

Discussion Paper Series

## **Co-Creation & Stakeholder Facits**

Findings from the Co-Creation Activities  
in Switzerland, Belgium and Austria  
(CARUcares Del. 2.1)

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## DEL 2.1

# Co-Creation & Stakeholder Facits

## Findings from the Co-Creation Activities in Switzerland, Belgium and Austria

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## Executive Summary

This report presents the findings from the co-creation activities conducted in Belgium, Austria, and Switzerland during the first phase of the “CARU cares” project.

**What was the aim of the co-creation activities?** 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 three planned features for the CARU sensor: a voice-assisted notification feature, a voice-assisted care documentation feature and a voice-assisted communication feature.

**Which methods did we use?** To achieve these goals, a set of creative tools and methods were employed, comprising (i) the Walt Disney Strategy, (ii) a Daily Routine reflection technique and (iii) semi-structured interviews. In total, 5 co-creation workshops and 14 co-creation interviews were conducted during November 2019 and February 2020.

**Who was involved?** The group of participants consisted of consortium members of the AAL-project “CARU cares”, including care professionals and managerial staff representing the three end-user organizations, engineers in charge of developing the new features (CARU AG, ihomelab and the University of Applied Sciences Wiener Neustadt) and WU Vienna University of Economics and Business (AT), responsible for the design of the co-creation activities.

### What are the main findings?

#### General user requirements

for a voice-assisted device for professional care (for details see section 6):

Overall, the *idea* of the three new features was *very well received*. Participants stressed the importance of a *simple, well guided voice interaction* with the system that requires *low mental workload* (e.g. intuitive keywords) for using the device. Besides *memorability* and *learnability*, the *customization* of the product was another important aspect considering the different needs and impairments of older people. *Data security*, particularly in the context of health care data and access rights, the feeling of *being in control of the contents being processed*, as well as *reliable functionality* of all features turned out to be indispensable for future users to accept the new features.

**Voice-assisted notification feature** (for details see **section 7**):

**Potential benefits:** For the voice-assisted notification feature, participants recognized several advantages for care clients in terms of *increased level of control* or *reduced feelings of stress*. However, care workers also saw great potential for their daily work as the feature could ease their workload by *reducing the time spent on phone calls* with clients. Further, automatic notification was considered useful for clients to *inform about greater delays*.

**User requirements:** In order to maintain care workers' flexibility and avoid stress, an *adequate time range* should be considered regarding the prediction of arrival time. Controversially discussed was the announcement of the *name and profession of the care workers*. An option to *control the transmission of the notification messages* could give care workers reassurance that the clients are informed.

**Voice-assisted care documentation** (for details see **section 8**):

Given the broad scope of care documentation, the voice-assisted documentation feature was discussed in four different application areas: (i) management of the care workers' tasks, (ii) the care report, (iii) management of vital data and (iv) medication management.

**Potential benefits:** Benefits were identified with respect to a general *reduction in multiple documentation*, spontaneous *hands-free documentation of vital signs data* right after measurement, *retrieval of history data* for improved communication among care workers and *reduced cognitive workload for medication management*. Participants also saw potential for care clients to *stimulate recording of e.g. vital signs on their own*.

**User requirements:** For successful implementation of the features, care workers expected *workflow efficiency, ease of use, or work quality enhancements*.

**Voice-assisted extended communication feature** (for details see **section 9**):

**Potential benefits:** The voice-assisted communication feature seemed promising with regard to *simplified communication for older people* and efficiency improvements due to a reduction of phone calls for care workers and service staff. In assisted living facilities, voice messages could be used to *inform the residents* of an apartment complex about general matters, whereas in home care organizations, voice messages could also adopt a *reminder function for medication intake or appointments*.

**User requirements:** Important user requirements referred to *control options for the sender* of voice messages, a filter function that may *protect from overuse* of the feature and *caller identification* based on a contact list.



# 1 Introduction

The project “CARU cares” aims to develop **three new features for the smart sensor “CARU”**:

1. The **extended communication feature** should allow users to communicate through voice messages recorded or played using CARU. In addition, CARU can be used for calling a care provider.
2. The **documentation feature** aims to facilitate care documentation or other documentation tasks by using verbal commands.
3. The **notification feature** should allow clients to get estimates of the expected time of arrival for the professionals visiting them. This feature builds on the crew schedules (precision level 1), GPS data (precision level 2), and traffic data (precision level 3).

All three features address working areas of professional (care) providers in assisted living or home care settings and aim to facilitate the exchange of information between care workers, provider organizations, and older people in need of care. Unlike the emergency feature that has already been developed and is about to be tested in Switzerland, the three features are still in the early stage of development, ready to turn into user-led solutions.

As a main goal of the project is to design usable features that fit the specific needs of its intended users, it was crucial to involve potential end-users into the early stage of product development. Direct contact with future users helps to gain relevant knowledge and understand the complex work environment and various context of use in which the system needs to operate (Kujala 2003). User involvement further allows defining user requirements and task requirements that are eventually translated into successful implementation of the system.

This paper aims to provide **the findings of the co-creation activities** that took place in Austria, Belgium, and Switzerland during the first phase of the project. The co-creation sessions addressed the three planned features involving potential users of the professional (care) organizations that are participating in the project.

## 2 Country-Specific Context of Use

The AAL-project “CARU cares” intends to develop and test the new features of CARU with three end-user organizations in three countries, namely Austria, Belgium, and Switzerland. Legislative as well as organizational differences may shape the expectations and needs of end-users and thus impact on the use cases and requirements of the new features. Indeed, “CARU cares” has to find solutions for at least two

different care services: Johanniter Innsbruck in Austria and Senior Living Group (SLGR) in Belgium. Both are home-care providers, with SLGR also offering assisted-living facilities for older people with limitations in daily living. Bonacasa in Switzerland serves a niche in the luxury assisted living sector providing facilities for higher income customers. These different settings are described further in the next section.

## 2.1 Home Care Settings in Austria and Belgium

Senior Living Group in Belgium and Johanniter Innsbruck in Austria both offer home care service to people who live at home. In addition, SLGR also runs assisted-living facilities and nursing homes. More information on the assisted-living facilities of SLGR will be provided in the next section.

Johanniter Innsbruck is a small home care organization in Tyrol, a province in the western part of Austria. Johanniter Innsbruck employs 20 care workers and provides different types of home care services to around 150 clients. Home care services comprise home help and housekeeping as well as nursing care. Nursing care is carried out by care assistants or registered nurses and involves support and implementation of physical care, assistance with dressing/undressing, blood pressure control, administration of medication, catheter treatment, etc. Home help is mainly carried out by home helpers and involves grocery shopping/accompanying client's grocery shopping, washing and ironing, heating up meals, assisting with physical care, putting on anti-thrombosis stockings and cleaning tasks. Housekeepers are mainly in charge of household tasks and cleaning services. Austrian clients have the possibility to use an emergency system in the household in the form of an alarm button worn around the wrist or neck. The system is provided by the Red Cross for a monthly fee of EUR 36. Currently about one third of the clients use this safety system.

Home care services offered by SLGR comprise different home nursing services (Thuisverpleging), specialized care services, family care<sup>1</sup> (home help and housekeeping) service checks (household tasks e.g. cleaning, washing, preparing meals, shopping, etc.) and cleaning services. Home nursing care is carried out by nurses and care workers and involves, for example, medical care such as wound care, diabetic care, injections, administration of medication. Specialized care services are tailored to people with disabilities, people who suffer from dementia or mental problems, and palliative patients. Family care includes assistance with everyday activities, such as grocery shopping, personal hygiene, and housekeeping tasks (washing, ironing, and cooking). Service checks involve household tasks, for instance, cleaning, washing, preparing meals, shopping. SLGR also offers a personal alarm system (PAS) to increase the safety of their clients. An alarm can be triggered by a button worn around the wrist or neck and is transmitted via automatic telephone

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<sup>1</sup> The original Flemish name for this type of care is "Gezinszorg" and translates literally as "family care". It is a professional care service and should not be confused with informal care provided by family members.

connection to an emergency center. Clients can combine the device with a smoke alarm, carbon monoxide alarm and/or a motion detector.

## 2.2 Assisted-Living Facilities in Switzerland and Belgium

Bonacasa (CH) provides assisted-living facilities, a type of housing designed for people who need various levels of support and personal care. The barrier-free apartment complexes offer a 24/7 emergency alert system (in cooperation with Medicall AG) and provide access to a variety of assistance services and smart home applications. Residents live in their own apartments or rooms and can individually order services depending on their needs.

Services provided by Bonacasa include housekeeping and laundry, apartment checks during longer absences and a range of individual services offered by a concierge. Individual services comprise housekeeping support (e.g. cooking), garden or balcony service, mobility service, administrative support, errands and shopping assistance, garbage disposal and other handy support. Additionally, the concierge offers support with organizations of mobile home care services and home meal services provided by other organizations. Mobile home care services may either be offered by a nursing home nearby or provided by the local home care organization (Spitex<sup>2</sup>). The concierge offers assistance during on-site working hours (e.g. one fixed day during the week) and is also available on demand.

In Belgium, SLGR offers assisted-living facilities with similar options and choices for older people. All apartments are provided with a 24/7 alert system. If needed, residents can choose individually from a variety of services, for example, meals, washing and ironing, grocery shopping and home care. An assistant, similar to a concierge, coordinates and organizes requested services and is available to answer questions and give advice. Further, residents have the possibility to join social activities offered regularly in the facilities.

## 3 Aims of the Co-Creation Activities

The aims of the co-creation activities are outlined with respect to the general objectives of the co-creation activities (Section 3.1) and to the specific and feature-related aims focusing on the planned new features of CARU: the notification feature, the documentation feature and the communication feature (Section 3.2).

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<sup>2</sup> Spitex stands for home care in Switzerland (“spitalexterne Hilfe und Pflege”)

### 3.1 General Aims

The aim of the co-creation activities of “CARU cares” was to obtain **valuable input on the planned CARU features** from end-user-organizations to inform the technical development of the new features of the voice assistant CARU. Bringing together care professionals and technical developers into the design process had two major goals: facilitating (i) the **exchange of knowledge and experiences** and (ii) **working together on potential design solutions**. In line with the concept of human-centered design ((ISO 9241-210:2019), our co-creation activities aimed at collecting feedback from end-users in terms of ambitions, concerns, and perceived usefulness in order to assess the potential benefits and weakness/challenges of the planned features and clarify the direction of the development process. By involving relevant stakeholders in a creative process, we intended to get a **common understanding of the needs and wants of future users, to develop concrete use cases and to define user requirements**.

In line with the project proposal, we focused on collecting ideas from the perspective of **two main target groups**: home care workers and other care service staff and the managerial staff from care organizations. We wanted to obtain input from *care workers and care service staff* as the planned features directly address their care activities and thus their needs and attitudes towards using the features play a decisive role. Moreover, it was important for us to get an idea of their work environment and daily working routines in order to identify challenges related to the planned features and clarify user-centered requirements in specified circumstances. At the institutional level, *care managers’ perspectives* were necessary to gain insights into the organizations’ processes and better understand the challenges and advantages of CARU for the care organization.

### 3.2 Specific Aims Related to the Planned “CARU cares” Features

The specific aims related to all planned features of “CARU cares” addressed four areas: (i) learning more about the current daily routines relevant to a specific feature, (ii) identifying the benefits and challenges of the feature, (iii) creating use cases and (iv) discussing user requirements.

Concerning the aims of the “CARU cares” **notification feature**, we wanted to identify potential benefits of the prediction of arrival time for care workers and their clients. We were interested in the advantages for care workers in using a location tracking system and in possible concerns that might occur with respect to this feature. Further, we aimed to gather information on the daily route planning and shift planning of care workers and processes behind and prevalence of rescheduling.

With regard to the “CARU cares” **documentation feature**, our goal was to identify the problems related to the current care documentation tools used by the service providers and collect ideas for improvements using the voice-controlled documentation feature. In detail, we intended to find out to what *extent* voice control can support the documentation process and which *parts* of the care documentation could be simplified

through CARU. We were also interested in specific requirements for this feature to overcome *potential challenges* with documenting care tasks using a voice assistant in private households.

The objectives for the “CARU cares” **extended communication feature** were to identify concrete *use cases* and *examples of future* use of the feature by getting insights in the daily exchange of communication between clients or residents and the service centers of the end-user organizations. We wanted to figure out to what extent the communication feature could *support the communication processes* and how effectively the use of asynchronous voice messages could facilitate communication.

## 4 Methodological Approach

The methodological framework of the overall CARU cares project refers to a user-centered design (UCD). Although there seems to be no agreed definition of UCD, one of the main ideas is to involve potential users from the start and in all stages of the system design in an iterative manner (Maguire et al 2018). Considering users’ needs and expectations throughout the whole development process thus forms the basic principle of user involvement. The idea is to enable a direct exchange between key users and technical developers in order to integrate users’ experiences and requirements into the development process and create solutions that are valuable and practical for future users (Nedopil et al., 2013, Kujala, 2003).

The following sections focus on the design of user involvement activities and the methods and creative techniques used. Section 4.1 gives an overview of the general approach planned for the co-creation activities. Section 4.2 describes the target group and the role of the project team partners during the co-creation activities. Section 4.3 presents the eligibility criteria for CCWS participants and interview partners and section 4.4 outlines the creative techniques and methods used for CCWS and co-creation interviews.

### 4.1 General Approach for the Co-Creation Activities

The first phase of testing and evaluation of ideas for the new planned CARU features included interactive co-creation sessions with care workers and semi-structured expert interviews with operational managers of care organizations in all three end-user countries.

An internal document with a detailed plan and guidelines for the workshops and interviews was provided by the WU to all project partners. The concept served as guidance for planning and running the co-creation sessions and involved a detailed description of scope and objectives, recruitment criteria for participants, methods and tools. In addition, outlines for the reports on the results of the co-creation workshops and interviews were provided.

## 4.2 Hosts and Participants

Hosts and participants together formed the team for the co-creation activities. The success of the co-creation phase does not solely depend on the users' involvement but also on the appropriate composition of the team, consisting of both end-users and project team partners. As it is of high importance for developers to understand what users really think and need, it was essential to connect future users with the technical developers of CARU. The role of the social scientist was to develop the concept and to create conditions that foster the direct dialogue between end-users and developers.

### 4.2.1 Role of End-Users

Two target groups were involved in the co-creation activities. The **target group for the CCWS** consisted of home care workers (with different caring duties) in Austria and Belgium, in addition to care service staff of assisted living facilities (Switzerland). The **target group of the co-creation interviews** comprised managerial staff of the care organizations or assisted living facility managers who will be involved in the pilot and the field trials.

In order to increase the heterogeneity of ideas and input, and to integrate different viewpoints, people of various professional backgrounds were invited. In total, we aimed for 30 participants to be involved in the first co-creation phase, i.e. 2x5 co-creation workshop participants and 3 interview partners for the co-creation interviews in each of the three countries.

### 4.2.2 Role of the Project Team Partners

The CCWS concept was developed by WU in cooperation with all project partners. The CCWS were chaired by WU in Austria, by SLGR in Belgium, and by Bonacasa in Switzerland. End-user partners in the three countries (Bonacasa, SLGR and Johanniter Innsbruck) recruited the participants and provided the locations.

