"A Second Voice": Investigating Opportunities and Challenges for Interactive Voice Assistants to Support Home Health Aides

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ABSTRACT

Home health aides are a vulnerable group of frontline caregivers who provide personal and medically-oriented care in patients' homes. Their work is difficult and unpredictable, involving a mix of physical and emotional labor as they adapt to patients' changing needs. Our paper presents an exploratory, qualitative study with 32 participants, that investigates design opportunities for Interactive Voice Assistants (IVAs) to support aides' essential care work. We explore challenges and opportunities for IVAs to (1) fill gaps in aides' access to information and care coordination, (2) assist with decision making and task completion, (3) advocate on behalf of aides, and (4) provide emotional support. We then discuss key implications of our work, including how materiality may impact perceived ownership and usage of IVAs, the need to carefully consider tensions around surveillance, accountability, data collection, and reporting, and the challenges of centering aides as essential workers in complex home health care contexts.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

Voice assistant, AI, intelligent agent, home health care, home health aides, community health, future of work.

1 INTRODUCTION

Home health aides (aides) are formal, paid caregivers, mostly women of color, who work long hours caring for patients with serious illnesses like heart failure, diabetes, dementia, and others [59]. Although aides provide essential care for patients, and are one of the fastest growing professions in the US [59, 75], research has shown that aides are paid low wages, undervalued by healthcare teams [34], and do not receive adequate training [72, 73].

Aides work in patients' homes, providing personal and medically-oriented care and helping with out-of-home healthcare logistics, including trips to the doctor and hospital [3, 22, 73]. Aides also help patients with the day-to-day management of their medical conditions, including tracking medications, monitoring fluid and dietary intake, measuring vitals, and preparing meals for patients who must adhere to specific nutrition requirements. Prior work has shown that the job requires not just specialized skill and physical endurance (shifts may last up to 12 hours at a time), but also complex emotional labor and the adaptability to respond quickly to patients' changing needs [25, 32, 42, 49]. Although a rich body of HCI research has explored the potential for technologies to support family caregivers [9, 31, 45, 66, 69, 77, 79, 88–90], relatively few studies to date have focused on home health aides [56, 60, 71, 81].

At the same time, new AI-driven, home-based technologies, like Interactive Voice Assistants (IVAs), are becoming widespread and have the potential to transform home-based care. IVAs are voice-based software agents that use voice recognition and language processing algorithms to process and respond to voice commands, thereby enabling hands-free interaction. A cluster of studies has examined IVA use by older adults and/or patients, including for self-care [14, 18, 40, 48], self-management of mental health [1, 24, 53, 82],

behavior change [4, 57, 58, 67], aging in place [54, 61], and rehabilitation [28, 29, 35, 50]. Although a few studies have explored how patients and informal family caregivers might use IVAs (e.g., [54, 68, 93]), we are not aware of any research that considers whether or how these technologies might impact home health aides' essential caregiving work. We see an urgent need to examine IVAs' potential impact *now*, before they are widely deployed in home health care, via methods that enable safe exploration of these sensitive, multi-stakeholder contexts. Doing so will help to inform the design of future IVA technologies that empower aides rather than adding to their burden or threatening their job security.

Our paper addresses this need with an exploratory, qualitative study with 32 participants (26 aides and 6 home care agency staff) that investigates the perceived benefits, challenges, and tensions that arise around ideas of aides using IVAs in patients' homes. We use mixed methods to explore a wide range of potential design opportunities, including ones that stretch beyond existing functionalities provided by today's commercially-available IVA systems. Specifically, we conducted speculative speed dating sessions [13] with storyboards that intentionally left the specific material embodiment of the IVA technology ambiguous, enabling the exploration of hypothetical usage scenarios and interactions, while discouraging participants from fixating on particular form factors or visual details [13]. We complemented these speed dating sessions with more grounded video elicitations [52] that illustrated higher-fidelity IVA prototypes implemented using existing IVA technologies. This enabled us to also explore participants' reactions to usage scenarios in which the embodiment of the IVA was concrete and specific.

Our findings show how aides perceived that IVAs may help to fill gaps in their access to information or support, such as providing stable access to a patient's care plan and tasks an aide needs to perform, on-demand information about patients' preferences (e.g., favorite meals or preferred times of day for certain tasks), or ideas for activities to improve patients' moods and help to coordinate hand-off between aides who care for the same patient. We also explored how IVAs might assist aides with everyday tasks and decision making, such as reminders to help them juggle a heavy workload, or providing step-by-step guidance. However, aides were also concerned that an IVA might try to take over their work or become too pushy, and wanted to be in control and able to turn off the IVA when they wanted.

Participants envisioned ways an IVA's presence in the patient's home may be useful as a third-party advocate for them. For example, they saw potential for an IVA to speak up during conflicts with patients, providing a second voice to help them enforce boundaries around their scope of work. Participants also envisioned ways an IVA might help to relieve their work stress. However, they were hesitant to confide their thoughts and feelings in a machine, and worried about their patients or employers having access to information they shared with the IVA.

We conclude by discussing implications of our findings for the design of IVAs for sensitive, multi-stakeholder contexts like home health care. One important implication is that the materiality of IVAs may govern people's perceptions of device ownership and control, and subsequently what tasks are appropriate or safe for aides to perform using an IVA. This suggests opportunities to design IVAs with different form factors, such as physically embedding an IVA into an aide's supply kit, which may help to make clear that the aide is in charge of the device and it is an approved work tool. Another implication for future IVA developers to carefully consider is how IVAs may function as surveillance devices in patients' homes. Although aides in our study were aware that patients often have privacy concerns, they suggested using an IVA to monitor and report abusive patient behaviors, with the goal of protecting aides. By contrast, nurses suggested using an IVA to monitor aides' performance and report it to their home care agency, an idea that aides themselves did not raise and would be unlikely to support.

Our findings also suggest implications for the design of data collection and reporting systems that would need to accompany IVAs in support of aides' work. Introducing new technologies into sensitive contexts like home health care may have unintended consequences [8]. For example, the need to collect and input data into such systems may introduce additional work. IVA designers will need to pay close attention to *who* is expected to perform this work, especially given that it is likely to fall to aides, a marginalized workforce that is *already* overburdened [26]. Building on this, we then discuss challenges of designing new technologies that aim to center aides, an essential but overlooked workforce whose needs and concerns are often systematically de-prioritized.

Taken together, our findings will be useful for HCI researchers and practitioners interested in exploring how new technologies like IVAs might be intentionally designed to subtly shift power towards marginalized workers. We also highlight the need for exploratory research, like ours, that investigates potential impacts new or emerging technologies may have in complex multi-stakeholder contexts *before* these technologies are deployed in ways that further marginalize or harm vulnerable workers.

2 RELATED WORK

2.1 Home Health Aides

Home health aides are one of the fastest-growing sectors of the U.S. workforce [59, 75]. Currently, aides care for 48 million Americans [59] and, between 2014 and 2024, aides will add more jobs to the U.S. economy than any other occupation [7, 38]. This growth is driven by the ongoing demographic shift towards an older population, with the number of adults over the age of 65 projected to almost double by 2050 [83]. As more people age and seek support for aging in place, an increasing number of adults will look to aides to support their health needs [30, 36, 64].

Despite aides' growing importance in healthcare and patients' increasing reliance on their services, prior work has shown that aides are undervalued by the healthcare team [3, 34, 73] and society at large [74], and do not receive sufficient training [55, 72, 73] or emotional support [22, 23]. Patients and aides suffer when aides experience high levels of stress [15, 27], burnout [27, 86, 87], on-the-job injuries [51, 85], and job turnover [5, 16, 19]. These challenges suggest an urgent need for research on how to improve aides' equity, job satisfaction, retention, and working conditions. A small number of studies in HCI have explored innovations, potential needs, or challenges of designing technologies specifically tailored toward aides. Okeke et al. [56] studied aides' existing workflows and discussed how their current tools and technology ecosystems are outdated, hard to use, and largely revolve around monitoring

aides' labor rather than supporting their work. Sterling et al. [71] explored how technology fell short of assisting aides in their work caring for and managing heart failure patients, calling for increased training and on-demand content to assist aides with their work in patient homes. Tseng et al. [81] used a tablet-based design provocation to elicit the perspectives of aides and their supervisors on how new technology might help improve equity for aides. Their findings show that designing technology for equity requires attention to structural problems in addition to aides' stated needs [81]. Finally, Poon et al. [60] examined how a computer-mediated platform might be used to deliver peer-to-peer support among aides and suggested that accessibility of equipment and online security should be carefully considered. Our study contributes to this nascent literature by being the first to explore the potential opportunities and challenges for interactive voice assistants (IVAs), an emerging technology that is specifically designed to be used in the home, to support essential work that aides perform in patients' homes. We now discuss relevant related work on IVAs.

