Intelligent Voice Assistants in home care: an initial overview on requirements, hopes and fears of professionals

Edith Birrer
iHomeLab
Lucerne University of Applied Sciences and Arts
Lucerne, Switzerland
Edith.Birrer@hslu.ch

Martin Biallas
iHomeLab
Lucerne University of Applied Sciences and Arts
Lucerne, Switzerland
Martin.Biallas@hslu.ch

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***Abstract*—In the scope of co-creation sessions, care workers provided insights on applications and on concerns about Intelligent Voice Assistants (IVA) in the home of their clients or patients. The sessions focused on the potential to support the care documentation process by IVA. Participants' expectations and worries spanned from the ability to handle dialects, to confidentiality issues, to integration in existing care documentation systems. However, there is a general openness toward the idea to employ IVA as means to improve the quality of care. The challenge foreseen for using IVA is to become as time efficient as care documentation systems in place. Alternatively, as suggested by participants, IVA could complement existing processes or even create new ones in the care context.**

Keywords—voice assistant, care documentation, technology acceptance, user-centred design, health care, home healthcare, human–computer interaction, medical information systems

I. INTRODUCTION

The usage of voice assistants (VA) in the consumer sector is increasing rapidly. Therefore, it is also being investigated to what extent they are applicable in the professional field in general, and in the medical field in particular.

A meta-study [1] states that voice in the medical field is used primarily in three domains: (i) for dictation, (ii) for commands, and (iii) as Interactive Voice Response Systems (IVRS) for patients. (i) The foremost use of voice in health care has been **speech recognition (SR) for dictation**, e.g., replacing typing the findings into the medical record. (ii) **Voice for commands** has only been used in a few cases, for example in the operating room, in the perioperative environment or for physical therapy practice. For these two applications, the study states that the voice interface was quite successful in many cases, like in speeding up input time or lowering error rates. (iii) For the application of **IVRS for the patient** however, the study states that the voice interfaces were not well adopted by the patients. There is evidence that fewer calls were made to the centre after IVRS implementation or even hang-ups occurred on hearing an IVRS. Findings also list difficulties with background noises or dialects and state that patients preferred a real person to interact with.

In a Delphi study from 2021 [2] about Voice-Controlled Intelligent Personal Assistants **(VIPAs) in the medical sector,** the panellists expect them to be able to provide solid medical advice based on patients' personal health information and to have human-like conversations. However, in the short term, VIPAs might neither provide a frustration-free user experience nor outperform or replace humans in health care. With a high level of consensus, the experts agreed with the potential of VIPAs to support elderly people and be widely used as anamnesis, informational, self-therapy, and communication tools by patients and health care professionals.

There are also several studies that evaluate the past and future application of **Intelligent Voice Assistants (IVA) for older adults**, e.g., to aid them in living healthier and longer at home to aid them in living healthier and longer at home [3] [4]. Although results are mixed, still listing performance and acceptance problems, most expect that with technological progress, voice interfaces will become more important in the future [3] [5] [6].

Overall, the existing papers cover two fields:

- **Voice input into Electronic Health Systems (EHS)**, used by medical professionals in their environment (hospitals, medical practices, laboratories). Here the voice input most of times merely supports an application also having a screen, where the spoken input is displayed and can be corrected.

- **IVA applications in active assisted living (AAL)**, like lifestyle support, health support, daily activities support. These applications tend to have no screen, relying on voice only.

However, we found **no studies concerning an IVA placed in the home of the elderly, used by professional care**. We are researching novel applications in this field because conversational interfaces are potentially one of the most natural and intuitive interfaces around. Can we improve the quality of care by using such a promising interface? In this study, we have asked the target groups if and how IVA could be used in a meaningful way.

II. METHOD

A. Setting

The aim of the co-creation sessions was to involve end-users into the early stage of design development and collect their needs, attitudes, and expectations towards (i) a voice-assisted device in general and (ii) towards three planned features for the project underlying the paper: a voice-assisted notification feature, a voice-assisted care documentation feature and a voice-assisted communication feature.

The co-creation sessions were of two types:
- co-creation workshops (CCWS)
- co-creation interviews (CCI)

In total, 5 CCWS and 14 CCI were conducted during November 2019 and February 2020, in Austria, Belgium and Switzerland.

