . [Those] sort of things that got really confusing. (17)</p> <p>There wasn't a ton of training. It was more of like learning as you go and then like asking questions. And then it was like building a ship that was already in the water. (13)</p> <p>I have, uh, many things open [in my browser]. I think this is also why people were complaining, why it's hard, but I'm used to it. Uh, I have many different software open. (7)</p> <p>I felt that even through that training process, which was a little bit kind of, um, patched together, the people that we were working with were so responsive and available to be helpful, guiding us through it all. That was really great. (5)</p>
Workplace support
<p>Being able to like actually contact people and, and warn them and provide them with resources, um, especially getting them tested and encouraging them to get tested and encouraging them to stay home, you know, feels very like effective or like positive and useful, um, in this, in this time. So, I've been really excited to be a part of a team that's doing useful work in a pandemic. (11)</p> <p>I love my job. So going to work is a joy. Um, so in the same way, like being, doing something greater than me is also helpful to me. (8)</p>
Rapport-building
<p>I feel like a lot of these [digital] tools, I think they're good for information gathering, like excellent. . . But in terms of like human connection, I don't think they're very good. Yeah. And so we're doing two things, right. We're trying to comfort in and support people and we're also trying to get as much information as we can. (17)</p> <p>The more you build rapport or trust . . . the more likely they are to heed the recommendations or guidance that you're giving them. (25)</p> <p>With the Latino community, it's more like, how are you and your family doing? You know, just, you know, setting the tone and the pace. Um, it's a little different. (6)</p> <p>It isn't about finding the right clinical terms. It's about, um, cultural relevancy, um, and doing your best to serve a community who has often been left out of receiving medical services or who could possibly have experienced, um, a lot of negative interactions with, with medical institutions. (22)</p> <p>Practicing empathy, active listening, um, validating, you know, a person's experience, um, practicing non-judgment and yeah, just kind of holding space, not making assumptions about where somebody is coming from. (29)</p> <p>We're trying to, um, like be, be mindful of like the spread of this pandemic, but it's like, these are people's lives. . . It's also like honoring them like, and their fears. (2)</p> <p>Providing. . . care that works for them and not trying to mold their attitudes or their way of life to what I think would be the best model of care. (28)</p>

Note: See [Supplementary Appendix SII](#) for individual codes and occurrence frequencies. Number in parentheses corresponds to the Participant ID.

by the digital system. Participants cited specific features such as logic calculations for isolation and quarantine dates, as well as the general usability of the platform, as a positive influence on their workflow.

### Workplace support

Participants highlighted the role of the digital platform in creating an enabling environment in support of a workforce that included many people with minimal prior public health experience. Several respondents highlighted the use of real-time online communication (eg, Zoom, MS Teams) with supervisors and colleagues to address technical challenges and create a supportive professional community. Each shift started with a brief video conference where CICT staff reviewed updates and ended with a team video conference to review complicated scenarios. One respondent highlighted this as an opportunity for connection and support:

We have our inbrief and outbrief twice a day with our team leads and that's another way of getting support. We can express how