As the co-creation workshop sessions aimed at connecting potential end-users and technical partners to create new ideas, technical partners responsible for the implementation of the planned features were involved. Thus, in Switzerland, iHomeLab, in charge of the documentation feature, and CARU AG, responsible for the development of the extended communication feature, participated in the CCWS. In Austria, FHWN, responsible for development and implementation of the notification feature, and colleagues from the iHomeLab were involved. In Belgium, the CCWS took place without technical partners as none of the technical partners were fluent in Dutch.

Co-creation interviews were conducted by the scientific partners in each country, WU in Austria, iHomeLab in Switzerland, and UCLL in Belgium.

### 4.3 Eligibility Criteria for Participants

A clear definition of eligibility criteria for CCWS participants and interview partners was essential for the quality of results of the co-creation activities. In the course of the selection process, we focused on the characteristics of the potential participants rather than on a high number of participants. In order to increase the participation and contribution of each person in the workshops, we decided to make two rounds and invite a maximum of six people for each workshop.

The following criteria were determined and formed the **participants' profiles for the CCWS**:

- Sufficient work experience in running field trials (minimum 3 years) and good understanding of the organizational structure and processes
- Work in areas that may be supported by the CARU features of interest
- Regular client contact
- Experience using electronic nursing software or service software
- Interested in using speech assistance for their work
- Ready to contribute and share ideas
- Good proficiency in the national language
- Men and women – gender distribution reflecting the distribution of the (care) sector
- All age groups – age distribution according to (care) sector

The selection of the **participants** for the **co-creation interviews** was focused on managerial staff of care organizations (BE, AT) or assisted living facilities (CH) that are planned to be involved in the forthcoming pilot and field trial. Eligibility criteria referred to the following points:

- Care managers or executive personnel responsible for resource planning or decision-making
- Minimum 3 yrs. work experience in management position with the care organization/assisted living facility
- Open for technological innovation and ready to contribute ideas

## 4.4 Methods for the Co-Creation Workshops

The CCWS had a four-phase format, comprising an introduction phase, an information phase on the daily routines of care workers, a creativity phase and, finally, a discussion phase. The goal of the first phase was to get to know each other before engaging in collaborative activities, to introduce the participants to the concept of CARU and its existing and planned features, and to the aims and methods of the CCWS. In the core phase of the workshop, the creativity session, we aimed to collect a variety of ideas and thoughts on the planned feature by using different methods and techniques that would help to stimulate creative thinking (see section 4.4.3). We planned to end the workshop with a final discussion, where each participant had the possibility to reflect on the experiences they had and to summarize their point of view.

In total, we planned to carry out two co-creation workshops in each country. The planned duration was about three hours for each workshop; however, the workshop organizers were asked to coordinate the final length of the workshops with the end-user organizations who provided their care staff during working hours. Furthermore, workshop organizers were given the possibility to shorten the session during the workshop day if the intended results were achieved.

To achieve the goals, outlined in section 3, a mix of creative techniques and methods was applied for the co-creation workshop and co-creation interviews. Section 4.4.1 – 4.4.3 covers the methods used for the CCWS. Section 4.4.4 describes the semi-structured interview method used for the co-creation interviews.

All co-creation activities were audio-recorded. Additionally, findings of the CCWS were put on flipcharts during the workshops. One of the interviews could only be partially recorded due to technical problems. It was documented post-hoc on the basis of notes and protocols. The audio-recordings of the CCWS and co-creation interviews were converted into verbatim or paraphrased transcripts (depending on the importance of the content). The transcripts were used by the country partners to report on the results. The information from the three country reports were taken as a source for this report.

### 4.4.1 Mockups and Storyboards to Introduce the New CARU Features

Mockups and storyboards were used to introduce the planned CARU features to the workshop participants at the beginning of the workshop. A mockup is a user interface prototype that is considered an easy and rapid way to draft user interfaces and demonstrate them to end-users. The basic idea of a feature is transmitted in a prototype and thus gives the end-users the possibility to discuss the function and discover user requirements (Rivero et al., 2014). Storyboards, which serve a similar purpose, consist of simple cartoons depicting user scenarios for a planned function (Nedopil et al., 2013).

For the planned documentation feature, a video mockup, drafted by iHomeLab, was shown to present possible use cases and interactions with CARU. A storyboard was used to introduce the notification feature based on a fictional story.

#### 4.4.2 Reflection on Care Workers' and Service Staff's Daily Routines

Professionals have everyday routines in their jobs that follow certain patterns with regard to their daily route planning, their client visits, or their communication flow within the care organization. Before diving into the creative process of collecting ideas and visions for the new CARU features, we aimed to gain a deeper understanding of the specific circumstances and work processes that may influence the development of user requirements and criteria for the usability of the planned CARU features.

In order to gain insights into these routines and daily activities, a reflection technique was applied that enabled participants to think about their (implicit) daily routines. Participants were asked to imagine a normal workday and think of a concrete process that was relevant for the discussed CARU feature (e.g. client visit and care documentation for the documentation feature). The workshop moderator then started to ask detailed questions about the single steps needed to perform the activities. Participants of the end-user organizations had to think of certain scenarios and common occurrences and to respond to a set of questions. The process of questions and answers continued until an appropriate depth of information was reached.

This technique paved the way for the subsequent method, as it helped participants to become aware of individual steps and processes in their work and thus facilitated the formulation of ideas and solutions regarding their tasks in the context of CARU.

#### 4.4.3 The Walt-Disney Method for Stimulating Co-Creation

The Walt-Disney Method is 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 (Steinhaus et al., 2018).

The method allows the participants to play different roles. As (i) “dreamers” they could come up with original ideas and wishes, as (ii) “realists” they were invited to engage in co-designing features and as (iii) “critics” they were asked to use critical thinking to express fears and skepticism. It was essential to separate the three phases so that participants can brainstorm freely in each phase (e.g. to take on the role of dreamers or makers or critics). In order to do so, it was recommended that the different phases were spatially separated (e.g. in different rooms or corners of a room) to make sure that the participants also have a spatial cue that facilitates their switching perspective according to the different roles. Each phase was planned to last around 15 – 20 minutes.

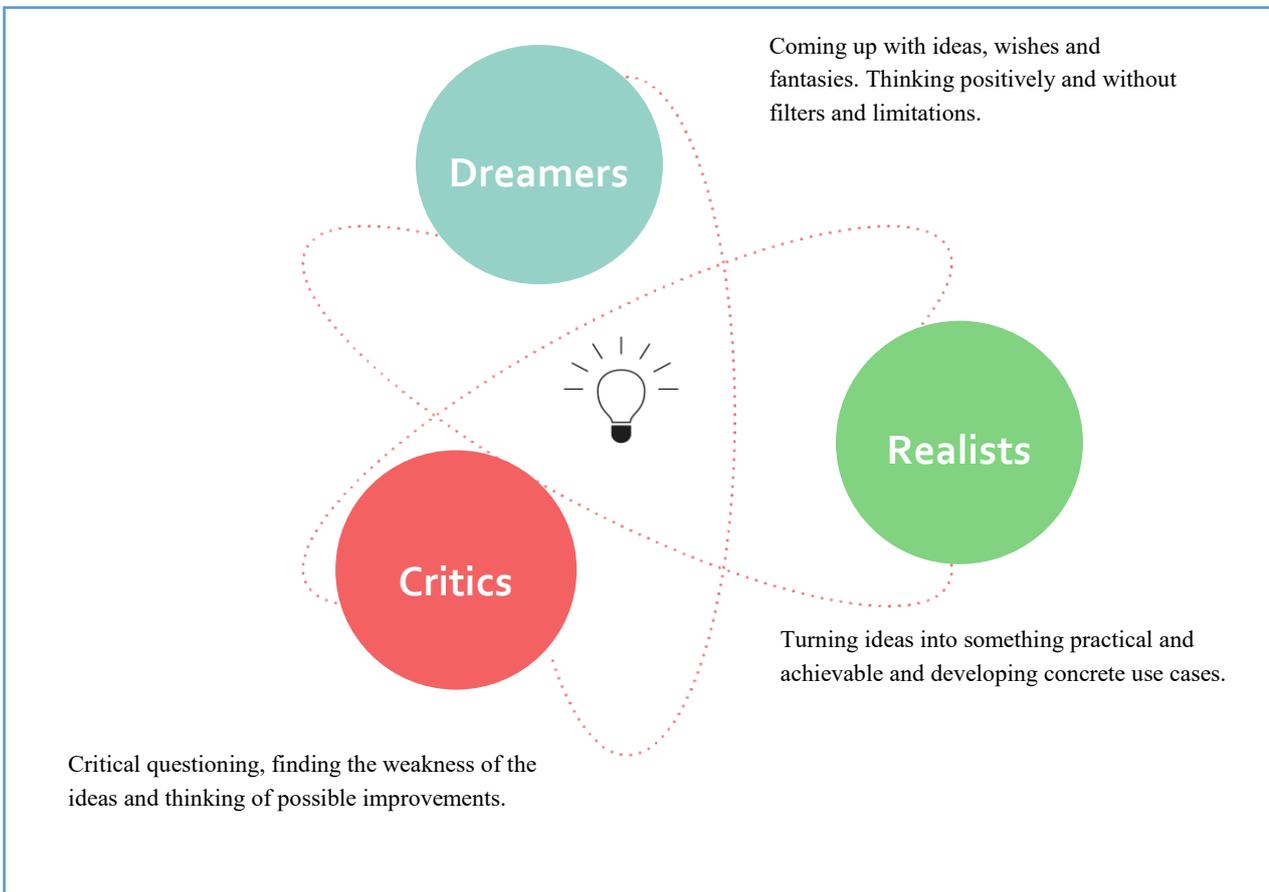
“Dreamers”: In the first phase, participants were invited to put themselves in the position of a dreamer and idea supplier. They were asked to set their creativity free and develop ideas and visions without caring about possible limitations. The phase of dreaming was supported by the following key question: *If this new CARU feature was part of your work activity X, what should it be able to do?*

“Realists”: In the second phase, the implementation phase, participants had to imagine their role as a realist or maker. They were asked to consider the steps required to put the most promising ideas into practice and discuss possible ways to implement the ideas. Ideally, participants created concrete use cases by developing dialogues between the smart sensor CARU and the user. If technicians and developers were present, they could support the process by defining the technical framework for implementing the ideas. This phase was guided by the following key question: *If you would turn the most promising idea into an action plan, how would this look?*

“Critics”: In the critical reflection phase, the last phase of the Walt-Disney Method, participants were asked to take up a critical position towards the CARU feature. The critical stance allowed them to assess the possible advantages and disadvantages of the collected ideas and to express concern and skepticism. In the role of critic, participants could define the contexts in which the feature may not work and offer any refinements to the ideas. The key questions that guided this phase was the following: *What are the obstacles and risks and how could we overcome them?*

Figure 1 illustrates the Walt-Disney Method composed of the three different roles that participants have to take on throughout the creative process. Eventually, as a result of the three stages, participants may have developed concrete scenarios based on their wishes, needs, and concerns.

Figure 1: The three roles of the Walt-Disney Method



#### 4.4.4 Semi-Structured Expert Interviews

In order to cover the institutional perspective of the care organizations on the advantages and challenges of the new features of CARU, we planned to conduct a total of nine expert interviews, i.e. 3 interviews in each country, with care managers or executive personnel of the end-user organization. The main goal of the co-creation interviews was to get feedback on opportunities and obstacles that need to be considered for the development and implementation of the CARU features. The structure of the interview guide therefore included general questions on the software's used by the organization for a specific application area and questions related to daily work processes and the implementation of the CARU features. The planned length of the co-creation interviews was 1 hour.

For the co-creation interviews with managerial staff of the end-user organizations, a semi-structured expert interview type was chosen. Interviews, as a form of direct communication, are a central means of generating knowledge in qualitative research that serve to gain insight into the perspective, views, beliefs and experiences of a participant concerning a specific phenomenon of interest. Semi-structured interviews, as one type of interview, are based on an interview guideline containing a list of topics and related open questions. The interview guideline partially structures the interview and helps to direct the conversation and collect specific information using open-ended questions. However, the guideline only serves as an orientation and as a reminder of necessary topics to cover. Wording and order of the questions are not predetermined and should be used flexibly. Furthermore, the interviewer also has to take up unexpected but relevant issues that emerge in the course of the interview (Kaiser, 2014, Flick, 2012, Coughlin, 2009)

Expert interviews in particular allow exploration into the organizational structures behind the expert (e.g. care manager) and insight into their specialist knowledge. The focus lies on learning more about the organizational context, revealing expertise and experiences relating to responsibilities, tasks, and activities of people who work with an organization or institution. The individual biography of the expert is less relevant (Kaiser, 2014).

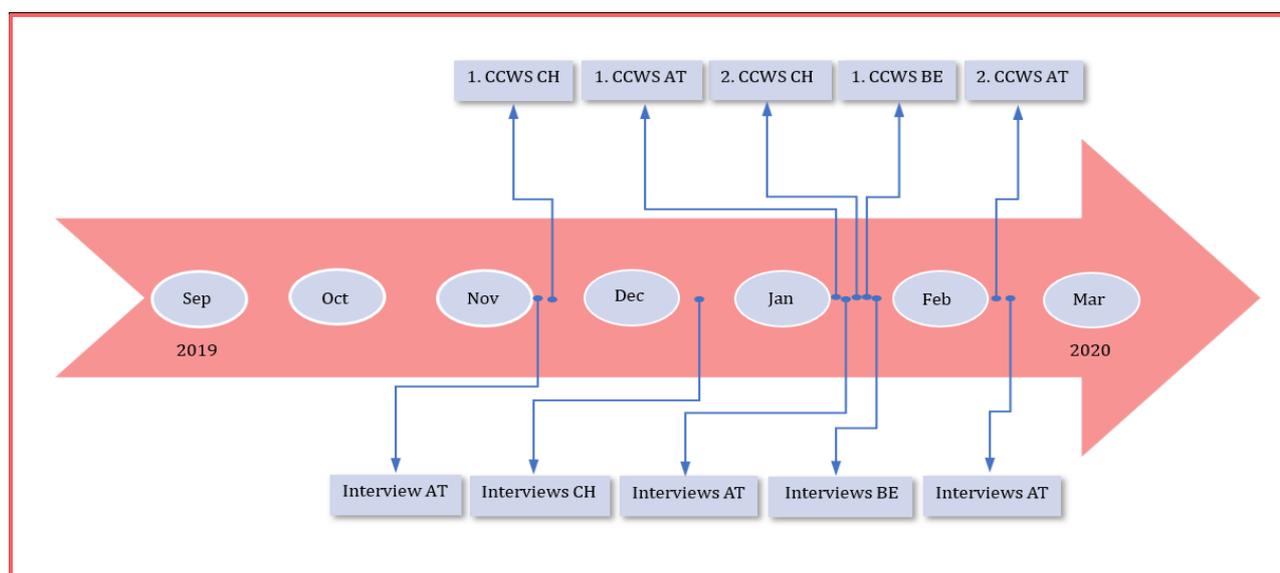
## 5 Description of Settings and Participants Involved in Co-Creation Activities

This chapter provides an overview of the different co-creation activities that took place in Austria, Belgium and Switzerland during the co-creation phase. Section 5.1 focuses on dates and settings of the CCWS and co-creation interviews. Characteristics of CCWS participants and interview partners are described in Section 5.2.