1) Co-Creation Workshops (CCWS)

Interactive sessions with experienced care workers. The end-user partners in the three countries recruited the participants and provided the locations for the CCWS in their country. During each of the CCWS, first a reflection technique was applied that enabled participants to think about their (implicit) daily routines. Then, the Walt-Disney Method was used, a creative strategy that aims at collecting ideas and visions, assessing their implementation, and reflecting on them critically. It involves three distinct phases: (1) the dreaming phase, (2) the implementation phase and (3) the critical reflection phase [7].

2) Co-Creation Interviews (CCI)

These interviews were held as semi-structured expert interviews. Such interviews are based on an interview guideline containing a list of topics and related open questions, serving as an orientation and as a reminder of necessary topics to cover [8]. The interviews were conducted by the scientific partners in each country, speaking with one person at a time for one hour each. The interviewed experts were operational managers of care organizations in Austria, Belgium, and Switzerland (for more details see Table 1). The main goal of the CCI was to get feedback on opportunities and obstacles that need to be considered for a VA in general, and more specifically about its usage in the care organization, for example to help with the care documentation. The desired gain in knowledge was threefold: First we wanted to gain insight into the institutional perspective as well as into the work processes and structures relevant for the implementation of an IVA. Second, we were interested in attitudes and feelings towards an IVA, to find out about interest, scepticism and perceived usefulness, and about user-centred requirements for usage of an IVA in the (care) organization. Last, we wanted to learn more about the IT requirements of the organization where an IVA would have to be integrated in.

B. Participants

Only persons who signed an informed consent document could participate in the co-creation activities. They belonged to three organizations located in Austria, Belgium and Switzerland.

CCWS were held with care organizations' staff at different hierarchy levels. CCI targeted persons at higher hierarchy levels. In more detail, the participants consisted of:

CCWS: 28 participants	CCI: 14 interviews
- 4 care managers - 1 head of emergency center - 3 home care nurses - 1 health professional - 2 concierges - 3 service center staff - 1 family care worker - 5 home helpers - 2 residents - 4 care assistants - 1 care assessor - 1 cleaning service	- 1 CTO (chief technology officer) - 1 head of nursing department - 2 heads of care centres - 4 coordinators of care services - 5 operational managers of home care - 1 registered nurse & training manager
- 12 from Switzerland - 5 from Belgium - 11 from Austria	- 3 from Switzerland - 6 from Belgium - 5 from Austria

Table 1: Structure of the participants in the CCWS and CCI

In our context of employee involvement, we assumed an average affinity for technology, therefore the age of the participants was not documented.

Regarding gender distribution, more than two thirds of participants at CCWS were female (20), and 8 participants were male. This roughly reflects the gender distribution in the care sector [9]. The majority of male participants were higher qualified (care assistants, nurses) or managerial staff. However, at the managerial level shown in the CCI, participants were equally distributed by gender.

III. Results

We intended to separate the interview questions and their responses into three categories: "Situation", "Expectations", and "Challenges". However, the participants of CCWS and CCI tended to mix "Situation" and "Challenges", so we keep these two together. In the list below, the main statements are grouped around common topics.

	Situation & challenges
(1)	The system would need to work well together with our existing documentation and time recording software.
(2)	There are all kinds of categories, so I would have to say the category first, for the computer to know where to put it.
(3)	in care documentation, there are 8-10 topics that come up again and again. They are standardized and catalogued, so the care documentation with these could be a good starting point.
(4)	It takes a long time for (care) people to be well trained.
(5)	Probably the nursing aid hardly thinks about always indicating the category before saying something.
(6)	I'm already glad if the carer documents anything at all.
(7)	When entering documentation by voice, you would need a way to log in so that not everyone can document.
(8)	On the laptop, each person has an own login. A voice system would therefore need a similar mechanism, to make sure that only authorized persons make entries.
(9)	Deviations from care plan have to be documented exactly (e.g. why did something take longer than planned / paid for).
(10)	In long-term care, you only have to document the deviation, which is different from acute care.
(11)	As long as the computers don't speak dialects, I think we will have problems here in Switzerland and Austria for a long time.
(12)	There are also carers with a mother tongue different than German, so their German is rather bad.
(13)	There is no screen, so how to know what has been understood, how to correct errors?
(14)	Documentation could be done while doing something, but this diverts attention away from the person being cared for.
(15)	If I know technical jargon, I can document much better without the residents or their relatives understanding. Or I can simply document outside the room. The people are old, not daft – their will has to be taken seriously.
(16)	If they find that something is not worth mentioning, but I still have to document it, it is easier if I do it outside the room.
(17)	Documentation must distinguish between time billable for the patient, and time not billable for the patient (but only for the carer).
(18)	It is defined what is paid and which education is required to do which tasks.
(19)	Equipment with hardware is not yet there (not even one tablet per employee, they share tablets). So do not expect one device per customer / cared person.
(20)	System should not lose connection when the carers walk from one apartment to the next.
	Expected benefits
(21)	Must be as efficient as possible.
(22)	System should allow documentation with as little effort as possible.
(23)	Voice input would save time (speaking is quicker than typing).
(24)	Documentation by language would be quicker than with keyboard.
(25)	Saying "Good afternoon" in a flat and the measured values (e.g. blood pressure), if the system were recording that in the care documentation, this would save on billable time for the patient.
(26)	If we could only save half a minute per visit, that would save a lot of time/money.
(27)	Documentation could be done while doing something, e.g. record blood pressure values while cleaning away the pressure meter.
(28)	Not having to touch a device is more hygienic.
(29)	If the computer could speak Swiss German, that would be great.

