

Transitioning to Remote User-Centered Design Activities in the Emergency Medical Field During a Pandemic

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ABSTRACT

During the COVID-19 pandemic, we had to transition our user-centered research and design activities in the emergency medical domain of trauma resuscitation from in-person settings to online environments. This transition required that we replicate the in-person interactions remotely while maintaining the critical social connection and the exchange of ideas with medical providers. In this paper, we describe how we designed and conducted four user-centered design activities from our homes: participatory design workshops, near-live simulation sessions, usability evaluation sessions, and interviews and design walkthroughs. We discuss the differences we observed in our interactions with participants in remote sessions, as well as the differences in the interactions among the research team members. From this experience, we draw several lessons and outline the best practices for remotely conducting user-centered design activities that have been traditionally held in person.

CCS CONCEPTS

• **Human-centered computing** → *HCI design and evaluation methods*.

KEYWORDS

Remote testing, usability testing, participatory design, near-live simulations, usability evaluations

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1 INTRODUCTION

In user-centered design (UCD), the primary focus is on the user and creating systems that will be useful for them [27]. UCD activities, such as interviews and usability evaluation sessions, play a critical role in the design cycle. In participatory design (PD), users are directly involved with designing and developing products through

a set of strategies for cooperation between researchers and participants [19, 25]. Projects that use the PD approach should have participatory development methods and technical flexibility, while users should have access to relevant information, express independent opinions, and be involved in decision making [8]. Traditionally, researchers have been conducting UCD and PD activities in person with users, usually in their homes, workplaces, or usability labs. Conducting these activities in the field gives researchers a better understanding of user environment, leading to better designs [15].

In the beginning of 2020, the COVID-19 pandemic forced countries around the world to issue shelter-in-place orders to avoid the spread of the disease. For many people who were sheltering in place, video-conferencing and other online collaborative tools became the primary methods of working, socializing, and finding entertainment [5]. Research institutions began prohibiting travel and in-person user studies due to the pandemic and shelter-in-place orders. As a result, HCI researchers, who were in the middle of conducting user studies or about to start new ones, faced the challenge of switching to remote user studies in order to move forward with research. Researchers began discussing different strategies for remote collaboration during this time [10] and for transitioning research from in-person to remote, such as evaluating the cost and benefit of video recording users in their homes, creating protocols that would limit the amount of setup required by the participant, and pilot testing the sessions before running with users [30].

In this paper, we describe how we transitioned four UCD activities from in-person to remote sessions. We used these activities to design and evaluate features for a digital checklist for pediatric trauma resuscitation. Prior to the pandemic, and over the past three years, we conducted multiple design sessions and activities in person with clinicians at a regional level 1 trauma center [20, 21]. To rapidly adapt these sessions for a remote setting, we used a range of technologies to conduct participatory design workshops, near-live simulations, usability evaluation sessions, and interviews with medical staff. We were not only separated spatially from the participants, but were also separated from other members of the research team while running the sessions from our own homes. With this case study, we explore the following research questions: (1) How do we rapidly transition to remote UCD activities while ensuring research continuity and data validity? (2) How did the transition from in-person to remote testing during the pandemic affect the interactions between researchers and participants? (3) How did this transition affect the interactions between research team members? Based on our experiences, we discuss several best practices that researchers can follow when pivoting to remote user research. Although our best practices emerged from academic research and limited resources, they speak to the universal issues of UCD, such

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as establishing good relationships with participants, and ensuring high-quality data and user feedback.

2 RELATED WORK

Prior work has investigated the relationships between researchers and participants in UCD, evaluated remote user testing, and explored the use of computer-mediated communication (CMC) technologies in user research.

2.1 Relationships Between Researchers and Participants in UCD

Effective UCD and PD require good relationships between researchers and users. To establish long-term partnerships that yield good iterative designs, the relationships between researchers and users should be based on mutual learning, trust, and reciprocity [14]. Følstad described five principles for building trust in PD, which included involving different interests, finding common ground, understanding the work and practice, facilitating skill-based participation, and recognizing all voices [11]. High quality conversations between PD members are also important, as differing intentions and spontaneity lead to new ideas and new concepts emerge from individual experiences [4]. Bratteteig and Wagner [3] studied power sharing and decision making in PD, finding that participants had different shares of power and the power dynamics depended on the context. In moving our UCD activities from in-person to remote, we observed how this transition affected our relationships with users, as well as mutual learning, trust, reciprocity, and power dynamics.

