



H2H-Care

Social robot-based solution for elders' Care management and coaching after discharge from Hospital to Home

D1.1 End-user requirements and specifications



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List of acronyms

Acronym	Description
AAL	Ambient Assisted Living
TUC	Technical University of Cluj-Napoca
TLU	Tellu IoT AS
HUG	University Hospitals of Geneva
SN	Seniornett
NIS	No Isolation
FC	Formal caregivers
IC	Informal caregivers
S	Seniors
H2H	Hospital to home
WP1	Work package 1
IoT	Internet of things
ICT	Information and communication technology
y/o	Years old
IMAD	Institution genevoise de maintien à domicile (Geneva Home Care Institution)
M	Male
F	Female
n/a	Not applicable
PhD	Doctor of Philosophy
ADL	Activities of Daily Living
IIBA	The International Institute of Business Analysis
e.g.	Exempli gratia (for example)
Covid-19	Coronavirus 2019



Executive summary

As part of the WP1, titled “H2HCare Architecture, Services Co-Creation & Personalization”, the present deliverable defines the initial step necessary to achieve the task 1.1 which encompasses the analysis of end-users’ requirements and the operationalization of a transitional care model. The task will be operationalized for all project partners to be enrolled in its successful achievement. To achieve the end-user requirement analysis, it is required to define target groups, identify plausible scenarios and use-cases in relation with transitional care, and gather information to conduct end-user interviews and workshops. The result of such tasks will allow project partners to define the entire transitional care value chain and ecosystem, notably through the conduction of a network analysis. End-users’ interviews and workshops will help define a list of main functionalities of H2HCare services, but also to identify and further translate IoT based transitional care in elders into services. H2HCare services will be evaluated in terms of advantages, disadvantages and feasibility.



1 Introduction

H2HCare is a digital assistant-based system offering support and assistance for elders suffering from heart failure during their transition from hospital to home care. The project will tackle challenges (see Table 1) revolving around the following areas: care support network, recovery management, formal recovery management and healthcare processes management. H2HCare aims to solve such a challenge for multiple end-users such as seniors and informal caregivers (primary), doctors/healthcare professionals (secondary), and healthcare organizations (tertiary). To bridge the care gap of patient transition from acute setting back into the community, H2HCare will adopt a user-centred development methodology involving relevant end-users for all phases: co-design and implementation, testing and validation and business modelling. Through such a holistic approach, various services (see Table 3) would be defined throughout the development of the project.

1.1 Intended Audience

This document is of interest to all those who are affected from afar or nearby an elderly person’s heart failure. Elderly people, as well as formal or informal caregivers, doctors, insurance companies can find new ideas in this project and get an idea of whether or not it responds to their problematics. Anyone interested in innovative projects relating to digital assistants or interested in the new technologies’ contribution in a medical field, will also be interested in reading this document.

1.2 Co-design and development phase

For H2HCare, the applicability and effectiveness of existing ICT technologies and envisioned support services in case of heart failure will be determined for end-users’ groups. In order to understand end-users’ needs, wishes and priorities in relation to transitional care, the following question will be addressed: How can we adapt, develop and integrate ICT solutions to address the specific problems of the transitional care process and what is the added value brought for individual end-users?

The core functionalities of envisioned services will be individually evaluated by elderly patients, caregivers and doctors for understanding their usefulness in addressing the potential gaps of the transitional care process.

1.3 Relations to other activities

WP1 main objectives are to provide relevant information on the inherent needs of all end-users. In this work package we will look at the method of data collection, the questions-type asked but also the elements of answers that will allow us to establish and have a deep understanding of end-users’ requirements. In other words, this deliverable contains the end-user’s requirements analysis and the transitional care model operationalization. As illustrated in Figure 1 Pert diagram, WP1 is a horizontal WP supervised by WP5 (Project Management and Coordination) and WP4 (Dissemination, Exploitation & Commercialization) that are related to general and continuous management. Its activity is part of an iterative and interacting loop basically between WP2 and WP3.



Figure 1: H2HCare project Pert diagram



1.4 Document overview

The remainder of the report is organized as follows:

- Section 2 presents the end-users requirements analysis
- Section 3 shows the transitional care value chain and ecosystem with valuable results
- Section 4 presents end-users' requirements completeness and prioritization
- Section 5 concludes the deliverable



2 End-users requirements analysis

2.1 End-users identification

Three end-users groups are the target groups for H2HCare:

- Primary end-user
 - **Older adults:** Older adults with heart failure, frequent hospitalization, living independently, male or female, over 65 years old, needing care assistance to self-manage post discharge treatment and lifestyle to avoid re-hospitalization
- Secondary end-user
 - **Doctors, formal caregivers:** doctors and nurses (hospital and community) involved in transitional care of elders (post-discharge at home)
- Secondary end-user
 - **Informal caregivers:** relatives of an older adult with heart failure that help him with post discharge treatment and lifestyle to avoid re-hospitalization

2.2 Inclusion criteria

- Patients/older adults
 - ≥ 65
 - Heart failure
 - receiving home care assistance by formal and/or informal caregiver to self-manage post discharge treatment and lifestyle to avoid re-hospitalization
 - Frequent hospitalization
 - Living independently (in their own home not in nursery home)
 - Good comprehension of written and spoken local language
 - Willingness to participate in the interview by signing the informed consent form
 - For Switzerland: living in Switzerland or cross-border
 - For Norway: living in Norway
- Formal caregivers
 - min. 18 y/o
 - caregivers (nurses, healthcare assistant, ...) or doctors
 - involved in transitional care of elders (pre (hospital) and post-discharge (home care))
 - at least one year of experience
 - Good comprehension of written and spoken local language
 - Willingness to participate in the interview by signing the informed consent form
 - For Switzerland: living in Switzerland or cross-border workers
 - For Norway: living in Norway
- Informal caregivers
 - family carer, relatives
 - helping an older adult with heart failure with his post discharge treatment and lifestyle to avoid re-hospitalization
 - Good comprehension of written and spoken local language
 - Willingness to participate in the interview by signing the informed consent form
 - For Switzerland: living in Switzerland or cross-border workers
 - For Norway: living in Norway



2.3 Planning task 1.1

Table 1: planning for task 1.1

Step	Activity	Period	Deadline	Research tools/outcome	Partners
1.	Recruitment	May-August	31st August	Database with volunteers Social media Contact in the hospital Contact with home care institution	SN/HUG
2.	Video call/phone call interviews	June-August	31st august	Interview guidelines	SN/HUG
3.	Interviews analysis	August-September	15th September	Results report	SN/HUG

2.4 User involvement

Table 2: user involvement for task 1.1

Step	Switzerland (HUG)	Norway (SN)	Total
Desired interviews	minimum 5 seniors	minimum 5 seniors	minimum 10 seniors
	minimum 5 formal caregivers (HUG will try 5 doctors and 5 nurses)	no access to formal caregivers	minimum 5 formal caregivers
	minimum 5 informal caregivers	minimum 5 informal caregivers	minimum 10 informal caregivers
			minimum 25 end-users
Interviews conducted	2 seniors	6 seniors	8 seniors
	4 formal caregivers (nurses)	0 formal caregivers	4 formal caregivers
	0 informal caregivers	5 informal caregivers	5 informal caregivers
	2 experts		2 experts

This table shows the predictions we made at the beginning of the work package and what we ended up with. It's easy to observe that Norway has succeeded in following or even exceeding the expected predictions. On the other hand, Switzerland is well below what was initially estimated and has even deviated by introducing a new audience. The reason is mainly due to the lack of resources for medical stuff and seniors during the Covid-19 pandemic period.

2.4.1 Consent form

Switzerland (HUG)

The consent form will be sent by post or mail to the participants and returned to us signed before the interview. In order to save time, we can ask participants to send us a photo (via phone with the WhatsApp application or via mail) of the signed consent form to start the interview.

Norway (SN)

The consent form was sent by email to the participants. It was filled in, signed, scanned and sent back by email before the interview.



2.4.2 Financial compensation

Switzerland (HUG)

Each participant will receive a financial compensation of 50CHF for their participation in the interview. After the interview, a participation sheet will be sent to participants by mail or post. They will have to sign it and return it to us by mail or post. Once the signed sheet is received, the financial transfer can be made.

Norway (SN)

The participants took part in the interview session without any financial compensation.

2.5 Interviews

In order to define end-users' needs, a set of research questions should be addressed to understand needs, wishes and priorities in regard to transitional care. Depending on the type of questions addressed, various levels of specification will be defined.

2.5.1 Methodology

The main goal behind this methodology is to understand 1) the process of the discharge and 2) the users' needs and difficulties (for the 3 end-user groups). In order to achieve results, three types of questions have been identified:

- General questions: Global questions concerning the entire transitional care value chain. Such questions can be asked to all end-users. It aims to identify the global transitional value chain and general needs for all end-users of H2HCare.
- End-user-focused questions: Tailor-made questions for specific end-user groups. Such questions are designed to identify specific needs, wishes, and priorities for specific end-user groups. They also aim to gather information on end-user requirements in regard to the transitional care value chain. The main goal is to help project partners to gather feedback and requirements in order to start the design of the conceptual architecture in task 1.2.
- Functionalities-related questions: Tailor-made questions for specific end-user groups in order to specify predefined IoT functionalities for H2HCare services.



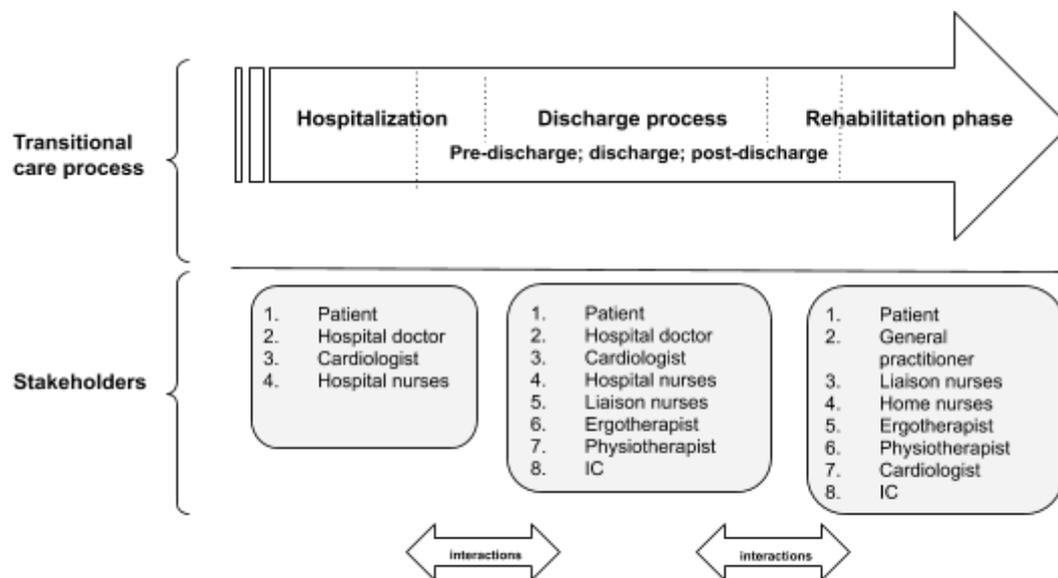
3 Transitional care value chain and ecosystem

From the initial feedback gathered from end-user interviews, a first draft of the transitional care value chain could be envisioned. At this stage, the vision on timely digital solutions for seamless coordination of care will be operationalized.

3.1 Network analysis

A network analysis considering the whole ecosystem for transitional care processes will be conducted. Following, partners will find health-related ecosystems in Switzerland and Norway based on national user experience studies.

To understand the health ecosystem involved in the transitional care process, studies were conducted with 3 groups of end-users (formal caregivers, informal caregiver, seniors) in Switzerland. Thanks to users' feedback regarding their interactions with healthcare professionals, an initial set of stakeholders involved in the transition care process has been identified (figure 2).