(30)	For care workers with limited abilities of the language spoken in the region, an auto-correction software should help. Or a language translation tool could enable care workers of other nationalities using their native language when entering data.
(31)	System could help with professionality of report by reacts to certain keywords that are judgmental, not adequate or ambiguous and prompts the care worker to change it.
(32)	Should allow retrieval of important data from past care reports.
(33)	If a system would recognize me being not in an apartment and thus on "non-billable time" and would record that, great.
(34)	Timing, i.e. when I have done what is also important.
(35)	Probably voice assistants are not yet intelligent enough for just saying "do this", but with a few steps in between one could search the way to the reality.

Table 2: Statements collected from the CCWS and CCI

IV. Discussion

First a categorization of the statements in Table 2. Those concerning the **situation** in the care organization and the **challenges** therein can be categorized as follows:

- (1) – (3): integration into existing software, organization of the care documentation
- (4) – (6): training of the users in the system and/or care documentation.
- (7) & (8): authorization / authentication
- (9) & (10): care plan and deviations
- (11) & (12): language and dialects
- (13): voice-only input
- (14) – (16): relation to the cared person
- (17) & (18): regulations about compensation
- (19) & (20): availability of hardware and network connections

The **expected benefits** are somewhat more difficult to categorize, and they overlap partially with statements mentioned under Situation/Challenges. Categories could be (with some statements belonging to several categories):

- (21) – (27)(28): Efficiency, timesaving, less effort
- (28)(27): Hygiene, contact with the cared-for person
- (29) – (30): helping with the language
- (30) – (32): quality of the care documentation
- (33) – (34): helping in the time tracking / billing
- (35): concerns about feasibility

Some groups of statements are related to each other.

The daily challenges which the caregivers face every day because of the care documentation are expressed in many of the statements. (1) – (10) show the high expectations about how care documentation must be done technically and content-wise. The care documentation's content is highly structured and regulated, there are clear definitions what must be documented and how. The statements above (especially (4) – (6), (9), but also (14) - (16), (18) and (32)(15)) show that the need for care documentation makes care also a straining job, psychologically. Increasing legal demands on documentation, which has become a pillar for quality control and billing, can lead to an erosion of the time spent for care of a patient or elderly person. Therefore, a time-efficient process of documenting is an important concern for both caregivers and care organizations. In the three organisations, digitization in care documentation is well advanced. The caregivers already work with mobile devices with highly sophisticated **care documentation apps**, with a data flow well integrated into the back-end systems. Further optimizing this process with an IVA is quite difficult because the speech-only-interface competes with care documentation applications having graphical user interfaces (GUI), which are made for efficient "ticking off" of the standard case. Only deviations must be documented manually, often by just selecting the applicable values.