2.2 Remote User Testing

Remote user testing had been used before COVID-19 and has both advantages and disadvantages over traditional, in-person testing. In remote user testing, researchers and users are separated by space and time, with video conferencing being used to extend the usability laboratory and connect the participants [16]. Remote testing minimizes travel, as well as productivity and opportunity costs associated with in-person user testing [23]. Because researchers are not contained by budget and time to a specific geographic area, remote testing can reach a wider range of participants, such as those with disabilities [28]. Prior work compared in-person lab experiments, remote synchronous testing, and remote asynchronous testing, finding similar results between remote synchronous and in-person lab testing [1, 18]. Even so, remote researchers may face technical difficulties, struggle to develop relationships with participants, and find it challenging to understand the participants' environment and obtain real-time feedback [9, 32]. Setting up the different technologies for remote sessions may be time-consuming for participants, while also raising concerns about privacy [24]. In most prior studies, researchers were separated from users, but they still had access to offices and could run the remote sessions from their work environment. Many researchers during the COVID-19 pandemic had to conduct remote sessions from their homes, which added additional differences from the traditional, in-person testing.

Different technologies have been designed to enable remote user testing [6, 7, 29]. Chalil et al. [6] developed a virtual usability testing laboratory for synchronous remote testing, and compared it with in-person lab and web-conferencing testing. Although the virtual

methods had no effects of on the number of identified issues or time-to-task completion, they led to higher participant workload. Chen and Zhang [7] similarly created a remote paper prototype testing system to observe users interacting with prototypes in their own environments. As COVID-19 was an unprecedented and sudden event, HCI researchers in the middle of studies or about to start new studies had to rapidly reconsider their approaches, rely on existing technologies, or invest in creating new tools to run remote user testing sessions.

2.3 Computer-Mediated Communication

During the COVID-19 pandemic, video conferencing replaced many face-to-face interactions, including UCD activities. As people began conducting most of their work and social activities through video conferencing, they began experiencing "Zoom fatigue" [34]. Prior research has studied the effectiveness of computer-mediated communication technologies at replacing face-to-face interactions, finding mixed results [2, 12, 17, 26, 33]. Video conferencing provides additional context compared to audio-only calls, and can better help collaborators develop mutual understanding and common ground [31, 33]. Bos et al. [2] found that while video conferencing performed similarly to in-person interactions, it could delay the formation of trust between individuals because they had fewer nonverbal cues to use when determining if an individual was trustworthy. Nguyen and Canny [26] discovered a significant difference in building empathy over video-conference calls in systems where only the head was framed vs. systems where the upper body was framed, as the upper-body framing provided additional body language cues. As all four of our UCD activities used computer-mediated communication tools, we observed similar effects of these technologies on our remote sessions.

3 METHODS

3.1 Study Background

Prior to this research, we had introduced a digital checklist for pediatric trauma resuscitation at a level 1 trauma center at Children's National Medical Center in Washington D.C. Surgical fellows and residents have been using the checklist since early 2017 while leading resuscitations. The digital checklist is based on the Advanced Trauma Life Support (ATLS) protocol and was implemented on a Samsung Galaxy tablet. Since the introduction of the digital checklist, we have been continuously improving the design and introducing new features based on user feedback. Because we had to continue with design improvements during the pandemic, it was critical that we also continue with UCD and PD activities. To run these sessions remotely, we used several different technologies to connect with participants and compensate them, to remotely access the digital checklist, and to communicate with each other (Table 1).

Because of our geographic distance from the research site, we had already developed the infrastructure approved by the hospital's Institutional Review Board (IRB) that allowed us to remotely access devices and data at the hospital. Any confidential data, such as videos of past cases, are stored on a server at the hospital, and are only accessible to members of the research team who have completed the ethics training and been added to the IRB protocol.

Table 1: Technologies Used In Our Remote User-Centered Design Activities

Name	Type	Purpose	Activity*
Adobe XD	Design tool	Create clickable prototypes shared via links	2,4
AnyDesk	Remote desktop application	Remotely access hospital's tablet	2,3
Facebook Messenger	Messaging platform	Communicate between the research team	2,3
Google Drive	File storage service	Store and share simulation videos	2
Google Forms	Survey administration app	Distribute pre- and post-session surveys	2
Google Sheets	Online spreadsheet program	Note taking during sessions	All
iMessage	Messaging platform	Communicate between the research team	1,2,3
LogMeIn	Remote desktop software	Remotely access hospital's computer	3
Microsoft Powerpoint	Presentation program	Share presentations during sessions	1,4
Venmo	Mobile payment service	Compensate participants after sessions	1,2,4
Zoom	Video-conferencing service	Video conference with participants	All