2.2 Interactive Voice Assistants in Home Care

IVAs are voice-based software systems that can receive and analyze speech input and provide vocal responses [37]. They enable hands-free interaction, and can be embedded in laptops, smartphones, or smart speakers [76]; popular examples include Apple Siri, Microsoft Cortana, and Amazon Alexa. Prior work has explored how IVAs can be used to perform household chores [47], assist crowd workers [33] and drivers [41], help with planning tasks and achieving goals [12], play a role in education and everyday life [78], and more.

Studies have also sought to develop IVA applications for healthcare contexts. For example, Yang et al. [91] analyzed the accuracy of multiple IVA platforms in responding to questions regarding postpartum depression, finding that IVAs were collectively able to provide 64% clinically appropriate advice. Lucas et al. [46] explored the potential for veterans who suffered from post-traumatic stress disorder to speak with a virtual human, reporting that people felt more comfortable disclosing their information to the virtual human than to a real human because they worried less about being judged [46]. Kenny et al.[39] prototyped an intelligent virtual patient to help train new clinicians on diagnostic skills, suggesting multimodal sensor input is a benefit. Vona et al. [84] experimented with a speech-based virtual assistant within Microsoft HoloLens that helped people with Cognitive Disabilities to improve their learning skills, concluding that voice-based assistants could help patients complete tasks in mixed-reality settings.

Another cluster of studies has examined IVA use by older adults. Pradhan et al. [63] discuss how IVAs affordances, such as hands-free, eyes-free capabilities, may make them easier for older adults to use compared to computers and smartphones. In another study, Pradhan et al. [62] examined how older adults categorize IVAs as social companions or as objects, discussing how the socioemotional context (e.g., loneliness) of the user results in increased anthropomorphism. While showing different companion robots to older people who lived alone, Coghlan et al. [10] discussed how many participants found a voiced-based robot to be intrusive and assertive, especially for people who desire solitude.

In home health care contexts, Zubatiy et al. [93] observed how dyads of older adults with mild cognitive impairments and their family caregivers interacted with an IVA. They found that IVAs empowered both stakeholders, although the utility of the IVA for the older adults largely depended on how much the caregiver scaffolded promising functionality (e.g., by setting it up for specific needs and desires). In another study, O'Brien et al. [54] analyzed reviews of Amazon Echo, finding multiple cases where an IVA supported family caregivers who cared for an older adult and implying that it might alleviate caregivers' workload. We contribute to this early literature with the first study of how IVAs might be designed to support the important work of home health aides, who are paid, professional caregivers that care for patients in their homes, and whose work processes, needs, and challenges differ significantly from family caregivers.

3 METHODS

We contribute an exploratory qualitative study that investigates perceptions of how IVAs might impact the essential care work that home health aides deliver in patients' homes. Our goal in this study was to explore a wide range of potential design opportunities for IVAs to support aides' work, not limited by the current capabilities of commercially-available IVA systems. To understand participants' desires and boundaries around potential IVA interactions, we conducted a combination of speed dating [13] studies and video elicitation [52] sessions. As discussed below, our speed dating sessions intentionally left the specific material embodiment of the IVA technology ambiguous. This approach enabled us to elicit participants' reactions to a range of hypothetical usage scenarios and interactions, while discouraging participants from fixating on specific form factors or visual details [13]. To complement this approach, in our video elicitation sessions, we presented participants with videos illustrating interactions with higher-fidelity IVA prototypes. These prototypes were implemented using currently available IVA technologies, enabling us to also observe participants' reactions to particular usage scenarios when the embodiment of the IVA was concrete and specific.

Recruitment and Participants. We recruited participants via ads in aide Facebook groups, direct outreach to aide labor unions, and existing research partnerships with several large home care agencies. In total, we recruited 26 aide participants and six agency staff who supervise aides' work, three nurses and three aide coordinators, some of whom had prior experience working as aides. Participants were asked to complete a survey that collected their demographic details and prior experience working in home care.

Our participants were all female and their ages ranged from from 21 to 73 years old. Participants' prior experience in the home care industry ranged from less than one month to over 30 years. Table 1 provides more participant details.

Speed Dating Sessions. Speed dating [13] is an HCI method aimed at rapidly exploring a wide range of possible futures with users, intended to help researchers/designers elicit unmet needs and probe the boundaries of what particular user populations will find acceptable (which otherwise often remain undiscovered until after a technology prototype has been developed and deployed) [13]. In speed dating sessions, participants are presented with a number

Table 1: Summary of study methods and participant demographics.

	Aides F1-F5 (n=15)	Aides S01-S11 (n=11)	Nurses N1-N3 (n=3)	Coordinators C1-C3 (n=3)
Method	Video elicitation	Speed dating	Speed dating	Speed dating
Experience (years)	0-5: 3, 6-10: 1, 11-15: 3, 16-20: 5, 20+: 2, Unreported: 1	0-5: 2, 6-10: 1, 11-15: 2, 20+: 2, Unreported: 4	6-10: 1, 11-15: 1, 20+: 1	6-10: 3
Location	New York	Pennsylvania:10, Maryland:1	New York	New York
Age (years)	<35: 3, 35-44: 3, 45-55: 4, 55+: 5	35-44: 2, 45-55: 1, 55+: 5, Unreported: 3	45-55: 2, 55+: 1	35-44: 1, 45-55: 1, 55+: 1
Sex	Female	Female	Female	Female

Table 2: Summary of speed-dating storyboards and video elicitations (also provided as supplementary material).

Storyboard Scenario	Scenario Summary	Participants
1. New Client Information	The voice assistant reminds the aide about her new case information e.g. name, address, and preferences.	Aides (S1-S11), nurses, coordinators
2. Performing Tasks	The voice assistant walks the aide step by step in real-time with instructions on how to conduct certain tasks.	Aides (S1-S11), nurses, coordinators
3. Inter-Aide Communication	The aide asks the voice assistant for a summary of what the previous care worker had already completed and what tasks are left to do.	Aides (S1-S11), nurses, coordinators
4. Boundary setting	The aide reaches out to the voice assistant for help in terms of boundary settings with the client.	Aides (S1-S11), nurses, coordinators
5. Preferences and Personalization	The voice assistant makes recommendations based on the scenario and the client's preference.	Aides (S1-S11), nurses, coordinators
6. Self Reflection	The voice assistant senses the aide's emotion and offers a deep conversation.	Aides (S1-S11), nurses, coordinators
7-a. Tracking Hours - For Agency	The voice assistant records the aide's clock-in and out so that the aide can inform the agency of the workload-scheduling issue.	Nurses, coordinators
7-b. Tracking Hours - For Aide	The voice assistant records the aide's clock-in and out so that the aide can ask for higher pay with the agency.	Aides (S1-S11)
8-a. Companion - For Agency	The aide follows the guide from the voice assistant, and the voice assistant also offers to connect the aide with the agency support.	Nurses, coordinators
8-b. Companion - For Aide	The aide follows the guide from the voice assistant, and the voice assistant also offers to connect the aide with the union support.	Aides (S1-S11)
Video Elicitation	**Scenario Summary**	**Participants**
1. Medical Task Assistance	The voice assistant helps the aide with the medical task step by step e.g. leg swelling measurement.	Aides (F1-F5 (n = 15))
2. Scheduling Assistance	The aide makes a note to the voice assistant, and the voice assistant reminds the aide of the incomplete task.	Aides (F1-F5 (n = 15))
3. Emotional Support	The voice assistant listens to the aide's complaint and shares some techniques for calming down e.g. breathing exercises.	Aides (F1-F5 (n = 15))

of hypothetical scenarios in rapid succession (e.g., via storyboards) while researchers observe to understand participants' immediate reactions. We chose speed dating for our exploratory study because it is well-suited to our goal of conducting a broad exploration of the design space early in the process, rather than converging on a narrow design space early on.

To generate our storyboards, we began by reviewing literature on aides' work and the struggles they face. Specifically, prior research has pointed out that aides often do not receive sufficient information about their clients' conditions, care plans, or the tasks they are required to perform [56, 81]. They find patients' symptoms frightening, do not know what to do, and struggle to reach their supervising nurses and patients' doctors when patients are symptomatic and they need help [70, 73]. They also face challenges coordinating care with their agency and other aides who care for the same patient [56, 81]. Finally, aides often work alone in a patient's home, operating day-to-day in isolation and do not receive sufficient social or emotional support [60, 73]. Based on these challenges, we generated multiple hypothetical scenarios in which an

IVA might be of use to aides. We then sketched these scenarios as storyboards (e.g., see Figure 1), sought feedback from peers and clinical collaborators, and performed multiple rounds of iteration.

