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Summary

D2.1 User Research Report is aimed at 1) assessing the state of the art in the scientific field and the type of services that are offered by home-care providers (public/private) to people within the established target of the SAVE project. The specific differences, challenges and offers among the involved European countries (Romania, Italy and Hungary) are discussed. 2) present the User Cantered Design methodology used in the SAVE project and discuss the preliminary results of the first co-design performed in Romania, Italy and Hungary.

1. State of the art

1.1. Position, location and orientation services

The study of the European Commission on the challenges in long-term care in Europe reviews the national policies of the member states (Coster et al., 2018) thoroughly. The study describes so well the Long-term Care (LTC) landscape in Europe that selected excerpts we decided to bring here:

„National LTC arrangements for the elderly (65+) vary substantially among the 35 countries under scrutiny in terms of organisation, funding and types of care offered. However, there are three trends and challenges common to many of them."

"First, most European countries face issues relating to access to and financing of LTC systems, due to the institutional and geographical fragmentation of LTC provision. This is problematic, also regarding the quality of LTC which remains a critical factor in maintaining and improving the quality of life of frail elderly people both in residential and home care settings."

"Second, there has been a clear trend towards prioritising home care. However, home care services and community-based care are the most difficult to access in many countries, since they are underdeveloped. One of the consequences of the importance given to home care and community-based provision has been that the availability of residential care has been decreasing in several countries over the past 25 years. Indeed, in countries with a long tradition of residential care, especially the Nordic countries, the process of deinstitutionalisation is highly visible. However, Southern and Eastern European countries have been increasing residential places, even though the demand for care considerably – and increasingly – exceeds the supply. In this context, several ESPN experts have pointed to a strong long-term trend towards the privatisation and marketisation of LTC and rapid growth of a commercial sector (e.g. BE, DE, DE, FI, LT, RO, UK). Homecare

also goes hand in hand with prevention and rehabilitation strategies, to enable the elderly to live independently and to keep them physically, mentally and socially active for longer. Nevertheless, only some countries have successfully implemented such strategies (e.g. DE, DK, LU, PT, as well as more recently FR, UK/England and Scotland)."

"Third, in all 35 countries analysed there is a high incidence and expansion of informal care, mainly due to the lack of accessible formal LTC facilities, the poor quality and the high cost of LTC as well as the traditional model of intergenerational and familial relations. Despite cultural changes, new attitudes and relative progress in the distribution of caregiving tasks, women continue to take responsibility for and carry out the bulk of caregiving. This negatively impacts female labour market participation. In spite of these challenges, only a limited number of countries have well-developed services (e.g. training, counselling, respite services) tailored to informal carers. Last but not least, domestic workers, often migrants, play an increasingly important role in informal care in many countries: the issues of their qualifications and working conditions need policy responses in many countries." (page 9)

„The health system is responsible for the care provided by health professionals, while services related to supporting the care-dependent person in the activities of daily life are usually organised by the social sector. Only some countries organise their system in a way which integrates health and social care horizontally (e.g. DK, IE, PT). In most countries, this horizontal split between the health and social sectors is accompanied by a vertical division of responsibilities, with powers attributed at different institutional levels: national, regional and local (e.g. AT, BE, BG, CH, CY, CZ, DE, EE, EL, ES, FR, HR, HU, IT, LI, LT, LV, MK, NO, PL, RO, SI, UK)" (page 6)

„In most countries there is, first of all, a horizontal sharing of responsibilities between the health and social care sector in terms of regulation, funding and service provision (e.g. AT, BE, BG, CH, CY, CZ, DE, EE, EL, ES, FR, HR, HU, IT, LI, LT, LV, MK, NO, PL, RO, SI, SK, UK [apart from Scotland]). Many ESPN experts highlighted that this horizontal division hampers coordination of care and in some countries the fragmentation even hampers service provision, due to political discord on who should pay what (e.g. LT). Some countries have managed to organise their system in a relatively integrated manner between health and social care (e.g. IE, DK, UK/Scotland, PT)." (page 12)

„In many countries (e.g. AT, DE, DK, ES, FI, FR, IS, LI, LU, NO, SE, SI), home care (care provided in and around the elderly person's own home) has priority over residential care (where the dependent person lives in a residential setting). However, in many countries formal home care services for the elderly remain underdeveloped (e.g. BG, CY, EE, EL, ES, HU, IE, MK, PL, RO, TR). " (page 6)