## 5.1 Dates and Settings of the Co-Creation Activities

The co-creation phase started in November 2019, 6 months after the project start, and lasted until March 2020. During these five months, a total of 5 co-creation workshops and 14 co-creation interviews were conducted. The timeline illustrated in Figure 2 illustrates the co-creation phase including time of CCWS and CC-interviews in all three countries, starting in the third month of the project.

Figure 2: Timeline of the “CARU cares” Co-Creation Phase



Notes: CCWS...Co-Creation Workshops; AT...Austria, CH...Switzerland, BE...Belgium

### Co-Creation Workshops with Staff

Altogether, five co-creation workshops took place in Belgium, Switzerland and Austria between November 2019 and February 2020. Bonacasa (CH) hosted two CCWS in Oensingen in one of its Smart Living Lofts. Johanniter Innsbruck (AT) hosted two CCWS in Innsbruck in the training room of the organization and offered a break-out room for working in groups. SLGR (BE) carried out one workshop in Willebroek at Seniorplaza, a senior residency and assisted living facility of SLGR.

In total, 28 people participated in the five CCWS. On average, 5 to 6 participants were involved in each workshop and additionally four project team members joined the groups in Austria and Switzerland, including scientific and technical partners. In Belgium, one project member participated in the workshop. The average duration of a CCWS was about 130 minutes, ranging from a shorter session of 74 minutes in Belgium to longer sessions of 180 minutes in Switzerland (see table 1). The results of the first CCWS were fed into the concepts of the second CCWS for further exploration and deeper insights.

### Co-Creation Interviews with Managerial Staff

In addition to the CCWS, 14 co-creation interviews with managerial staff were conducted in all three countries between November 2019 and February 2020. There were three interviews in Switzerland, six in Belgium and five in Austria. The interview settings varied from individual interviews, to tandem interviews (with two interviewers) to larger group interviews where several project team members had the chance to obtain first-hand information on the subject. Except for two skype interviews, all interviews were conducted face-to -face. On average, the length of the interview was 1 hour. The majority of interviews took place in the office rooms of the interviewees; one interview was conducted at the university.

The following table provides an overview of the settings and participants of the CCWS and CC-interviews in all three countries.

Table 1: Settings and participants of the co-creation activities in Switzerland, Belgium and Austria.

CCWS			
<b>Number of participants</b>	11	5	11
<b>Duration</b>	2x180 minutes	74 minutes	2x120 minutes
<b>Professions</b>	3 care manager 1 head of emergency center 2 concierge 1 care assesor 1 health professional 1 Bonacasa service center 2 Bonacasa residents	2 home care worker (nurses) 1 family care worker 1 cleaning service 1 service check	1 care manager 1 registered nurse 4 care assistants 5 home helper
INTERVIEWS			
<b>Number of interviewees</b>	3	6	5
<b>Duration</b>	45min each	40 – 75 minutes each	60 – 75 minutes each
<b>Professions</b>	<ul style="list-style-type: none"> <li>1 CTO Bonacasa</li> <li>1 head of nursing department</li> <li>1 head of care center</li> </ul>	<ul style="list-style-type: none"> <li>2 coordinator (home care/regional service)</li> <li>3 operational manager of home care</li> <li>1 director home care</li> </ul>	<ul style="list-style-type: none"> <li>2 care manager</li> <li>1 registered nurse and training manager</li> <li>2 scheduler</li> </ul>

## 5.2 Characteristics of the Participants Involved in the Co-Creation Phase

The group of CCWS participants and interviewees reflected various professional backgrounds and experiences. This enabled us to obtain a wide range of inputs and thoughts on the planned CARU features from different angles. The majority of CCWS participants represented home care workers and service staff, whereas the group of interviewees – as planned – was predominantly composed of people in managerial positions. Additionally, two residents of assisted living facilities were involved in one workshop group.

**CCWS participants** in Austria and Belgium covered all relevant professions that are represented in the partner care organizations, Johanniter Innsbruck and SLGR respectively, carrying out a variety of home care services. This ranges from home helpers, care assistants, and registered nurses to care managers in Austria and from cleaners, service checks, family care workers to registered nurses in Belgium. In Switzerland, workshop participants consisted mainly of Bonacasa service staff and managerial staff. However, two residents of a Bonacasa apartment complex also took part in the workshops. The Bonacasa care service staff comprised Bonacasa service center staff, emergency center staff, and concierges. Although not initially foreseen, five CCWS participants represented managerial staff, i.e. department managers of the Bonacasa emergency center and of a nursing home that also provides assisted living facilities.

The **co-creation interview partners** were mostly people in managerial positions or in coordinating roles working for the end-user organizations in the respective country. In Austria, this included two coordinators responsible for the working schedule, one training manager and the care manager of Johanniter Innsbruck. In Belgium, interview participants involved a home care coordinator (responsible for several regional coordinators), a coordinator of regional services (responsible for education), three operational managers of OTV home care (responsible for home care and care homes in different regions) and the director and the director of OTV home care. In Switzerland, interview partners included the CTO of bonacasa, who is responsible for IT infrastructure and manages the bonacasa app, the CEO of the care center GAG and the manager of a nursing department Läbesgarte Biberist.

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

## 6 Results of the Co-Creation Activities for the CARU Sensor in General

Although co-creation sessions did not explicitly focus on the advantages and challenges of the CARU smart sensor in general, several benefits and user requirements could be derived that pertain to overall functionality of CARU. Section 6.1 discusses expected benefits of the CARU sensor in general. Section 6.2 outlines general user requirements and Section 6.3 deals with further aspects relevant for technical implementation.

## 6.1 Expected Benefits of the CARU Sensor in General

Based on the findings concerning the planned CARU features, a few aspects were identified that refer to general advantages using CARU for voice assistance. More feature-related benefits will be discussed in the subsequent chapters.

The multifunctional use of CARU, **consolidating several features in one device**, was seen as a major advantage from the perspective of service providers/care workers for their work and - putting themselves into the position of their clients – for their clients. CARU would enable older people to combine a variety of useful functionalities and thus reduce the number of technical devices needed (emergency call system, smartphone, landline telephone, etc.). From the supply side, participants recognized the advantage of a cost-effective product that could **increase competitiveness** in the growing sector of assisted-living and smart-home applications. CARU could be combined with existing features of smart-home appliances and serve as a **universal voice-control platform**. This would enhance equipment and functionality of assisted-living facilities and could increase attractiveness for investors and real estate companies.

General benefits of a voice-controlled interface include the **simplification of use and increased convenience** of carrying out actions. People with various disabilities could access modern technology without needing to operate any device. **Hands-free interactions** would particularly increase independence for people who have difficulties typing on a smartphone or a keyboard, blind or visually impaired people, and bed-ridden persons. However, provided a simplified software system, any person that can use their own voice could benefit from reduced effort in performing certain tasks without being overwhelmed by the complexity of the interface design.

CARU was also considered a **personal companion for older people** that could have a positive effect on psychological well-being. Comparing CARU with a pet, participants expected the device to address social isolation and loneliness and contribute to positive feelings of connectedness in addition to feelings of safety. Participants imagined that older people would build trust in CARU with increasing use and probably attribute pet-like qualities to the device.

## 6.2 General User Requirements

A range of user requirements that may apply to general interactions and the general use of CARU could be identified based on the outcomes of the co-creation activities. Table 2 lists the main user requirements that are discussed in more detail below.

*Table 2: User requirements for CARU sensor in general*

USER REQUIREMENT CATEGORIES [CARU general]	USER REQUIREMENTS
Ease of remembering & understandability	<ul style="list-style-type: none"> <li>- Simple keywords and voice-outputs</li> <li>- Repeatability of voice-outputs</li> </ul>
Individual setting options	<ul style="list-style-type: none"> <li>- Individual settings options for different user types, (e.g. personalized dialogues, female/male voice, ...)</li> <li>- Individual volume regulation at the device</li> <li>- Dialect recognition for STT</li> <li>- Option for muting at predefined times (e.g. at night)</li> </ul>
Security & freedom	Protection of data and personal rights (as little technical surveillance as possible) & being in control of input/output
Reliable functionality	For users to develop trust in CARU's features
Practicality	Waterproof CARU case & sufficient battery for mobile use (signal when CARU is unplugged and runs on battery)
Financial resources	Affordability of CARU for clients

An **intuitive, simple, and easy-to-learn voice-controlled interface** was stressed as an essential condition for participants to accept CARU and its features. As CARU uses a purely auditory interface that does not present information persistently, users are cognitively challenged when operating the system. Considering the memory capacity of older people, intuitive keywords that are easy to memorize are thus required for users to start and repeat a task quickly. Users should be able to carry out any action without the manual. Similarly, voice outputs need to be understandable and provide an option for being repeated as users might be distracted for a moment or did not pay attention to the words said. Due to limited resources and training time available, high memorability and learnability are also important for care organizations. The less time and effort needed to make care staff familiar with the system, the lower the training costs will be for the service organization.

In order to design CARU for a wide range of older people with different capabilities and needs, **individual setting options** should be considered. Individual volume regulations directly on the device would enable users to adjust the voice output to different hearing capacities or varying acoustic situations. The design of CARU also needs to provide options for people with visual impairment or blind users who are not able to recognize and react to visual outputs. Providing choices for certain settings, for instance the degree of personalization of dialogues (purely functional, personal, entertaining dialogues), the sound of the CARU voice (male/female/neutral) and silent mode options (e.g. during the night) would cover the needs of a broader spectrum of user types. Further, flexible adjustments and setting options also refer to personalized speech

recognition for voice commands and dictation. Customization options may involve several user levels that allow for different degrees of complexity such as simple, medium, or expert level.

Another major issue expressed by the participants referred to **data integrity and information safety**. As users would start sharing their life with CARU, they need to make sure that personal data are safe. Security issues are of high importance particularly in the context of health care and health data. Users have to be sure that there is a controlled handling of personal information and sensitive data and that the device does not read out personal content to anyone activating CARU with a command. In order to secure privacy, it needs to be guaranteed that nothing is recorded unless users are sending a command to CARU. A user-friendly layout of the feature must thus not be at the expense of data security.

For all features, participants viewed **reliability and accurate functionality** as paramount to achieve users' acceptance of CARU. This refers to system quality and software quality of the device that need to reduce failures to the lowest possible minimum. Correctness and accuracy of the software are crucial for users to develop confidence to trust the system. As care workers have a legal responsibility to protect the clients they care for, they need to have certainty that the system works correctly and guarantees data safety. Similarly, older people need to fully rely on the device in order to experience associated benefits such as security and safety.

Besides its appealing design, the device needs to be **practical and suitable** for daily use and care settings. Participants required mobile use of the device that provides sufficient battery to be carried around if needed. In particular, care workers expected mobile use for immediate documentation of the care activities in any room. Further, a waterproof case was required that allows for using the device in wet rooms and general protection if accidental water contact occurs. As CARU is plugged in during normal operation, it should provide a signal if it runs on battery to ensure that the user will connect it to the main power supply again.

Thinking of **financial resources** of older people, **affordability of CARU** seemed to be a major issue. Older people often lack financial resources and need to spend their money very carefully. Addressing both home care clients and residents of assisted living facilities, the different socio-economic status of future users' needs to be considered. Johanniter care workers reported that a majority of their clients live on a minimum pension and probably could not afford additional monthly expenses for CARU. However, as most clients are using a 24/7 alarm system for a monthly fee of about EUR 36, they would probably be willing to pay this amount for CARU if it replaces the current system and provides more features.

### 6.3 Further Lessons for Technical Development and Implementation

Successful implementation and acceptance of CARU seems to depend largely on the **reliability of all features**. Participants agree that the device needs to provide full functionality and work in any condition. This applies to all features equally as poor functionality of one feature may result in general skepticism

concerning CARU as a whole. If one feature does not work properly, users may lose confidence in the other features and may no longer associate safety and security with the product. Further, if users cannot trust the features, they may quickly revert to their familiar and proven tools. Therefore, smooth functionality is required for users to experience good results and benefit from the positive effects of the features.

**Seamless integration of CARU with the existing infrastructure and interoperability with existing devices** is a major challenge for technical implementation. The diversity of infrastructures and currently used devices need to be considered for successful implementation in the different service provider environments. Even within the same application domain, end-user organizations use different infrastructures, software tools and data storage systems. Furthermore, in the context of assisted-living facilities, CARU needs to conform to the smart home infrastructure (based on ABB free@home technology) and to the Information and Communication infrastructure that is currently used. Thus, in order to achieve good communication between different technological systems and software applications, the technical integration of CARU needs to be implemented well ahead of the actual start of the field trial.

Technical developers constantly need to keep the needs, abilities, and constraints of the target group in mind when designing the features. As there is no single interface that can satisfy the needs of a heterogeneous user group, an adaptive interface is required that accommodates different needs. **Customization options** would thus enable users to match the product with their individual needs. The challenge of development is to find a balance between identified user needs and practical issues of technical feasibility within the given timeframe of the project.

Another major issue of CARU's interface design refers to the **cognitive challenges in terms of task complexity and memory load**. Technical development needs to aim at keeping the user's memory load small, particularly with regard to the primary end-user group of older people. Thus, dividing information into groups and limiting the spoken items to a small number will be necessary to ensure a high rate of task completion. In addition, interactions and dialogues with CARU should follow similar principles throughout different features to ensure an effective learning process and reduce cognitive load. Similarly, light outputs need to be consistent for different features to avoid confusion and simplify user orientation in the system.

## 7 Results of the Co-Creation Activities for CARU Notification Function

Home care providers are facing daily work scheduling challenges due to unexpected circumstances, emergencies or changing needs of clients. Although care workers try to meet clients' preferences for visiting times, they often have difficulties to proceed in a timely manner with scheduled visits. The CARU

notification feature thus addresses the dynamic setting of home care, offering a new possibility for clients to be notified about planned arrival times or changes in schedule.

The following chapter discusses advantages and challenges of the notification feature for end-users and service provider organizations. It mainly focuses on requirements in home care settings, as services provided internally by assisted-living facilities are not affected by the unpredictable nature of visiting times. However, a slightly different use of the feature for concierges in assisted-living facilities shall also be discussed. Section 7.1 presents the basic principle of the voice-assisted notification feature. Section 7.2 outlines the organizational context of the three end-user organizations with respect to shift planning. In section 7.3, expected benefits of the feature for clients, care workers and home care providers are discussed. Requirements for these end-users are presented in section 7.4. In the subsequent chapter some useful ideas for the interaction between the clients and the system are provided (7.5). Section 7.6 concludes with important remarks for the technical development and implementation of the notification function.

## 7.1 Basic Principle of the Voice-Assisted Notification Feature

As many (care) service users have to rely on rough estimations with respect to the arrival time of their care workers or service providers, they often face a state of uncertainty not knowing at what time they can expect the visit. This may cause anxiety and stress among older people in need of care. The new CARU notification feature aims to **inform older people** who receive care services about **the actual arrival time of care workers** controlled by simple voice commands. CARU then predicts the arrival time on the basis of location- and context-driven data.