When sketching the scenarios, we left several aspects of the IVA intentionally ambiguous. For instance, ownership of the device was not specified, which enabled probing around topics like control, usage, and privacy, which prior work has shown to raise tensions in home health care [81]. Similarly, to avoid constraining participants' imaginations to existing IVA functionalities and form factors, we left the materiality of the IVA ambiguous in some storyboards [13]. We ultimately converged on eight storyboards for our speed dating sessions, which are summarized in Table 2. The storyboards are also provided as supplementary material.

We then conducted an initial 11 speed dating sessions with aides. Since our study took place during the COVID-19 pandemic, we conducted our speed dating sessions over Zoom with screen sharing. All speed dating sessions were conducted individually, lasted one hour, and were audio recorded with participants' consent. Aides joined Zoom calls from their personal spaces, while nurses and
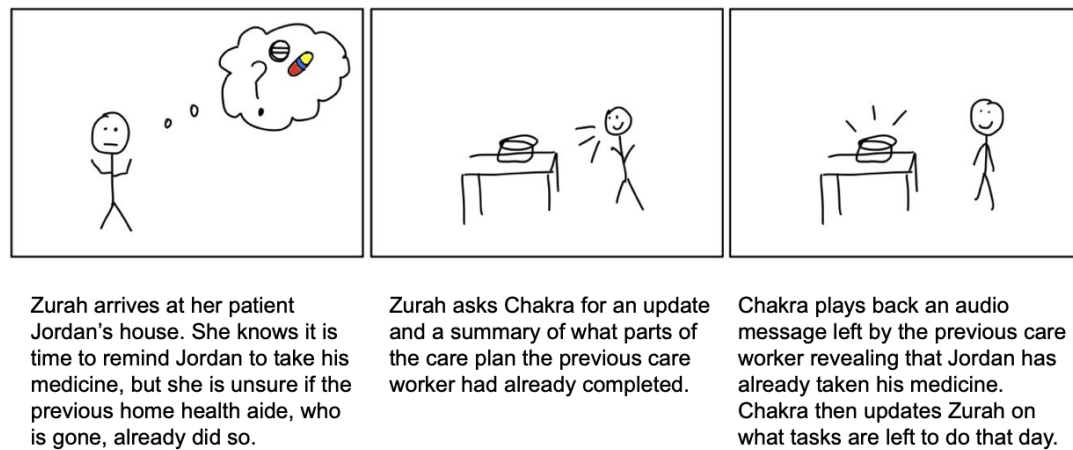
Figure 1: An example speed dating storyboard shown to participants. (All storyboards are provided as supplementary material).
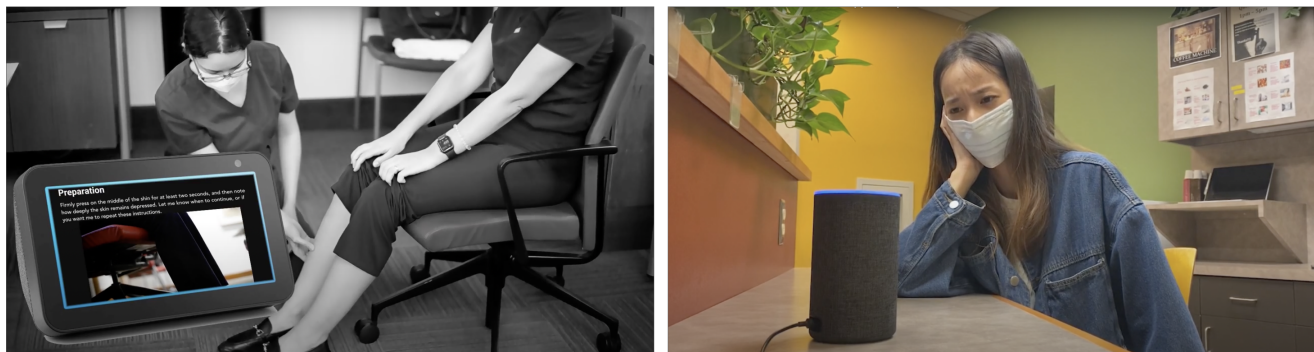

Figure 2: Frames from elicitations for medical task and emotional support. (Videos are provided as supplementary material).

coordinators joined individual Zoom calls from their employer's offices. We started by obtaining consent and collecting participants' demographic information. Then, in keeping with the original speed dating method [13], we presented participants with our storyboards, which included a mixture of scenarios that we anticipated would be received both positively and negatively. We asked open-ended questions to understand aides' initial reactions to each storyboard. We followed up with additional, storyboard-specific questions to further probe participants' reactions, before asking them to broadly reflect on which storyboards resonated with their experiences.

After transcribing and analyzing the interviews from these 11 sessions, we iterated upon our storyboards based on emergent findings and insights. We developed an additional storyboard and re-contextualized previous storyboards to focus on the agency-aide relationship. We de-prioritized less relevant and redundant story-boards; one focused on tracking aides' working hours and a second demonstrating the IVA as an emotional companion. Using the updated and prioritized set of storyboards, we conducted another six speed dating sessions with agency staff who supervise aides' work: three with agency nurses and three with aide coordinators.

Video Elicitation Sessions. We complemented our speed dating sessions with more grounded video elicitations to obtain aides'

reactions to higher-fidelity prototypes using currently available IVA technologies. Video elicitation is a form of photo elicitation, a method where photographs, videos, or other visual media are used to elicit different kinds of knowledge than might be obtained via verbal interactions alone [52]. Our video elicitation sessions allowed participants to more concretely envision how an IVA might be used in their work.

We conducted these sessions as focus groups, rather than individual interviews, to facilitate rich group discussions around aides' responses and perspectives. Aides participating in focus groups joined Zoom calls from their employing agency's office spaces. Participants (n=15 across five focus groups, with 2–5 participants per group) watched three videos, each approximately two minutes in length, that illustrated situations in which an IVA might assist aides in their work (see Figure 2). Each video featured actors (members of our research team) interacting with real IVA prototypes that we developed. In Video 1, medical task assistance, an IVA provides verbal and visual assistance to guide an aide through assessing the severity of patient's edema (leg swelling), a common symptom of heart failure. In Video 2, scheduling assistance, an IVA helps an aide keep track of scheduled work tasks, alerting them that it is time to bathe the patient and reminding them not to forget the patient's

skin cream. In Video 3, emotional support, an IVA verbally guides an aide through a breathing exercise to help them manage their stress. These tasks were chosen based on a literature review and feedback from medical professionals. The prototypes were developed iteratively, with conversation flows that were contextualized by real scenarios aides experienced or hypothetical scenarios in which the IVA might prove useful. After building the prototypes, we wrote video scripts that staged the prototypes in their respective contexts alongside aides.

We began each focus group by providing background on IVAs and our research goals, and obtaining participant consent. We then showed videos one by one to the group, eliciting participants' reactions to each video, and following up with open-ended questions and discussions that probed how an IVA may, or may not, support aides needs. Questions sought to understand aides' thoughts on the IVA's modality, usability, feasibility, and on the perceived challenges of incorporating IVAs into aides' work. Focus groups lasted one hour and were audio recorded with participants' consent.

Data Analysis. We audio recorded and transcribed all speed dating and video elicitation sessions. We used thematic analysis [6] to analyze our data, a constructivist approach inspired by grounded theory [20]. We first analyzed transcripts from aide sessions and began with multiple passes reading these transcripts, allowing codes to emerge. Each of the transcripts was then double-coded by two authors, with all coders meeting multiple times to discuss and reconcile their codes. We used affinity diagramming to facilitate code refinement discussions and iteration. Via this process, we converged on a stable codebook of 39 codes, e.g. *aide concern about own privacy*, *IVA as messaging medium*, and *reminders*. Codes were grouped into overarching themes, e.g. *care plan access*, *aide hesitation*, and *care coordination.*

We coded nurse and coordinator sessions after the aide sessions. Using the existing codebook as a starting point, we looked for deviations from and confirmations of our themes and narratives. In this, the nurse and coordinator data helped to triangulate themes and codes emergent in aide sessions, facilitating appropriate representation of the data.

In reporting our findings, we refrain from reporting the numbers of participants who discussed a particular topic. This is because our elicitation sessions involved focus groups, in which it is easy for participants to both silently agree or disagree with things another participant says. Thus, counting the number of times a topic is raised may not provide an accurate representation of its prevalence or importance in our data.