„In order to enable the elderly to live independently and to keep them physically, mentally and socially active as long as possible (and thus in order to prevent reliance on care services and social isolation), prevention and rehabilitation strategies are of the utmost importance. However, only some countries have successfully implemented such strategies (e.g. DE, DK, LU, PT, as well as more recently FR, UK/England and Scotland). " (page 6)

„Similarly, in many countries residential care facilities for the elderly are underdeveloped (e.g. EE, EL, HR, HU, MK, PL, RO, TR), while in others supply has been reduced as a result of policies aiming for deinstitutionalisation13 (e.g. DK, FI, IS, NL, SE, NO). Since demand largely exceeds supply in many countries, a private commercial sector for those care dependent persons who can afford it (e.g. CY, EL, HU, MK, MT, PT, RO, RS, TR, UK) and ineffective use of healthcare provisions (e.g. extended stay in hospital awaiting discharge) have emerged. " (page 6)

„LTC for the elderly provided by health professionals such as nurses physiotherapists and general practitioners is typically regulated and funded at national level (e.g. BE, CH, CY, CZ, EL, FR, HR, HU, IE, LI, LT, LV, MK, NL, PL, RO, SI, UK) and sometimes at the regional level (e.g. DK, IT)." (page 12)

„Social care for the elderly, which includes care services that aim to help the care-dependent person to carry out activities of daily life (such as household tasks, eating etc.), is funded and regulated at the national (e.g. BG, CY, EL, HU, IE, IT, LU, MK, MT, SI), at the regional or local level (e.g. DK, FI, LV, NO, UK), and often as a mix between these three levels (e.g. AT, BE, CH, ES, FR, HR, HU, IS, LI, LT, NL, PL, RO, RS, TR). Ensuring provision of social services is often a responsibility of the regions (e.g. AT, BE, CH, ES, FR, HR, IT, MT, NL, RO) and municipalities (e.g. BG, DK, EE, EL, IT, LT, CY, FI, IS, NL, NO, RO, SI, TR, UK). Home care is most often provided by the municipalities. Some countries also have state run LTC services, in particular for residential care (e.g. BG, EL, HR, LV, MT, SI, RS, TR, UK) or homes run by pension funds (e.g. MK). LTC care can be provided by public providers/municipalities, not-for profit organisations, private for profit providers and individuals, usually contracted or co-funded by the municipalities (e.g. AT, BG, BE, CY, CH, CZ, ES, FI, IS, LV, MT, NL, NO, SI, TR). Care providers may also be contracted by care insurance bodies (e.g. DE)." (page 12-13)

„LTC relies heavily, in all 35 European countries covered in this Synthesis Report, on the care provided by informal carers, mainly spouses and children of the care-dependent person. In most cases, they are women. In some countries, family responsibilities between children and parents are enshrined in law (e.g. HU, LV, LT). Countries vary greatly in the extent to which the informal carer is supported by public policies. A limited number of countries grant cash benefits directly to the carer (e.g. CH, FI, HU, IE, UK) and many countries have care leave schemes, that allow caring relatives to take some time off from gainful employment or to reduce their working time." (page 7)

„Home care first of all, includes assistance in the activities of daily life (bathing, clothing, eating, shopping, cooking, etc.). This can be provided by professional services or by individuals. In some countries (e.g. BG, FI, RO, SE, DK) the elderly can appoint a person to carry out care tasks – often a female family member – provided that they enter into an employment contract with the public authorities. In Sweden, this rarely happens in practice. Home care furthermore includes subsidised food services (meals on wheels or meals provided in a service centre) (e.g. BE, DK, FI, HU, MT, PT, RS, SI), alert systems through which the elderly can connect to a help post in case of need (e.g. BE, FI, HU, LV, MT, UK), nursing and technical aids and devices such as nursing beds (e.g. DE, DK, EE, FI, LV, UK), support to adapt private houses (e.g. DE, DK, FI, FR, RO, UK), social counselling (e.g. EE, FI), tele-assistance (e.g. ES, FI) and handyman services (e.g.FI, MT).” (page 13-14)