*1: PD Workshops, 2: Near-Live Simulations, 3: Usability Evaluations, 4: Interview & Design Walkthroughs

3.2 Participatory Design Workshops

3.2.1 Prior to COVID-19. Before the pandemic, we ran three PD workshops with digital checklist users at the hospital. One workshop involved three surgical residents while the others had two residents. We began the sessions by having the participants discuss recent trauma cases to help ground their design thinking in real, concrete scenarios. We then gave an overview of the checklist features and findings from prior user studies. Following this presentation, we asked participants to jot down main issues with the digital checklist on post-it notes. The participants could access the checklist during this time if they wanted to remind themselves of any issues. We then asked the participants to discuss the issues and group their post-it notes into categories. Next, we had a group design activity where participants used cardboard cutouts of checklist features and functions to co-design an ideal checklist. We then asked each resident to create their own sketches of new checklist features and describe them. Finally, we had leaders vote on feature prioritization by first writing each feature on a post-it note on the wall and then placing three stickers on their top features. We recorded videos of the residents describing their sketches, took pictures of all artifacts, and kept the sketches after the session.

3.2.2 During COVID-19. Due to travel restrictions from the pandemic, we had to run the last workshop remotely using Zoom, a video conferencing platform. We had trouble recruiting participants for this last session and ran the workshop with just one resident in April 2020. As two researchers were able to join this session, one researcher led the workshop while the other observed and took notes. Using the screen share feature on Zoom, we could still present the PowerPoint about the checklist and past studies. Because we were remote and only had one participant, we did not have them write issues with the checklist on post-it notes, but just describe them over the call. If we had more participants, we would have needed a tool to replace the functionality of the post-it notes. Additionally, the participant joined the session from their home so they were not able to access the hospital tablet to remind themselves of the checklist and any issues. Instead of using the cardboard cutouts for the co-design activity, we asked them to sketch out their ideas for new checklist features. They then held up their sketches to the

laptop camera and discussed them. We video- and audio recorded the Zoom session to facilitate our analysis and retrospective view of their sketches.

3.3 Near-Live Simulation Sessions

We conducted four remote near-live simulation sessions throughout April and May 2020 to evaluate potential new features for the digital checklist (Figure 1). In near-live simulations, which imitate clinical workflows, a single provider watches videos of actors simulating clinical cases, while using systems to evaluate their usability and effectiveness [22]. An advantage of single-provider, near-live simulation over in-person, group session is that the clinical team does not have to gather together to perform the simulation, which is often a challenge given their busy schedules. This advantage was especially relevant during the COVID-19 pandemic, allowing us to proceed with the originally planned near-live simulation approach, albeit with some modifications. The participants were residents and fellows who had past experience using the digital checklist in trauma resuscitation. Three researchers joined the sessions, with one leading the session and the other two taking notes and managing the different technical aspects.

3.3.1 Before the Session. We recruited participants via email, asking them to schedule a one-hour session with us at a time when they would be at the hospital with access to the tablet. Before each session, we sent the participant an email with a link to our pre-evaluation survey on Google Forms. The email also contained a Zoom link for the video conference, a link to the simulation videos on Google Drive, links to the two Adobe clickable prototypes, a link to the post-evaluation survey on Google Forms, and a participant payment form to fill out for receiving compensation. Immediately before the session, we remotely accessed the hospital tablet using AnyDesk to install the new version of the digital checklist with the proposed features.

3.3.2 During the Session. After the research team and participants joined the Zoom call, we began the session by asking the participant to describe their most recent trauma resuscitation. Next, we explained the new features and gave a brief demo of each. We then instructed the participant to watch the first simulation video and

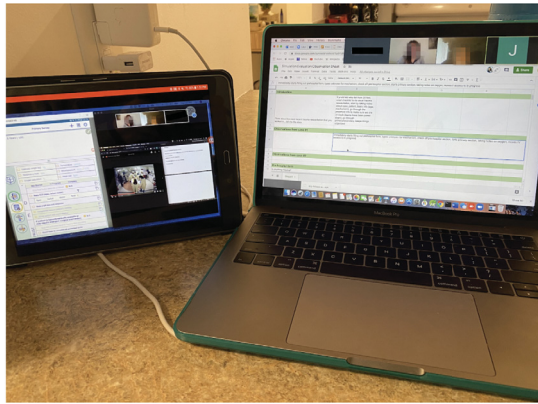


Figure 1: A researcher's near-live simulation setup in their home. A view of the participant's screen and the zoom screen share are on the tablet while the laptop has the Google Sheets for note-taking.