Ethics and Participant Safety. Home health care is a sensitive landscape and aides are a vulnerable and marginalized workforce. We assured all participants that taking part in our study was completely voluntary and their responses would be kept strictly anonymous. We emphasized that anything they told us would not affect their employment or any benefits they were entitled to. Further, since the study occurred during the COVID-19 pandemic in 2021 and participants are healthcare workers who serve people vulnerable to the disease, the study was conducted remotely via Zoom video conferencing with screen sharing. All participants provided informed consent and were compensated for their time with a $25

giftcard. All procedures were discussed in advance with our home care agency partners and IRB approved.

Positionality. Feminist Standpoint Theory acknowledges that every person's experiences and background give them a unique perspective [21]. In line with prior calls in HCI [17, 43, 65], we now reflect our own identities and motivations for conducting this work. Our team comprises a mix of students and faculty at US academic institutions, including six women and three men. We have diverse identities and multicultural backgrounds, including Black, Asian, and white researchers from Asia, Africa, and North America. Several authors have years of experience conducting research with underserved communities, including work with home health aides for the past four years. Our main motivation for conducting this research is to understand if technology might have a role in elevating aides as essential but currently overlooked workers and improving equity for this vulnerable and marginalized workforce.

4 FINDINGS

Our analysis provides the first look at how home health aides perceive IVAs might play a role in helping them deliver essential care to patients. We organize our findings around four major themes. We begin by 1) describing how aides perceived opportunities for IVAs to fill gaps in access to information and support. We then 2) highlight how IVAs might provide guidance to help aides complete tasks and make decisions. We also show that 3) aides thought an IVA's presence could be useful as a third-party advocate for them, providing data to negotiate their workload and compensation, and helping them to set and enforce appropriate boundaries with clients around their scope of work. Finally, we 4) discuss challenges and concerns that arose around the idea of using an IVA to provide aides with emotional support.

4.1 Filling Gaps in Access to Information and Support

Aides saw opportunities for an IVA to fill in where they perceived a lack of information or support, in other words, "gaps", in their work. These ranged from ensuring aides have stable access to patient care plans, which contain the definitive record of the care work an aide needs to perform, to prompting the aide with new ideas or innovative suggestions to personalize patient care.

Ensuring access to a patient's care plan. At the beginning of a shift, aides usually start their work by consulting their patient's *care plan*, a paper-based document that is meant to be prominently displayed in the patient's home, e.g., on the refrigerator. Written by a visiting nurse and signed by the patient's physician, the care plan is intended to provide a definitive record of the contract between the aide and patient, outlining (1) exact tasks that need to be done, e.g., prepare meals, (2) the details of each task, e.g., low-salt diet, and (3) the timing and frequency of the task. Aides' scope of work is supposed to be strictly limited to the tasks outlined on the care plan. Aides are expected to be familiar with their patient's care plan and use it to build a daily routine with the patient. However, aides in our study described how they frequently struggled to get access to the patient's care plan. In some cases, wear and tear caused the paper document to become, for example, *"wrinkled after a while because of*

water damage" (F2,P1). More problematically, aides described how patients would often intentionally hide their care plan with the goal of changing or expanding the aide's scope of work, e.g., adding housework or removing dietary restrictions. One aide explained:

> *"They want you to do all the stuff that the nurse didn't agree for you to assist with, so they hide [the care plan]. When you go in they say 'Could you bend down there and pull out that box for me?' That's not on the care plan, you are not to do that. When they hide it you don't know what you're supposed to do."* (F3,P1)

Not having access to the patient's care plan can significantly hamper aides' abilities to effectively perform their work, and aides suggested that it would be beneficial to *"have the care plan committed inside of [the IVA]"* (F2,P1), so that it could provide access when the aide needed it. Although digitization alone is not a feature that is unique to IVAs, e.g., an app or website might provide a digital care plan, aides perceived that storing the care plan in an IVA might provide *"a second voice"* to help them set and enforce boundaries with patients (discussed in Section 4.3). They also envisioned that having the care plan stored in an IVA might facilitate opportunities for the aide and patient to communicate and discuss the care plan with one another, forming a more collaborative care environment.

Nurses and coordinators also rely on aides to document any changes and report any details that they deem relevant and important to the patient's care. However, this often results in incomplete patient notes, as aides are tasked with remembering to document these details in the midst of providing direct care, while their attention, and their hands, are otherwise occupied. Aides expressed that voice entry through an IVA might be an easier method of adding notes to the care plan, compared to handwritten or typed notes.

Updating or personalizing the care plan. Although the patient's care plan is supposed to clearly outline the set of tasks that an aide should perform for a patient, aides discussed how the care plan could often be out of date or not accurately represent the care required by the patient. Aides taking on new patients, for example, emphasized that when they visited a patient's home for the first time, they sometimes found the patient in worse condition than they expected based on the information received from their supervisors. One participant shared:

> *"I was told I was going to see a patient that had high blood pressure and diabetes ... they never told me that this patient was bed bound because he was in his motorized wheelchair. The patient could barely stand up, he couldn't use his legs. His condition was worse than they knew."* (S09)

In these cases, aides discussed how *"you got to look at the person's situation and adapt"* (S02). They felt it would be helpful if they could use the IVA to provide feedback and note necessary updates to the care plan, explaining that the IVA *"has to be adapted for each one, for people with special needs, for regular patients"* (S02). Even if aides' update notes remained unofficial until a visiting nurse might be able to formally update the care plan, they could still help aides be more prepared for the variety of situations encountered in a patient's home. There are also details worth noting that would help explain *how* specific tasks should be done that go unspecified on the care plan. As one participant described:

> *"When it comes to ... grooming, you don't know what time ... they like to bathe. But you ask these questions. You don't know what they want for breakfast, but you ask them, 'Are you ready for breakfast? What would you like?'"* (F4,P1)

Our participants saw opportunities to use the IVA to record a patient's personal preferences, including specific foods or grocery store items to purchase, when and how to provide personal care, and more. Although aides may currently record this information for themselves via their own note taking (e.g., on paper), they pointed out that storing this information in an IVA would mean it is quickly available to other aides or family caregivers. Agency nurses corroborated this idea and discussed how this would enable aides' care to be more patient-centered. As one nurse said:

> *"I am someone [a patient] that in the evening I will take a warm bath, but in the morning I take cold showers ...I'm curious ... is there an opportunity for the IVA to be providing step-by-step instructions that are patient-centered? ... respecting the patient's preferences for how they'd like to have [aide tasks] done?"* (S04)

Making suggestions and providing new ideas. Beyond being able to collect and store patient preferences and aides' updates to the care plan, aides also saw opportunities for IVAs to provide them with *new* suggestions or ideas that made their work easier. For example, in one focus group, aides discussed how an IVA could make *"suggestions when the client doesn't know what [they want] to eat"* (F2,P1). Aides continued, recounting how this would be helpful in moments when patients wanted to eat their native cuisines, but the aides did not know how to prepare them.

As another example, in response to a storyboard in which an IVA suggested repeating something that the patient had previously liked, one aide connected this to the importance of routine for patients with cognitive impairments. This aide provided an example of the daily sunset as a critical determinant of a dementia patient's mood, and how it can often result in what is sometimes called sun-downing syndrome, where dusk initiates increased disorientation:

> *"When the sun-downing issue happens ... [the IVA could] change the lighting or play music in the background quietly [to] change the mood. This person gets agitated a lot at this time of day, so let's run this routine for the house or ... be able to say a trigger word. [Say] 'we're a little bit upset right now. Could you run a routine' and calm things down."* (S04)

Building on our design provocations, aides also imagined an IVA that would provide *"cool"* features that might *"light-up"* patients' moods. Suggestions included IVAs being able to passively sense patients' moods and trigger features in response, although many aides also expressed a preference for controlling and triggering the IVA themselves, as discussed in Section 4.2. In making these suggestions, we noticed that aides and nurses alike often focused on features that centered the *patients*, despite the fact that *all* our storyboards and videos specifically centered the *aides*, a phenomenon we discuss further in Section 5. One aide explained, *"You always have to remember the patient's comfort. You have to put everything aside and think of the patient's needs and wants"* (S11).