Stakeholders: Actors involved at different stages of the transitional care process. They are listed by order of importance in terms of involvement.

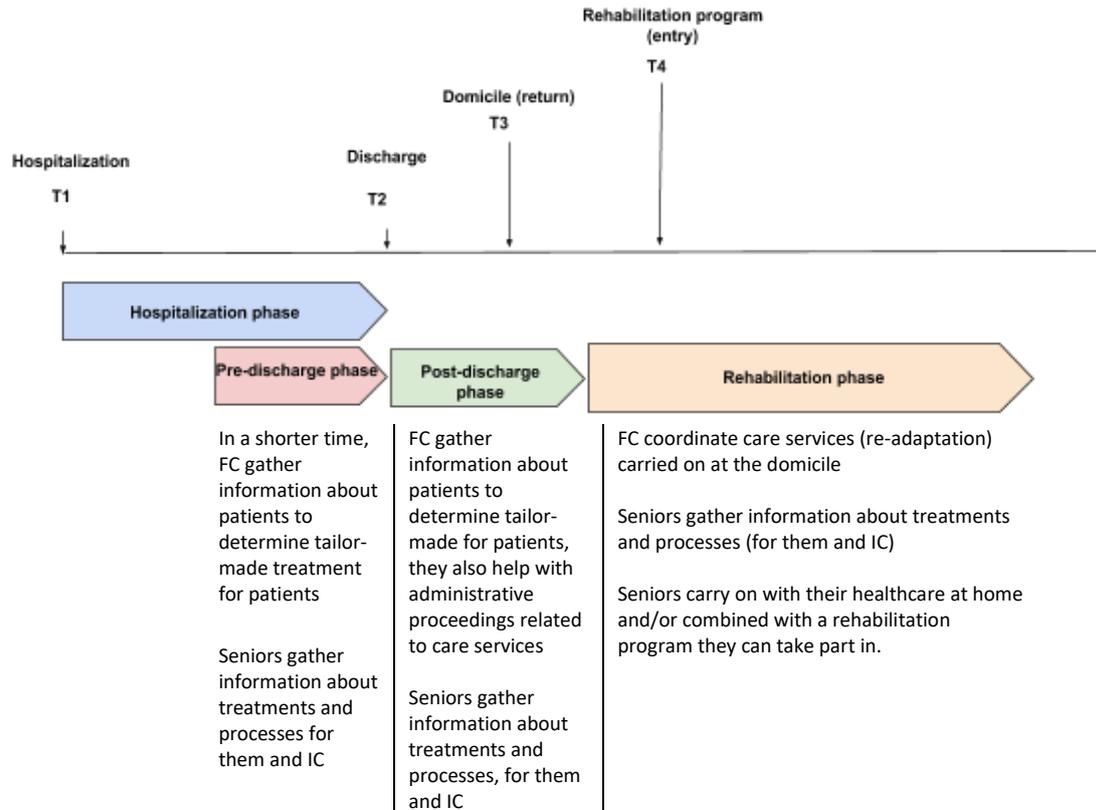
Figure 2: Stakeholders involved in the transitional care process.

The transitional care process described in Figure 2 illustrates 3 main stages: hospitalization, discharge phase, rehabilitation phase. The hospitalization represents the time during which patients are at the hospital from their initial medical procedure to their discharge. The discharge phase encompasses 3 phases: pre-discharge, discharge, post-discharge. The pre-discharge phase begins at the end of the hospitalization and ends at the patient's discharge. The discharge represents the moment patients leave the hospital. The post-discharge phase starts when patients leave the hospital and return to their domicile and/or enter a rehabilitation centre. Finally, the rehabilitation phase consists in the longer stage where patients return to their domicile and/or enter a rehabilitation centre and pursue their ongoing rehabilitation treatment.

For clarity purposes for the research project, such phases were identified in order to design a timeline associated with specific procedures (medical, administrative) and stakeholders of importance. For this reason, some phases can overlap each other as they have a short duration in time (especially, for the



discharge process). Based on users' feedback, such phases encompass various processes that gather main activities for FC/IC/seniors (see Figure 3).



T1: T1's duration depends on the heart disease

T2: The post-discharge phase is short lived (within 24h)

T3: T3's duration starts from the arrival to the patient's domicile and his entrance to a rehabilitation center (within 1-2 weeks after the discharge)

T4: T4 starts when the patient enters into a rehabilitation center. If the patient doesn't take part in a rehabilitation program, the rehabilitation phase is achieved at the domicile and is considered as the ongoing carry on with daily life management.

Figure 3: Stakeholders involved in the transitional care process and their respective activities per phases.



Following the identification of stakeholders, the ecosystem of stakeholders involved in the transitional care process in Switzerland is identified. A visual representation of this ecosystem is illustrated in Figure 4. To understand the interactions and interdependencies between such stakeholders, Figure 5 illustrates the ecosystem of stakeholders and their relations between each other.

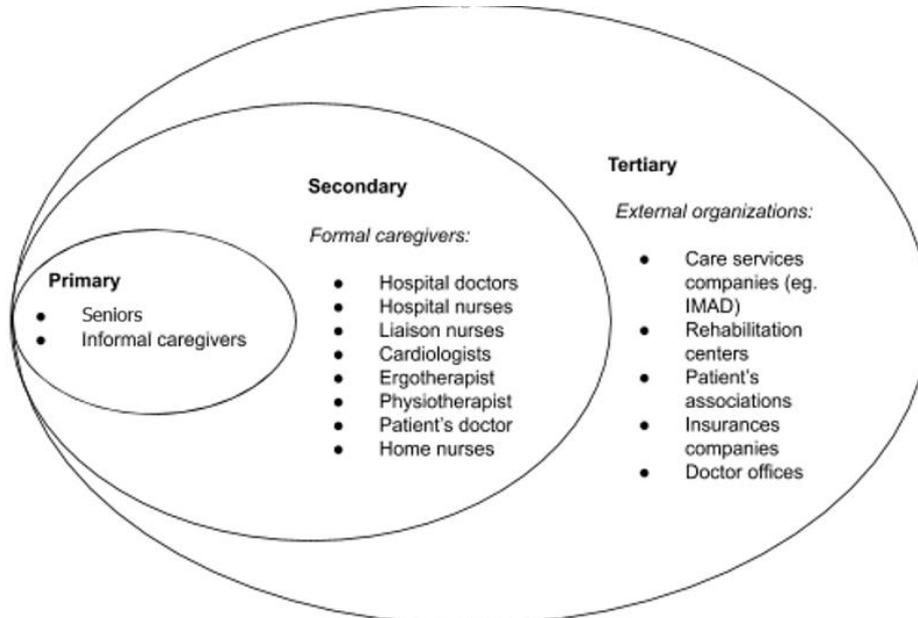


Figure 4: Stakeholders involved in the ecosystem for transitional care processes.

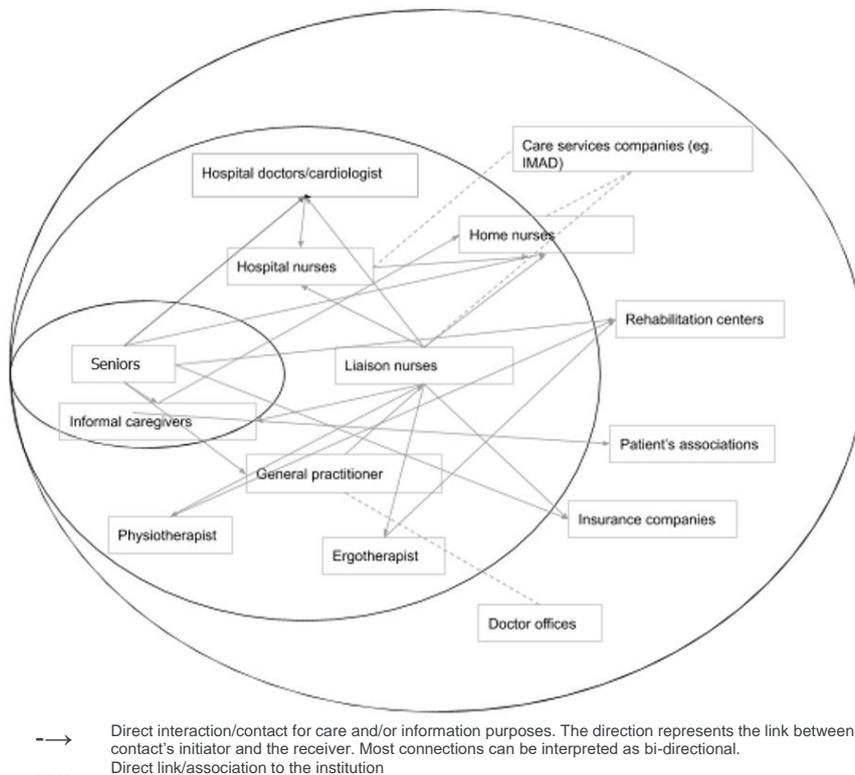


Figure 5: Ecosystem of stakeholders and their inter-relations in relation to the transitional care processes.



3.2 Needs analysis

After conducting interviews with seniors, formal caregivers, and informal caregivers, results have been identified regarding user requirements. Results are gathered in this section as follows: results from Switzerland, results from Norway, common results (summary of results from Switzerland and Norway).

3.2.1 Switzerland's results

In order to understand formal caregivers (FC), informal caregivers (IC), and seniors' needs, studies have been carried out. The following set of results have gathered all the related activities challenges/difficulties of our intended audience, without forgetting the digital assistant-based possibilities. Those results correspond to Switzerland users.

In Switzerland, 2 seniors and 4 formal carers took part in the study. The full account of participants for Switzerland is 6 for this user research. In addition, and to complete such results, HUG proceeded to bring additional inputs from 2 local experts in the health sector and innovation.

Demographics information

Table 3: Demographics information of seniors involved in Switzerland

N°	Gender	Age	Town	Country	Context of the diagnostic
1	M	75 y/o	Geneva	Switzerland	Was hospitalized 4 years ago to place a heartmate. The hospitalization for heart failure lasted 5 months (in 2016)
2	M	67 y/o	Geneva	Switzerland	In cardiac rehabilitation for more than 2 years as part of the EURECA project.

Table 4: Demographics information of formal caregivers involved in Switzerland

N°	Gender	Age	Town	Country	Institution	Function
1	M	35 y/o	Gex	France	Home care service	Nurse
2	M	>18 y/o	Geneva	Switzerland	IMAD	(liaison) Nurse
3	F	>18 y/o	Geneva	Switzerland	IMAD	(liaison) Nurse
4	F	>18 y/o	Morges	Switzerland	"La Côte" Foundation	Nurse

Table 5: Demographics information of experts involved in Switzerland

N°	Gender	Age	Town	Country	Position	Education
1	M	n/a	Geneva	Switzerland	Director of digital health and organization (IMAD)	PhD level



2	F	n/a	Geneva	Switzerland	Member of Forum Managed Care	PhD Level
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Description of formal caregivers' activities:

Table 6: Description of formal caregivers' activities in Switzerland

N°	Activities	Description of activities
1	Assessment of patients' needs (in terms of services and treatment)	<ul style="list-style-type: none"> During the discharge phase, FC gather patients' information from multiple sources (hospital doctors/nurses, patients' doctor, and other care providers) to assess patients' needs as they transition from the hospital to the domicile. FC also provide information to patients/informal carers/patients' doctors either to coordinate care services or to help them to understand care services. Following a full patient evaluation (at the discharge phase), FC gather information from the patient's doctor and hospital carers to assess patients' needs in terms of medication for the post-discharge phase.
2	Gathering of patient data	At the discharge phase, FC achieve a full patient evaluation. To this effect, they gather information about patients' vital parameters (vital/ clinical parameters). They gather such information thanks to a "transfer sheet" (parameters before hospitalisation) and hospital nurses (parameters during the hospitalisation). They collect, fact-check, and analyse data to understand patients' needs and put in place personalized services for patients' domicile.
3	Coordination of information (hospital environment - home care teams - patient care teams)	FC coordinate care services for patients. To achieve these tasks, they gather all relevant information from different parties so they can put in place appropriate care services for patients during the post-discharge phase.
4	Administrative management related to patient care	FC prepare administrative documents related to care services. Such documents are also shared with/validated by the patients' doctor. FC also provide guidance to doctors regarding official (reimbursed) care services.