„In many countries home care has priority over residential care (e.g. AT, DE, DK, ES, FI, FR, IS, LI, LU, NO, SE, SI). The Nordic countries in particular have made major efforts to make it easier for people to stay as long as possible in their own homes and to reduce the number of people living in institutions (e.g. DK, FI, IS, NL, SE).” (page 14)

„In several other countries, home care services for the elderly are underdeveloped (e.g. EE, EL, HR, HU, MK, RO, TR). As a result, only a limited number of people in need of LTC can enjoy these services. In still other countries, important efforts have been made recently to strengthen home care (IE, HU, LV), often with support from the European funds (e.g. BG, EL, EE, IT, LT, SI, RS). In recent years, several countries have tightened their eligibility criteria, restricting services to individuals with the most severe care needs (e.g. EL, HU, IE, SE, UK/England). This tightening of eligibility has usually been driven by austerity policies. In some countries, measures seriously restricting access to services were taken in response to the 2008 financial crisis (e.g. EL, IE, UK/England).” (page 14)

“In nearly all countries, out-of-pocket payments (OOPs) may be required both for home care services and for residential care. In some countries, the full price is directly paid by the resident (e.g. AT, EE). In some countries, home care services are free of charge (e.g. DK, TR and LU) or charges are very low (e.g. MT, BG, SE, Scotland, Wales and Northern Ireland). OOPs for home care are means-tested in the UK. Accommodation costs (meals, housing) in residential settings are usually borne by the residents (e.g. AT, BE, CH, DE, DK, FR, LU, MK, NL, SI). In case of insolvency of the cared for, the family bears these costs in many countries (e.g. BE, EL, HU, LV, MK, RO,). There may be a cap on the price (e.g. HR), on the total amount to be paid by the resident (e.g. DK, SE) or on the amount as percentage of the income (and assets) due (e.g. AT, HU, IE, IS, LT, LV, MT, NO, NL, RO) in public care homes. In many countries, a certain amount or percentage of the residents’ income is safeguarded as pocket money (e.g. AT, IS, LU, LV, MT, UK). OOPs can also depend on the income of the resident (e.g. HU, IE, IT, LT, LV, MT, NL, NO,

PL, RS, SI, UK,) or the income of both of the resident and his family (e.g. MK, RO). In some countries a cash benefit can be used to (partially) cover the cost of the formal services, both for home care and residential care (e.g. AT). In most countries, municipalities (e.g. AT, BE, DE, LT, LV, NL, RO, SI), the state/region (e.g. AT, IE, FR, LU, MK) or insurers (e.g. CH) cover the costs of those care-dependent persons who themselves, or their relatives, are unable to pay the cost of the care. Accommodation costs for residential care are usually borne by the resident." (page 15)

„In some, mostly Nordic, countries, formal services have priority over cash benefits (e.g. DK, FI, IS, NO, SE, UK), while in others the LTC system is predominantly based on cash benefits (e.g. AT, CY, IE, IT, LT, RO). In some countries, beneficiaries can choose between cash, formal care or a combination of both (e.g. AT, CY, DE, LU, NL, UK), in others such a combination is not possible (e.g. ES). A choice can also be required between a personal assistant (such as a family member employed by the municipality) or an equivalent monthly indemnity (e.g. RO, UK)." (page 16)

„Several ESPN experts have pointed to a strong long-term trend towards the privatisation and marketisation of LTC (e.g. BE, DE, FI, LT, UK). In some countries (SE, UK/England), private for-profit and non-profit institutions have developed as a result of deliberate policies to increase competition and create markets in LTC provision. In many countries, private for-profit care institutions qualify for public funding (e.g. BE, DE, DK, EL, ES, FI, FR, SI, SE, UK) or public authorities contract a number of beds in commercial homes (e.g. MT, TR). ESPN experts in these countries highlight the rapid growth in the commercial sector. Shortages in formal care have encouraged some countries to set up cash benefit schemes, to enable care-dependent people to purchase care from private providers (e.g. ES, LV, MT). Some ESPN experts highlight that the establishment of personal care budgets will boost the market for private for-profit providers (e.g. FI). In countries with severe shortages of publicly provided formal care, a private commercial sector for those care-dependent persons who can afford to pay for it themselves has emerged (HU, LV, MK, MT, RO, RS, TR, EL, UK). Box 1 illustrates some cases of marketisation of LTC services." (page 18-19)

To underline the above statements, the participating countries of the SAVE project reviewed the market of assistive technologies in their countries.