Helping with aide coordination and hand off. Another essential juncture where aides perceived an IVA might help was by easing coordination issues between aides who provide care to the

same patient. Whether transitioning from a night-shift aide to a day-shift aide, or getting an on-call aide up to speed, aides described a responsibility for a patient's care needs to be rapidly handed off from one aide to the next. Although agencies generally recommend that aides stay until the next aide arrives and provide pertinent patient information to the incoming aide, aides described how this frequently did not happen, as aides are often in a rush and/or have a lot to relay. One participant described:

> *"I get there late at night. [The previous aide] ate, they're ready to go home. So they rush out of the door, they don't tell me anything. Sometimes I don't even know what the plan of care is. So I have to try to figure it out. So something like an IVA would be great for me because then it could tell me what this patient needs. Sometimes I don't even [know] if they're on medication, where the medication is at."* (F4,P1)

Aides could alternatively call their supervisor or nurse at the agency, but they can be notoriously difficult to reach over the phone given tight time constraints aides might be working under. Nurses and coordinators supervise many aides simultaneously, making it harder for aides to reach their nurses. Interestingly, nurses also highlighted the potential for IVAs to fill in gaps for incoming aides, rather than needing to call the nurse with questions:

> *"Sometimes we have our issues when we send somebody, maybe they are new, or have not been with the patient for a long time. They call a lot and ask questions about the patient. If we already have it [with the IVA], it's good."* (C3)

4.2 Task Support and Decision Making

We now discuss how participants perceived that IVAs might play a role in assisting with everyday tasks and making decisions about patient care. This included reminders to help them manage their heavy workload, delivering on-demand guidance, tracking changes in the patient's status, and validating that the aide performed tasks correctly. We also discuss how aides saw themselves as being in control of the IVA, with the power to turn it off when they wanted.

Providing reminders. Our participants saw enormous potential for IVAs to be able to remind them of essential tasks or items that they might forget due to their heavy workload.

Aides' daily tasks might include assisting the client with personal care such as bathing and dressing, nutrition such as meal preparation and weight measurement, movement such as turning bedridden patients and assisting with exercises, medical treatment such as wound care and medication reminders, monitoring vital signs such as blood pressure and heart rate, performing household maintenance such as grocery shopping and housekeeping, and travel such as to medical and other appointments. Through it all, aides must balance executing tasks against managing patients' moods, providing social support, i.e., companionship, and managing the priorities or desires of the patient's family members. Aides described how the number of tasks they need to do can be overwhelming, as one aide noted:

> *"Sometimes when you're with a patient you're so busy and focused, you're getting that patient dressed, you don't remember to do these things, you don't remember to check the patient's legs with edema (leg swelling)."* (F1,P2)

Aides and nurses agreed that having an IVA provide simple reminders about tasks that aides might forget, or lose track of, would be hugely helpful. Despite many tasks becoming routine over time, we found that some aides still kept a thorough task list to track completed tasks. When we introduced storyboards with scenarios where the IVA provided reminders, aides explained how this would simplify their need to track a large number of tasks. Aides described how they currently track varying day-to-day needs of individual patients, *"sometimes the patient is on the bed, sometimes they need to turn over every two hours"* (F1,P2), which is amplified if they work with multiple patients who all have different needs, *"there's some patients that [can] walk, some patients this is different"* (F1,P2). Aides envisioned an IVA that would remind the aide of *"everything they [need] to do for each [patient]"* (F1,P2).

Supporting tasks and helping with decision making. In addition to providing reminders, aides discussed how it would be helpful if the IVA was able to follow up with, if needed, on-demand assistance such as step-by-step instructions for tasks. Aides emphasized that they are sometimes uncertain if they are completing a task correctly and discussed the importance of having someone like a nurse provide assurance, building confidence in their work:

> *"We got a homecare nurse about two weeks after and, you know, I'm telling her step by step what I'm doing. And she's just like, 'that's great'. No, I need direction. I'm not a doctor."* (S03)

Beyond IVA-provided task support, aides explained how they found it very frustrating to not be able to talk to someone when they faced a problem, saying, *"you feel that frustration and you don't know what to do, and you call in the office and nobody answering and you don't know what to do"* (F2,P2). Our participants saw how it might be beneficial to have an always-available *"second voice"* to help them decide, or validate their decision, about when they should continue to monitor and observe a situation or when they should escalate a problem to seek medical care:

> *"It's not a real human but this machine is right there talking, guiding us through things and asking if they should call the nurse and so on. That's a big help to a lot of us who need that second voice there next to us. A lot of times we don't have that."* (F1,P1)

By contrast, a few aides were skeptical or resistant to the idea of receiving support from an IVA, and voiced a strong preference for getting assistance from a real human who they could trust:

> *"I really wouldn't depend on a machine...I need assistance from a professional, a nurse or doctor, to show me and to tell me. This machine is not there, seeing me actually do this thing. I disagree with these machines."* (S08)

Aides also stressed the importance of ensuring that any guidance the IVA does provide should use accessible language and avoid complicated medical terms that aides may not understand. In addition to tracking individual tasks, some participants saw opportunities for an IVA to collect and track data from aides' observations that could subsequently be analyzed to show trends and/or inform the medical care team about what is happening with the patient. A nurse told us:

> *"So if we're thinking about AI, how do we create an opportunity for the aides to enter their observations and then on the back-end have systems that [can pick up on trends] so that we have AI*

coming in and saying, hey, wait a minute, this is trending in a way where we [the care team] don't want it to, let's be proactive about it." (N2)

This idea connects to prior work that calls for new ways for the insights that aides might glean from their work to be made available to clinical care teams [81]. The nurse further extrapolated this idea to discuss how, for multiple aides working with the same patient, this trend detection might enable insights that could otherwise be lost across shifts, helping to unify observations across aides and enable better high-level decision making:

"This is ... helpful if you have more than one aide on a case ... it could be that an aide today works and [the IVA] says, the patient has not had a bowel movement and then you have another aide that goes in today. Patient also has not had a bowel movement. So now the IVA is saying, okay, there was no bowel movement yesterday, and now there's no bowel movement today. So we're looking at the third day." (N2)

This nurse also suggested examples where the IVA could track specific behaviors or symptoms exhibited by a patient that led to an emergency, like a hospitalization. It could then alert the aides and/or the clinical care team if similar patterns emerge to help aides act faster or seek help earlier to prevent future emergencies/hospitalization.

Validating task completion. Agency participants described how aides frequently receive in-person or online training via their agencies and union, but clinical care teams often have little insight into how the aides' training impacts their care of patients. Nurses and coordinators perceived that IVAs might provide a useful channel for assessing aide competence, not by acting as a validating agent itself, but rather as a medium for the care team to validate the aide to help them assess if the aide understood the guidance provided by an IVA and performed the task correctly:

"After she has the instructions, how are we assessing that she actually did it correctly? Right? We want to make sure that the aide got the [appropriate] support from the IVA. ... how do we assess that proper care was actually performed? I think what is important is how are we assessing that she actually did the task [and] demonstrated competence?" (N2)

This concern further extended to how patients might want or need validation of the aide's performance, especially if the guidance that the aide received was coming from a machine, rather than a qualified medical professional:

"If I were a patient, I don't know how I would feel about having a computer, essentially saying to a worker, this is what you need to do, and not having someone check to make sure that it was done properly." (N2)

Assessing aide competence on a task, although important, introduces potential issues of monitoring, which could undermine and marginalize aides by re-positioning the technology as a means of surveillance rather than as a tool to help aides deliver high-quality care. We found it interesting that the idea of using the IVA to assess aides was raised by our nurse and coordinator participants, but not

by aides themselves. In general, our aide participants saw themselves as being the ones to control the IVAs and have the authority to *"turn it off"* as we now discuss.

Controlling the interaction. Although aides perceived that IVAs would be useful for providing reminders and assisting with tasks, they were also concerned that the IVA might *"take over"* their work and expressed a desire to be able to turn off the IVA. In line with our storyboards and videos, aides wanted to be the ones in control of the interaction and be able to adjust the IVA as their needs changed or based on their discretion. For instance, one aide wanted an IVA to only trigger reminders for new tasks, and be able to convey when they don't need those reminders anymore. Others only wanted reminders for intermittent tasks that were not part of their everyday routine, like a patient's doctor appointment. Others still wanted to be able to convey to the IVA on any given day that they did not want reminders at all. One aide said:

"Like a switch where we can turn it off and turn it on if we need her. Say, "All right, we've had enough of her voice for the week." Because I can get like that. I was like, "I've had enough of your voice today. I got to turn you off" ... Okay, after our shift just remember, "I'm going to turn it on for the next shift just in case they [the next aide] want it on." So on my shift, I will turn it off because I know what I want to do today. So I don't need [the IVA] to help me today. If we can do that, to have a switch to turn it on and off that would be great." (F4,P2)

This aide went on to describe how it was important that she be able to control the IVA and adjust the interaction in case her patient responded negatively to it, saying *"I don't want her [the IVA] to be too much for the [patient]. Or the [patient] is stressed out because [the IVA] is just too much"* (F4,P2). This aide wanted to be assured that the IVA would only be activated if called on, and only talk in response to an aide, expressing a concern that the IVA should not be *"talking all day throughout the day."* Another aide explained that patients might be resistant or have privacy concerns about the aide using an IVA in their home. They discussed how their agency had required her to use a tablet to keep track of work in the past, but her patient eventually requested she stop using it, telling us, *"We had [a tablet] we used to record what's going on, and ... we had to take it out ... they don't want you to report their business"* (F3,P2).