Description of seniors' activities:

Table 7: Description of senior's activities in Switzerland

N°	Activities	Description of activities
1	Participation in rehabilitation programs	Seniors take part in rehabilitation programs at the hospital and/or at dedicated rehabilitation centres. During those sessions, they take part in physiotherapy and ergotherapy: they must learn again to eat, walk, etc.
2	Treatment follow-up	Seniors must strictly follow their medication treatment. This can be done individually or with the help of medication weekly planners put in place by pharmacies or liaison nurses at the hospital. Home nurses can also help with this aspect.
3	Exercises (physical) follow-up	Seniors need to carry on with physical exercises when they return to the domicile. They can need the help of physiotherapists (a couple of hours per week at the hospital).
4	Informal caregivers management	Since IC are not necessarily part of the discharge process, seniors must provide the majority of the information to support them. They must manage what information to give, as they take into consideration IC's sensitivity and ability to provide care.
5	Formal caregivers management	Seniors must carry on with weekly/monthly visits with FC (hospital doctors/nurses, cardiologists, ergo/physiotherapists, patient's doctor, home nurses) and to gather information from them.
6	Psychological monitoring (general mood, mental health)	At the discharge phase, seniors must remain stable in terms of psychological state. There is not proper follow-up after the discharge process, as they mainly have to carry on their own treatments. In terms of mental health, the post-discharge phase is challenging and no psychological support is currently in place (at hospitals, as care services at the domicile).
7	Daily life management	Seniors have to adapt to a new diet, they have to adapt their home (adapt the space, acquire tools such as a scale).
8	Information management	Seniors gather information from FC (hospital doctors/nurses, patient's doctor) on their own and make the differentiation between the various sources of information, as much as defining the relevancy of such information.



Following the definition of end-users activities (FC/seniors), results demonstrate multiple challenges/difficulties:

Description of difficulties for formal carers:

Table 8: Description of difficulties for formal carers in Switzerland

N°	Difficulties	Description of difficulties
1	Information gathering	For liaison nurses, the main challenge is to obtain patients' information (updated information, and medical background). They have to obtain norms of vital parameters (due to insurances, certain scales must be observed when leaving the hospital). They have to connect with various health professionals to gather them.
2	Communication within the healthcare system	For liaison nurses, they identify a lack of communication (or precision) within the healthcare network. Information has to be asked directly to multiple interlocutors and fact-checked due to the lack of precision of information.

Description of difficulties for seniors:

Table 9: Description of difficulties for seniors in Switzerland

N°	Difficulties	Description of difficulties
1	Physical challenges	Due to the hospitalization, patients have difficulty with mobility. This requires physiotherapy (this service is available in hospitals), multiple hours per week. When patients return to their domicile, they have difficulty carrying on with physical exercises.
2	Medication management	In the pre-discharge phase, depending on the treatment, some patients have to wait several days to stabilize their medication intake. In the post-discharge phase, seniors have to manage and remind themselves about their medication intake.
3	Psychological difficulties (e.g. feelings of loneliness)	After leaving the hospital, both seniors expressed loneliness linked to their newly found autonomy and having to face their health alone. The transition has an abrupt effect as they have to carry daily tasks on their own.
4	Healthcare follow-up	Patients report a lack of ongoing follow-up after the discharge phase, especially in terms of reinforcement of key information (about care procedures, health best practices, etc.). Seniors need health check-ups within shorter intervals of time. In terms of organisation, seniors have to schedule (and note) FC's weekly/monthly visits to follow-up with their health care. Seniors who have a specific diet need to note their nutritional intakes.
5	Informal carers management	Seniors have difficulty discussing health issues with IC. They have to manage the information provided to IC (directly by them or by hospital doctors and nurses).
6	Communication with the healthcare network	Seniors and informal caregivers have a difficulty understanding which health care stakeholders to reach out to and when.



7	Information management	Seniors and IC have a general difficulty to gather relevant information for their rehabilitation. The medical information is also difficult to comprehend for seniors and IC. There is also a lack of information reinforcement after procedures and treatments.
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Following the description of users (FC/seniors) activities and difficulties, results have been identified regarding digital assistant-based system’s possibilities.

Description of digital assistant-based possibilities for formal caregivers:

Table 10: Description of digital assistant-based possibilities for formal caregivers in Switzerland

N°	Digital assistant-based possibilities	Description of possibilities
1	Treatment follow-up (for patients)	<p>Functionalities have been identified by FC such as creating reminders to achieve tasks (medication intake, visits, etc.). The tool could also play a role of structure for daily life: having one place with all the relevant information, contacts, instructions (about treatment, daily life advice):</p> <ul style="list-style-type: none"> ● Taking physiological data (monitoring weight gain, dietary monitoring, taking blood pressure) ● Giving warning signs in the event of changes, ● Reminders to take treatment, ● Reminder to wear compression stockings, ● Reminder of important information for the senior (information previously provided by a health professional), Provide physiotherapeutic follow-up (motivate seniors with exercises), ● Have the times of waking up/sleep, ● Possibility of providing “social” support (especially for patients without caregivers), incl. coaching functionalities and the ability to answer questions to patients ● Personalized/tailor-made advices for daily life, ● Calendar functionalities (to remind patients about medical visits) ● System linked to an alarm system/number (linked to an emergency call center) <p>FC mention the need for patients to be monitored daily (especially in case of decompensation).</p>
2	Communication with the healthcare network (for patients)	<p>Offer the possibility of contacting nurses (who assesses the situation and who can coordinate care with the attending physician), or other care professionals involved in seniors’ treatment (doctors on call, cardiologists, medico-social centre coordinators or referral nurses, liaison nurses, patient’s physicians, ergotherapist/physiotherapists /dieticians, home nurses)</p>



3	Coordination and transmission of the information (within the healthcare network)	FC require a direct transmission of the information between healthcare professionals (in hospitals, rehabilitation centers, independent care professionals, doctor offices). They also need patients' medical information (medical background, past/recent treatments and reasons for interruption of treatments, updated prescriptions, updated physiological data). There are no transversal efforts in terms of coordination of information. Being able to consult rapidly such information and following care professionals' interventions (hospitalizations, medical visits, physio/ergo. visits, and home nurse visits) is of interest for FC.
4	Synchronization with current healthcare tools (digital)	FC would like a synchronization of the various systems in place (digital patient files, etc.) to gather all the information in one place. The idea would be to diminish the amount of information (and sources) to gain in efficiency and accuracy. Currently, the information present in digital systems is incomplete which forces FC to gather information from various sources of information within the healthcare network.
5	Information management	Provide clear and accessible information for seniors and IC (information about treatments, planning of care, contacts information, etc.). Provide auxiliary information linked to new found needs of seniors in the post-discharge phase (e.g. administrative procedures for the reimbursement of services such as household help). Information should be available for healthcare professionals, but also IC (both profiles should be able to consult and add information).

Description of digital assistant-based possibilities for seniors:

Table 11: Description of digital assistant-based possibilities for seniors in Switzerland

N°	Digital assistant-based possibilities	Description of possibilities
1	Treatment follow-up	The digital assistant-based system could help with medication intake, serve as a reminder to achieve physical exercises, provide recommendation for physical exercises, give access to a calendar (for visits)
2	Communication with the healthcare network	The digital assistant-based system should provide contact information about healthcare professionals, and information on who and when to contact them.
3	Psychological support	The digital assistant could offer social and psychological support, but also provide information about external sources of support (heart failure-related associations)
4	Information provider	The digital assistant could offer seniors advice to improve their daily life, but also information about treatments, medication, best practices, etc.



3.2.1.1 *Additional experts' results*

For this project's research we have interviewed a new kind of audience, who can be referred as experts. Our purpose is to discuss the seniors' transition processes between hospital and home while questioning the eventual digital assistant-based possibilities and functionalities that they would have chosen to provide it. The information collected will not be, strictly speaking, used as data but as a solution guidance.

The first thing that was pointed out by experts was the need to adapt the system for patients and for medical care services. In order to do so, the fluidity of the patients' journey has to be improved, maybe, in part, by making decisions with the patients, not for them. This is important but not enough to enhance the transition's system, we have to think beyond it.

If we really want to improve the hospital-home transition, seniors and informal caregivers need to be specifically trained to understand and integrate all the inputs coming from medical actors. Indeed, both experts recommended an educational approach for patients so they can navigate better between the various inputs they receive from the medical staff. Such approach should also concern informal caregivers, as they bring significant help to seniors. With regard to formal caregivers, they have to establish a coherent, coordinated and continuous sharing of information between the different health care structures with the aim of supporting the seniors' care.

Nevertheless, according to the experts, the real problem isn't located in the transition between hospital and home but conversely between home and hospital. For the seniors, the transition phase is to be thought continuously over the long term if we want it to be efficient. Informal caregivers are tired most of the time, they lack help, listening and appreciation. They must be included in the process because they mostly are the support interface between the medical world and the patient. Formal caregivers, for their part, often lack information about the medication intake or prescription (e.g. danger of double prescription).

Both experts interviewed in our study considered the discharge process as being part of an integrative process that should be fluid in terms of coordination between health stakeholders and in terms of communication between them and patients. Also, there has been an emphasis on the adaptation of the follow-up of initial instructions given at the discharge stage for patients. Indeed, the transition process should be considered in the long term and instructions/follow-ups should be (re)adapted in consequences to guarantee a continuum in the care of patients.

For this purpose, the experts propose to integrate a new actor in the system, who will be in charge of making and monitoring the therapeutic plan. This new actor could be a digital assistant because it can reinforce the transition process. Indeed, a digital assistant has a lot of functionalities that can be useful to ensure follow-ups and continuity of care regarding to seniors. Moreover, we notice that it can help simplifying health networks' communication. The digital assistant can store and share information with the right person. In this case, the misunderstood information by seniors and informal caregivers is supplemented by the digital assistant.

In other words, digital assistants can specifically train seniors or informal caregivers to understand medical information and can ensure a better coordination and sharing of information between health networks. According to the digital assistant's benefits, these types of machines can reinforce the feeling of confidence of the patient and the medical network. At the same time, it reinforces medical decisions made and to be made, e.g. avoiding duplication. So, to limit problems, it is necessary to set up a real partnership between the four different "audiences": the seniors, the informal caregivers, the formal caregivers and the digital assistant.



This set up will be useful in terms of coordination of actions and information between health stakeholders. Experts have reported the importance of the notion of a “clinical roadmap” that compares to the patient journey which integrates the patient's point of view. For experts, the digital assistant-based system should improve the fluidity of the patient journey and help him navigate between different health structures and *stakeholders*. Such fluidity is gained through a continuous ongoing update of information that should be shared between stakeholders. Indeed, the fragmentation of sources in the health care network can bring coordination issues so there is a strong need to increase consistency and coordination in the communication between patients and health stakeholders.

However, although the digital assistant has facilities for the transition period, the expert notices some important limitations such as: case-by-case feasibility, possibility of parameterization if addition health problems (e.g. Alzheimer), varying degree of commitment among seniors, some are resistant to change and won't accept this tool. There is the cost/benefit's limitation too and also the fear of data sharing. It should also be noted that if the patient has too many diseases, it will be too many applications for a single digital assistant. So, we have to be careful to focus the digital assistant on the patient and not on his/her diseases.

In order for the pilot project to work, it's first necessary to target users-friendly and to support the use of the digital assistant since patients are enthusiastic at the hospital but demotivated once at home. The digital assistant should not be too standardized but flexible. The tool must be calibrated in several steps and by several people. The person presenting the digital assistant must be external and be under an interested and integrated in the existing process (systemic aspects) hierarchy.