## 7.2 Differences in Shift-Planning of Care Staff across the Three End-User Partners

The organizational conditions and practices with respect to scheduling care visits and coordinating care workers differ in all three end-user organizations, which may affect the technical development and implementation of the new feature.

Table 3 summarizes the main characteristics concerning schedule planning and care worker coordination for SLGR (Belgium), Johanniter Innsbruck (Austria) and bonacasa (Switzerland):

Table 3: Organization-specific context concerning schedule planning and care service coordination

	 Senior Living Group	 Johanniter Innsbruck	 bonacasa
Coordination of care services	<p>A regional manager is responsible for 20 - 25 care workers (nurses).</p> <p>Family service and cleaning service are managed separately</p>	<p>Coordinators are responsible for 20 care workers.</p> <p>Central coordination of all home care services provided by the organization</p>	<p>A concierge is responsible for several apartment complexes</p> <p>Services are provided on call or during attendance time</p>
Schedule planning	<p>Monthly schedule provided per email or Siilo</p>	<p>Monthly schedule planning</p> <p>Daily shift plan provided on previous day</p>	<p>Monthly schedule provided</p> <p>Daily detailed plan, spontaneous appointments during attendance time</p>
Internal notification of schedule changes	<p>Care workers have to inform regional manager via Siilo</p>	<p>Care workers have to inform service central</p> <p>Outside office hours the chief care worker is informed</p>	<p>Concierge has spontaneous appointments with residents</p>
Software used	<p>Outlook, Excel; Siilo</p>	<p>MOCCA 360°</p>	<p>Outlook, Visual Planning</p>

At Johanniter Innsbruck (AT), two coordinators are responsible for monthly scheduling and the coordination of visits for 20 care workers. This includes all home care services provided by the organization. They use MOCCA 360°, a specific planning software developed for care organizations. Care workers receive an updated daily shift plan on their mobile phone one day in advance. The coordinators usually have to be informed about spontaneous changes of schedule or changes in route by the care workers. However, outside working hours of the coordinators, the schedule is not updated continuously.

At SLGR (BE), a regional manager coordinates 20 – 25 nurses and provides a monthly schedule via email or Siilo. Scheduling planning is usually done with Excel spreadsheets. If care workers change their time schedule, they need to communicate it to the regional manager. However, not all home care services offered by SLGR are under the control of the regional manager, e.g. family services and cleaning services are managed separately.

At bonacasa (CH), a concierge is responsible for the residents of several apartment complexes. Unlike in home care settings, the concierge offers services on call or during on-site work hours. The concierge sticks

to a rough monthly plan and a more detailed plan, involving spontaneous appointments, on daily basis. Until now, the software used was Outlook, but the organization is in the process of switching to a system called *Visual Planning* for future schedule planning.

### 7.3 Expected Benefits of the Voice-Assisted Notification Feature

Care workers and service staff came up with several potential benefits of the notification feature for clients, care workers, and care service organizations. The largest array of advantages was expected for clients who use home care services. As the group of co-creation participants consisted mainly of care workers or other care professionals, the benefits for clients are considered mainly from this point of view.

Table 4 displays an overview of the expected benefits for end-users. The following sections 7.3.1, 7.3.2 and 7.3.4 provide more details on the listed aspects.

Table 4: Expected benefits of the voice-assisted notification feature for end-users.

	Clients/residents	Care workers/ Service provider
Expected benefits [ CARU notification feature]	<ul style="list-style-type: none"> <li>- <b>Higher level of control</b> for clients due to better information (also for those not doing phone calls</li> <li>- <b>Eases daily planning</b> for clients</li> <li>- <b>Overview</b> of daily/weekly schedule</li> <li>- <b>Reminders</b> for the service</li> <li>- Allows clients to be better prepared for the visit</li> <li>- <b>Temporal orientation</b> for people suffering from (mild) dementia</li> <li>- <b>Stress reduction</b> for clients and increased feeling of safety</li> <li>- Easing burden for informal carers</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Easing burden</b> on office workers and care workers</li> <li>- Less time spent on phone calls with clients</li> <li>- <b>Lower pressure</b> for care workers to justify delays to the office and to their clients</li> <li>- <b>Consistency of notifications</b> for all clients</li> <li>- Uniform tool for care workers from all disciplines</li> <li>- <b>Higher care client satisfaction</b> and <b>employee satisfaction</b></li> <li>- <b>Easier coordination</b> between concierge and clients</li> </ul>

#### 7.3.1 Expected Benefits for Clients/Residents

The notification of arrival time may primarily **improve the amount of information received by clients** who often do not feel sufficiently informed about the arrival time of the care worker. The voice-controlled notification feature may **enhance the sense of control for clients** as they have the possibility to access information on arrival time through CARU whenever they need it. If the feature allows clients to receive regular updates about the planned visit, this will **increase their awareness of temporal shifts** and thus may

**reduce waiting times.** This may also apply for clients who do not make phone calls for different reasons and can instead use CARU to get informed.

Better information about the arrival time of the care workers may facilitate clients' **daily or weekly planning**. It may give clients the chance to make clearer decisions about other appointments or plans during the day. For instance, they may decide if they already start having breakfast or would rather wait for the care worker first. Another example relates to medication. Some medication should be taken before the care worker arrives (e.g. inhalers or medication for Parkinson's disease). Similarly, if provided by the notification feature, clients will benefit from the **overview of the daily or weekly schedule**. CCWS participants particularly suggested this for older people with (mild) dementia or poor memory who have difficulties keeping an overview of their schedule and could benefit from this advantage.

Furthermore, the notification of arrival time may also serve as a simple **reminder of the service**. Especially for clients who have several visits and appointments during a day or a week, it is easy to mix up different services or just forget about a visit. Care workers reported that some clients were surprised when the care worker rang at the door because they did not expect anyone to come. Hence, the notification feature could remind clients/residents of their services every day in the morning and/or in the evening for the next day. This may help clients to keep their appointments in mind and to better prepare themselves for the upcoming visit.

CCWS participants also noticed the advantage of **stress reduction for clients** and an **increased feeling of safety**. As some care clients highly depend on the care service, they may easily become nervous if the care worker is running late and they have not been informed about the delay yet. The notification feature may provide reassurance, telling the clients that someone is on the way and prevent them from feeling "forgotten".

### 7.3.2 Expected Benefits for Relatives

Another group of end-users that may profit from the notification feature is the relatives of the clients. Relatives are often strongly involved in the care process and the visit by the care worker may be valuable time they can use for themselves. Thus, the aforementioned advantages of the notification feature may also apply to informal carers, easing their stress and burden. As the focus of this project is on older people and professional staff, the CCWS did not further deliberate over the implications for informal carers.

### 7.3.3 Expected Benefits for Care Workers/Employees and Service Organization

As a major benefit for care workers and employees of the information service, CCWS participants mentioned that the notification feature would **ease the burden for care workers**. Usually the care workers or the employees planning the shifts of Johanniter Innsbruck and SLGR have to inform their clients about a delay or earlier arrival. As changes in the schedule happen quite often, these calls may have to be placed several times a day. The situation becomes more stressful and time-consuming for care workers when they cannot

reach the client on the first call (if the receiver has not been hung up properly it may be even more difficult to inform the clients). Furthermore, care workers at SLGR, who can be directly reached by their clients for requests, could be relieved if CARU takes over the task of notifying about the arrival time. The notification feature may thus actually **reduce the number of phone calls for care workers** and therefore free resources for other duties.

Another advantage of the notification feature that the CCWS participants came up with was the **improved consistency of notification** for all clients. This would involve equal treatment for all clients and less individual approaches when it comes to informing the client about the arrival time. A consistent approach would hence level the varying expectations from clients. To give an example, care workers at Johanniter Innsbruck are asked to call their clients only if they expect a delay of more than half an hour. However, some care workers inform their clients even in case of shorter delays shaping the expectations of clients to be notified in any case. The notification feature could solve this problem, as **care workers would be no longer responsible for informing their clients personally about delays** which also contributes to decrease their workload.

The notification feature could possibly provide another advantage for care workers as it **reduces their pressure to justify delays**. Care workers of Johanniter Innsbruck mentioned that they often had to explain to their clients why they were running late. The feature could increase their credibility with clients but also with their employer as they can refer to the location tracking system, including traffic data, in case they have to report greater delays.

Moreover, CCWS participants expected **greater acceptance for delayed arrivals** of care workers on the part of clients. They supposed that the clients' possibility to ask CARU about the arrival time would increase their understanding for time deferrals as long as they are kept informed. CCWS participants particularly mentioned a group of users who are regularly complaining about late arrivals and might be less reproachful when starting to use the feature.

CCWS participants of bonacasa (CH) saw the greatest benefit of the notification feature in **improved coordination between clients and the concierge**. At present, the concierge has regular attendance (e.g. Wednesday afternoons) and follows a time schedule. During these work hours, residents can also call the concierge for spontaneous requests (e.g. changing a light bulb). However, in many cases the concierge is not available as they are busy with other residents and the caller does not know when they can reach the service. Participants therefore suggested combining the notification feature and the communication feature with the aim of informing the residents through CARU about the concierge's current availability and free time slots.

If the feature lives up to its promises, the care organization could benefit from **increased client and employee satisfaction**. Savings on phone calls with clients in case of a delay or earlier arrival may lead to a reduction in administrative tasks and to an increase in resources for other activities. If the notification feature **takes**

**pressure off** care workers and thus contributes to better job satisfaction, this could have a positive impact on the quality of care and may increase satisfaction for both clients and their care workers.

## 7.4 User Requirements for the Voice-Assisted Notification Feature

Participants had certain expectations for the functionality of the feature and its potential to meet different needs of end-users. Table 5 summarizes the main user requirements for the new CARU cares notification feature.

Table 5: User Requirements for the CARU notification feature

USER REQUIREMENT CATEGORIES [CARU notification feature]	USER REQUIREMENTS
No extra work/pressure for care and service staff	- Automatic notification of a delay or earlier arrival
Reliability of the feature	- Predictions of arrival time need to be accurate within a certain expected time range (e.g. one hour)
Allow care worker flexibility	- Consider an appropriate buffer and predict a time range
Additional information	- Include the date and the day of the week

Participants highlighted the need for **automatic notification in case of delayed or earlier arrival**. Besides a notification of arrival time upon request (e.g. “CARU, when are the Johanniter coming”), they proposed informing the users automatically about certain changes. However, the automatic notification feature needs to work gently in order not to frighten clients. Therefore, it could be helpful to use light output and sound output (e.g. bell tone) in order to prepare the client for the announcement. In addition, this would allow them the possibility to have time for approaching CARU and listening to the message if they are in another room. CCWS participants were also aware of the fact that an automatic notification feature would bear a **risk of information overload and excessive notifications**. As a way to address this problem, they proposed a solution that can be personalized. Hence, users could decide under which conditions they want to receive an automatic notification (e.g. delays of more than 30 minutes) or if they prefer a notification upon request.

A quite important issue for care workers is to **keep a certain time flexibility** when it comes to the prediction of arrival time and scheduling of breaks. Care workers want to avoid stress and accusations or disappointment by clients in case the actual arrival time differs from the announced arrival time. CCWS participants therefore suggested to **consider an appropriate buffer and the prediction of a time range** instead of a specific point in time. Similarly, Johanniter care workers mentioned the need for a certain flexibility for break times during

the day. They are obliged to take a break of 30 minutes if their shift lasts longer than six hours. Although their break is scheduled in their shift plan, they can decide themselves if they want to postpone it for later and if they want to split it into several shorter breaks (e.g. 3 x 10 minutes). Additionally, it might occur that care workers have kept their working time below the 6-hour threshold and do not take a break at all. Other circumstances that require care workers' flexibility and need to be taken into account are events of spontaneous rescheduling due to absences of colleagues or urgent needs of clients. Care workers and service staff may plan ad-hoc visits by themselves that are not simultaneously scheduled by the planning software and are therefore difficult to predict.

The **reliability of the notification features** is a central requirement for care workers as they have to trust the accuracy of the notification feature. For some care workers, it seemed to be quite difficult to let the notification of delayed or earlier arrival time out of their hands. Several participants expressed their need for controlling the sending and updating of notifications. They suggested to integrate an option for sending voice messages to their clients in case of unforeseen occurrences and spontaneous changes of plans. Additionally, participants suggested an option for controlling the receipt of the notification. In any case, care workers want to make sure that their clients are informed and do not wait anxiously or impatiently for the visit.

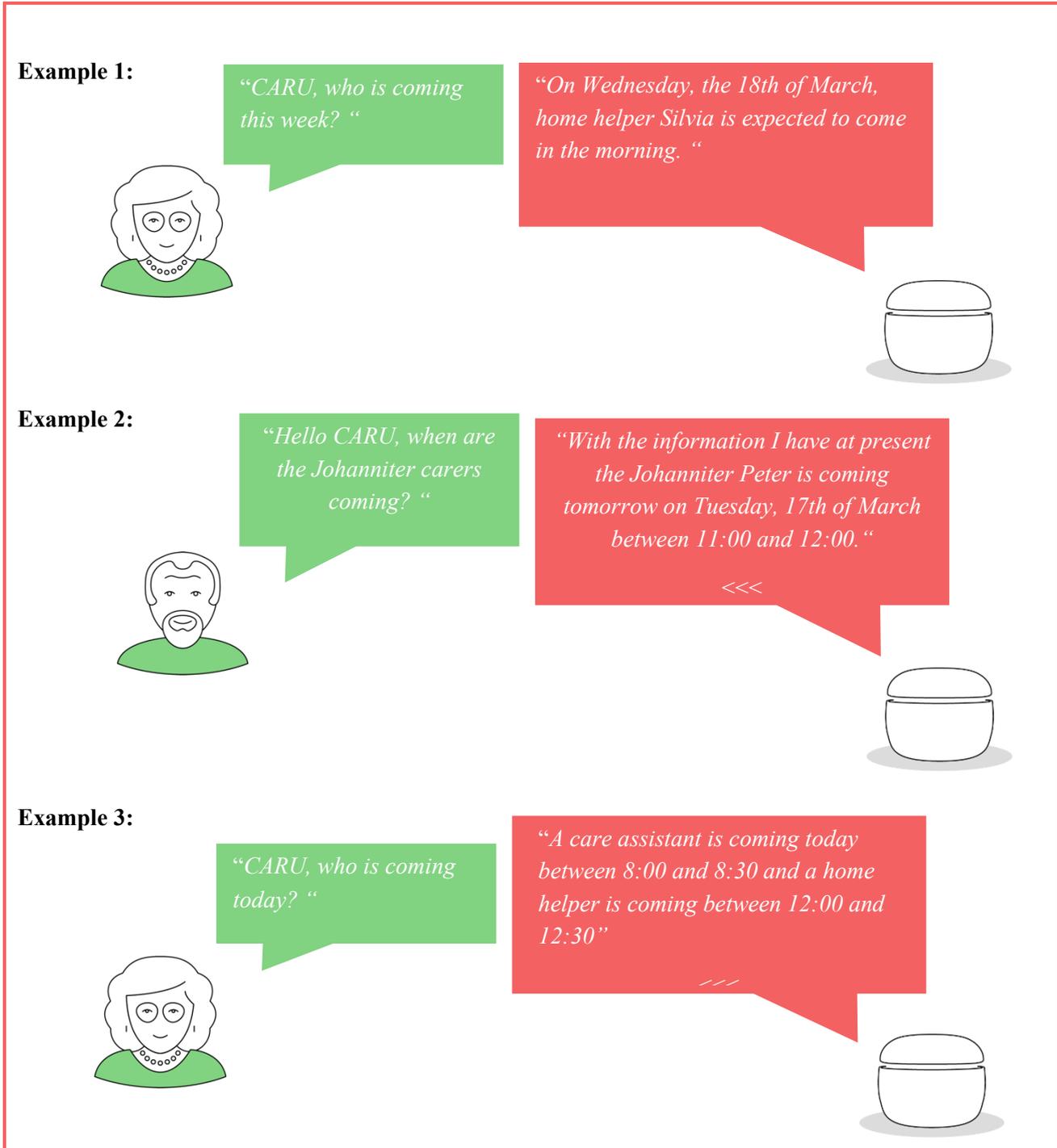
Participants came up with different notions of **additional information** that might be useful along with the notification of the arrival time. It seemed essential for most participants to include a certain time specification of the day, such as the day of the week and the date of the day (e.g. tomorrow on Wednesday, 26<sup>th</sup> of March). Participants were unsure if the name of the care worker should be mentioned by CARU. While some participants thought it would help clients to know whom they can expect, others worried that this information could result in special request from clients who are not satisfied with the person assigned. Another piece of information that might be of interest for clients, however, is the transport mode of the care worker. Care workers of Johanniter Innsbruck mentioned that their clients planned different activities depending on whether the care workers arrive by car or public transport. Having certain information in advance could facilitate the preparation for clients.