4.3 Advocacy and Boundary Setting

Beyond providing reminders and support for care-related tasks, participants discussed how an IVA's presence in the patient's home may provide a third-party advocate for them. In particular, an IVA might help to keep track of aides' work, which could prove useful for negotiating their workload and compensation with their agencies. They also perceived that the IVA might be a voice to back them up in conflicts around their scope of work, helping to set and enforce boundaries with patients. We now elaborate on these findings.

Negotiating workload and compensation. In aides' current workflows, they are required to clock in when they arrive at a patient's home and clock out again when they leave. They do this using a telephonic punch code system, calling the system from the patient's phone, which additionally proves their presence at the patient's home. As discussed in prior work [56], this system

is time consuming and error prone, and one aide commented, *"On the phone, we got to listen, and we got to make choices, and press and press ... it's annoying because it's time consuming"* (F4,P1). Aides quickly saw how an IVA might be able to record their clock in/out times, as well as provide ways to check that they had done so: *"You can just ask [the IVA], 'Did I enter my start time today?'"* (S07). Aides perceived that IVA recorded data would be more accurate and reliable than the punch code system, which would be beneficial if there was a dispute over their work hours. Moreover, by keeping track of aides' work, *"[the IVA data] might help in like an appeal for hours, or requests for an increase in hours"* (S04). Along these lines, aides described a recent issue where their work hours were cut by the agency due to funding issues associated with the COVID-19 pandemic, and they needed to prove to their agency why the needed the hours and what they were doing with them. In response, several aides took task tracking into their own hands, hoping that the data would help them advocate for themselves. The last aide described:

> *"I literally went and wrote down every hour of the day, wrote down what I was doing ... we had five minutes to talk, and I literally sped talk through the entire schedule, like: 'This is what I do. Now, you tell me I could do that in this cut amount of hours.'"* (S04)

In our interviews, aides discussed how IVAs might be able to perform this data collection for them, *"'[Alexa] Record this.' And then you've got proof, because sometimes you're the last person they [the agency] believe."* (F5, P1). As an example, aides discussed how it is common for them to miss their lunch break because they have too much work to do and/or their patient prevents them from taking it. They perceived that the IVA would be able to record this issue and provide evidence that would aid in their negotiations for improved work hours or higher compensation. As an aide explained:

> *"I'm giving [the patient] a free 30 minutes of my time ... If [the IVA] is able to capture this fact ... it becomes evidence that, hey, this is what happens on an ongoing basis ... they can use that to increase our pay."* (S02)

This aide recognized that their agency might not be supportive of an IVA that tracks extra hours since *"companies usually look at things for their own benefit"* (S02) in which case the IVA might simply remind them to take their break, rather than act as an advocate for more equitable workloads.

Helping to enforce boundaries. As discussed in Section 4.1, the aides' scope of work is strictly limited to tasks that are listed on the patient's care plan. However, patients and their families frequently try to demand that aides perform extra work such as extra cleaning and housekeeping. These demands place aides in a difficult position: on one hand, it is the aides' job to provide high-quality, safe care, and to reinforce the care plan, and on the other hand, having a good relationship with patients and their families is important for trust and for the aides' job security. The inherent power dynamics of the context, in which the patient is also essentially the aide's employer, exacerbate the challenges aides face in enforcing boundaries around their scope of work. Aides in our study discussed how it is common to simply avoid conflict by complying with out-of-scope requests rather than speaking up or defending themselves. One aide described how she frequently complied with requests, such as rubbing a patient's feet, *"just so [the patient] can be happy"* (F3,P3). Others preferred to just do the work, even if it crossed their boundaries, out of the fear that, *"We're replaceable"* (F5, P1), one aide explained that patients might leverage this by saying *Well, the other aide, they [would] do it* (F3, P3).

Participants discussed how an IVA could help them reinforce boundaries with patients and their families around the scope of their work by verbally reiterating the tasks on the care plan in front of patients and families. They also envisioned that an IVA could back up the aides when they refuse to perform tasks that are not on the care plan by confirming that this is agency policy, not an aide being mean. One aide explained:

> *"[Having the IVA] say, 'this is agency policy ... the aide can't do this.' Because a lot of times, we get cursed out because we say no. But it's not us being mean, it's us trying to keep our jobs."* (F2,P1)

Aides perceived that, by increasing transparency and providing a *"second voice"*, the IVA would make it easier for them to advocate for themselves and push back on patients' excuses when it came to expecting them to do extra work because, as an aide commented, *"what [are] they [patients] going to say? They can't say they don't know ... because [the IVA is] throwing [care plan duties] out there"* (F2,P1). Aides also imagined that an IVA might help them with conflict resolution, acting as an independent and unemotional third party to reinforce that the aide is trying her best to work within the constraints of the job, or helping to inspire patients to have empathy for the aide:

> *"[The IVA could] talk to the [patient] and say '[Patient], you have to understand that this [aide] is helping you as best as she can. Could you please just calm down? Could you just relax?"* (F1,P1)

Nevertheless, aides worried that some patients would simply ignore or dismiss the IVA if it did not say what the patient wanted to hear, saying *"you might find one of these hotheaded patients, they're not going to [accept] what [the IVA] is saying. They don't care"* (F5,P2). In such situations, aides envisioned an IVA that could resort to recording unfair incidents for proof that they could show their agency. Participants mentioned that this might be especially useful for aides who may not be comfortable engaging in conflicts or arguing about their scope of work, as an aide said:

> *"Not everybody has that in them to advocate. So having a way to track that information, and almost having like a virtual advocate to say, 'Yeah, this is what's been going on in the house.'"* (S04)

4.4 Emotional Support

Prior work has highlighted a need for aides to receive more emotional support. They work long hours, often in isolation. Their work is challenging and unpredictable, involving a mix of physical and emotional labor in response to clients' changing needs and moods [73]. Research has shown that aides are paid low wages, undervalued by the clinical care team and experience high levels of stress [15, 27], burnout [15, 27, 87], on-the-job injuries [51, 85], and job turnover [5, 16, 19]. As one aide put it, *"It can be enough for somebody to literally walk off the job"* (S03). To explore the potential role IVAs might play in providing aides with emotional support, one of our video elicitations depicted a scenario in which an aide shared their emotional challenges with an IVA, who guided them through calming exercises. We now discuss the potential benefits

and concerns participants raised around the idea of using an IVA for emotional support.

Potential benefits of using an IVA for emotional support. We received a range of responses about the appropriateness of using an IVA for emotional support and whether or not aides would use it. Several participants could see themselves using an IVA to relieve their work stress by, for example, listening to meditation music or guided meditation:

"So, being able to walk away, maybe just sitting on the front porch and ... if it's something that's in my ear... then maybe just sit down and play, like some meditation music, you know, to help me calm down, helps me clear my head." (S06)

In line with our prior findings in Section 4.1 where aides often centered their suggestions around what their *patients* might need, instead of themselves, aides were quick to point out how an IVA might provide emotional support for patients. One participant had a patient who had used an IVA previously to make her feel better when she had a bad day:

""She used it for music, she used it for movies, she used it to tell her jokes because she felt bad that day, you know? To tell her a little story, so it helps the patient." (F4,P2)

Others discussed how the patient and aide might do activities together, to provide both with emotional support while also enabling them to strengthen their bond. As an aide explained:

"If there's some downtime and you know the patient's having one of his or her off days, [the IVA], for instance, could play relaxing music, or we can do the meditation together because the patients have an off day." (F2,P1)

Concerns about using the IVA for emotional support. When we pushed aides to consider their own emotional support only, they expressed concerns about the physical location of the device and corresponding potential lack of privacy. In particular, they felt it would be difficult or inappropriate to use the IVA for emotional support while they were at work in the patient's home. Some concerns stemmed from patients being able to hear what they were personally going through, which might negatively impact the patient-aide relationship. One aide told us, *"[If] the patient hears you saying '[IVA], I'm frustrated', they're going to ... be ready to fight"* (F2,P1). This aide discussed how she would need to turn the IVA's volume down if she used this feature in patient's home:

"Unless you're working in a big house, where [the IVA] is going to be in a whole different part ... of the house where the patient can't hear you, you gotta say, '[IVA], turn the volume down to three'." (F2,P1)

Another reason not to use the IVA at work, aides explained, was because in discussing their own emotions and burdens, their patient may become upset, and they would not want their emotional challenges to negatively impact their patient's care or well-being:

"Do I really want to, you know, cry, you know, bring my own emotions from work into the patient's room, because that may affect the patient's emotions as well." (S02)

Even if the patient was unable to overhear the aide, there were still reasons why participants felt it inappropriate to use the IVA for emotional support in the patient's home.