In regard to digital assistant possibilities, the two experts had a positive vision towards the functionalities offered by H2HCare - especially for monitoring aspects, recall functionalities, and coordination aspects between health stakeholders and end-users. Only the coaching functionality has been referred to as less important. The functionality of coaching seniors' motivation has been accepted by experts but not highlighted as holding strong importance. Indeed, both experts highlight the fact that such motivational aspects must be carried out by informal and formal carers to strengthen the social/human bond. However, they do view such functionality as an aspect of interest for younger populations.

They also both emphasized strongly the fact that the digital assistant-based system should offer personalized functionalities, but also that they should be of added-value for seniors and informal caregivers. Otherwise, they believe the technology will simply not be used by those end-users. There is also a notion of accessibility in terms of information/design/calibration of functionalities that experts are sensitive towards: the more the technology is easy to understand and to manipulate by seniors, the higher the chances of adoption of the product are. In their point of view, the digital assistant should also be updated in an ongoing manner to support seniors during their entire journey of recovery and ongoing adaptation to daily life.

On experts' side, the overall project has been perceived as a good proposition to facilitate the transition for seniors. Restrictions have been mentioned, notably for technological aspects (accessibility, data sharing concerns, synchronization with e-health existing platforms) and the onboarding of seniors. Overall, they believe such tools should be implemented in a coherent manner and be thought of as an incremental part of the care roadmap without being only a supplementary tool that will be abandoned by end-users later. The capacity of such digital assistant-based systems to provide better coordination between health care agents and to provide educational information about health but also about formal care procedures was strongly highlighted by both experts who view those types of functionalities as added-value solutions to answer current seniors' needs.

Nevertheless, we would like to highlight that both experts have difficulties to ideate solutions in terms of functionalities for the digital assistant-based system. This is probably due to the lack of knowledge



about the H2HCare digital assistant and similar devices in general. Such conclusion is to be taken into consideration, as interviewees had the tendency to agree to H2HCare functionalities - potentially, for a lack of better ideas.

3.2.2 Norway's results

Following the results illustrated with formal caregivers, informal caregivers, and seniors in Switzerland, similar studies have been carried on in Norway in order to understand formal caregivers (FC), informal caregivers (IC), and seniors.

For Norway, 6 seniors, 0 formal carers, and 5 informal careers took part in the study. The full account of participants for Norway is 11 for this user research.

Demographics information

Table 12: Demographics information of seniors involved in Norway

N°	Gender	Age	Town	Country	Diagnostic Context
1	M	79 y/o	Blommenholm	Norway	Pacemaker since 2014
2	M	74 y/o	Tønsberg	Norway	First hospitalized 2011 – second 2018.
3	F	69 y/o	Vega	Norway	Bypass twice
4	F	81 y/o	Kråkerøy	Norway	Hospitalized in 2008
5	M	72 y/o	Levanger	Norway	Hospitalized in 2017
6	F	76 y/o	Oslo	Norway	Heart attack twice, 2015 and 16

Table 13 Demographics information of informal caregivers involved in Norway

N°	Gender	Age	Town	Country	Relation
1	F	78 y/o	Blommenholm	Norway	Spouse
2	F	76 y/o	Tønsberg	Norway	Spouse
3	F	78 y/o	Kråkerøy	Norway	Friend living near by
4	F	72 y/o	Levanger	Norway	Spouse
5	F	77 y/o	Oslo	Norway	Friend living near by

As a result, the following set of feedbacks have been gathered: IC/seniors activities, IC/seniors challenges/difficulties/digital assistant-based possibilities.

Description of activities for informal caregivers:

Table 14: Description of activities for informal caregivers in Norway

N°	Activities	Description of activities
1	Treatment follow-up	IC assume responsibility for the medicine intake for seniors during the post-discharge phase.
2	Exercises (physical) follow-up	IC assume responsibility for the physical training of seniors in the post-discharge phase.
3	Information gathering	Ongoing gathering of information looked out or provided by the health care network.



Description of activities for seniors:

Table 15: Description of activities for seniors in Norway

N°	Activities	Description of activities
2	Treatment follow-up	Patients assume responsibility for the medicine intake during the post-discharge phase.
3	Exercises (physical) follow-up	The patient assumes responsibility for the physical training in the post-discharge phase.
5	Formal caregivers management	Patients have contacts with ADL (during working hours) or emergency hospital services.
8	Information management	Ongoing management of information looked out or provided by the health care network.

Following the definition of users' activities (FC/IC/S), results demonstrate multiple challenges/difficulties for FC/IC/seniors:

Description of difficulties for informal caregivers:

Table 16: Description of difficulties for informal caregivers in Norway

N°	Difficulties	Description of difficulties
1	Information management	IC have difficulty understanding medical jargon. A lack of access to comprehensible and accessible information (from the healthcare network) has also been expressed.
2	Involvement	IC are not involved in the patient's process (until the post-discharge phase). They express the need to be involved to ensure the patient's well-being.

Description of difficulties for seniors:

Table 17: Description of difficulties for seniors in Norway

N°	Difficulties	Description of difficulties
1	Healthcare follow-up	<ul style="list-style-type: none"> Patients would benefit from motivational inputs (training, activities, medication intake, possible side effects, etc.) Patients lack a communication system (who to contact, who does what and who knows what)
2	communication with the health network	In case of questions, patients have to contact ADL or emergency hospital services. ADL are only available on business hours. Patients express a need to have access to assigned contacts 24/7 in case of emergencies/advice. A preference is given to contacts who know the patient's history/condition.
3	Information management	<ul style="list-style-type: none"> Questions arise regarding the discharge process and the post-discharge phase (patients would like comprehensible run-through of the different processes). Patients have to look out for the right information/interlocutor to gain knowledge.



		<ul style="list-style-type: none"> • A need for vulgarisation of the medical information is expressed. • Patients need advice on how to carry on with their life.
4	Psychological difficulties (e.g. feelings of uncertainty)	Light depressive reactions are observed in patients, due in part because of the difficulty to access information and get answers.

Following the description of users (FC/IC/seniors) activities and difficulties, results have been identified regarding digital assistant-based system's possibilities for FC/IC/seniors. Results concern the Norway studies.

Description of digital assistant-based possibilities for informal caregivers:

Table 18: Description of digital assistant-based possibilities for informal caregivers in Norway

N°	Digital assistant-based possibilities	Description of possibilities
1	Daily treatment follow-up	<ul style="list-style-type: none"> • Easy access (via a dashboard) to patient status by IC. • Possibility to take part in the pre-discharge process and further.
2	Communication with the healthcare network	<ul style="list-style-type: none"> • Immediate access (24/7) to responsible and informed professional health care person / expert-centre in emergencies and for advice. • Automatic emergency message to responsible doctor / nurse based on monitored patient status. To reduce fear and burden on the IC. • Easy / effective access to the patient's ADL
3	Information provider	<ul style="list-style-type: none"> • Accessibility (via a dashboard) to comprehensible info about the pre-discharge process (what to expect, daily life advice, medicine information, important activities and offers from the health system). • Digital assistant-use course and training pre-discharge, personalization of the digital assistant in cooperation with the patient and IC.

Description of digital assistant-based possibilities for seniors:

Table 19: Description of digital assistant-based possibilities for seniors in Norway

N°	Digital assistant-based possibilities	Description of possibilities
1	Treatment follow-up	<ul style="list-style-type: none"> • Medicine reminders • Feedback on physical activities • Motivation feedbacks
2	Communication with the healthcare network	<ul style="list-style-type: none"> • Immediate access (24/7) to responsible and informed professional health care person / expert-centre in emergencies and for advice. • Automatic emergency message to responsible doctor / nurse based on monitored patient status. To reduce fear and burden on the IC. • Easy / effective access to the patient's ADL



3	Information provider	<ul style="list-style-type: none"> • Accessibility (via a dashboard) to comprehensible info about the forward process pre-discharge (what to expect, daily life advice, medicine information, important activities and offers from the health system). • Digital assistant-use course and training pre-discharge, personalization of the digital assistant in cooperation with patient and IC.
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3.2.3 Common results

After conducting interviews with our intended audience (seniors, formal and informal caregivers) regarding their main activities, challenges, and the eventual digital assistant-based possibilities, inherent personal and digital needs' results have been identified for Switzerland and Norway. These results have been gathered in order to finally predefine several users' requirements. The end-users' requirements harvested in the interviews will establish a first draft of the final digital assistant-based possibilities and the functions it must, should and can provide. The purpose of this section is then to summarize, compare and choose the best results to map out the device functionalities.

Following a complete user study with participants from Switzerland and Norway, a total of 8 seniors (6 from Norway; 2 from Switzerland), 4 formal caregivers (4 for Switzerland, 0 from Norway) and 5 informal caregivers (0 from Switzerland; 5 from Norway) took part in the study. The total account of participants for both countries is 17 for this user research.

As we can notice, the two countries haven't covered the same study's audience regarding quantity and quality. It's then necessary to point out that, the formal caregivers' opinion are probably variable between Switzerland and Norway. As we only have Swiss formal caregivers' data, we are going to base our results on them. The same happens for the informal caregivers' information that would probably be more complete if we also had the Switzerland's data. Nevertheless, our common activities data are firstly useful to bring to our understanding the inherent responsibility tasks and needs of our target population.

3.2.3.1 Activities tasks and challenges on different time spells

The next following table will represent the different tasks performed by each end-user, which have been collected during the research time in Switzerland and Norway. The aim is to make clear all activities, and the relative difficulties or challenges which can improve or prevent the good progress of the home care. Otherwise speaking, this data briefly shows what they need to do in order to improve the care and what they would like to do but cannot do properly. What needs to be done and what can hardly be done, are important components which must be inserted and compensated by the digital assistant's functionalities, usually known as end user's requirement.

In order to do so, this section's table highlight the common responsibility's tasks of our three different target audience on four different time spells (pre-discharge, discharge, post-discharge and rehabilitation phase). In other words, each tasks or difficulties' stakes, are determined on different treatment times, to know what should be done, by who and at what time.

Before reading the table, we would like to point out that we have attached the pre-discharge with the discharge phase and the post-discharge with the rehabilitation phase. Indeed, at the end of several interviews we were already struck by a first observation: there's no isolated pre-discharge. Any action taken in a pre-discharge phase has to be nearly followed on the discharge phase to maintain a quality service. We have identified the same phenomenon during the rehabilitation phase. There is no



isolated rehabilitation. Any action taken in a post-discharge phase has to be nearly followed on the rehabilitation phase to also maintain a quality service.

Table 20: End-users' tasks, activities and challenges

Users	Phases	Tasks	Activities	Challenges
Seniors	Pre-discharge & Discharge phases	Medication management	Seniors have to strictly follow their medication treatment. This can be done individually or with the help of medication weekly planners put in place by pharmacies or liaison nurses at the hospital. Home nurses can also help with this aspect.	In the pre-discharge phase, depending on the treatment, some patients have to wait several days to stabilize their medication intake. In the post-discharge phase, seniors must manage and remind themselves about their medication intake.
		Information management	Seniors gather information from FC (hospital doctors/nurses, patient's doctor) on their own and make the differentiation between the various sources of information, as much as defining the relevancy of such information. Ongoing management provided by the health care network.	Seniors have a general difficulty to gather relevant information for their rehabilitation. The medical information is also difficult to comprehend for them. There is also a lack of information reinforcement after procedures and treatments. <ul style="list-style-type: none"> • Questions arise regarding the discharge process and the post-discharge phase (patients would like comprehensible run-through of the different processes). • Patients have to look out for the right information/interlocutor to gain knowledge. • A need for vulgarisation of the medical information is expressed. • Patients need advice on how to carry on with their life.
		Informal carers management	Since IC are not necessarily part of the discharge process, seniors have to provide the majority of the information to support them. They have to manage what information to give, as they take into consideration IC's sensitivity and ability to provide care.	Seniors have difficulty discussing health issues with IC. They have to manage the information provided to IC (directly by them or by hospital doctors and nurses).