use the new version of the checklist as if they were the team leader in the simulation. We asked the participant to share their screen over Zoom to allow the research team to observe the video that they were watching. One member of the research team also accessed the tablet remotely via AnyDesk to observe the screen of the participant's tablet. Because only one person can access a device at a time on the free version of AnyDesk, this research team member shared their screen on a Google Hangouts call so that other team members could also see the hospital tablet screen. We informed participants at the beginning of the session that we would remotely view their tablet's screen. After the participant finished watching the first video, we asked them questions about their experience with the new checklist features. We also had them use the clickable Adobe prototypes at this time and asked questions about the new features shown by the prototypes. We then repeated this process with the second simulation video. After the second simulation video, we asked final questions about the new checklist features. Throughout the session, members of the research team took notes on a shared Google Sheet, and communicated and coordinated with each other using iMessage and Facebook Messenger.

3.3.3 After the Session. We asked participants to complete the post-evaluation survey on Google Forms after the call and fill out the payment receipt forms. After they returned both items, we distributed the money to them.

3.4 Usability Evaluation Sessions

In April 2020, we conducted two usability evaluation sessions to test a new alert feature that we were planning to release on the digital checklist. This new alert would activate on the checklist if users omitted entering the vital sign values within a certain time limit. We wanted to ensure that the alert appeared at the right time, did not have any detrimental effects on the app, and that the users noticed the alerts. We had originally intended to perform this testing in the trauma bay, with a clinical member of the research team observing a resuscitation and using the new version of the

checklist. However, due to the COVID-19 pandemic, only essential clinicians were allowed at the hospital and in the trauma bay. We revised our usability study protocol so that clinicians would watch videos of past cases and use the app as if they were the team leader in that video. Since the alerts are activated when there is a delay in documenting vital sign values on the checklist, we included videos where the team was delayed in attaining vital sign values.

3.4.1 Before the Session. To replicate the views that participants would have in the trauma bay, we had included different views of video recordings from past cases. One view showed the patient bed and team, while the other view showed the vital signs monitor. Instead of having to pull up two different videos and scroll to the appropriate time points during the session, we created a screen recording of the two videos playing side-by-side. Immediately before the session, we remotely accessed the hospital tablet to install the new version of the checklist.

3.4.2 During the Session. Because we were using videos of past cases with real patients, the videos could only be stored and viewed on a hospital computer. The session was conducted at a computer in the hospital that the research team could access remotely using LogMeIn, a remote access service. We met with participants using Zoom. Participants were not familiar with the new alert. At the beginning of the session, we informed participants that we were testing new checklist features, and asked them to use the checklist and think aloud while watching videos of past cases. We also informed participants that we would be able to see their tablet screen through remote access. We then accessed the hospital computer remotely to play videos of five different cases. After they had watched all five videos, we interviewed the participants about their experience with the new alert feature. Throughout the session, the researchers took notes using a shared Google Sheet, and communicated with each other using iMessage and Facebook messenger.

3.5 Interviews & Design Walkthroughs

We ran three individual interviews and design walkthroughs with residents and fellows during August 2020 (Figure 2). The first part of the session was a design walkthrough of two mockups for a real-time vitals display on the digital checklist. The second and third parts of the session were interviews about the vitals display and existing vitals alerts.

3.5.1 Before the Session. Before the sessions, we created interactive mockups with clickable features using Adobe XD. Although we chose Adobe XD due to our familiarity with the tool, it also allowed us to share prototypes through links that participants could easily open in any web browser. We also made a presentation showing different design options and developed the interview protocol. We remotely ran a pilot session to ensure that the prototypes worked as expected. We recruited participants over email and scheduled 30-minute video conferences via Zoom with interested participants.

3.5.2 During the Session. After the participant joined the Zoom call, we gave an overview of the session, letting them know that we were finalizing the design of a real-time vitals display based on earlier interviews and PD workshops. We then described the participant rights and asked if we could record the session on Zoom.