Even if aides used the IVA during their free time, a nurse thought that patients might perceive that the *"aide is socializing and taking out part of the time that [aides] are supposed to spend on [patients]"* (N3), which could cause misunderstanding and unnecessary conflict between aides and patients.

Considering these concerns, both aides and agency representatives agreed that ultimately such emotional support would find its best fit outside of patients' homes. Many envisioned the ideal IVA would be small and portable *"so it can fit in [our] purses"* (F3, P2), for example. Another imagined using an IVA for emotional support in her car when she was taking a break saying, *"you can go sit in your car, and use the voice assistant on your phone to do all these things"* (S04).

However, even if an aide used an IVA for emotional support when they were *not* at the patient's home, aides and agency participants voiced concerns about an aide communicating work stresses to an IVA. They worried about the unknown issues related to data ownership, as it might be unclear who would collect and have access to the data, which could include private patient health data. Agency staff also brought up potential liability concerns, where agencies' failure to act on information aides might discuss could have legal consequences. A nurse described:

"Introducing a tool where people are saying how they're feeling in their check-ins has a liability. What if someone is saying they feel depressed and we have them taking care of vulnerable patients in the community and something happens? So now from a legality perspective, they're going to say, what did you do? [The aide's] telling [the IVA] she feels like she wants to die, what do we do? ...how much do we want to know where we're making things discoverable and putting ourselves at risk. Can we do things that supports wellness and wellbeing in a way that's less risky?" (N2)

Beyond privacy and liability concerns, aides further doubted that they could *"depend on something as cold as a machine to give us comfort"* (S07). Explaining further, the aide discussed how she felt an IVA would be unable to sense her emotions and thus not be able to connect with her on a personal level:

"I can't just get cold advice from a machine because there are too many emotions going on that cannot be interpreted properly through [an IVA]...too many emotions that can be hurt if they're not interpreted properly." (S07)

These findings differ from prior work, in which veterans suffering from PTSD expressed a preference for confiding in a virtual agent over a real human, since the agent would not be critical or judgmental [46]. By contrast, aides in our study perceived a preference for using an IVA to connect them with a real human to talk to as we now discuss.

Connecting aides to more appropriate sources of emotional support. Instead of using an IVA to provide aides with emotional support, participants perceived that it would be more useful and appropriate to use the IVA to connect aides to other sources of emotional support that they might now know about, particularly other *people* who would understand what the aide was going through and empathize. As one participant described,

"We're hidden from the world, we just go into other people's homes, people don't see us, we don't see people. So when the stress and

everything you know comes on, we tend to like hide away. So being able to connect with other people who are going through the same thing, especially caregiver to caregiver, I think is vital. We have that through our union, where we have our own little, like, chat group to, you know, talk frustrations out." (S03)

Participants suggested that it would be helpful if the IVA was pre-loaded with content and reminders about home health aide support groups, Facebook groups, meetups, and other resources that would provide an accessible list of ways an aide might meet other aides and seek support. A participant explained:

"We need to keep retention, that's important...knowing that one, you're not alone...there's help...you don't have to go [to a patient] not knowing what you're doing...somebody's always just a question away. So now you don't need to know where to go, there's something [the IVA] that you can use that can tell you where to go to get that answer." (S03)

5 DISCUSSION

Our findings yield rich insights into stakeholders' perspectives regarding whether and how IVAs should play a role in their work. Our approach enabled us to explore a broad range of possible futures with participants. On the one hand, speed dating enabled us to explore participants' desires and boundaries around potential interactions with IVAS, without being overly bound to the technical constraints of current technologies. On the other hand, our video elicitations depicted currently available IVAs, thereby eliciting more grounded suggestions for how IVAs might be used in the near term. In this section, we synthesize our findings into key implications for designers and developers interested in deploying IVAs in home health care and related contexts.

Implications regarding the materiality, form factor, and location of IVAs. One key design implication suggested by our findings is that the materiality of the device may impact people's perceptions regarding who is likely to own or control the device, what tasks are acceptable to perform using it, and the overall viability of IVAs as a tool for aides' work. We define materiality as the notion that the physical properties of an artifact have consequences for how the object is used [44]. Prior work that explored the potential design of a tablet-based application for home health aides reported how technology might trigger conflict in patients' homes, since patients would assume aides are distracted by the device, using it for personal matters, and not paying attention to them [81]. In our study, we focused specifically on IVAs, which have fundamentally different physical properties to text-based mobile or tablet applications. In addition to offering hands-free interaction, which might be beneficial for aides who have their hands full assisting patients, IVAs are also not necessarily *personal* devices. Many of our storyboards and video elicitations depicted IVAs housed in physical smart speakers that were positioned in patients' homes, but ownership of the device was intentionally left ambiguous, with the implication that anyone in the same room as the device could speak to the IVA and, in turn, hear its spoken responses. These choices left room for participants to make their own interpretations and suggestions regarding who should be in control of the device, and what specifically this might entail.

For example, we saw how the physical instantiation of IVAs in patients' homes affected perceptions of IVAs' potential role in aides' work. In some cases, aides viewed the IVA as an objective third party, whose presence would enable the IVA to speak up and vocally advocate for aides within the home environment. Aides also saw IVAs' presence as being able to improve transparency, making it more difficult for patients to hide their care plan and manipulate the aide into doing more work. The multi-user nature of IVAs also inspired ideas for using the IVA collaboratively with their patient, thereby strengthening the bond between patient and caregiver. All these findings suggest opportunities for IVA developers to design and build new voice-based tools that support aides' work.

However, although aides generally saw themselves as being in control when it came to decisions about whether and how to use the IVA, or whether to turn off the device, the choice to physically locate the device in the patient's home negatively impacted its perceived appropriateness as a tool for emotional support. Aides expressed fears such as being overheard by patients or being thought unprofessional for talking about their stress and/or challenges while in the patient's home. Moreover, housing the IVA in the patient's home led aides to strongly associate it with their work agency and patient. Even if they could not be overheard, aides were hesitant to share their honest thoughts and feelings with the IVA for fear that the information they confided might be accessible to patients or employers. In these contexts, they perceived the IVA more as a surveillance device rather than a supportive tool for their own use.

These findings provide implications for designers interested in developing IVAs for complex, multi-stakeholder contexts like home health care. In particular, designers might experiment with, for example, creating IVAs that have different form factors and/or placing them in different physical locations that might make them more acceptable or appropriate for use by aides. For example, a design that explicitly assigns ownership of the IVA to aides could embed a smart speaker into a physical kit that aides carry with them, and that is physically stored with aides' other supplies (e.g., gloves, masks, first aid supplies, etc.) Aides could then open their supply kit and use the IVA when completing tasks, putting it away again when they are finished. This might clearly mark the IVA as a work tool, that aides can bring out and pack away when needed. It may further prompt patients to accept that aides' interactions with the technology are care-related, not because they are distracted.

By contrast, an IVA that aims to provide emotional support may instead be instantiated via an app on an aide's personal device. This might provide much needed distinction and separation between work and personal contexts. However, even if such an approach is taken, our findings suggest a need for strong privacy protections and clear communication about the confidentiality of the information that aides share with the IVA.

Implications regarding privacy, surveillance, and accountability. Our findings also yield important implications around the need for IVA designers and developers to pay close attention to the potential privacy and surveillance concerns that may arise due to the always-listening nature of these devices. Prior work on IVAs has suggested that these devices may create privacy and surveillance challenges in a range of different contexts [2, 92]. We were interested in exploring how these challenges might manifest in the

sensitive, multi-stakeholder context of home health care, and our data reveals nuanced tensions and differing stakeholder priorities when it comes to issues of monitoring and surveillance. On one hand, aides and agency staff saw the potential for IVAs to help with care coordination, for example by tracking what tasks had already been done to help the next aide or identifying higher-level medical issues that individual aides might miss. On the other hand, participants were concerned that patients would be resistant to having their information tracked by the IVA (a finding corroborated by prior work [81]), pointing out past failures where technology was ultimately removed from patients' homes due to privacy concerns. This is a fundamental, and perhaps unsolvable, tension in home care that designers and developers will need to navigate carefully: aides require up-to-date, detailed information about a patient's condition to provide quality care, but patients do not want their private health information to be shared, including with aides and agencies.