		Daily life management	Seniors must adapt to a new diet, they have to adapt their home (adapt the space, acquire tools such as a scale).	N/A
		Psychological monitoring (general mood, mental health)	At the discharge phase, seniors have to remain stable in terms of psychological state. There is no proper follow-up after the discharge process, as they mainly have to carry on their own treatments. In terms of mental health, the post-discharge phase is challenging and no psychological support is currently in place (at hospitals, as care services at the domicile).	After leaving the hospital, seniors expressed loneliness linked to their newly found autonomy and having to face their health alone. The transition has an abrupt effect as they have to carry daily tasks on their own. Light depressive reactions are observed in patients, due in part because of the difficulty to access information and get answers.
	Post-discharge & Rehabilitation phases	Healthcare follow-up	N/A	Patients report a lack of ongoing follow-up after discharge phase, especially in terms of reinforcement of key information (about care procedures, health best practices, etc.). Seniors need health check-ups within shorter intervals of time. In terms of organisation, seniors have to schedule (and note) FC's weekly/monthly visits to follow-up with their health care. Seniors who have a specific diet need to note their nutritional intakes. Patients would benefit from motivational inputs (training, activities, medication intake, possible side effects, etc.) Patients lack a communication system (who to contact, who does what and who knows what)
		Physical exercises	Seniors need to carry on with physical exercises when they return to the domicile. They can have the help of physiotherapists (a couple of hours per week at the hospital). The patient assumes responsibility for the physical training in the post-discharge phase.	Due to the hospitalization, patients have difficulty with mobility. This requires physiotherapy (this service is available in hospitals), multiple hours per week. When patients return to their domicile, they have difficulty carrying on with physical exercises.
		Treatment management	Patients assume responsibility for the	In the pre-discharge phase, depending on the treatment, some



			medicine intake during the post-discharge phase.	patients have to wait several days to stabilize their medication intake. In the post-discharge phase, seniors have to manage and remind themselves about their medication intake.
		Formal caregivers management	Seniors have to carry on with weekly/monthly visits with FC (hospital doctors/nurses, cardiologists, ergo/physiotherapists, patient's doctor, home nurses) and to gather information from them. Patients have contacts with ADL (during working hours) or emergency hospital services.	Seniors have a difficulty understanding which health care stakeholders to reach out to and when. In case of questions, patients have to contact ADL or emergency hospital services. ADL are only available on business hours. Patients express a need to have access to assigned contacts 24/7 in case of emergencies/advice. A preference is given to contacts who know the patient's history/condition.
		Participate in rehabilitation program	Seniors take part in rehabilitation programs at the hospital and/or at dedicated rehabilitation centres. During those sessions, they take part in physiotherapy and ergotherapy: they have to learn again to eat, walk, etc.	N/A
Formal caregivers	Pre-discharge & Discharge phases	Assessment of patient needs (in terms of service and treatment)	During the discharge phase, FC gather patients' information from multiple sources (hospital doctors/nurses, patients' doctor, other care providers) to assess patients' needs as they transition from the hospital to the domicile, in terms of medication for the post-discharge phase	For liaison nurses, the main challenge is to obtain patients' information (updated information, and medical background). They have to obtain norms of vital parameters (due to insurances, certain scales must be observed when leaving the hospital). They have to connect with various health professionals to gather them.
		Gather the patient database	At the discharge phase, FC achieve a full patient evaluation. To this effect, they gather information about patients' vital parameters (vital/ clinical parameters). They gather such information thanks to a "transfer sheet" (parameters before hospitalisation) and hospital nurses (parameters during the hospitalisation). They collect, fact-check,	N/A



			and analyse data to understand patients' needs and put in place personalized services for patients' domicile.	
		Coordinate the information (hospital environment – home care teams – patient care teams)	FC also provide information to patients/informal carers/patients' doctors either to coordinate care services or to help them to understand care services. FC coordinate care services for patients. To achieve these tasks, they gather all relevant information from different parties so they can put in place appropriate care services for patients during the post-discharge phase.	For liaison nurses, they identify a lack of communication (or precision) within the healthcare network. Information has to be asked directly to multiple interlocutors and fact-checked due to the lack of precision of information.
		Administrative management related to patient care	FC prepare administrative documents related to care services. Such documents are also shared with/validated by the patients' doctor. FC also provide guidance to doctors regarding official (reimbursed) care services.	N/A
	Post-discharge & Rehabilitation phases	N/A	N/A	N/A
Informal caregivers	Pre-discharge & Discharge phases	Gather information	Ongoing gathering of information looked out or provided by the health care network.	IC have difficulty understanding medical jargon. A lack of access to comprehensible and accessible information (from the healthcare network) has also been expressed.
	Post-discharge & Rehabilitation phases	Follow up the treatment	IC assume responsibility for the medicine intake for seniors during the post-discharge phase.	IC are not involved in the patient's process (until the post-discharge phase). They express the need to be involved to ensure the patient's well-being.



		Follow-up the physical exercises	IC assume responsibility for the physical training of seniors in the post-discharge phase.	
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As we can notice, the interviews have generated more information about elderly end users than caregivers, and it's quite normal because we work to specifically help this kind of people. By the way, we already knew that the digital assistant will specifically simplify seniors' actions and tasks because they are the end-users who are unable to adequately follow their treatment. This table also shows that even if the seniors are supported by informal caregivers at home, these ones are not always able to provide effective assistance. Furthermore, it shows that even formal caregivers encounter problems in supporting the home care phase. We can thus assert that these results corroborate what we supposed to be helpful and what we would love to improve when we first started this project.

3.2.3.2 Needs and end-users' requirements

The activity and tasks' analysis has shown several end-users' needs which involve requirements that would be useful to implement as digital assistant-based possibilities. Before taking an interest in it, let's remind some definitions stemming from the International Institute of Business Analysis (IIBA).

- A need *"is a high-level representation of the requirement needed. The need is the end result or purpose"*. A requirement *"is what is required to solve a problem or achieve an objective"* [4].
- A requirement is *"a statement of a customer need, a statement that identifies a condition, capability, characteristic, or quality factor of a system that is necessary for the system to have value and utility to user"*. Requirements are currently used *"to capture the information needed to design, build and test a process, service, product or system"* [3].

According to these definitions, it was more logical to focus first on the needs, thus on what we want to make possible and support. Then, we were able to specify the end-users' requirements, thus what we can provide. In our case, the end users' requirements will help to design, build and test the digital assistant-based functionalities.

The following table summarizes the end users' needs and all the requirements that we found when analysing the Swiss and Norwegian interviews. To make it more intelligible, the table contains additional information such as: different care time phases and the kind of intended audience. In this way, we can understand when needs and requirements emerge and who it involves.

Table 21: End-users' requirements

Phases	End-users' needs	Profile	End-users' requirements
Daily health monitoring/treatment follow-up			
Pre-discharge & Discharge	Asses patients' health (e.g. weight gain, blood pressure, diet effects...)	FC	<u>Dashboard with factual health' information</u> Taking physiological data (monitoring weight gain, dietary monitoring, taking blood pressure)
	Make a diagnosis	FC	Health check-ups and fact check



	Be reinforced on treatment-key information	S	Important information reminders for seniors (information previously provided by a health professional; e.g. reminder to wear compressions stockings)
	Adapt themselves and their home, manage the daily life	S	Lifestyle tips reminders
Post-discharge & Rehabilitation	Be helped with a strictly and regular medication intake	S	<u>Dashboard with personal health reminders and check-ups ongoing</u> Medicine and treatment intake reminders
	Get instructions and advices about tailor-made physical exercises to improve mobility and note nutritional intakes	S	Exercise reminders (instructions, provide physiotherapeutic follow-up / motivate seniors with exercises)
	Receive some recommendation on a diet plan	S	Diet program, monitoring, general advices and tailor-made diet program for daily life
	Have access to a medical or personal visits calendar	S	Appointment reminders
	Be able to record incidents on camera and call the emergencies	S	Alarm system, giving warning signs in the event of changes (linked to emergency call center)
Healthcare network's communication			
Pre-discharge & Discharge	Have difficulty understanding which healthcare stakeholder reach out.	S – IC	<u>Network's care general dashboard</u> instructions about who to contact, for what, and when; information's completeness by all end-users
	Fill in the communication gap between healthcare network	FC	
Post-discharge & Rehabilitation	Reach some healthcare's contact (who and when) like nurses, physiotherapists, ergotherapists, etc.	S – IC	Direct contact with care system's interlocutors (available professional's contact list)
	Reduce fear and be more independent from the informal caregivers	S	Automatic emergency message
Coordination and transmission of the information			
Pre-discharge & Discharge	Coordinate care services to seniors and informal caregivers to understand care services	FC	<u>General dashboard for FC</u> who to contact – contact information-; for what -which information they can deliver-; and when – daily availability-; at which stage of the transitional process
	Put in place appropriate care services for patients	FC	
	Obtain quickly patient's information by connecting with various health professionals to gather them	FC	



Post-discharge & Rehabilitation	Receive directly information from healthcare professionals	S – IC	<u>Dashboard gathering patient's information from hospital environment, home care teams, patient care teams</u>
	Be able to consult rapidly such information about care professionals' interventions.	S-IC-FC	
	Be able to consult medical histories, data's patient that would be useful and fulfil the information	S-IC-FC	(e.g. procedures, medical background, care network contact, physiological data, norms vital, clinical parameters ; care procedures : start, duration, aim, health best practices)
	Participate in rehabilitation programs (physiotherapy and ergotherapy)	S	Rehabilitation programs, information centers
Synchronization with current healthcare digital tools /features			
Pre-discharge & Discharge	Recognize the different digital tools and their meanings (digital assistant-use training's contribution, e.g. personalization)	S-IC-FC	<u>Digital tool that offers efficiency and accuracy</u> Short explanatory booklet on the digital assistant's operation and feedbacks' tips
	Provide "social-coaching" support (especially for patients without caregivers)	S	Personalize digital assistant functionalities
	Diminish the amount of information and sources	FC	Most complete relevant information's selection
Post-discharge & Rehabilitation	Have to schedule medical visits monthly and weekly	S – IC	<u>Detailed Calendar functionalities</u> To remind patients about medical visits (medical visits, dedicated space to write questions for meetings and dedicated option to gather paper information)
	Find easily what he is searching in the amount of information (appointments, medical state, medication or exercise, etc.)	S – IC	
	Collect basic information (e.g. sleep's quantity and quality)	FC	Track and record daily life data (have the times of waking up/sleep)
Information management			
Pre-discharge & Discharge	Prepare administrative documents related to care services shared and validated by the patient's doctor	FC	<u>Dashboard with general and curated information and access to administrative information</u> medical procedures, processes, interlocutors involved, etc.
	Provide guidance to doctors regarding official (reimbursed) care services.	FC	



	Gather relevant information from FC on their own by differentiating and defining their relevance	S-IC	
Post-discharge & Rehabilitation	Access to “transfer sheet” or any personal information about the vital and clinical parameters	S-IC-FC	<u>Vulgarize all kind of information</u> create clear and accessible information about medical procedures or daily care advices in order to manage FC-IC or to help S
	Be helped on gathering and managing relevant information of/ to formal and informal caregivers	S	
	Discuss properly health issues and manage information provided to IC	S	
Psychology state/support			
Pre-discharge & Discharge	Remain stable in psychological terms	S	<u>Daily mental state’s monitoring</u> Motivational feedbacks (provide information about other help forms)
	Need reinforcement for the personal involvement	S	
Post-discharge & Rehabilitation	Feel lonely because of their newly found autonomy	S	<u>Access to mental health support</u> (via contact/about information regarding existing mental health professionals/centers) (app via a connection to existing external services or via contact, centers)
	Face health problems alone	S – FC	
Information provider			
Pre-discharge & Discharge	Collect, fact-check and analyze data in order to understand patients’ needs and put personalized services for home care	FC	<u>Dashboard with patient’s medical and administrative information</u> (procedures, medical background, care network, contacts, physiological data, norms vital, clinical parameters) <u>Centralized information</u> (e.g. all files with personal or health treatments information, planning of care, contact, parameters before and during hospitalization)
	Gather patient data, “transfer sheet”, information and all administrative documents related to care service in one place.	FC	
	Provide clear and accessible information to seniors and informal caregivers	FC	
Post-discharge & Rehabilitation	Access to comprehensible information about the forward process pre-discharge (what to expect, daily life advice, medicine information, important activities and offers from the health system)	S - FC	(e.g. frequently asked questions, phone or email contact)



	Locate quickly a place where to find reunited information about their health problem and their medical background, history	S-FC-IC	
	Provide auxiliary information linked to new found seniors' needs (reimbursement)	FC	

3.2.3.3 End-users' requirements descriptions

End-users' requirements are separated into seven different categories, known as: treatment follow-up, healthcare network's communication, coordination and transmission of the information, synchronization with current healthcare digital tools, information management, psychological support and information provider. Below is a table explaining all the end users' requirements in detail.