## 7.5 Useful Ideas for the Interaction between CARU and the Users in General

During the co-creation sessions, participants were asked to think of possible scenarios with respect to the notification arrival time and to create some dialogues between end-users and CARU. The examples shown below reflect three scenarios with different accuracy levels depending on the time of request. The user (speech bubbles on the left) triggers CARU with a question and CARU (speech bubbles on the right) gives an answer. The information on arrival time provides different details (e.g. name of care worker, day of the week and date), reflecting various ideas from the participants. In the first example, the user wants to be informed about the forthcoming visits that week. The second example refers to a more open question on

arrival time. The third example refers to a user-system interaction for the day of the visit and considers two home care visits.

Figure 3: Examples for the interaction with CARU



## 7.6 Further Lessons for Technical Development and Implementation

We can draw several conclusions from the findings of the CCWS and co-creation interviews that are relevant for the technical development and implementation of the notification feature.

Firstly, different **organizational conditions** in all three end-user organizations have **to be considered** for successful implementation of the feature. More information is needed on the availability of **central digital planning software** and an **interface for data query** at SLGR. According to the information at present, different planning tools are used for different home care services, i.e. simple excel sheets for scheduling nursing care services and a digital tool for other home care services. Thus, the success of the implementation of the feature depends on the current infrastructure and planning tools used within the organizations. The notification feature cannot cover all home care services offered by an organization if there is no common pool data interface.

Secondly, **dynamic updates of daily schedules** may be challenging for the successful implementation of the feature. Schedule updates happen daily and are not always registered by the software. Developers need to be aware of these scenarios.

Thirdly, it is important to **be aware of differing target groups** facing home care settings in Belgium and Austria and an assisted living facility setting in Switzerland. Home care clients of SLGR (BE) and Johanniter Innsbruck (AT) usually receive regular care services and are often confronted with uncertainty with respect to the arrival time of the care worker. Residents of bonacasa (CH) have the possibility to order small services on demand or during attendance time of the concierge. As the concierge is only one responsible for a certain apartment complex, delayed arrivals usually do not occur. Thus, further discussions are necessary with regard to usefulness and application area of the feature at bonacasa.

Fourth, in consideration of care workers' needs it is important **to maintain a minimum time frame** (+/- 30 min), despite a precise forecasting option. A greater time buffer allows care workers to keep spontaneous break time and may increase their feelings of trust in the reliability of the feature.

Fifth, when using **real-time location data**, developers need to be aware that location movements may have different interpretations. They do not necessarily indicate an approach to the next client. Care workers sometimes go shopping with the client. Using GPS data, this movement should therefore not be mistaken for a ride to the next client.

## 8 Results of the Co-Creation Activities for CARU Documentation

Care documentation is an essential part of home care practice that involves high administrative workloads and as a result, care workers attributed a lot of potential to the planned voice-assisted care documentation feature. However, it also seems to be a challenging feature, as care documentation comprises many topics and developing such a voice-assisted feature requires a deep understanding of the documentation practices to find technical solutions that can be successfully integrated into the daily routines of care workers.

The next subsections provide a general overview (8.1) of the care documentation structure, describe the basic idea of the feature (8.2) and give insights into the care documentation practices of the end-user organizations involved in the project (8.3). Then, the expected benefits of the voice-assisted care documentation feature (8.4) are discussed. The sections on user requirements is divided into general user requirements (8.5) and user requirements for specific topics of the feature (8.6). Some useful ideas for the feature are collected in 8.7. Finally, in subsection 8.8, the most relevant aspects are considered with respect to technical development and implementation during the project.

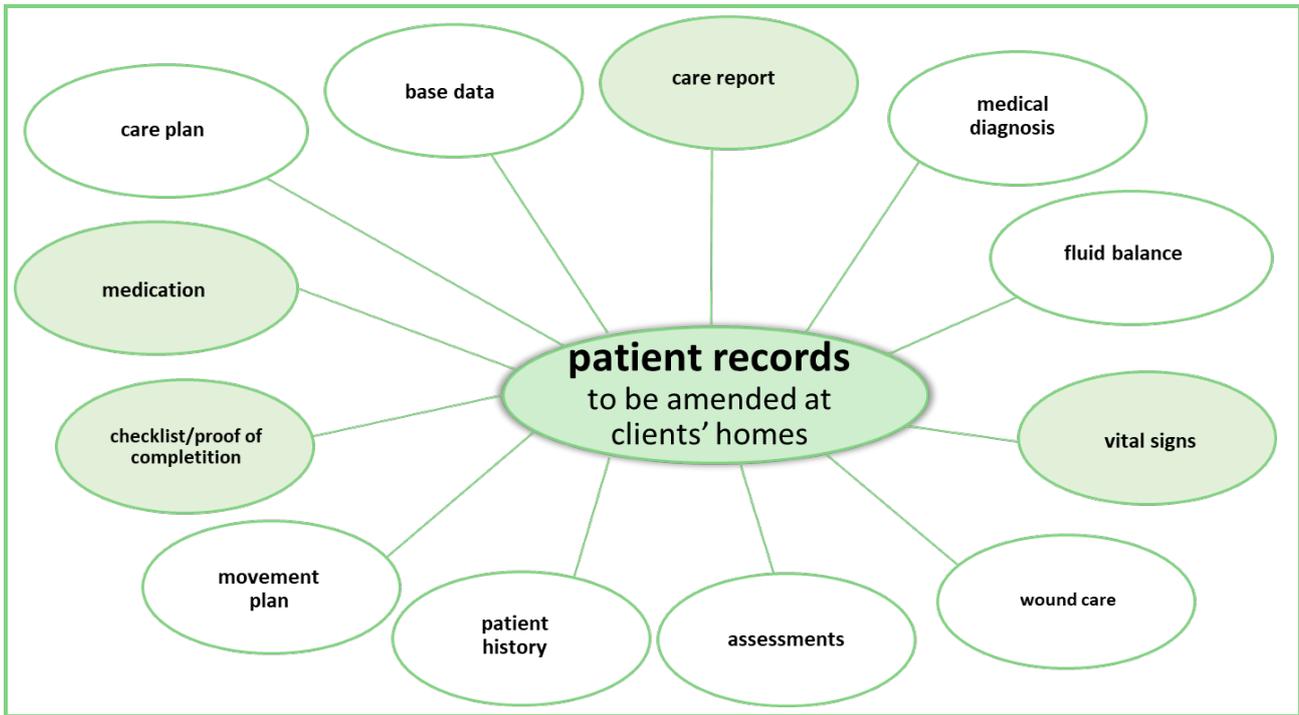
### 8.1 Care Documentation – an Overview

Care documentation is a comprehensive field that ranges from assessment and planning to implementation and evaluation. One of the main purposes of care documentation is to ensure quality and continuity of care through systematic documentation of client characteristics, care processes, and results. It covers the assessment of the client, care planning, implementation of interventions and continuous evaluation of the results (Gjevjon and Hellesø, 2010).

For the co-creation activities, several parts of care documentation were preselected that refer to the implementation of interventions and are thus most frequently used by care workers in the homes of their clients. This comprises the list of carers' tasks, the care report, the vital sign records, and documentation of medicine administration. Wound care was not considered as it usually requires pictures of the wound to assess the situation correctly. A conversational interface alone, such as CARU's, seemed insufficient to record and exchange information about wounds.

Figure 3 illustrates the scope of the care documentation and highlights the four parts of patient records relevant for the co-creation activities.

Figure 4: Care documentation individual parts of patient records:



Notes: shaded areas indicate the parts of the patient records relevant for the CCWS

The **list of professional carers' tasks** comprises all interventions that have to be completed by the care workers on a visit. It usually involves tasks grouped into categories (main and subcategories that provide more details on the task). After completing their tasks, care workers have to check off every single intervention on their device.

Any remarks or reasons for not performing a task usually have to be documented separately in the **care report**. The care report also contains information on any deviations from the care plan (e.g. ad-hoc interventions), exceptional occurrences (e.g. falls, pain) and other observations with respect to the physical/psychological condition of a client. The care report is usually written in the care workers own words, without formal structure.

The **vital sign documentation** covers data on basic functions of a person, such as pulse rate, blood pressure, insulin level, etc.

**Medicine management** involves prescription, preparation, administration, control (of narcotics) and storage of drug. Based on a medication list, the prescribed medication is prepared in dispensing aids by nurses dispensing medication for the week/day and handed over to the client for administration or delegated administration to care assistants. Lower skilled care workers are only allowed to remind clients to take their medicines or help them to remove the drugs from the dispenser.

## 8.2 Basic Concept of the Voice-Assisted Care Documentation Feature

The basic idea of the CARU care documentation feature is to simplify the care documentation process using voice control to report daily care activities. A voice recognition (VR) tool and a speech-to-text (STT) function should enable care workers to document their tasks via speech, interfacing directly with the electronic care software. Entries are confirmed by CARU via light, sound, or voice output. The feature aims to improve the quality of care by making sure that all interventions are implemented and documented successfully. It intends to support the care worker in the process of data entry; however, it does not aim to replace the existing care documentation tool.

## 8.3 Organizational Differences Related to Care Documentation

This section describes the different documentation practices and care documentation tools used by the end-user partners of the “CARU cares” project. As the staff of bonacasa mainly uses documentation for time logging, focus lies on the two home care organizations SLGR (BE) and Johanniter Innsbruck (AT) that are most relevant for the feature (see table 7). Results of the co-creation activities, however, also include contributions from concierges or care workers from different service providers.

Table 6: Documentation characteristics of the two home care organizations

Documentation characteristics	 Johanniter Innsbruck	 Senior Living Group	 bonacasa
Software/tool used	Grips MOCCA	ORBIT	-
Mobile devices	All care workers are provided with a smartphone and use the same software	Only nurses and specialized nurses can access the software using tablets.  Other care workers need to document in notebooks	-
Tools for information sharing	Paper notebook at client’s home E-Mail Phone	notebook at client’s home Messaging App “Siilo”	-

### 8.3.1 Documentation Software and Tools

At Johanniter Innsbruck (AT), Grips is the electronic care software used for care documentation and MOCCA is used for general care planning. Both software programs are provided by RECOM and are closely interlinked as the interventions entered in MOCCA are automatically transferred to Grips. All care workers are provided with smartphones and thus have access to the same documentation tool. The structure of the

care document involves about 9 to 10 different tabs according to different categories of care activities (such as control of vital signs, measurement of blood sugar, personal hygiene, etc.).

At SLGR (BE), an electronic care documentation software called ORBIT is used for care documentation purposes. Nurses and specialized nurses from SLGR have tablets in order to log in to ORBIT with a certain security number (RIZIV-number). They usually document at the client's place after the care tasks have been completed and often add more detailed documentation in the afternoon.

However, not all professional groups of SLGR have access to this documentation software. Family care workers ("Gezinszorg") and cleaning services are not provided with tablets and instead use paper notebooks available at the client's place.

### **8.3.2 Tools for Information Sharing**

At Johanniter Innsbruck, unusual occurrences and important details are documented in the care report and additionally shared via handover emails, available to all colleagues at the end of a shift to make sure that everyone is up to date. In certain situations, care workers also call colleagues to inform them about client-specific issues.

At SLGR, an app, called Siilo, is used for internal communication (although not for sensitive data sharing). Again, this app is only accessible to nurses and specialized nurses. Thus, in order to make sure that important information is shared among all colleagues, professional care workers also use paper notebooks as a parallel tool of documentation.

## **8.4 Expected Benefits of the Voice-Assisted Care Documentation Feature**

Although the voice-assisted documentation feature focuses on the improvement of the documentation practices carried out by care workers, participants of the co-creation activities also came up with several benefits for clients.

The table below displays the expected benefits of the feature for clients/residents and for care workers and their service providers.

Table 7: Expected benefits of the voice-assisted care documentation feature for end-users

	Clients/residents	Care workers/ Service provider
Expected benefits [CARU care documentation]	<ul style="list-style-type: none"> <li>- Self-documentation and administration of vital signs check</li> <li>- Increased transparency and higher involvement in care documentation process</li> <li>- Quick access to important data in emergencies</li> <li>- Comprehensive care documentation – all data are stored in the care software</li> </ul>	<ul style="list-style-type: none"> <li>- Enhanced quality of care through better data entry and data availability</li> <li>- Time saving due to simplified documentation process</li> <li>- Spontaneous hands-free documentation and better task-management</li> <li>- Speech-supported notes</li> <li>- Access to a central care documentation for all professional groups</li> <li>- Reduction of duplicate documentation</li> <li>- Improvement in interdisciplinary documentation</li> <li>- Improved medication management</li> </ul>

### 8.4.1 Expected Benefits for Clients

Care workers saw a major advantage of CARU’s documentation feature for clients in **supporting them to record certain health-related parameters on their own**. Several clients who are still capable doing so on their own need to keep records of certain body and vital sign measurements (such as blood pressure and pulse, insulin level, body weight, etc.). In most cases, they write these values down in a notebook. However, keeping records on a regular basis is challenging for many clients. Participants mentioned that CARU could assist clients in **recording and measuring vital signs**. This could simplify the process of self-documentation for clients, as they just have to speak to CARU to enter the values. In addition, CARU could remind clients to record their vital sign information. Thus, such a feature could lead to more complete and regular vital sign records.

Another potential benefit in the context of self-documentation refers to the possibility for encouraging clients to answer certain health-related questions asked by CARU (e.g. “How are you today?” “Are you in pain?”) to check in with the patient and determine their health condition. Care workers appreciated the idea that clients could save personal information on their health condition autonomously with the support of CARU. However, the acceptance of such a device asking personal questions has to be tested.