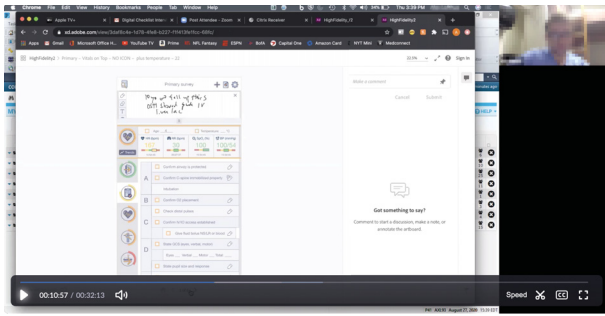


Figure 2: Screenshot from a design walkthrough where a participant is exploring mockups for a new feature on the digital checklist.

We messaged the link to the first interactive mockup in the chat and asked the participant to share their screen while clicking on the link. We let them know that the mockup was interactive and asked them to explore it while thinking aloud their initial impressions. After they were done, we followed up with specific questions about the mockup. We then repeated this process with the second mockup. After receiving their feedback on the mockups, we started screen sharing the presentation with the images of different design choices, asking the participant about their preferences and how the different features would impact their work. In the last part of the session, we asked them questions about the vitals alert feature we had previously released to understand how it affected their use of the checklist. We concluded the session by asking for any final thoughts and determining the best way to distribute the compensation (e.g., mail them a check or use a mobile payment service, like Venmo). After we received the completed participant payment receipt, we sent them the compensation using their preferred method.

4 FINDINGS & DISCUSSION

While running these four UCD activities, we developed a better understanding of how to rapidly transition to remote UCD activities while ensuring research continuity and useful data. We also observed how running these sessions remotely affected our interactions with participants, as well as the interactions between research team members. We discuss several best practices that emerged from our experiences (Table 2).

4.1 Rapid Transitioning to Remote UCD Activities for Continued Data Quality

While transitioning to remote UCD activities, our goal was to ensure that we continued collecting high-quality data and obtaining valid results from the sessions. We found that the ability to remotely access devices at our research site made remote user testing run more smoothly. Having remote access allowed us to prepare for the sessions and reduce the amount of work required by the participants. For example, because we had remote access to the hospital tablet, we could install the new version of the checklist before the sessions instead of having to ask participants to do it during the session. Remote access also allowed us to easily observe the participants using the tablet in real time instead of asking them to record their

screen to share with us after. The protocols we had in place even before the pandemic started allowed for remote access to hospital systems, which made our transitioning to remote studies easier and quicker. In the future, researchers may want to consider adding remote access considerations to their study and ethics protocols in case the need for pivoting to remote user research arises. In addition to setting up the remote access infrastructure, we also ran pilot tests to discover and fix any technical problems. We created backup plans to use when we faced technological issues during the sessions. These strategies helped us run uninterrupted sessions and collect more data.

The differences in the data collected from remote sessions vs. in-person sessions varied between the four UCD activities. In some activities, the remote sessions provided additional data. For the interviews and design walkthroughs, we could easily capture videos of participant interactions with the mockups over the Zoom calls. We were also able to record the remote view of participant interactions with the digital checklist during near-live simulations and usability tests. Remote access to the checklist tablet even provided a better view of the participant's screen than we would have had in person. In contrast, collecting data from the remote PD workshop proved harder, making this activity the most challenging to run remotely. The in-person PD sessions primarily relied on sketching and the use of cardboard cutouts. We were able to photograph the residents arranging the cardboard cutouts into new designs and bring back the physical copies of their sketches. In the remote session, we could not use the cardboard cutouts and had to ask participants to hold their sketches up to their computer camera to capture them on the recordings. Additionally, we were not able to visit the hospital, missing out the important contextual data and understanding of the user environment. This challenge was especially hard for the new members on our team, who compensated for this loss by watching videos of the past cases to better understand the trauma bay and environment. Finally, the remote nature of the workshop made it harder to build the trust and mutual understanding required of PD sessions.

4.2 Interacting with Participants

Moving from in-person to remote sessions affected our interactions with participants. We asked participants to think-aloud in the interviews and design walkthroughs, near-live simulations and usability evaluation sessions while exploring mockups and using the checklist. In the near-live simulation and usability evaluation sessions, we struggled to hear participants because they were talking while watching the videos. Participants also thought aloud less in these sessions so we had to retrospectively ask them about their experiences with the checklist. Instead of getting feedback from participants in the moment, we were getting it after they had used the checklist for an entire case. Additionally, during the near-live simulations, participants made comments indicating that they forgot that we could view their tablet screen.