Table 22: End-users' requirements descriptions

N°	End-user's requirement	Description of possibilities
1	Daily treatment follow-up	Seniors
		<p>The digital assistant-based system could help with medication intake, serve as a reminder to achieve physical exercises, provide recommendation for physical exercises and give access to a calendar (for visits).</p> <ul style="list-style-type: none"> • Medicine reminders • Feedback on physical activities • Motivation feedbacks
		Formal caregivers
		<p>Functionalities have been identified by FC such as creating reminders to achieve tasks (medication intake, visits, etc.). The tool could also play a role of structure for daily life: having one place with all the relevant information, contacts, instructions (about treatment, daily life advice):</p> <ul style="list-style-type: none"> • Taking physiological data (monitoring weight gain, dietary monitoring, taking blood pressure) • Giving warning signs in the event of changes, • Reminders to take treatment, • Reminder to wear compression stockings, • Reminder of important information for the senior (information previously provided by a health professional), Provide physiotherapeutic follow-up (motivate seniors with exercises), • Have the times of waking up/sleep, • Possibility of providing "social" support (especially for patients without caregivers), incl. coaching functionalities and the ability to answer questions to patients • Personalized/tailor-made advices for daily life, • Calendar functionalities (to remind patients about medical visits) <p>System linked to an alarm system/number (linked to an emergency call center) FC mention the need for patients to be monitored daily (especially in case of decompensation)</p>
		Informal caregivers



		Easy access (via a dashboard) to patient status by IC. Possibility to take part in the pre-discharge process and further.
2	Healthcare network's communication	Seniors
		The digital assistant-based system should provide contact information about healthcare professionals, and information on who and when to contact them. <ul style="list-style-type: none"> • Immediate access (24/7) to responsible and informed professional health care person / expert-centre in emergencies and for advice. • Automatic emergency message to responsible doctor / nurse based on monitored patient status. To reduce fear and burden on the IC. • Easy / effective access to the patient's ADL
		Formal caregivers
		Offer the possibility of contacting nurses (who assesses the situation and who can coordinate care with the attending physician), or other care professionals involved in seniors' treatment (doctors on call, cardiologists, medico-social center coordinators or referral nurses, liaison nurses, patient's physicians, ergotherapist/physiotherapists/dieticians, home nurses)
3	Coordination and transmission of the information	Informal caregivers
		<ul style="list-style-type: none"> • Immediate access (24/7) to responsible and informed professional health care person / expert-center in emergencies and for advice. • Automatic emergency message to responsible doctor / nurse based on monitored patient status. To reduce fear and burden on the IC. • Easy / effective access to the patient's ADL
4	Synchronization with current healthcare digital tools	Formal caregivers
		FC require a direct transmission of the information between healthcare professionals (in hospitals, rehabilitation centers, independent care professionals, doctor offices). They also need patients' medical information (medical background, past/recent treatments and reasons for interruption of treatments, updated prescriptions, updated physiological data). There are no transversal efforts in terms of coordination of information. Being able to consult rapidly such information and following care professionals' interventions (hospitalizations, medical visits, physio/ergo. visits, and home nurse visits) is of interest for FC.
5	Information management	Formal caregivers
		FC would like a synchronization of the various systems in place (digital patient files, etc.) to gather all the information in one place. The idea would be to diminish the amount of information (and sources) to gain in efficiency and accuracy. Currently, the information present in digital systems is incomplete which forces FC to gather information from various sources of information within the healthcare network.
6		Formal caregivers
		Seniors



	Psychological state/support	The digital assistant could offer social and psychological support, but also provide information about external sources of support (heart failure-related associations)
7	Information provider	Seniors
		The digital assistant could offer to seniors some advices to improve their daily life, but also information about treatments, medication, best practices, etc. <ul style="list-style-type: none"> • Accessibility (via a dashboard) to comprehensible info about the forward process pre-discharge (what to expect, daily life advice, medicine information, important activities and offers from the health system). • Digital assistant-use course and training pre-discharge, personalization of the digital assistant in cooperation with patient and IC.
		Informal caregivers
		Accessibility (via a dashboard) to comprehensible info about the forward process pre-discharge (what to expect, daily life advice, medicine information, important activities and offers from the health system. Digital assistant-use course and training pre-discharge, personalization of the digital assistant in cooperation with patient and IC.

Seniors have to be monitored daily, no matter where they come from, either Switzerland or Norway. All those requirements work for a possibility of providing “social” support (especially for patients without caregivers), including coaching functionalities and the ability to answer questions to patients. So all of them have to be easy and effective for the use of our target audience, in order to improve the elder’s daily life.

Moreover, requirements have to be really useful and filed by their significance. As we can notice in the previous table, every end user requirement has a specific audience, sometimes several at the same times. Those with more than one audience seems therefore to require special attention and have more significance. The most important requirements appear so to be, the first two in the table: daily treatment follow-up and healthcare network’s communication. Then, follows, in order of importance, the information provider. According to the facts, elderly people home care is not qualitatively satisfactory. The biggest barrier so far is the lack of ongoing follow-up and the misunderstood or forgotten information that could be hopefully provided by the H2HCare digital assistant. At the end we find: coordination and transmission of the information, synchronized with current healthcare digital tools, information management and psychological state/support.



4 End-users' requirements completeness and prioritization

After harvesting all the end-users' requirements from the interviews' analysis, it was firstly essential to try to complete those ones with all partners' ideas and secondly to proceed with a prioritization. In order to do so, two brainstorming sessions have been organized, in two different times. Those brainstorming sessions were an opportunity to discuss the different points of view between partners regarding these end-users' requirements.

The purpose of these two processes is to have a small complementary database and to choose the most relevant end-users' requirements for our study. In other words, the aim was to have a maximum of identified requirements and to highlight the most relevant and feasible ones. For this purpose, a brainstorming exercise between all project partners was set up on *Mural*.

4.1 Brainstorming among project partners

4.1.1 First brainstorming: completeness

During the first brainstorming, the 7 end-users' requirements' categories established in the previous chapter have been presented with their specific end-users requirements and their relative digital assistant's functions. Those requirements have been completed with the partner's inputs during this first brainstorming.

Some interesting new end-users' requirements have appeared during this process but also one digital assistant-based possibility has been suggested to complement. See the tables below for more information about the end-users' requirements that complemented our study.

Table 23: New end-users' requirements

Requirement's category	New end-users' requirements
Daily health monitoring	<ul style="list-style-type: none"> Treatment information (start, duration, aim)
Healthcare networks' communication	<ul style="list-style-type: none"> General medication Medication related to heart-failures issues
Coordination and transmission of the information	<ul style="list-style-type: none"> Direct contact with interlocutors of the care system Functionality that allows health stakeholders to fulfil and centralize information (for other FC)
Synchronization with current healthcare digital tools	<ul style="list-style-type: none"> Space to write information to ask during meetings
Psychological state/support	<ul style="list-style-type: none"> Social functionalities to coach and be a presence for seniors Media social contact (with pairs, familiars, etc.) to maintain social aspects with connected videos
Information provider	<ul style="list-style-type: none"> Direct access to contacts with interlocutors of the care system Instructions on: who to contact / when / for what Reminders/reinforcement of information about care procedures or best health practices How to react in case of emergency. What to do if... Sources for more information related to the patient's condition

Requirement's category	New digital assistant-based possibility
Healthcare network's communication	<ul style="list-style-type: none"> Dashboard with medication history

All these new inputs have been added to the interviews' results, with the aim of having a larger database to prioritize.



4.1.2 Second brainstorming: prioritization

During the second brainstorming we commonly used the MoSCoW method to rank end-users' requirements. Regarding this method, the most important and feasible end-users' requirements have been selected as must-haves. So, in a first step we will focus our interest on the requirements that must be in our project, according to what has been agreed upon. Effectively it seems interesting to show what kind of requirements have been chosen and why these should be prioritized over others.

Regarding our entire database, only one category -including the possible digital assistant functionalities and the end-users' requirements has been almost totally selected as a must-have. Indeed, the category named "*synchronization with the current healthcare digital tools*", is relevant in the H2Hcare project regarding the following end-users' requirements: have a short explanatory booklet or video on digital assistant's operation, have a most complete relevant information's selection and the possibility of personalization. We can therefore state that providing the digital assistant with a digital tool that offers efficiency and accuracy is totally valuable. Moreover, the second digital assistant functionality (*detailed calendar information*), has two end-users' requirements that have also been selected as must-haves. Those ones are the medical visit reminders and the track and record daily life data.

If we analyse the results in a general way, we notice that reminders are always relevant for our project. Indeed the category "*daily health monitoring / treatment follow-up*" groups all types of reminders under the "*dashboard with personal health reminders and ongoing check-ups*" such as: medicine and treatment intake reminders; physical exercises incentives, instructions and reminders; diet program, advices reminders. To these are added some requirements from other categories like: medical visit reminders; reminders/reinforcement of information about care procedures or best health practices. We then retain that reminders are the elements that will help make the information understandable and that they represent, among others, the must-haves of our project.

The other relevant requirements detected refer to basic but essential elements. At first glance, they don't seem to be important, but the lack of access or forgetfulness of this information is sometimes the reason of taking a treatment in the wrong way, and therefore being rehospitalised. Those requirements are: how to react in case of emergency – what to do if...-, the frequently asked questions, phone or email contacts to reach, but also instructions on: who to contact (when/for what/which stage) and taking physiological data (weight, blood pressure, etc.).

As the "*information management*" category mentions, creating clear and accessible information about medical procedures, daily advices, clinical parameters, etc. is totally a must-have too. So it will be relevant to provide the digital assistant with all kind of vulgarized information and with several reminders, in order to ensure the seniors' and informal caregivers' understanding. Information problems identified during the interviews could only be addressed in this way, for the moment. The information aspect will be installed in the digital assistant but with simpler functionalities than those implicitly requested.

Indeed, the others categories referring to information are irrelevant regarding the second brainstorming's results. The reason is that unfortunately we don't have the resources in terms of time, funding and programs yet. Furthermore, we concluded that the category "*coordination and transmission of the information*" was quite entirely irrelevant watching the progress of our project. The related end-users' requirements such as information on: who to contact, when, for what, which stage, or even the direct contact with interlocutors of the care system, just as the functionality that allows health stakeholders to fulfil and centralize information, won't be a part of the digital assistant as a general dashboard for formal caregivers, as we thought at the beginning. Those information's requirements are thus defined as being would-haves regarding to the MoSCoW method.

Furthermore, there were three quite similar dashboards, including information elements, that have been commonly deleted –*Dashboard with patient's medical and administrative information*,



dashboard with general and curated information and access to administrative information, general dashboard for formal caregivers– . Those ones were too broad and precise at the same time. They are not possible to do and quite deviated from our baseline. In other words we can't solve every need by a digital assistant, they need to have intern structures without procedures' issues.