Another potential major benefit of a voice-controlled documentation feature referred to the **increased transparency in the care documentation process**. Clients would get more involved in the documentation practices as they can listen to what the care worker is reporting to CARU. Thus, they may become more aware of what has been done and can prove and acknowledge the documentation of completed care activities. It would give clients more control over documentation and over accurate financial compensation resulting from the documented interventions. A voice-controlled documentation practice may also lead to a better understanding of clients of the documentation task because they would notice what information is being documented. Care workers reported that some clients have little patience with them typing the care activities

into their phones not knowing what they are recording about them. Using CARU instead could provide more insight for clients and acceptance of the documentation practice.

One potential advantage of CARU's documentation feature is the access to important data in case of an emergency. Besides using CARU for the purpose of care documentation, care workers also imagined that CARU could **provide quick access to relevant parts of the documentation history of the client**. Thus, doctors or any other professionals could ask CARU for certain information in order to respond swiftly and correctly to a certain emergency for the benefit of the clients.

Care workers remarked that clients could benefit from **comprehensive care documentation** storing all data relevant for the care procedures in the care software. This would make parallel documentation systems (e.g. use of paper notebooks) redundant and ensure that no important information is overlooked.

#### 8.4.2 Expected Benefits for Care Workers/Service Organizations

Care workers and service providers expected to see an advantage in the documentation feature due to **better data availability and data entry** leading to an **enhanced quality of care**. They supposed that CARU would make relevant data available informing the care workers about certain particularities they need to consider or certain interventions that have not been implemented during the last visit and need to be done. Obtaining a care status report on demand would therefore give care workers the ability to retrieve important information on past interventions. Voice-assisted and systematic data entry implies more certainty for the care workers about the completeness of documentation. This again would ensure that care workers could rely on the data entries of their colleagues. Better data availability and entry would therefore make it easier to identify interventions that contributed to certain outcomes of the client and thus improve quality of care.

The time-consuming nature of recording care activities is another issue that participants expected CARU to address. They wished to **spend less time on the documentation process** while still meeting the necessary documentation requirements. This would mean that care workers could record all information smoothly without having to switch between various categories of data entry as the information is automatically assigned to the correct parts of the report. Care workers of Johanniter reported that their care software provides many different tabs that needed to be filled with information. They expected the voice-controlled documentation feature to thus make the documentation process less complicated and more productive. Similarly, care managers expected the documentation feature to reduce the workload for their employees as they have to struggle less with the documentation process. This, in turn, would correlate with increased client satisfaction.

Another potential benefit mentioned by the participants referred to a **spontaneous voice-controlled documentation** resulting in **better task management**. Care workers appreciated the voice-controlled tool enabling them to document right after the implementation of certain interventions. This would be particularly

helpful for wound treatment or measurements (e.g. of blood pressure or insulin levels) as care workers would not have to take off their gloves for entering the data into their mobile phones/tablets but can stay with the client using voice-inputs instead. Further, care workers remarked that voice-assisted documentation would enable them to be more available for their clients during the documentation process as they need to spend less time looking into their mobile devices.

Similarly, **speech-supported notes** were another expected advantage of a voice-controlled care documentation that participants came up with during the co-creation activities. They considered it useful to record certain observations and thoughts right at the moment without trying to memorize them until they had finished the care activities. Thus, the documentation feature could reduce the cognitive workload of care workers allowing them to concentrate on the workflow putting the client to the center of the care process.

Participants also expected CARU's documentation feature to provide **access for all professional groups to one central care documentation database**. This would have the advantage of improving interdisciplinary documentation and reducing multiple documentation. As an example, participants of SLGR mentioned that not all care staff involved in the care process of a client have access to the main documentation software used by the organization. This currently results in using different documentation tools that are not necessarily coordinated, leading to double documentation and possibly loss of information. Providing access to one central software for all would ensure that all professional groups are sharing the same level of information and can thus better contribute to the actual needs of the client.

Participants particularly recognized potential benefits for the **medication management** in terms of **increased efficiency and reliability**. They imagined that a voice-assisted system of medication management would help them focus on the preparation of the medication without getting distracted reading the specifications (prescriptions) on their mobile phone. They imagined that they only have to listen to CARU announcing medication and drug doses and simultaneously prepare the dispenser for the clients.

## 8.5 General User Requirements for the Voice-Assisted Care Documentation Feature

In order to meet the different needs of end-users, several categories of user requirements were identified that refer to the use of a voice-assisted documentation feature in general. More specific user requirements that refer to individual application areas of the feature are discussed in chapter 9.6. Table 9 summarizes the main user requirements for the CARU documentation feature, followed by a more detailed explanation.

Table 8: General user requirements for the voice-assisted care documentation feature

USER REQUIREMENT CATEGORIES [care documentation]	USER REQUIREMENTS
Ease of use and clear guidance	<ul style="list-style-type: none"> <li>- Easy voice commands</li> <li>- Clear documentation structure and easy menu navigation to prevent from over-documentation</li> <li>- Repetition of voice announcements at demand</li> </ul>
Reliable functionality even under difficult conditions	<ul style="list-style-type: none"> <li>- Dialect recognition &amp; mumbled speech (AT, CH)</li> <li>- Dealing with possible sources of interference (e.g. disturbing relatives, ambient noise...)</li> <li>- Control options of STT (on smartphone/tablet)</li> <li>- Fast troubleshooting in case of technical issues</li> </ul>
Adequate handling of sensitive data	<ul style="list-style-type: none"> <li>- Maintaining an option for written documentation</li> <li>- Supporting the use of professional expressions</li> </ul>
Retrieval of client history data	<ul style="list-style-type: none"> <li>- Availability of all relevant data</li> <li>- Obtain access to client history data on demand</li> </ul>
Different levels of access rights	<ul style="list-style-type: none"> <li>- Predefined and differentiated access levels</li> <li>- Ensuring data security and privacy protection</li> </ul>
Link to existing software/tools	<ul style="list-style-type: none"> <li>- Smooth collaboration between software tools already used and CARU (regular synchronization)</li> </ul>

For the voice-assisted documentation feature to be user friendly, participants indicated their need for **easy-to-use and clear guidance** during the process of documentation. A clear documentation structure combined with easy menu navigation would help them complete the documentation with little effort. Participants requested easy and intuitive voice commands and feedback from the device if they forgot to enter certain data or need to be informed about the status of documentation. Clear and simple instructions are necessary to help users to navigate the software. Currently, care workers of Johanniter often experience that they are prevented from navigating to a new tab, but are not informed about the reason. Simple usage of the feature would also involve less effort in training and simplify the learning curve for new users.

**Reliable functionality** seemed to be another major requirement for care workers and care managers to accept the feature as they want to avoid any system problems (additional to the current software problems) interfering with client care. They pointed out that the integrated voice recognition needs to deal with different dialects and limited familiarity with the language spoken in the region, as care workers often have different linguistic backgrounds. Another issue that needs to be taken into account concerns possible sources of interference that might affect voice recognition, such as ambient noise. Also interacting with clients could be

distracting for care workers trying to record their own speech without being interrupted. To make sure the data entered is correct, care workers have therefore proposed a **visual control option** in form of speech-to-text (STT) on their mobile work tool (smartphone/tablet). Participants also requested fast troubleshooting in case of technical issues given the sensitive area of health-related data.

The potential use of a voice-controlled documentation also raised the issue of **adequate handling of sensitive data documentation** that refers to observations of the client’s behavior (e.g. client seemed aggressive, was drunk, etc.). Some participants feared that talking to CARU in front of the client could be offensive or aggravate a certain situation. They suggested maintaining the option of written documentation. Other care professionals, however, pointed out that as long as care workers use correct and nonjudgmental expressions or the right technical jargon this should not be an issue. CARU could thus support the use of professional expressions by checking back on some key words (see chapter 8.6.2)

An option for **retrieval of history data** was another need of care workers who expected CARU to provide access to stored client data. With the change from paper documentation to electronic documentation, care workers have less access to records of past activities. Having an option to obtain certain history data on demand can improve the flow of information and the coordination between care workers with respect to the implementation of interventions. This requirement will also be discussed in more detail with respect to specific areas of application in chapter 8.6.1 and chapter 8.6.3.

Participants highlighted the importance of **different levels of access rights** that entitle persons to enter and retrieve data depending on their function. As the care document provides different data fields for different groups of care professionals, CARU needs to make sure that each group of professionals can only access those parts of the health records relevant to their professional service. Thus, predefined and differentiated access levels that are set in accordance with their area of responsibility need to be considered. This guarantees data security, confidentiality, and privacy protection of clients.

An important aspect for the implementation of the voice-assisted care documentation feature is a **smooth collaboration between the existing software tools** of an organization and CARU. This implies good integration with the back-end systems and requires regular synchronization with the respective software.

## 8.6 User Requirements for Specific Topics of the Voice-Assisted Care Documentation

In the next subsections, user requirements for the four planned application fields that have been elaborated in the co-creation activities are discussed in detail:

- voice-assisted management of carers’ tasks (8.6.1)
- voice-assisted care report (8.6.2),

- voice-assisted entry of data on vital signs (8.6.3) and
- voice-assisted medication management (8.6.4).

These application fields refer to the four specific parts of care documentation that were the focus of the co-creation activities.

### 8.6.1 User Requirements for a Voice-Assisted Management of the Carers’ Tasks

For the voice-assisted management of carers’ tasks, not only user requirements of care workers and care managers were captured but also ideas and needs of concierges of assisted living facilities who have to document their activities after the resident visit. Table 9 shows the user requirements for the specific feature that are discussed in more detail below.

Table 9: User requirements for a voice-assisted management of the carers’ tasks

USER REQUIREMENT CATEGORIES [Checklist]	USER REQUIREMENTS
Announcement of care tasks	- CARU reads out the to-do list (CH, AT) - Adding ad hoc services (AT)
Reduced complexity & Ease of remembering	- Division of measures into main categories and subcategories - Activities of to-do list are announced gradually - User can ask for repetition/ remaining tasks
Continuous documentation	- Voice-controlled documentation of activities (CH) - Simultaneity of implementation and documentation - Small device to carry around - Option to add remarks → link to care report - Keeping option to read and check off activities on existing documentation tool (AT)
Access to previous entries	- User can ask CARU about measures performed from past visits - User can ask CARU about the last date of performance of concrete measure (e.g. hair washing)

A simple way of improving task efficiency for care workers and concierges is the **announcement of upcoming care activities** and tasks. CARU would support their work by reading out the to-do-list at the beginning of the visit. This would particularly help care workers and concierges who are new at an older person’s place or who do not regularly provide support for that client/resident. In addition, care workers also request the possibility of adding certain ad-hoc interventions that are not on the list but have been carried out anyways.

As care workers and concierges must be able to **remember the tasks read out loud**, they suggested that CARU should announce the activities in a set of steps in order to **avoid information overload and reduce complexity**. Participants could use simple commands (e.g. “CARU, next”) to ask for the next task. In addition, the tasks will be more manageable if they are divided into main categories and subcategories (e.g. “personal hygiene” as a main category involving “assistance for showering and hair washing”). Further, to ensure understandability and guarantee completeness, care staff need to have the option to ask for repetition of the remaining tasks.

Further, **continuous voice-controlled documentation of the completed tasks** would allow increased simultaneity of implementation and documentation. For care workers, simultaneous documentation, however, requires **good voice recognition despite distance** or a small mobile device that can be carried around easily. Smooth documentation of care tasks would also involve the possibility of instantly adding certain remarks or reasons for not doing the task. Care workers of Johanniter reported that this would save a lot of time as opposed to doing it separately, as their current software requires.

CARU could then automatically **link these remarks to the care report**. Concierges requested to have an automatic transfer of the activities into the corresponding excel-sheets. They expected to save 15 minutes as a result. Other participants preferred to keep the option of checking off the activities on the existing documentation tool, convinced that this is the faster way. Thus, individual choices for users for whether to record using written or spoken documentation should be considered.

**Access to previous entries** seemed to be an important requirement for care workers who often have very little information about the care process and about the interventions that have been last carried out by their colleagues. Thus, CARU could be supportive in providing access to the performed measures from past visits on demand. Similarly, care workers should be able to ask CARU about the last date of performance of concrete interventions. To give an example, care workers of Johanniter mentioned that some clients who dislike hair washing a lot, refuse the task, claiming that it has been done recently. In this case, care workers would be happy to be informed through CARU about the last performance of hair washing, knowing that clients might not say the truth or just do not remember the day.

### 8.6.2 User Requirements for a Voice-Assisted Care Report

A voice-assisted care report would serve care workers who have to enter text including different observations and remarks on the client’s health status. However, care staff who normally take hand-written notes could also benefit from this feature, as in both cases a speech-to-text (STT) program, processing speech into a text-based form, would be required. Table 11 displays the main user requirements for a voice-assisted care report.

Table 10: User requirements for a voice-assisted care report

USER REQUIREMENT CATEGORIES [Care report]	USER REQUIREMENTS
Clear navigation	<ul style="list-style-type: none"> <li>- Use of simple keywords to begin and end an entry</li> <li>- Possibility to mark the entry as important</li> <li>- Reduce complexity by separating different categories</li> </ul>
Improving quality of care records	<ul style="list-style-type: none"> <li>- Maintaining/improving professionalism</li> <li>- in voice input</li> <li>- CARU reacts to certain certain key words (CH)</li> <li>- STT with auto-correction</li> <li>- Translation of foreign language into the official language</li> </ul>
Allow for control over data entries	<ul style="list-style-type: none"> <li>- Immediate review of care report in text-based form (STT-entries)</li> <li>- Edit-option: New entries and deletion of existing ones</li> </ul>
Data link	<ul style="list-style-type: none"> <li>- Link checklist with care report</li> <li>- Automatic transfer of tasks that were not completed but need to be done next time</li> </ul>
Retrieval of past reports	<ul style="list-style-type: none"> <li>- Retrieval of specifics from previous reports</li> </ul>

A voice-assisted care report requires a **clear navigation** for users with respect to **starting, ending, or interrupting a data entry**. Thus, care workers suggested a simple key word to trigger CARU signaling the beginning or ending of the report. Additionally, they should have the option to mark those entries that are of higher priority. When developing the feature, it is important to consider different care report structures and standard templates that are currently used, depending on the group of professionals.

As already brought up in chapter 8.5, CARU could **improve the quality of care reports** by assisting users in **maintaining or even improving the professionalism of expressions used for data entry**. Although care workers are trained with regard to linguistic requirements and professional composition of care report correctly, there are major differences in quality. Participants had the idea that CARU **reacts to certain entered key words** that are judgmental, not adequate or ambiguous and prompts the care worker to edit. Although this might be more time consuming at the beginning, it could improve the use of the right wording for care workers in the long run, making care reports more consistent and comparable. For care workers with limited abilities of the language spoken in the region, an **auto-correction software** should correct the words during the process of translating speech to text. Another consideration in this context was a language translation tool to enable care workers of other nationalities using their native language when entering data via CARU. In certain cases, this could increase the comprehensibility of a care report for others.

**Control over data** is a crucial aspect as care workers are responsible and accountable for documentation and accuracy of data. Thus, care workers need to be able to review the document in a **text-based format on their**

mobile device. Further, they need an option **to edit the report if necessary**, by making new entries or correcting the existing ones and eventually accept them to become a part of the electronic care report.