An IVA is better suited for **input of free text**. It could simplify taking notes, making remarks, or mentioning details. But without a screen, and thus without knowing what has been understood by the speech-to-text engine, dictating the text leaves a feeling of uncertainty with the carer. This is expressed by (13) and further aggravated by the speech recognition problem mentioned in (11) and (12). To make sure that the correct content is entered into the system, the caregiver would need a means to check and confirm his/her input. However, if the text that has been understood by the system were repeated for the carer to acknowledge, the process is likely to become more time consuming than writing with a keyboard. Worse still is the case where something has been misunderstood and the entry must be changed or re-entered. A compromise would be to use to combine the best of the two worlds: using the GUI of the caregiver app for selection of items, checkboxes etc., and complement this with voice input for free-text fields such as remarks and details. This could be done by simply using the speech-to-text assistants built into the operating systems (OS) of the mobile devices, where the carer could directly see what has been understood. However, no matter if the mobile OS is Android, iOS, or Windows, all these OS are provided by non-EU companies, and therefore, compliance with EU regulations concerning the privacy of the spoken and translated data is a challenge, currently (a more detailed discussion of legal issues is given later in this chapter).

Notwithstanding all the rules and regulations for care documentation, it cannot be taken for granted that the caregivers document well. This is expressed in (4) – (6), (11) & (12), but also (30) and (31). These statements touch three different levels. First there is the **effort to document at all**. It seems to be a challenge that the caregivers not only care, but also document it well (expressed in (4) and (6)). Whether pure voice with an IVA would help here seems questionable, rather training and/or motivation seems an adequate solution.
On the second level, if a caregiver is motivated to document the care, it cannot be taken for granted that an IVA would understand all that is being said. The two main challenges on this level are **dialects and non-native speakers** (expressed in (11) & (12)). Concerning the dialects: In recent years, VAs have been continuously improved, understanding standard spoken language gradually quicker and with greater accuracy. However, both in Austria and in Switzerland, the language usually spoken differs vastly from the standard German language. Same for Belgium, whose language Flemish is a dialect cluster of the Dutch language. Nevertheless, we tried to find out whether the current state of the VAs is suitable for practical use - in the knowledge that all users of the IVA have to speak in the country's standard language. We found that this is still a challenge, with the persons having a various degree in strength of their accent. Many participants also expressed the desire to be able to interact in their local language (29), which is even more challenging for the time being. However, with the progress of research in this area [10] [11] it is expected that IVA

will learn to understand dialect.
The third level of language-related challenges concerns the wording of the documentation. Even persons fluent in the documentation's language have the effort **to use professional wording** and to avoid phrases that are judgmental, not adequate, or ambiguous. (31) wishes support by an IVA on this level: the IVA should detect if the caregiver uses inappropriate wording and if so, it should intervene and encourage the caregiver to better formulate or should even make suggestions for a more neutral or appropriate way to express the same idea. This would certainly increase the quality of the care documentation and probably also help the caregiver to find better sentences in the future. Such applications might be close to reality for everyday language, but for the care documentation with its highly specialized expressions and wordings, they are currently not available. Still, also for such applications a voice-only interface has the problem of how the understood content is checked and confirmed.

An interesting idea is mentioned in (30): to connect the care documentation **IVA with a translation tool**. This would allow non-native caregivers to document in their native language and the content would be translated. However, it is doubtful whether such applications are mature enough yet. On the one hand, the highly specialized language used in care documentation is only a subset of the language, so a translation certainly is easier. On the other hand, compared with translation of everyday language, there is less need and thus less investment in such specialized translation tools. So they will probably only become available when big players in the related businesses (health, care) decide to invest considerable sums there.

In addition to the highly structured and strongly regulated care documentation, also the **compensation and billing** process adds to the mental workload of the caregivers (expressed in statements (17) & (18)). The carers are obliged to track somehow exactly how much time they have spent for each patient, and/or the care plan regulates how long the caregiver may spend on each activity. The expected benefits (33) & (34) express the wish to simplify this process. Whatever relief an IVA might give, it would greatly relieve the burden on caregivers. (33) wishes for a system that detects when the carer is not with a patient. Combining this with the idea of (25) where the system recognizes that a carer is with the patient, an IVA could be utilised to simplify the billing process. The involved organisations envisioned a system that uses voice-recognition in the room of each patient and starts the tracking of the billable time for this patient. This would eliminate the need of some disputed devices like wearable GPS tracker or indoor localization.