We also experienced some of the issues discussed by Dray & Siegel [9], such as building trust with participants and combating technological issues. These UCD sessions were the first time we were meeting most of the participants, forcing us to establish a connection remotely. One participant never joined our scheduled

Table 2: Best Practices For Remote UCD Activities

Rapid Transitioning to Remote UCD Activities
1. Establish remote access for as many systems as possible.
2. Include remote access in IRB protocols.
3. Run pilot tests before conducting sessions with participants.
4. Have backup plan(s) in case of technological issues.
Interacting with Participants
5. Inform participants ahead of time about any technical requirements.
6. Use technologies that will be familiar and common to participants.
7. Use retrospective questioning if facing issues with the think-aloud method.
8. Gather information about the field site before running sessions.
Interacting with Other Researchers
9. Define the roles for each research member before the session.
10. Introduce the research team members and their various roles at the beginning of the session.

Zoom call for an interview and design walkthrough. They informed us several hours later about a conflict in their operating schedule and needed to reschedule our session. If we had been conducting these sessions in person at the hospital, it would have been easier to ask other clinicians about that participant's status or even recruit another user on the same day. Technological issues also created stress in our interactions with participants. In one usability evaluation session, the sound stopped working when we remotely accessed the computer at the hospital. We had to disconnect and direct the participant on which videos to play. Because our participants were residents and fellows with limited time and packed schedules, we did not want any technological issues to cause delays in these sessions.

Due to the COVID-19 pandemic, we were forced to conduct these remote sessions from our homes, which resulted in a direct collision of our personal lives with our professional lives. People tend to present themselves differently based on the setting and the group of people they are with at a given time [13]. Tensions arose from the need to present ourselves in a certain manner while also being in our homes. We therefore conducted the sessions in locations of our houses that were acceptable for video conference calls.

From our experiences interacting with participants, a few best practices emerged that could help researchers establish good relationships with remote users. Using technologies familiar to the participants can reduce their setup time and help them feel more comfortable. We also found it beneficial to inform participants about any technological requirements in advance. In the past, users would just show up to our sessions and we would bring any required materials. However, for these remote sessions, we had to inform the users ahead of time of any technical and material requirements (i.e. access to a laptop and the hospital tablet, having a pen and paper nearby). We also faced issues with the think-aloud method, as users would either not think aloud, or we would struggle to hear them over the videos. We observed that the retrospective questioning provided similar thoughts and feedback that we would normally get from the think-aloud method. Finally, because we could not travel to the field site, we watched videos of the trauma bay to get

familiar with the setting and better contextualize comments made by participants during the sessions.

4.3 Interacting With Other Researchers

Multiple researchers were able to join all four UCD activities due to minimal costs associated with the remote sessions. In the past, only one or two members of the team would travel to the hospital due to travel and time costs. Researchers would be in the same room as the participant and not able to back-channel with each other during the session. One researcher would lead the session while the other would focus on taking notes. The researchers would then communicate the results of the session with the larger research team via email or in-person meetings, hours or days after the actual session. When conducting the remote sessions, more researchers were able to join and support the process. One researcher was assigned to leading each session while the others were tasked with observing, note taking, or helping with the session logistics. Taking notes became a collaborative activity through the use of the same Google Sheet. We were able to see in real time the notes that our teammates were taking and determine if we also noticed that same aspect of the session. In our traditional in-person user testing, the research team would have discussed the sessions after they occurred. In remote sessions, we had a set of discussions during the sessions and then another set of discussions after the sessions.

Because the research team was distributed, we communicated during sessions using iMessage and Facebook Messenger. We not only communicated about the session's logistics, but also shared our observations about the participants' use of features and the different design issues. The messages between our research team became another source of field notes and we referred back to them to better contextualize the results. This enhanced communication also allowed us to discuss the protocol and any issues that arose during the session. For example, in the second usability testing session, we discussed and collaboratively decided to modify the protocol so that the participant would see alerts during their session. In traditional, in-person sessions, this decision would have fallen on the researcher running the study. Additionally, we found it was

best to define the roles for each research member before the session. One member would lead the session and interact with participants, while the others focused on taking notes. When meeting remotely, it can be more challenging to tell if others are about to speak due to limited social cues and technical lags. Designating one person to interact with the participant reduced interruptions and confusion. That researcher would introduce all other researchers at the start of the session to make participants aware of the other roles.