In order to guarantee practicality of the specific feature, care workers would need a **direct link between the checklist and the care report** (as mentioned in the previous section). Ideally, when reviewing the care report, the remarks on the checklist have already been converted into a text-based format and transferred to the care report for final control. Additionally, the care tasks that were not completed but need to be done at the subsequent visit should be automatically transferred to the care report. Thus, all data that is relevant is gathered in the care report and retrievable for the next care worker, which leads to the last point.

As sharing information is an essential aspect of care documentation, CARU’s documentation feature should allow **retrieval of important data from past care reports**. Currently, Johanniter care workers have access to their clients’ last care report on the smartphone. Some participants, however, preferred to ask CARU about updates and get relevant information concerning their upcoming care tasks based on the remarks and specifics captured in the last care report.

### 8.6.3 User Requirements for a Voice-Assisted Entry of Data on Vital Signs

Voice-assisted entry of vital data would provide support to nurses and care assistants who are responsible for measuring and documenting vital data or to other care workers who are allowed to assist in measuring and entering data on vital signs. Besides care workers, clients could also be entitled to use the feature for self-documentation purposes. Table 12 summarizes the main user requirements for a voice-assisted entry of vital data, followed by further explanations below.

Table 11: User requirements for a voice-assisted entry of vital signs data

USER REQUIREMENT CATEGORIES [Vital signs]	USER REQUIREMENTS
Well guided data entry with control options	- Intuitive data collection - Allow for options to check data entry
Immediate and continuous documentation of vital signs	- User and care workers document vital signs directly after measurement
Retrieval of client history data	- Playback of previous entries - Access option for general practitioner, care workers, clients...
Autonomous use for clients or their relatives to avoid duplicate documentation	- Access option for clients to document certain values (e.g. blood pressure, insulin level, body weight, etc.)

Turning to the area of medical data, **reliability** becomes an even greater issue for users and thus, a **well guided data entry tool with control options** is a necessary requirement for users. The entry of vital data via

speech needs to follow an intuitive form of data collection and enable users to check data entry and allow for the correction of recorded data in case of an error. Moreover, reference values adopted by the World Health Organization (WHO) could be stored in the back end and help CARU assess correctly and asks for clarification if the entered values differ strongly.

Voice-assisted data on vital signs would support task efficiency of care workers if it enables **prompt and continuous documentation of vital signs**. Care workers would thus document the values right after measurements. Consequently, CARU could replace notebooks that are currently used in parallel to the electronic documentation software.

However, notebooks would still be necessary if care workers did not have an **option to retrieve historical data**. Thus, care workers and also general practitioners or other health professionals would require access to previous entries in order to assess the vital data collected.

In addition to care workers and other health professionals, clients who are able to monitor health-indicators on their own and their relatives can also be target groups of the documentation feature. In order to provide an **autonomous use for clients and their informal carers**, they need to have access to certain values (e.g. blood pressure, insulin level, body weight, etc.). A central tool for documenting vital signs available to all people involved would therefore avoid multiple documentation.

#### 8.6.4 User Requirements for a Voice-Assisted Medication Management

The specific topic of voice-assisted medication management concerns qualified nurses who are responsible for preparing and dispensing medication for clients. Preparation of medication is either done at the organization or directly at the client’s place, usually on a weekly and in some cases (narcotic drugs), on a daily basis. The main user requirements for voice-assisted medication management are summarized in table 13 and discussed in more detail below.

Table 12: User requirements for a voice-assisted medication management

USER REQUIREMENT CATEGORIES [Medication]	USER REQUIREMENTS
Task efficiency of medication administration	<ul style="list-style-type: none"> <li>- CARU announces all different kinds of medication (regular medication, not daily medication...)</li> <li>- CARU announces medication instructions for use on request</li> <li>- The number of drugs for each client need to be stored in the back-end system</li> <li>- Automatic update and option for adjustments</li> </ul>

Well guided medication management	<ul style="list-style-type: none"> <li>- Step-by-step medication management</li> <li>- Speech-controlled order of medication via CARU</li> <li>- List is automatically sent to the responsible doctor</li> </ul>
Error prevention	<ul style="list-style-type: none"> <li>- CARU provides a control option</li> <li>- absolute reliability of the function required</li> </ul>

Participants expected great **improvements in task efficiency of medication administration** if CARU announces the medication that needs to be prepared on a daily or weekly basis for clients. For a comprehensive use of the feature, CARU needs to be able to differentiate between regular medication and non-daily medication (e.g. only on Thursdays and Fridays). A precondition of this functionality is a direct connection between CARU and the back-end system that stores the number of drugs for each client. Further, an automatic update would enable nurses to have an overview of the remaining number of drugs.

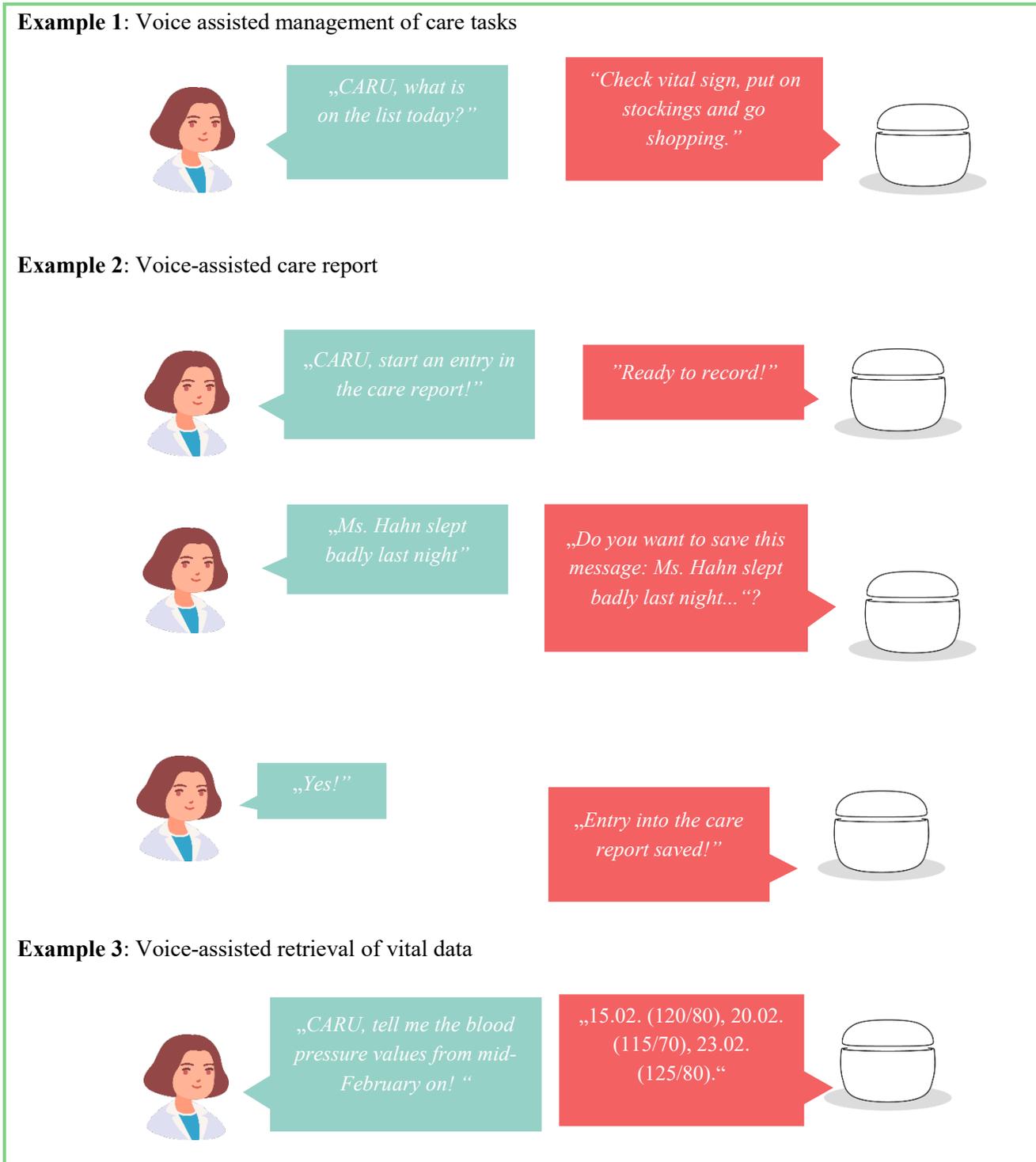
Further, a **well guided medication management** should involve an automatic update of the remaining number of drugs to provide users an overview and ease the administration of medication. Ideally, CARU would remind nurses about the next order before the medication is used up. In its further development, the feature should also provide the possibility for speech-controlled ordering of medication through CARU. Alternatively, the medication is ordered automatically by CARU sending the list of medications to the responsible general practitioner (GP) of the client.

An important requirement for users to use voice-assisted medication management is **error prevention**. Absolute reliability of the function needs to be guaranteed. Although the use of voice output already seems to reduce the sources of error, as users no longer have to check the number of drugs on their small devices, nurses, however, need to be able to control the results to ensure safe dispensing practice. Thus, CARU could provide a final overview of the medication for each day, e.g. Monday: 3 drugs for the morning, 2 drugs for noon, etc.).

## 8.7 Useful Ideas on the Interaction between CARU and Users of the Documentation Feature

Based on dialogue examples for voice-assisted documentation that were presented during the co-creation sessions, participants could create their own dialogues and add new ideas for user-friendly interaction with the software. The examples below show a selection of potential user-system dialogues referring to three application areas: voice-assisted management of care tasks, voice-assisted care report, and voice-assisted retrieval of history data.

Figure 5: Examples for the Interaction with CARU documentation



## 8.8 Further Lessons for Technical Development and Implementation

Findings from the co-creation activities show that there is a **variety of specific application fields** that could benefit from a voice-assisted documentation feature. This section focuses on those aspects that seem to support care workers the most in their daily documentation practice.

**In general**, for the voice-assisted care documentation feature to be successful and accepted by care workers and care managers, developers need to keep the following usability aspects in mind when selecting concrete functions for implementation: workflow efficiency, ease of use or work quality enhancements. This means that the documentation feature does not necessarily have to improve task completion time if it improves the ease of use of performing a certain task or increases quality of care documentation. Furthermore, when thinking of an acceleration of the documentation process or of quality improvements, the potential effects of the feature need to be considered within the comprehensive context of care documentation. As an example, a reduction in multiple documentation, improved exchange of information with other health care professionals and accurate and complete documentation entries could all contribute to a reduction in workflows and to better quality of care.

With respect to a **voice-assisted management of care tasks**, three different implementation possibilities seemed to be relevant for the project. The first possibility refers to an announcement of the *list of care activities* that need to be completed by the care staff. This would need to involve a step-by-step announcement of the tasks and an option for repeating the remaining tasks. The second implementation option refers to voice-assisted documentation of the *completed tasks*. This, however, only seems to be useful if it could be combined and automatically **linked with the care report**. It would allow care workers to document the performance of the care activities and at the same time enter remarks that concern the respective care tasks (e.g. reasons for not performing the task). Care workers would thus need a possibility to record speech notes (STT) that are transferred to the care report for subsequent text-proofing and further additions. This combination could largely improve task efficiency. Otherwise, if the feature only allows for voice-controlled documentation of the care tasks, ticking off the tasks on the mobile device would probably still be preferred. A third possibility for implementation refers to the *retrieval of client history data* for care workers to get information on the measures performed from past visits. Care workers would then be able to ask CARU about the last time a certain intervention has been implemented to make sure they are making the right decisions.

A **voice-assisted care report** that is interlinked with care task documentation could also serve as a **handover message** as it involves all relevant information including notes and remarks on the interventions that have (not) been implemented. Care workers could then listen to the message before they arrive at the patient's home. Although the functionality may be challenging in terms of voice recognition it could definitely improve communication and information flow between care workers and different care professional groups.

**Voice-assisted medication management** seems to be another promising area of application under certain conditions. Providing voice-assisted dispensing of weekly medication CARU could increase task efficiency and help to reduce sources of error and cognitive workload of care workers. It would enable nurses to focus on preparing the medication for the client while listening to the voice output. For implementing this function in Austria, it needs to be considered that the preparation of medication in dispensing aids is not done at the

client's residence but at the center of Johanniter. Thus, for testing the functionality of the feature, a device needs to be installed directly there.

**Voice-assisted entry of data on vital signs** may not only serve care workers but also clients who have to keep records of certain vital signs or body values. An implementation of the feature would provide care workers with an opportunity to try out spontaneous hands-free documentation right after measurement without the need for taking notes. Care workers would therefore better meet hygienic requirements as they no longer have to touch the screen of their working devices during the performance of care activities. The feature would also enable clients to document vital data on their own, provided that the dialogues are simple. Ideally, CARU reminds the client to measure and enter the values in order to improve frequency of measurements. This requires an individual configuration for each client using the feature. In any case, the user must have an option to confirm the value or correct it, if it was not saved correctly. For clients as users there needs to be an individual log-in option that guarantees that no other person can enter values (except for themselves and their care workers).

In general, for the implementation of any voice-assisted documentation feature, a **secure identification** feature needs to be considered that **guarantees data protection** for clients. Different access levels should enable care workers of different disciplines but also clients to access those parts of the care documentation that is relevant to them. Ideally, users only have to log in once at the beginning of the visit and do not have to repeat the login process whenever they are inactive for several minutes.

## 9 Results of the Co-Creation Activities for "CARU cares" Extended Communication

Efficient service delivery depends to a large extent on a smooth communication between clients/ residents and their care workers/ service provider organization. The CARU cares extended communication feature provides new communication options for older people in order to simplify daily communication tasks for relevant parties.

First, section 9.1 explains the background of the extended communication feature followed by a description of the different communication processes of the end-user organizations involved in the project in section 9.2. In section 9.3, expected benefits of the extended communication feature for clients/residents and for the service provider organizations are discussed. Requirements of end-users for the feature are presented in section 9.4. Finally, in section 9.5 most relevant aspects are outlined with respect to technical development and implementation during the project.

## 9.1 Basic Principle of the “CARU cares” Extended Communication Feature

Communication technologies are important for older people who want to live safely and independently in their homes and feel connected to other people. The use of (mobile) phones enables older people to stay in touch with family and friends and to call whomever they need. However, mobile communication technologies are mainly designed for younger, more able, users and still may exclude groups of older people who do not find access to modern communication tools that meet their needs and capabilities. The extended communication feature of “CARU cares” tries to enhance communication for older people by providing a low-barrier, voice-controlled tool to stay in contact and communicate with other people. Users can initiate a phone call using a keyword or answer a call with a simple voice command. In addition to direct communication, CARU also allows for indirect voice-message communication. Similar to the known messenger systems, people can post and receive asynchronous voice messages.

## 9.2 Organizational Contexts Related to Communication Processes

The three end-user organizations have different practices and routines with respect to the everyday communication processes that involve home care clients and residents. The following section focuses on the means of communication between clients/residents and their care workers/concierges, on the one hand, and between clients/residents and the main/central office/service center [of the care organization] on the other hand. Table 14 provides an overview of the main characteristics of the three end-user organizations with respect to relevant communication channels.