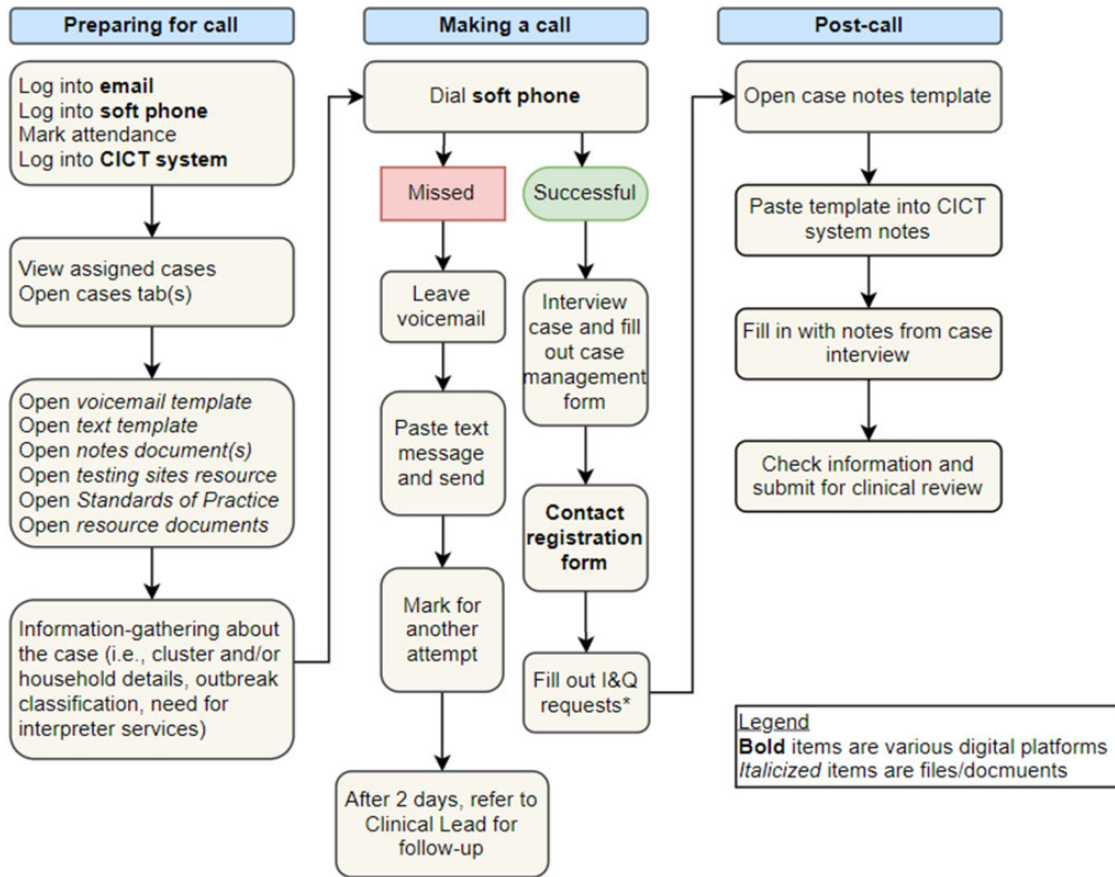
our day went, what difficulties we had and they, and vice versa. They'll do the same thing. (32)

Seventy-three percent of participants ( $n=27$ ) reported a high sense of job satisfaction associated with contributing to meaningful work and feeling supported. The digital platform contributed to the sense of workplace belonging by connecting the remote workplace and facilitating collaborative work.

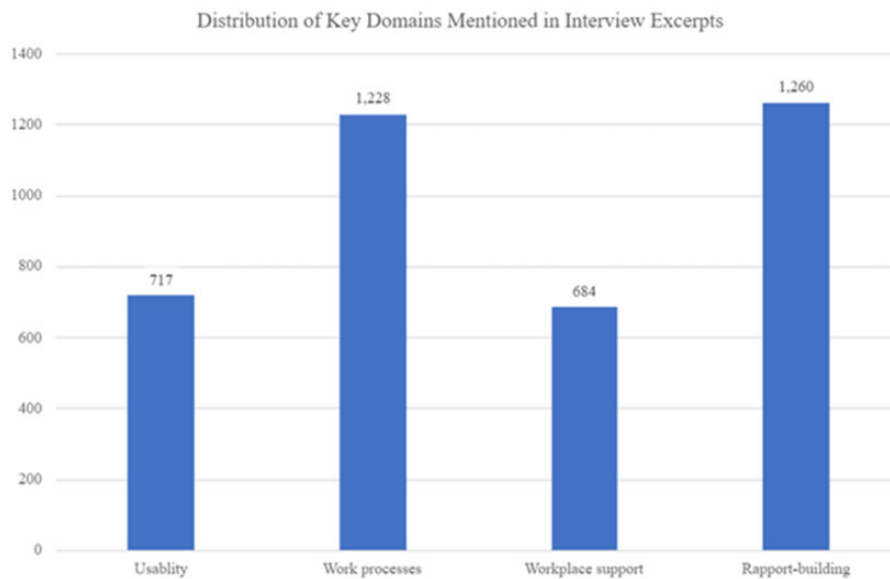
### Rapport-building

Many participants noted that rapport-building with cases and contacts was a critical aspect of CICT work and highlighted the need for digital systems to be designed to directly support this facet of CICT. Aspects of rapport-building, such as motivational interviewing, harm reduction, and cultural humility were raised by more participants than any other domain, comprising 32% ( $n=1260$ ) of all coded excerpts (see [Figure 2](#)).