Despite aide concerns around patients' privacy, they saw opportunities for IVAs to monitor patients, collect evidence, and report when a patient becomes abusive or makes demands outside the aide's scope of work. But, as discussed previously, patients would likely not want to be surveilled and reported by an IVA. In turn, agency staff suggested that IVAs might monitor aides and report whether or not they demonstrate competence in their work. Although aides discussed instances of how improved information and tracking of their work might be used to advocate for them to secure improved compensation or recognition, they certainly did not suggest that the IVA monitor their competence and report it to their supervisor. Instead, aides wanted control of what information would be tracked as well as when and how it would be used to advocate for them.

These findings suggest opportunities for designers of IVAs to explore how to create new mechanisms that enable both aides and patients to have a voice in what information is collected by the IVA and who has access to it. For example, design activities might investigate types of information that patients and aides mutually agree would be useful and acceptable to know and share. Mechanisms might then seek consent of all parties before sharing is enabled. As we discuss below, careful consideration is needed to ensure that these mechanisms elevate and enable aides, rather than reinforcing existing power dynamics that often deprioritize this vulnerable and marginalized workforce [81].

Implications regarding data collection and aide responsibilities. As is well known in the HCI community, the introduction of new technologies may often result in unintended consequences [8], including creating more work and/or additional burdens for people who must spend time and effort learning to use and maintain the technology. In our study, the speculative nature of our methods encouraged participants to think of hypothetical future uses for IVAs, which yielded exciting ideas for future research. At the same time, many of these hypothetical uses would, at least in the short term, require additional work in the form of data collection and/or reporting that someone would need to perform. For example, enabling an IVA to learn a patient's preferences would require someone to input data regarding those preferences. Similarly, tracking the performance of care tasks would require additional reporting about how those tasks are completed. Although some functionalities may

eventually be enabled by technologies like smart sensing and computer vision, there will still likely be extra work associated with collecting and reporting data.

Thus, another important implication of our work is that IVA designers will need to pay close attention to *who* will perform this additional, potentially invisible, work and how they will be recognized for it, especially since it seems likely to fall on aides, who are already an overburdened and under-appreciated workforce. We are reminded here of Gray and Suri's research on "ghost work"—invisible, unrecognized labor that underpins many celebrated machine-learning systems [26]. Without proper care and attention, introducing new technologies like IVAs into complex home health care contexts may end up further burdening an already vulnerable and marginalized workforce. At the same time, prior work has suggested that aides want to learn about and use new technologies, especially if those technologies elevate their role in the healthcare team and highlight the essential caregiving work that they provide [80]. Thus, rather than simply not designing technologies for aides, we instead recommend that IVA designers adopt social-justice oriented design methods (e.g., [11, 17]) that center aides as a key stakeholder when building voice-based technologies for deployment in home health care contexts. We now discuss challenges our study highlighted around the idea of centering aides.

The challenge of centering aides in multi-stakeholder home health care contexts. Although aides, who are mostly women and minorities, spend more time with patients than any other care provider, prior work has shown how they are overworked, poorly compensated, and experience high levels of stress and burnout [72, 73]. Their current tools and technologies are hard to use, outdated, and largely revolve around verifying aides' labor rather than supporting their work [56]. In addition, the nature of their work means that they are, as one aide put it, *"hidden from the world"* (S03), operating day-to-day in isolation and struggle to reach supervisors or clinicians when they need help.

Although addressing these problems is important from an equity and social justice standpoint, it is also increasingly an urgent practical problem. With the number of adults in the US over the age of 65 projected to almost double by 2050 [83], more and more people are looking to aides to support their health needs [30, 36, 64], but job turnover is high among this workforce and retention is a critical challenge [5, 16, 19]. To maintain high standards of patient care, aides' jobs will need to be elevated by offering improved working conditions, recognition, and respect. Ultimately, we believe that caring for aides is what will both enable growth of this workforce and positively impact their care of patients.

Thus, joining a small cluster of prior studies [56, 81], we sought to explicitly *center aides* within the home care ecosystem. However, our findings show how both aides and agency staff struggle to center aides when considering home health care and how they often worked to bring the focus back to patients, prioritizing what patients would want or how patients might react. A stark example is when, in response to the idea of using an IVA to provide emotional support for *aides*, participants quickly suggested using it to instead provide emotional support for *patients*.

Nevertheless, our study pushed to explore nuanced ways in which IVAs might help to shift power towards aides. For example,

an IVA in the patient's home may, in subtle ways, prioritize an aide's need to access the patient's care plan over the patient's desire to hide it. Similarly, an IVA might prioritize an arriving aide's need to know what tasks have been completed by the previous aide over the patient's desire to keep information about their care private.

At the same time, we acknowledge that patients are also a vulnerable population of primarily older adults who may be suffering from serious health conditions. Designing technologies that carefully and deliberately balance these tensions, and selecting whose needs and desires to prioritize, is an enormous challenge. Ideally, of course, we could create technologies that satisfy the needs of all stakeholders simultaneously. A compelling example from our findings is a collaborative activity that aides and patients do together for emotional support. However, the fundamental tensions and conflicts that exist in home health care suggest that, ultimately, technology designers will have to choose which stakeholders to prioritize and how. We therefore see an urgent need for more exploratory research, like ours, that helps to inform these decisions by uncovering the benefits, challenges, and tensions that new technologies like IVAs might bring to complex, multi-stakeholder ecosystems *before* these technologies are developed or deployed in ways that further marginalize or harm aides, ultimately also harming patient care.

5.1 Limitations

We conducted a small-scale, exploratory study that sought to investigate perceptions around how IVAs might play a role in aides' work. We now discuss several limitations of our study, including the context of our work, our exploratory research methods, and that we did not engage directly with patients.

Context. As with much HCI research, whether qualitative or quantitative, our findings must be understood in context and are not intended to be representative or generalize to all aides or home care contexts. Our participants worked in urban environments and most were employed by agencies. Aides in rural communities or who do not work for an agency may have different opinions or priorities.

Methods. As discussed above, our methods were speculative in nature; while the strengths of the methods mean that participants are encouraged to imagine hypothetical futures that are not necessarily limited by the functionality of today's IVAs, they also have limitations, and our findings must be interpreted in light of those limitations. For instance, participants proposed several possible uses for IVAs that may not be technically feasible without significant advances, such as automatically detecting when tasks are completed or inferring preferences from e.g., image data. Thus, some findings may have limited applicability to immediate IVA deployments. On the other hand, our findings do provide insights into aides' desires, priorities, and opinions that will inform the design of future technologies to meet the needs of these caregivers.

Participants. Home health care is a complex, multi-stakeholder context. As such, another major limitation of our study was that we did not speak with patients and their families, who are key stakeholders in the home care ecosystem, and whose perspectives and opinions are not captured by our data. Future research is needed to explore how patients might react to aides' use of IVAs in their homes and in their care, which will undoubtedly raise additional tensions around security, privacy, and the acceptability of using these devices in home care settings. In addition, our interviews with agency nurses and coordinators took place in agency offices. Though individual participant's utterances remain anonymous to agencies, we recognize that the physical context may play a role in what our participants chose to share.

6 CONCLUSION

This paper described an exploratory study that investigated aides' perceptions of how IVAs might play a role in supporting their work. We discussed how IVAs might fill critical gaps in aides' access to information, help with care coordination, and assist with decision-making and task completion. We also uncovered important tensions surrounding the materiality of the device and unpacked questions regarding device ownership, surveillance, accountability, privacy, data collection and reporting, and technology use in patients' homes. Our findings contribute to the nascent HCI literature on how technology could help to elevate and improve equity for aides, a vulnerable and overlooked workforce in need of more attention, and for whom few technologies have been developed.

7 ACKNOWLEDGEMENTS

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A CODEBOOK

Table 3 summarizes the codebook produced by our analysis.

Theme / Code	**Theme** / Code
Communication	**Device Form Factor**
IVA as a message medium	IVA Accessibility
Story Sharing	Utility of Screen
Approachable language	Utility of Voice
Multilingual capabilities	Shape and Size
Burnout	**Potential Technical Capabilities**
IVA for help with burnout	Multilingual capabilities
Burnout factors	Utility of Camera
COVID-19 impacts	Smart-sensing capabilities
Story Sharing	Technical shortcomings
Scope of work	
Privacy Concern	**Device Control**
HHA concerns about own privacy	Control to reduce IVA involvement
HHA perceives client concern about privacy	Control to increase IVA involvement
Liability	Degree of Alliance
IVA Uses	**Stakeholder Preferences**
Assistance in HHA training	HHA perceives client does not want their data collected
IVA appropriate manual tasks	Customizing based on client preferences
IVA as a message medium	HHA work preferences
IVA for proof of work	Access to client details
IVA as a wellness coach	
IVA as an encyclopedia	
IVA for accessing medical support and information	
IVA for companionship	
Reminders	
Second Voice	
Tracking	
Entertainment	

Table 3: Summary of themes and codes from qualitative data analysis.