The ability to communicate in separate channels during sessions could affect the power dynamics of PD workshops. When everyone is co-located, it is easy to understand the different conversations taking place. However, in the remote sessions, subgroups of attendees could be discussing aspects of the session in a separate channel, creating their own sets of decisions and consensus. Participants in these subgroups might have more power in decision making compared to those who are not in these side discussions. Additionally, in remote UCD sessions, it was harder to tell who is fully engaged in the session as we could not easily view when other participants simultaneously engaged in the activities.

5 CONCLUSION

Although the pandemic forced us into remote UCD activities, our experiences have shaped our workflows going forward. Because of our geographic distance from the research site, we had IRB approvals and the infrastructure setup to remotely access our data. We were able to quickly setup another system for remotely accessing the checklist tablet at the hospital and create protocols for conducting different design activities. Despite these preparations, we observed several effects on our interactions with each other and with the participants. While some effects were due to the pandemic, other effects, such as our challenges in getting participants to think-aloud, were not specific to running the sessions during a pandemic. Running the sessions from our homes also meant that we had to manage our professional self-presentations intersecting with our home lives. Through this experience, we saw how these different activities, especially the near-live simulations and usability evaluation sessions, could be conducted remotely. Now that we have enhanced the remote infrastructure, we can choose to conduct these activities virtually to reduce travel costs, increase the number of researchers that can participate, and make it easier to schedule around the clinicians' busy schedules.

The COVID-19 pandemic does not have a clear end date. Even after institutions allow in-person user research and testing again, some users may not be comfortable meeting in person and researchers might still want to offer remote sessions as an option. Researchers may have to design protocols for sessions that can be conducted both in person and remotely, depending on participants' comfort levels and the state of the virus. If sessions are held in-person, social distancing and masks may make it harder to establish trust or read people's facial cues. Participatory design sessions, which were the hardest to conduct remotely, may also be the hardest to transition back to in-person sessions as they rely on multiple people coming together and potentially sharing materials, such as cardboard cutouts or sketches. Relying on the lessons learned, we will be more likely to use remote sessions in the future, especially for near-live simulation and usability evaluation sessions. We hope

our experiences and best practices offer valuable information to other HCI researchers as they plan and transition their research apparatuses from in person to remote.

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REFERENCES

- [1] Morten Sierker Andreassen, Henrik Villemann Nielsen, Simon Ormholt Schröder, and Jan Stage. 2007. What happened to remote usability testing? An empirical study of three methods. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1405–1414.
- [2] Nathan Bos, Judy Olson, Darren Gergle, Gary Olson, and Zach Wright. 2002. Effects of four computer-mediated communications channels on trust development. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 135–140.
- [3] Tone Bratteteig and Ina Wagner. 2012. Disentangling power and decision-making in participatory design. In *Proceedings of the 12th Participatory Design Conference: Research Papers-Volume 1*. 41–50.
- [4] Jacob Buur and Henry Larsen. 2010. The quality of conversations in participatory innovation. *CoDesign* 6, 3 (2010), 121–138.
- [5] Vinton G Cerf. 2020. Implications of the COVID-19 pandemic. *Commun. ACM* 63, 6 (2020), 7–7.
- [6] Kapil Chahil Madathil and Joel S Greenstein. 2011. Synchronous remote usability testing: a new approach facilitated by virtual worlds. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2225–2234.
- [7] Kevin Chen and Haoqi Zhang. 2015. Remote Paper Prototype Testing. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 77–80.
- [8] Andrew Clement and Peter Van den Besselaar. 1993. A retrospective look at PD projects. *Commun. ACM* 36, 6 (1993), 29–37.
- [9] Susan Dray and David Siegel. 2004. Remote possibilities? International usability testing at a distance. *Interactions* 11, 2 (2004), 10–17.
- [10] Mark Embrett, Rebecca H Liu, Katie Aubrecht, Andriy Koval, and Jonathan Lai. 2020. Thinking Together, Working Apart: Leveraging a Community of Practice to Facilitate Productive and Meaningful Remote Collaboration. *International Journal of Health Policy and Management* (2020).
- [11] Asbjørn Følstad. 2017. From participatory design to co-creation. In *Innovating for Trust*. Edward Elgar Publishing.
- [12] Susan R Fussell, Robert E Kraut, and Jane Siegel. 2000. Coordination of communication: Effects of shared visual context on collaborative work. In *Proceedings of the 2000 ACM conference on Computer Supported Cooperative Work*. 21–30.
- [13] Erving Goffman et al. 1978. *The presentation of self in everyday life*. Harmondsworth London.
- [14] Judith Gregory. 2003. Scandinavian approaches to participatory design. *International Journal of Engineering Education* 19, 1 (2003), 62–74.
- [15] Jan Gulliksen, Ann Lantz, and Inger Boivie. 1999. User centered design—problems and possibilities: a summary of the 1998 PDC & CSCW workshop. *ACM SIGCHI Bulletin* 31, 2 (1999), 25–35.
- [16] H Rex Hartson, José C Castillo, John Kelso, and Wayne C Neale. 1996. Remote evaluation: the network as an extension of the usability laboratory. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1531–1540.
- [17] Demetrios Karis, Daniel Wildman, and Amir Mané. 2016. Improving remote collaboration with video conferencing and video portals. *Human-Computer Interaction* 31, 1 (2016), 1–58.
- [18] Diane Kelly and Karl Gyllstrom. 2011. An examination of two delivery modes for interactive search system experiments: remote and laboratory. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1531–1540.
- [19] Finn Kensing and Jeanette Blomberg. 1998. Participatory design: Issues and concerns. *Computer Supported Cooperative Work (CSCW)* 7, 3-4 (1998), 167–185.
- [20] Leah Kulp and Aleksandra Sarcevic. 2017. Design in the wild: Lessons from researcher participation in design of emerging technology. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. 1802–1808.