Table 13: Organization-Specific Context Concerning Communication Channels

Communication characteristics	 Johanniter Innsbruck	 Senior Living Group	 bonacasa
Communication with Service Line	Office hours from 7:30am – 3pm	24/7 service hotline	Service hotline from 8:00am – 5:30pm Additional: smartphone app
Typical Requests for Service Line	Cancel appointments, Ordering services, Arrival time, Billing-related issues, Shopping request	Arrival time, Complaints, Change of care worker, Cancelling/rescheduling appointments	Damage report, Ordering services, Billing-related issues
Communication between Clients and Care Workers/ Concierge	Care workers – clients Clients cannot call their care workers directly  By phone	Clients - care workers Care workers - clients  By phone (mainly), text messages	Residents – concierge Concierge – residents  By phone, in person (during attendance time)

### **9.2.1 Communication between Clients/Residents and Main/Central Office/Service Center**

At Johanniter Innsbruck, clients can call the office between 7:30am and 3pm for information and requests concerning their home care services. Between noon and 3pm calls are, however, automatically transferred to an answering machine and clients can leave a message and get a call back. Any call that reaches the office after 3pm is processed by the coordinators on the next day. Clients usually call the office to set, cancel, or reschedule an appointment. Other reasons for calling refer to questions on the arrival time of the care worker or billing-related issues. Only in very few cases do clients call the main office and ask for certain errands they need.

At the SLGR, clients can call a 24/7 hotline for concerns and requests. The main reason for clients' calls are cancellations or rescheduling an appointment. Other reasons to call the office refer to complaints about the performance of a care worker, information on the arrival time of the care worker, or requests for the change of a care worker.

bonacasa provides a service hotline and a smart phone app to its residents. Residents of bonacasa can either call the service center between 8:00 am and 5:30 pm or use the application on their smartphone or tablet in order to make a request. Using the app, they can choose among different categories in order to arrange a service, make a damage report or discuss billing-related issues.

### **9.2.2 Communication between Clients/Residents and Care Workers/Concierge**

At Johanniter Innsbruck, only care workers can initiate phone calls with their clients. In case of a request, clients can reach the office (Section 9.2.2.) but they do not have the contact details of their care workers. This protects care workers from extra work. Additionally, care workers are asked by their employer to minimize phone calls to their clients unless it is necessary (e.g. to announce greater delays) in order to avoid habituation.

At SLGR, clients have the number of their care workers and calls can be initiated from both sides. Thus, clients call their care workers directly to inform them about different concerns. This leads to a high number of calls that care workers have to deal with every day including calls that are of little importance.

Communication between bonacasa residents and the concierge happens either personally during fixed working hours (once or twice a week) or by phone. Usually, residents contact the concierge if they request support or want to make an appointment.

### 9.3 Expected Benefits of the “CARU cares” Extended Communication Feature

Table 15 provides an overview of the expected benefits of the extended communication feature for clients/residents and for the care organization that were discussed in the co-creation workshops. The following sections 9.3.1 and 9.3.2 provide more details on the listed aspects.

Table 14: Expected benefits of the extended communication feature for end-users and service providers

	Clients/Residents	Care Workers/Service Provider
Expected benefits [CARU communication feature]	<ul style="list-style-type: none"> <li>- Increased independence due to simplification of phone calls</li> <li>- Clients can resolve requests much faster via voice message</li> <li>- (e.g. order of mobile home care, transport, meals)</li> <li>- Clients can reach care workers outside office hours in urgent cases</li> <li>- Clients can reach the office via simple voice command</li> <li>- Clients can ask for spontaneous errands via voice message (shopping list)</li> <li>- STT and TTS<sup>b</sup> for sending and receiving messages</li> </ul>	<ul style="list-style-type: none"> <li>- Efficiency improvements</li> <li>- Office workers can inform clients about absence of a care worker more easily</li> <li>- Improved exchange of information among care workers</li> <li>- Easy access for all professional groups to the same communication tool</li> <li>- Unifying different communication channels in one central device</li> <li>- Medication reminder per automatic voice message</li> </ul>

Notes: <sup>b</sup> SST...speech-to-text; TTS...text-to-speech

#### 9.3.1 Benefits for Clients/Residents (Expected by Care Workers/Service Staff)

Care workers expected that (phone) **calls would be easier for their clients** using the voice-controlled “CARU cares” communication feature, which may **increase their feeling of independence**. The low-barrier use of communication technology could **simplify the organization of appointments** (e.g. hairdresser, transport service/ taxi, care organization) and reinforce independent living of older people. The voice-controlled use of the communication feature could be of particular interest for **specific user groups**, such as blind users or older people with an impairment of fine motor skills or difficulties in pressing buttons or using the keyboard of a phone.

The care workers and service staff expected the **voice message feature** to help **initiate requests much faster**. They referred to less complex requests, such as canceling or setting an appointment or ordering different kinds of services (e.g. meals on wheels, SPITEX-services) that just need to be confirmed by the person responsible. Voice messages allow clients to send a request at any time of the day.

Another advantage of the communication feature refers to the **possibility for clients to communicate with care workers** (also outside office hours) **via CARU in case of spontaneous needs**. This may increase efficiency as older people could ask for errands via voice message and care workers can do the shopping on

their way instead of stopping at the client's home and then go shopping. In addition, care workers mentioned a toilet transfer assistance upon request initiated by CARU extended communication feature that could be of advantage for the group of clients needing support going to the toilet. This could increase the quality of life of older people as the request could be passed on to all care workers in the area and be met by a care worker nearest to the client. This aspect was mentioned by care workers of Johanniter Innsbruck who are not allowed to share their phone number with clients. However, it seems that in certain cases, a direct way of communication with care workers initiated by clients would improve care activities.

### 9.3.2 Benefits for Care Workers/Service Providers

A major advantage of the communication feature mentioned by the care workers and service staff referred to **a reduction in phone calls** that have to be completed **by the service line**. This particularly relates to the voice message option that allows sending information to a person or to a group of people. The feature could be useful for bonacasa residents who do not use a smartphone and therefore do not receive push notifications sent by the service line. Participants suggested using the voice message feature to *inform the residents of an apartment complex about general matters*, such as “elevator is out of order” or “the water supply will be interrupted due to construction work between 2pm and 4pm”. Other examples included *confirmations of appointments* or of *successful payments*. Sending voice messages instead of making phone calls could be **time saving** for the responsible employees as they do not need several call attempts in case of unavailability of the client but can send or confirm a message straightaway.

Similarly, the extended communication feature could also lead to **a reduction in phone calls between clients and care workers, particularly for reminders**. This particularly refers to SLGR, where care workers and clients exchange a lot of information by phone. For instance, participants of SLGR saw an advantage in sending automatic voice messages for clients for the purpose of *medication reminders* or *appointment reminders* (e.g. doctor's appointment, hairdresser, etc.). At present, these reminder services take a lot of time as all clients who ordered the service are called personally by the care workers. Automatic voice messages could therefore increase efficiency and considerably reduce the workload of care workers.

Turning the focus on internal communication between all professional groups involved in the care process, participants of SLGR expected the extended communication feature to **consolidate different communication channels into one central device**. They stated that different care professions use different apps or communication tools leading to multiple ways of communication via various channels. Participants of SLGR highlighted the *need for a communication tool that is accessible for all professional groups*, including, for instance, family care workers and cleaning services that are currently excluded from the main communication channels. It is important to note, however, that these aspects imply a different understanding of communication that also addresses aspects of information sharing and care documentation. Thus, aspects of this issue are taken up in section 9.

Furthermore, participants suggested integrating a **speech-to-text (STT) and a text-to-speech (TTS) function for sending and receiving voice messages**. Integrating these options could increase the usability of the voice message feature, particularly for the CARU app users at the other end of the line. Receiving voice messages in text form enables care workers to quickly identify the issue and do not lose time listening to less urgent voice messages.

## 9.4 User Requirements for the “CARU cares” Extended Communication Feature

Participants had certain expectations for the functionality of the feature and its potential to meet different needs of end-users. A selection of the main user requirements of the CARU cares communication feature is provided in Table 16. The various aspects are discussed in more detail below.

*Table 15: Selected user requirements for the CARU extended communication feature*

USER REQUIREMENT CATEGORIES [extended communication]	USER REQUIREMENTS
No extra work/pressure for care and service staff	- Filter to sort calls by topic and priority - Agreements on response times
Assurance of the success of the transmission of the information	- The sender needs a confirmation of message receipt - The sender needs to be sure that all requests have been sent
Multidisciplinary use/easy access	- Easy access for all care workers and other parties
Voice-controlled phone book	- Option to store several contacts
Caller identification	- Client is informed about the caller based on contact list - Clients can decide if they want to accept the call
Quality improvements compared to existing solutions (e.g. app)	- Advantages of the feature need to outweigh practicality of Bonacasa app

Participants were aware that **the opportunity to simplify the communication channels between clients and care workers could actually result in higher workloads for care workers** and service staff due to increased calls and requests. They assumed that older people would tend to use the communication feature more often if it was very easy to use. This may refer to older people who feel lonely and have limited social contact but also to others who may change their communication habits due to higher usability of the feature. Thus, the advantages of usability for older people should not result in overburdened care workers.

In order to meet the requirements of care workers and to avoid higher pressure and overuse of the feature, participants suggested **integrating a filter into the communication feature**. A filter could help **to sort calls and messages according to topic or priority**. This requirement was particularly mentioned by participants from SLGR who have different regulations related to client communication compared to Johanniter Innsbruck (see 9.2.1) and currently already experience a high number of client calls.

So far, only the person who has access to the CARU app can check if the message has been received and if has already been read by the user of CARU. However, older people using the CARU device might also **require confirmation** in order to make sure that the message was successfully transmitted. Having **certainty about the receipt of the message** would be necessary for older people to use the voice message feature for transmitting important content, such as appointment requests or cancellations. Participants additionally mentioned that the sender might also need to have **certainty about whether all content has been sent or not**. This could possibly be solved if CARU confirms the delivery of the message. The more people feel that the communication feature does what it aims to, the more useful the feature will be for improving the communication between clients and service providers.

Furthermore, participants suggested combining the communication feature with a **voice-controlled phonebook**. Users need to have a possibility to store contacts and to manage their phonebook (e.g. adding new contacts, deleting contacts, etc.). This requirement goes hand in hand with **caller identification** for incoming calls. Participants suggested that CARU provide information on the caller, based on the individual user's phonebook. This enables users to decide whether they want to accept the call or call back later depending on the person.

Participants emphasized the need for universal access to the same communication feature for all care workers and other parties involved in the care process (**multidisciplinary use of a central communication feature**). This requirement addresses the internal communication channels and information interfaces with respect to different professional groups caring for an older person, e.g. different kinds of care services, doctors, relatives, etc. At present, information flows are restricted and not all parties have access to the same tool for exchanging information about a client. As an example, care workers at SLGR use a variety of different channels and tools to communicate with each other (Siilo, texts, e-mail, telephone), however, not all parties have access to these tools, i.e. family care workers and cleaning services are excluded from certain communication channels. Consequently, client information cannot be shared equally among the professional groups involved. In order to increase the scope of the communication feature for internal communication among professional groups, it is therefore necessary to develop a central platform and communication tool that are accessible for every entitled person involved in the care process of an older person.

Another aspect that needs to be considered in order to guarantee user satisfaction is the comparison of similar features and communication technologies that currently exist and are used by potential end-users. If end-users already use certain communication tools, they may have correspondingly high expectations for a new

feature. Thus, the communication feature (but also other features of CARU) need to focus on those **certain advantages that outweigh the practicality of the familiar communication tools**. As an example, participants mentioned the Bonacasa app that enables residents to make different kinds of requests via smartphone or tablet. The mobile application clearly simplifies communication processes for their residents; however, it may not be user-friendly for people who have difficulties using a mobile phone due to different reasons (loss of fine motor skills, eye sight, etc.). Thus, the CARU communication feature needs to focus on the aspects that are currently not covered or not satisfying by common communication technologies.

## 9.5 Further Lessons for Technical Development and Implementation

First, it is important to **define which contents are most appropriate to be shared between carer/service providers and their clients** by using the extended communication feature. The option of *direct communication* via CARU seems to be relevant between clients and main office/service line within the home care settings and between residents and service line within assisted-living facilities of Bonacasa. The option of *indirect communication* (via voice messages) might be interesting for the same areas but communication between clients and care workers in home-care settings should also be considered. In general, the use of voice messages seems to be more useful for simple communication and notifications for messages that do not necessarily need further discussion (e.g. spreading news, cancelling or confirming appointments, etc.). Direct communication, however, might be preferable to clarify more complex issues (e.g. billing-related issues, complaints, questions about the services, etc.).

Similarly, for testing the functionality of voice messages, the **target group of the CARU app (mobile app/web app)** needs to be specified. Is it only the service center that will be able to send and receive messages or will care workers also be included in the target group using the mobile app on their smart phones? In addition, will users of the CARU device only be able to receive or also send voice messages to the person/institution? However, the implementation of the feature needs to go in line with existing organizational rules and regulations regarding the communication processes. Thus, it needs to be clarified if, for example, Johanniter Innsbruck will agree on testing the mobile CARU app on their care workers' smartphones, as so far Johanniter care workers cannot be reached directly by their clients.

Further, it needs to be discussed what **options** users of the CARU device will have **for managing phone calls and voice messages** themselves. The technical development should aim at maximum autonomous usage possibilities and support solutions that enhance independent living among older people. Thus, there needs to be a simple way for users to store phone contacts and to add new contact data. For managing voice messages, the option to skip and delete voice messages directly on the device should be considered. Moreover, users need to know for how long voice messages can be stored and if they are deleted automatically after a certain time period.

## 10 Results for Additional Features of CARU

Among the great number of ideas and preferences that were collected during the co-creation activities, some more findings are presented that go beyond the basic ideas of the planned features. The suggestions are divided into ideas for an extension of the planned features and ideas for new functions of CARU.

### 10.1 Extension of Planned Features

Listing the extension of planned features, the notification feature and the communication feature were merged, as several items rather reflect the overlap of both features.

#### 10.1.1 Extension of CARU Notification and CARU Communication Feature

- **Reminder/calendar function** (e.g. doctor's appointment, medication use, mealtime, drinking, etc.)
- Notification feature **for other services** (e.g. meals on wheels, transport service)
- **Notification/announcement of general info** (e.g. elevator out of order, heat warning and drink reminder, vaccination reminder, "check your mailbox", etc.)
- **Unifying different** (already existing) **notification** functions in one device
- **Notification of presence** of concierge

#### 10.1.2 Extension of CARU Documentation

- **"How are you?"-function:** CARU asks client/resident about their personal condition based on a scale and saves the answer
- **Ordering function** for certain care supplies (e.g. hygiene articles) needed for the client or for ordering meals on wheels/menu for the next day
- **Shopping list** that can be retrieved by care workers to get the products already on the way to the client
- **Information office** providing access to **emergency contacts** or other important information

### 10.2 Ideas for New Features

This list provides a small selection of additional functionalities that were suggested by participants as useful add-ons for older people:

- **Weather information** on demand
- **Alarm function** or **motivational aid** for getting up
- **Entertainment function** (memory games, jokes, etc.)
- **Door opening function** (instead of key safe)

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