Establishing a personal connection through techniques such as empathy and active listening was perceived to be critical to complet-



**Figure 1.** A typical contract tracing workflow. This chart of a typical shift workflow was created based on qualitative interviews with contact tracers, case investigators, and clinicians in the City and County of San Francisco (n=37). Items in **bold** represent different digital platforms used by contact tracers; *italicized* items are individual files and/or documents.



**Figure 2.** Distribution of key domains mentioned in interview excerpts. This chart represents the occurrence of 4 main themes in interview transcripts with contact tracers, case investigators, and clinicians in the City and County of San Francisco (n=37). Interview transcripts were coded using Dedoose qualitative coding software, and researchers utilized applied thematic analysis to identify themes and quantify code occurrence.

ing calls. Participants discussed the centrality of rapport-building to their work using the digital tools. In addition, several participants noted the need for digital solutions that facilitate these “soft skills” and are optimized for rapport-building.

Equally important to rapport-building was cultural congruence. Several respondents (41%,  $n = 15$ ) discussed the importance of cultural compatibility in addition to language support. CICTs who interviewed members of their own linguistic and/or cultural communities reported ease and familiarity with cases and contacts that positively impacted their calls.

## DISCUSSION

To our knowledge, this is the first qualitative study assessing the usability of digital tools for manual contact tracing for COVID-19. This analysis highlights the critical role of these tools in the delivery of a culturally sensitive, language concordant public health response. The following 3 themes emerged in our analysis: (1) the importance of usability to ensure rapid onboarding and effective data capture as part of an emergent public health response; (2) the role of digital platforms in optimizing culturally sensitive care; and (3) the role of digital tools in building a collaborative and supportive work environment.

### Factors impacting usability

Firstly, this analysis highlights the importance of the usability of digital tools to COVID-19 CICT efforts. Notably, we found that the tools used in CCSF had a high mean SUS score and could be used by a diverse workforce including many with no previous experience using similar tools; this was critical given that many CICTs had limited to no public health experience.<sup>13</sup> Future efforts to optimize contact tracing efforts for pandemic response should also focus on how to enable more rapid data collection and interpretation, potentially through system integrations and increased data sharing between systems.

### The importance of cultural humility and language concordance

Secondly, this study underscores how digital platforms for CICT need to be expressly designed to support an equity-informed public health response. While mounting evidence suggests that the COVID-19 pandemic has been associated with greater morbidity and mortality in racialized groups that struggle with poverty and poor access to care,<sup>14–16</sup> there has been a lack of attention to ensuring health equity in the development of digital health solutions for COVID-19. The importance of language concordant, client-centered care in CICT work highlights the need to ensure health technologies are optimally designed to address structural inequities that undermine public health actions.

### Creating an enabling work environment

Finally, this study highlights how public health workers prioritized tools and digital resources that fostered community. While several workers acknowledged how working remotely was isolating and emotionally demanding, they noted the importance of digital solutions that helped foster collaboration and community among teammates and supervisors. These insights highlight how digital platforms for public health need to be designed to create an enabling professional environment, where staff have direct access to supervi-

sors who can address technical questions and coach them to deliver compassionate care.

### Limitations

This study is explorative and contains 2 complementing data sources—interviews and SUS data—collected at 2 different time points. One limitation of this study is that participants were sampled from those that had volunteered to take part; these may have been public health practitioners who were enthusiastic about using the technology. It was also a sample of staff working entirely remotely, and as such findings may not be normative for an office-based workforce using similar tools. Further, results reflect the perceptions of the CICT workforce working in a large, diverse urban setting and thus may not be generalizable to other settings. Strengths include recruitment of a diverse participant sample representing various professional roles with multiple perspectives into CICT implementation.

## CONCLUSION

Findings not only highlight the importance of usable digital tools in improving the manual contact tracing efforts but also underscore the need for tools that are expressly designed to optimize language concordance and culturally sensitive public health response.

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## AUTHOR CONTRIBUTIONS

All authors acknowledge that they: (1) made substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of the data for the work; (2) contributed substantially to the drafting and final approval of the version to be published; and (3) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *JAMIA Open* online.

## CONFLICT OF INTEREST STATEMENT

HB, YXH, and NL report the following details of involvement in an organization with a financial interest in the subject matter discussed in this manuscript: Authors are employed by Dimagi, which hosts CommCare, the case management platform for CICT evaluated in this work.

## DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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