Wherever personal data is concerned, and even more pronounced in health-related topics and/or concerning particularly vulnerable people such as the elderly, **data protection and privacy** must have highest priority. An IVA faces two problems here. One, authentication/authorization, is expressed in (7) & (8). The other, being compliant with EU law, has not been mentioned by the interview partners, probably because it is taken for granted. First about **authentication and authorization**. Authorization must be done in the care documentation system, to make sure that only the right persons can enter content there. For it to work, the person using the system must be authenticated, meaning she/he must be identified correctly. Doing this by only voice requires spoken training data from each user. This certainly could be done if the care organization is willing to do so and the systems were set up to use this method. Background noises can make it more difficult to log in, and there are other factors to be considered, so one might support or replace voice authorization with other methods, like a personal badge that activates the IVA or similar hardware-supported methods. Compliance with the **EU laws about data protection** seems to be a harder problem. There is a great reluctance to use non-European companies, also due to the fall of the "Privacy Shield" agreement in 2020 and the strict GDPR in the EU [12] [13]. In our project, we proposed using a device which is not "always-on" (not always connected to the internet) but containing a SIM card and providing a connection to the internet only after the detection of certain keywords and while clearly indicating with sound and lights that a call is being made. This reduces the problem somewhat by making the user aware when data is recorded and by reducing the amount of recorded data. But the remaining data still must be processed according to EU law. However, all the big companies providing text-to-speech and speech-to-text functionality currently reside outside the EU. There are few and smaller companies offering EU-compliant speech services. Some of them have developed their own speech assistants (but they still lack accuracy compared with the big ones), some of them use one of the non-EU-based services but have special data protection agreements to be compliant with EU law. It is also possible that the big companies will start to provide services compliant with EU law. For example, there are efforts to do speech recognition locally instead of internet based [14] [15]. In all cases however, any IVA will have to carefully consider this point.

Some statements of the care professionals express their experience with systems they use already, influencing their hopes and expectations about IVA. It looks like sometimes in their professional environment, even the most **basic requirements for digital assistants** are not met fully. Remarks about having to share hardware (19), about battery life and network availability (20) show this. Past disappointments with digital tools or only slow progress are probably also the reason for the concerns about feasibility expressed in (35), but the person is still somewhat optimistic that eventually an IVA can help with care documentation.

Moving the focus away from the technology and towards the human being, we must consider that good care documentation does not automatically mean **good care**, and vice-versa. If half a minute were saved per care visit (as hoped for in (26)), what would be done with this time? Would it be used for the benefit of the patient, or would it just be used to treat more persons during the same time? Saving time by "documenting while doing something else" contradicts the idea of high-quality care, which also brings human contact and not just doing the work. Caregivers care for "their" patients, also giving them their time and attention. The question is whether the quality of care is increased more by, for example, documenting the measured blood pressure values by means of an IVA while storing away the blood pressure device, or more by using this moment for some informal words with the patient ((14) vs. (27)). Even if the hands-free interface of an IVA helps with good **hygiene** as stated in (28), some caregivers express concerns to speak their documentation in front of the patient. (15) mentions that in such cases, using "care tech jargon" would help because then the cared-for person would not understand what is being said. (16) would do the documentation outside the room, so also after and not while working with the patient. This helps with good care but contradicts (26). It shows that

the caregivers generally see the cared-for persons not as "objects of work", but as **human beings**, and respect their wishes.

V. Conclusion

As a **conclusion** we find that, although the target groups would be open to using IVA, the hurdles to using them are very high. So high, in fact, that it is currently quite a challenge to use them meaningfully in context of care. Particular attention should be paid to the following requirements for voice interfaces:

- Usage of IVA must be efficient, with no time overhead compared to the existing visual interfaces, and with seamless integration into the existing systems.

- Purely voice-controlled interfaces help with hygiene but should not distract attention from the person being cared for.

- Challenges of IVA are authentication and data protection / privacy on the technical side, on the user side speakers' accents and dialects.

The quicker and user-friendlier the existing systems and their (visual) interfaces are, the more difficult it is to enhance the overall process through voice. Therefore, we propose to use IVA rather as a complement or extension of existing systems.

As an **outlook**, we see interesting new fields of applications:

- IVA could be used to get additional information (compared to services subject to compulsory insurance), for example: caregivers could record subjective impressions about the cared for as a voice message, or the cared for person could briefly answer "how am I doing today".

- IVA services could not only involve the caregivers, but also other players in the care environment. For example, more than half the phone calls to the care centre ask the time or day of the next care visit. If the cared-for person could ask the IVA instead, it would save a lot of time and effort on the care centre staff.

In order to address the challenges of using IVA in care, further research is required on the ability of IVA to understand accents and dialects, on the acceptance of IVA that help using appropriate language, on possibilities to check/correct the transcribed text and on exploring new applications of IVAs.

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