- [21] Leah Kulp, Aleksandra Sarcevic, Richard Farneth, Omar Ahmed, Dung Mai, Ivan Marsic, and Randall S Burd. 2017. Exploring design opportunities for a context-adaptive medical checklist through technology probe approach. In *Proceedings of the 2017 Conference on Designing Interactive Systems*. 57–68.
- [22] Alice C Li, Joseph L Kannry, Andre Kushniruk, Dillon Chrimes, Thomas G McGinn, Daniel Edonyabo, and Devin M Mann. 2012. Integrating usability testing and think-aloud protocol analysis with “near-live” clinical simulations in evaluating clinical decision support. *International Journal of Medical Informatics* 81, 11 (2012), 761–772.
- [23] Edward McFadden, Danny R Hager, Claude J Elie, and Jason M Blackwell. 2002. Remote usability evaluation: Overview and case studies. *International Journal of Human-Computer Interaction* 14, 3–4 (2002), 489–502.
- [24] Mei Miao, Hoai Anh Pham, Jens Friebe, and Gerhard Weber. 2016. Contrasting usability evaluation methods with blind users. *Universal Access in the Information Society* 15, 1 (2016), 63–76.
- [25] Michael J Muller and Sarah Kuhn. 1993. Participatory design. *Commun. ACM* 36, 6 (1993), 24–28.
- [26] David T Nguyen and John Canny. 2009. More than face-to-face: empathy effects of video framing. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 423–432.
- [27] Donald A. Norman. 2002. *The Design of Everyday Things*. Basic Books, Inc., USA.
- [28] Helen Petrie, Fraser Hamilton, Neil King, and Pete Pavan. 2006. Remote usability evaluations with disabled people. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 1133–1141.
- [29] Jerry Schnepp and Brent Shiver. 2011. Improving deaf accessibility in remote usability testing. In *Proceedings of the 13th international ACM SIGACCESS Conference on Computers and Accessibility*. 255–256.
- [30] Anthony Steed, Francisco R Ortega, Adam S Williams, Ernst Kruijff, Wolfgang Stuerzlinger, Anil Ufuk Batmaz, Andrea Stevenson Won, Evan Suma Rosenberg, Adalberto L Simeone, and Aleshia Hayes. 2020. Evaluating immersive experiences during Covid-19 and beyond. *Interactions* 27, 4 (2020), 62–67.
- [31] John C Tang and Ellen Isaacs. 1992. Why do users like video? *Computer Supported Cooperative Work (CSCW)* 1, 3 (1992), 163–196.
- [32] Katherine E Thompson, Evelyn P Rozanski, and Anne R Haake. 2004. Here, there, anywhere: remote usability testing that works. In *Proceedings of the 5th Conference on Information Technology Education*. 132–137.
- [33] Elizabeth S Veinott, Judith Olson, Gary M Olson, and Xiaolan Fu. 1999. Video helps remote work: Speakers who need to negotiate common ground benefit from seeing each other. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 302–309.
- [34] Brenda K Wiederhold. 2020. Connecting Through Technology During the Coronavirus Disease 2019 Pandemic: Avoiding “Zoom Fatigue”. *Cyberpsychol Behav Soc Netw* 23, 7 (2020), 437–438.