After reviewing the project's must-haves in terms of end-users' requirements, we will look at those who should be a part of the digital assistant. According to the MoSCoW method, the should-haves are important but not so relevant, they should be made as far as possible. Among the should-haves, we can find some requirements of the "psychological state/support" category, like: media social contact (with pairs, familiars, etc.) to maintain social aspects with connected video, social functionalities to coach and be a presence for seniors and some tailor-made motivational feedbacks.

However, care must be taken as the other requirements in this same category have been classified as could-haves. So, the "psychological state/support" has to be checked if it's possible to do and if it's useful. Requirement like provide connection with existing external services like professionals of the mental health supports could be done if there is no negative impact, but it's not really relevant.

To summarize this chapter, we created the following table. Cases with italicized words refer to the end-users' requirements or digital assistant based features that have been added during the first brainstorming:

Table 24: Prioritization of end-users' requirements

Priority	Requirements categories	Digital assistant-based features	End-users' requirements
Must	Synchronization with the current healthcare digital tools	Provide a digital tool that offers efficiency and accuracy	Short explanatory (booklet/ video) on digital assistant's operation
			Personalize digital assistant functionalities
		Detailed calendar	Most complete relevant information's selection
			Medical visits reminders
	Information management	Vulgarize all medical information for seniors and informal caregivers	Track and record daily life data
			Create clear and accessible information about medical procedures, daily care advices, clinical parameters, etc.
	Information provider	Dashboard with patient's medical and administrative information	<i>Reminders/reinforcement of information about care procedures or best health practices</i>
		Centralized information	<i>How to react in case of emergency. What to do if...</i>
			Frequently asked questions
	Healthcare network's communication	Dashboard of general network's care	Phone or email contact
		<i>Dashboard with medication history</i>	Instructions on: who to contact (when/for what/which stage)
	Daily health monitoring / treatment follow-up	Dashboard with factual health and medication information	<i>Medication related to heart-related issues</i>
			Taking physiological data (weight, blood pressure, etc.)
		Dashboard with personal health reminders and ongoing check-ups	Medicine and treatment intake reminders
		Physical exercises incentives, instructions and reminders using videos	
		Diet program, advices reminders	



Should	Psychological state/support	Access to mental health support	<i>Media social contact (with pairs, familiars, etc.) to maintain social aspects with connected video</i>
		Daily mental state's monitoring	<i>Social functionalities to coach and be a presence for seniors</i>
			Tailor-made motivational feedbacks
	Healthcare network's communication	<i>Dashboard with medication history</i>	<i>General medication</i>
	Daily health monitoring / treatment follow-up	Dashboard with personal health reminders and ongoing check-ups	Medical appointments reminders
		Dashboard with factual health's and medication information	Health check-ups and fact check <i>Treatment information (start, duration, aim)</i>
Could	Coordination & transmission of the information	Dashboard gathering patient's information from all environments	Information on rehabilitation programs and centers (location, contacts, specializations)
	Psychological state/support	Access to mental health support	Connection with existing external services like professionals of the mental health supports
	Information provider	Centralized information	<i>Sources for more information related to the patients' condition</i>
Would	Information management	Dashboard with general and curated information	Medical procedures, processes, interlocutors involved.
	Coordination & transmission of the information	General dashboard for formal caregivers	Instructions on: who to contact/when/for what/which stage
			Direct contact with interlocutors of the care system
			<i>Functionality that allows health stakeholders to fulfil and centralize information (for FC)</i>
		Dashboard gathering patient's information from all environments	Medical background, care procedures, clinical parameters, administrative information regarding care services
	Information provider	Dashboard with patient's medical and administrative information	Procedures, medical background, care network, physiological data, norms vital, clinical parameters
			<i>Direct access to contacts with interlocutors of the care system</i>
		Centralized information	<i>Instructions on: who to contact/when/ for what</i>
			All files with personal or health treatments information, planning of care, contact, parameters before and during hospitalization
	Healthcare network's communication	Dashboard of general network's care	Information completeness by all end-users
<i>Direct contact with care system's interlocutors</i>			
		Automatic emergency message	
Daily health monitoring / treatment follow-up	Dashboard with personal health reminders and ongoing check-ups	Alarm system (incident or health problem warning) linked to emergency call centre	



5 Conclusion

Data collection, through Swiss and Norwegian interviews, provided us with important information about the inherent needs of our three audiences. To understand what their needs are, we have investigated on main variables like: profiles' main activities, difficulties/challenges and digital assistant-based possibilities.

Transformed into needs, those main variables helped to highlight all the end-users' requirements that were gradually appearing and that could potentially be useful in terms of digital assistant functionalities. It's through a second step and thanks to the MoSCoW method's brainstorming, that we commonly choose, with all project's partners; the *must-haves* end-users' requirements and the requirements *nice to have*. This distinction, or otherwise called prioritization, bring to our knowledge and highlight, which requirements are the most fundamental for providing the digital assistant.

We would like to conclude by advising that it's important to do specific short trainings (how to use the digital assistant and how to live life) or get a leaflet on how to use the digital assistant efficiently, with all the important functionalities, like how to easily add information to personalize the digital assistant, in order to increase the end users' interest. All these contributions will motivate seniors and informal caregivers to use it daily. Feedbacks should also not to be neglected, to the detriment of a training offer. Indeed, these feedbacks are like external assessments that encourage users to feel involved and important in the smooth running of the project.

5.1 Limitations

As we already know, 17 participants took part in our user research; 8 seniors (6 from Norway; 2 from Switzerland), 4 formal caregivers (Switzerland) and 5 informal caregivers (Norway). The difference in our intended audiences, in terms of quality and quantity, between Switzerland and Norway could represent a first limitation. Nevertheless, this kind of distinction has not hampered us from generating common results to both countries.

However, some limitations regarding each interviewee have been identified too. Some of the informal caregivers confessed to have difficulties to envision the value and use of the technology for seniors. The same applies for formal caregivers who say to be unable to envision such a product as an added-value to their work. Despite the lack of projection as to the digital assistant's usefulness, patients and formal caregivers reported a positive attitude toward the H2Hcare's initiative and they understand the need of such a project in the future.

Additionally, seniors, informal caregivers and formal caregivers reported a lack of a proper discharge process (with steps on a timeline) as procedures were carried out by formal caregivers simultaneously and in a continuous manner within a short period of time (during the discharge phase). While such a conclusion is due to traditional medical processes, interviewees reported room for improvement regarding medical actions and the communication about such actions - either within the care network or with patients and informal caregivers.

Now, if we look at the research itself, we can discern and report more limitations. The first of them is, as expected regarding our current situation, Covid-19. This unexpected pandemic rendered difficult the finding of participants. Indeed, our seniors' audience have a high-risk of coronavirus contamination that could be lethal to them. From another side, we encountered the difficulty for reaching available formal caregivers. In the last's pandemic months, caregivers had to increase their efforts.

The limited knowledge in technology and smart devices also played a negative impact as interviewees had a general difficulty to identify digital assistant's functionalities (or digital assistant-based



possibilities). Finally, a broader set of participants would have brought further feedback on their experiences and on the project.

Finally, we can state that the general study's results have remained consistent in terms of areas of investigation and global alignment with the H2HCare's goals even if some limitations have been found.



6 References

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7 Appendix

7.1 Interview material by end-users

7.1.1 Interview - Older adults

- Step 1: Project introduction - Introducing the goal of the project.
- Step 2: Demographics information
- Step 3 : General questions
- Step 4 : specific questions to older adults

Step 1: Project introduction

Thank you for your time and interest in our study. First, we will start by giving you a brief introduction of the project. H2HCare is an international research project that is working on the design and development of a digital assistant-based system that aims to offer support and assistance for elders suffering from heart failure during their transition from hospital to home care. In order to define customizable and integrated support services, we conduct interviews with a set of participants who would be in contact with such digital assistant-based system. To give you an example of the type of applications we envision for older adults, the system could monitor and coach individuals to follow the post-discharge treatment and overall care plan. The system could facilitate communication with health care professionals (when in doubts about the post-discharge treatment, for e.g.). Ultimately, the system could also provide weekly health status updates and instructions for medication intake.

Step 2: Demographics information

(To be filled in by the researcher)

- Age
- Gender
- Level of education (optional)
- Nationality
- City and country of residence
- Health context
- Time (year) of heart failure diagnosis
- Which type of care assistance do they receive

Step 3: General questions

Table 25: General questions to older adults

N°	Type	Questions	Other related questions
1	Discharge process	What is the discharge process for patients with heart failure?	<ul style="list-style-type: none"> - What does the discharge process look like? - How many steps/phases the discharge process encompasses? - What is the general timeline for the discharge process? For each main phase of the discharge process, what is their duration in time? - Who are the main stakeholders (care-related) involved in the discharge process?



2	End-user interaction	For each discharge phase, which care-related stakeholder has the most importance (in terms of involvement)?	
3	End-user involvement	Which phases of the discharge process are completed by formal professionals?	- Which phases of the discharge process are completed by informal caregivers? - Which phase(s) of the discharge process are completed by older patients? (Ex: taking medication during the post-discharge phase)
4	End-user needs	What are the general needs you would identify during the discharge process? (for all end-users)	
5	End-user challenges	What are the general difficulties you would identify during the discharge process (for all end-users)?	
6	Discharge process	In your opinion, what could be improved in the discharge process? (at all stages/phases)	
7	Digital assistant opportunities In your opinion, do you think a digital assistant-based system could help improve the discharge process?	In your opinion, do you think a digital assistant-based system could help improve the discharge process?	
8	Digital assistant opportunities	In your opinion, which type of help a digital assistant-based system could provide during the discharge process?	- At what stage of the discharge process? - Which care-related stakeholder could be impacted?
9	Digital assistant opportunities	In your opinion, which type of difficulties could a digital assistant-based system tackle for the discharge process?	

Step 4: specific questions to older adults

Table 26: specific questions to older adults

N°	Topic	Questions
1	End-user needs	In general, what would be the needs of a senior involved in care processes for patients of heart failure?
2	End-user needs	As an older patient, what do you feel you need to receive appropriate care when it comes to your condition?
3	End-user challenges	In general, what would be the challenges or difficulties for an older patient during the various phases of the transition care process (pre/post-discharge)?
4	End-user challenges	As an older patient, what are the challenges or difficulties you encountered during the transition care process?



5	End-user tasks	As an older patient, what are the main tasks you need to perform in order to properly complete the transition care process? For said number of tasks, could you give a ranking of importance?
6	End-user network	With which interlocutors from the health care system do you need to interact with during the transition care process? How often do you need to interact with them? Please rate the importance of your interaction with the interlocutors previously mentioned.
7	End-user network	In addition to health care professionals, who else is involved in your transition care process?
8	Information	What type of information do you need from health care professionals to properly follow the transition care process?
9	Digital assistant	In your opinion, could a digital assistant-based system help/assist you with the transition care process? Would you be open to the idea of having a digital assistant-based system to help you with it?
10	Digital assistant	What functionalities should a digital assistant-based system have to assist you during the transition care process?
N°	Phase	Questions
1	Pre-discharge	As an older patient, what are your needs during the pre-discharge phase?
2		As an older patient, what are the difficulties encountered during the pre-discharge phase?
3		What are the main activities an older patient achieves during the pre-discharge phase?
4		In your opinion, what activities from the pre-discharge phase could be optimized?
5		In your opinion, what functionalities would be needed for a digital assistant-based system in order to facilitate the pre-discharge process?
6		During the pre-discharge phase, with whom in the health care system do you need to interact to gain information about the transition care process?
7		In the pre-discharge phase, what information do you need to ensure a successful recovery?
1	Post-discharge	As an older patient, what are your needs during the post-discharge phase?
2		As an older patient, what are the difficulties encountered during the post-discharge phase?
3		What are the main activities an older patient achieves during the post-discharge phase?
4		In your opinion, what activities from the post-discharge phase could be optimized?
5		In your opinion, what functionalities would be needed for a digital assistant-based system in order to facilitate the post-discharge process?
6		During the post-discharge phase, with whom in the health care system do you need to interact to gain information about the transition care process?



7		In the post-discharge phase, what information do you need to have to ensure a successful recovery?
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7.1.2. Interview - Formal caregivers

- Step 1: Project introduction - Introducing the goal of the project.
- Step 2: Demographics information
- Step 3 : General questions
- Step 4 : Specific questions to formal caregivers

Step 1: Project introduction

Thank you for your time and interest in our study. First, we will start by giving you a brief introduction of the project. H2HCare is an international research project that is working on the design and development of a digital assistant-based system that aims to offer support and assistance for elders suffering from heart failure during their transition from hospital to home care. In order to define customizable and integrated support services, we conduct interviews with a set of participants who would be in contact with such digital assistant-based system. To give you an example of the type of applications we envision for formal caregivers, the system could provide a longitudinal view of patients which would allow to personalize the post-discharge care plan, for example. The system could also provide remote monitoring and regular follow-up examinations and assessments of patients. Ultimately, the system could facilitate communication with health care professionals (between doctors, home caregivers and patients).

Step 2: Demographics information

(To be filled in by the researcher)

- Age
- Gender
- Level of education
- Nationality
- City and country of residence
- Work context :
- Where they work (city and institution)
- Number of years of experience

Step 3: General questions

Table 27: General questions to formal caregivers

N°	Type	Questions	Other related questions
1	Discharge process	What is the discharge process for patients with heart failure?	<ul style="list-style-type: none"> - What does the discharge process look like? - How many steps/phases the discharge process encompasses? - What is the general timeline for the discharge process? For each main phase of the discharge process, what is their duration in time? - Who are the main stakeholders (care-related) involved in the discharge process?



2	End-user interaction	For each discharge phase, which care-related stakeholder has the most importance (in terms of involvement)?	
3	End-user involvement	Which phases of the discharge process are completed by formal professionals?	<ul style="list-style-type: none"> - Which phases of the discharge process are completed by informal caregivers? - Which phase(s) of the discharge process are completed by older patients? (Ex: taking medication during the post-discharge phase)
4	End-user needs	What are the general needs you would identify during the discharge process? (for all end-users)	
5	End-user challenges	What are the general difficulties you would identify during the discharge process (for all end-users)?	
6	Discharge process	In your opinion, what could be improved in the discharge process? (at all stages/phases)	
7	Digital assistant opportunities	In your opinion, do you think a digital assistant-based system could help improve the discharge process?	
8	Digital assistant opportunities	In your opinion, which type of help could a digital assistant-based system provide during the discharge process?	<ul style="list-style-type: none"> - At what stage of the discharge process? - Which care-related stakeholder could be impacted?
9	Digital assistant opportunities	In your opinion, which type of difficulties could a digital assistant-based system tackle for the discharge process?	

Step 4: Specific questions to formal caregivers

Table 28: Specific questions to formal caregivers

N°	Topic	Questions	Notes
1	End-user needs	In general, what would be the needs of a formal caregiver involved in care processes for patients of heart failure?	Idea: needs is vague in order to target different types of needs (for IC, seniors, the health care system), general version of question 2
2	End-user needs	As a formal caregiver, what do you feel you need to care properly for an elderly patient suffering from heart failure?	
3	End-user challenges	In general, what would be the challenges or difficulties for a formal	general version of the next question



		caregiver involved in care processes for patients of heart failure?	
4	End-user challenges	As a formal caregiver, what are the challenges or difficulties you encounter while caring for an elderly patient suffering from heart failure?	
5	End-user tasks	As a formal caregiver, what are the main tasks you perform in order to care properly of elderly patients? For said number of tasks, could you give a ranking of importance?	
6	End-user network	With which interlocutors from the health care system do you need to interact with in order to care properly for elderly patients? How often do you need to interact with them? Please rate the importance of your interaction with the interlocutors previously mentioned.	
7	Information	What type of information do you need from other health care professionals so you can properly care for elderly patients?	
8	Information	What type of information do you need to know about your elderly patients so you can properly provide care services?	
9	Involvement	How much involvement do you have in the care of elderly patients?	
10	Digital assistant	In your opinion, could a digital assistant-based system help/assist you with the care of elderly patients?	
11	Digital assistant	Would you be open to the idea of having a digital assistant-based system to help you with the care of elderly patients?	
12	Digital assistant	What functionalities should a digital assistant-based system have to assist you in your tasks as a formal caregiver?	
N°	Phase	Questions	Notes
1	Pre-discharge	What are the main activities a formal caregiver achieves during the pre-discharge phase?	
2		As a formal caregiver, what are your needs during the pre-discharge phase?	
3		For a formal caregiver, what are the difficulties encountered during the pre-discharge phase?	
4		In your opinion, what activities from the pre-discharge phase could be optimized?	
5		In your opinion, what functionalities would be needed for a digital assistant-	



		based system in order to facilitate the pre-discharge process?	
6		During the pre-discharge phase, with whom in the health care system do you need to interact to gain information about the care process or the elderly patient?	
7		In the pre-discharge phase, what information do you need to have to care properly of elderly patients?	
1	Post-discharge	For a formal caregiver, what are your needs during the post-discharge phase?	
2		For a formal caregiver, what are the difficulties encountered during the post-discharge phase?	
3		What are the main activities a formal caregiver achieves during the post-discharge phase?	
4		In your opinion, what activities from the post-discharge phase could be optimized?	
5		In your opinion, what functionalities would be needed for a digital assistant-based system in order to facilitate the post-discharge process?	
6		During the post-discharge phase, with whom in the health care system do you need to interact to gain information about the care process or elderly patients?	
7		In the post-discharge phase, what information do you need to have to care properly of elderly patients?	

7.1.3 Interview - Informal caregivers

- Step 1: Project introduction - Introducing the goal of the project.
- Step 2: Demographics information
- Step 3 : General questions
- Step 4 : specific questions to informal caregivers

Step 1: Project introduction

Thank you for your time and interest in our study. First, we will start by giving you a brief introduction of the project. H2HCare is an international research project that is working on the design and development of a digital assistant-based system that aims to offer support and assistance for elders suffering from heart failure during their transition from hospital to home care. In order to define customizable and integrated support services, we conduct interviews with a set of participants who would be in contact with such digital assistant-based system. To give you an example of the type of applications we envision for informal caregivers, the system could facilitate the management of the post-discharge treatment by receiving the right information regarding the treatment, for example. The system could also monitor seniors' daily life activities, which could help with the follow-up of the



adherence to post-discharge treatment and lifestyle changes. Ultimately, the system could also prevent incorrect medication dosages by providing care and treatment advice.

Step 2: Demographics information

(To be filled in by the researcher)

- Age
- Gender
- Level of education
- Nationality
- City and country of residence
- Informal caregivers context :
 - Who are they helping?
 - How (what main tasks)?
 - How old are the people they are helping?
 - Since when the person they are helping is diagnosed with heart failure?

Step 3: General questions

Table 29: General questions to informal caregivers

N°	Type	Questions	Other related questions
1	Discharge process	What is the discharge process for patients with heart failure?	<ul style="list-style-type: none"> - What does the discharge process look like? - How many steps/phases the discharge process encompasses? - What is the general timeline for the discharge process? For each main phase of the discharge process, what is their duration in time? - Who are the main stakeholders (care-related) involved in the discharge process?
2	End-user interaction	For each discharge phase, which care-related stakeholder has the most importance (in terms of involvement)?	
3	End-user involvement	Which phases of the discharge process are completed by formal professionals?	<ul style="list-style-type: none"> - Which phases of the discharge process are completed by informal caregivers? - Which phase(s) of the discharge process are completed by older patients? (Ex: taking medication during the post-discharge phase)
4	End-user needs	What are the general needs you would identify during the discharge process? (for all end-users)	



5	End-user challenges	What are the general difficulties you would identify during the discharge process (for all end-users)?	
6	Discharge process	In your opinion, what could be improved in the discharge process? (at all stages/phases)	
7	Digital assistant opportunities	In your opinion, do you think a digital assistant-based system could help improve the discharge process?	
8	Digital assistant opportunities	In your opinion, which type of help could a digital assistant-based system provide during the discharge process?	- At what stage of the discharge process? - Which care-related stakeholder could be impacted?
9	Digital assistant opportunities	In your opinion, which type of difficulties could a digital assistant-based system tackle for the discharge process?	

Step 4: Specific questions to informal caregivers

Table 30: Specific questions to informal caregivers

N°	Topic	Questions
1	End-user needs	In general, what would be the needs of an informal caregiver involved in care processes for patients of heart failure?
2	End-user needs	As an informal caregiver, what do you feel you need to care properly for an elderly patient suffering from heart failure?
3	End-user challenges	In general, what would be the challenges or difficulties for an informal caregiver involved in care processes for patients of heart failure?
4	End-user challenges	As an informal caregiver, what are the challenges or difficulties you encounter while caring for an older patient suffering from heart failure?
5	End-user tasks	As an informal caregiver, what are the main tasks you perform in order to care properly of your older patient? For said number of tasks, could you give a ranking of importance?
6	End-user network	With which interlocutors from the health care system do you need to interact in order to care properly for your older patient? How often do you need to interact with them? Please rate the importance of your interaction with the interlocutors previously mentioned.
7	Information	What type of information do you need from health care professionals so you can properly care for your older patient?
8	Information	What type of information do you need to know about your elderly so you can properly care for him/her?
9	Involvement	How much involvement do you have in the care of your elderly? If possible/applicable, would you like to be more/less involved at a specific stage (pre/post-discharge) of care?
10	Digital assistant	In your opinion, could a digital assistant-based system help/assist you with the elderly care? And if so, how?
11	Digital assistant	Would you be open to the idea of having a digital assistant-based system to help you with the care of your older patient? How about your elderly?
12	Digital assistant	What functionalities should a digital assistant-based system have to assist you in your tasks as an informal caregiver?
N°	Phase	Questions



1	Pre-discharge	What are the main activities an informal caregiver achieves during the pre-discharge phase?
2		As an informal caregiver, what are your needs during the pre-discharge phase?
3		For an informal caregiver, what are the difficulties encountered during the pre-discharge phase?
4		In your opinion, what activities from the pre-discharge phase could be optimized?
5		In your opinion, what functionalities would be needed for a digital assistant-based system in order to facilitate the pre-discharge process?
6		During the pre-discharge phase, with whom in the health care system do you need to interact to gain information about the care process?
7		In the pre-discharge phase, what information do you need to have to care properly of your older patient?
1	Post-discharge	For an informal caregiver, what are your needs during the post-discharge phase?
2		For an informal caregiver, what are the difficulties encountered during the post-discharge phase?
3		What are the main activities an informal caregiver achieves during the post-discharge phase?
4		In your opinion, what activities from the post-discharge phase could be optimized?
5		In your opinion, what functionalities would be needed for a digital assistant-based system in order to facilitate the post-discharge process?
6		During the post-discharge phase, with whom in the health care system do you need to interact to gain information about the care process?
7		In the post-discharge phase, what information do you need to have to care properly of your older patient?

7.2 Table of main services offered by H2HCare

Table 31: Main services offered by H2HCare

Type of service	Description of service	Targeted end-user
Care support network	Not having a proper care support network in place to reduce patient anxiety or worries	Primary
Recovery management	Patients and family caregivers lack sufficient knowledge and skills to optimize self-management in recovery and avoid hospital readmission if unexpected deterioration occurs.	Primary
Formal recovery management	Patient difficulties in adherence to post-discharge instructions, e.g. medication usage or behavioural changes.	Primary
healthcare processes management	Time-consuming process for the health professionals due to the lack of accurate monitoring and follow-up support leading to hesitations in discharging patients and unnecessarily prolonging hospitalization.	Secondary / Tertiary