Assisted LTC relies very much in LBS (Location-Based Services). The state-of-the-art in the LBS communication protocols is LISP – "Location (from) Identity Separation Protocol" (D. Saucez, et al. 2016, T. Balan, et al. 2016).

LISP communications networks are able to facilitate the mobility of portable devices (smartphones, wearable devices etc.) and their transition to IPv6. As the number of users (human or instrumental) is constantly growing, routing policies, multi-homing and traffic engineering have

significantly increased the size of routing tables. The contribution of LISP to meet these challenges is to replace IP addresses with two very useful and at the same time new components. These two components are: RLOC (Route Locator) which describes how a device is attached to the network and can also be used to redirect packets over the network and EID (Endpoint Identifier) that which gives information about the identity of the device.

Implementing a communication network using the LISP protocol can create a complex, incrementally implementable, network-based architecture that allows service providers to simplify multi-homing routing, facilitate highly scalable network virtualization, support machine mobility related virtual resources in the Cloud and reduce operational complexities. The two factors that improve the scalability properties of Internet routing are: Multi Homing and Security. With the help of these two very important IP pillars there can be achieved goals that come to the aid of users such as reaching the availability of hosts through Internet connection in a proportion of almost 100%. Multi-homing refers to a host computer that has multiple IP addresses on connected networks.

A "multihomed" host is physically connected to several data links that may be on the same or different network. For example, a Windows platform with more IP addresses may be called "multihomed" and may serve as an IP router. Using Stream Control Transmission Protocol (SCTP), multihoming allows a single point SCTP to support multiple IP addresses, which means that one session is more likely to survive a network failure. In a single-homed session, a network failure can isolate the final system or make the transport temporarily unavailable. Multihoming means that redundant local area networks (LANs) can be used to support local access. To reduce the effects of failures, various approaches can be taken, such as using addresses with different prefixes to force routing via different operators or even using redundant networks, which can reduce failure. It is commonly used in Web management for load balancing, redundancy and disaster recovery. LISP is more than just a scalability solution; it provides both inbound and outbound traffic techniques, it can be used as a routing-level IPv6 transition, and can be used for inter-domain multicast.

LISP has the potential to support Internet mobility of devices and to support the mobility of virtual machines in multi-location data centres and VPNs. These last two uses are not discussed further, as they do not apply to ”SAVE”. Multi-homing can have three implementation methods: host level, classic multi-homing and multi-homing with multiple addresses. A single host can be connected to multiple networks. For example, a mobile phone may be connected to a WiFi and 4G network simultaneously, and a desktop computer may be connected to both a home network and a VPN. A multihomed host is usually assigned multiple addresses, one on a connected network.

In classic multihoming, a network is connected to several providers and uses its own range of addresses (usually from an independent provider). Network edge routers communicate with

providers using a dynamic routing protocol, usually BGP (Border Gateway Protocol) which announces the network address range. If one of the connections fails, the dynamic routing protocol recognizes the failure in seconds or minutes and reconfigures the routing tables to use the remaining connections transparently to the hosts, expensive because it requires the use of the address space accepted by all providers, an autonomous public system (AS) number and a dynamic routing protocol. Because the multihomed address space cannot be aggregated, it increases the overall routing table.

In this approach, the network is connected to multiple providers and is assigned multiple address ranges, one for each provider. Hosts are assigned multiple addresses, one for each provider. Multi-address multihoming is cheaper than classic multihoming and can be used without any cooperation from providers (for example, in a home network), but requires additional technology to perform routing:

• For incoming traffic, hosts must be associated with multiple DNS A or AAAA records so that they can be accessed by all providers;

a. DNS A means that the record returns a 32-bit IPv4 address, most commonly used to map the host name to a host IP address, but is also used for DNSBL, storing subnet masks. DNSBL (Domain Name System-based Blackhole List) is an effort to stop email spam.

b. DNS AAAA means that the record returns a 128-bit IPv6 address, most commonly used to map the host name to a host IP address.

• For outbound traffic, a technique such as source-specific routing must be used to route packets through the correct provider, and reasonable source address selection policies must be implemented by hosts.

For LISP, most threats can be mitigated using current best practices, i.e. with careful implementation and configuration (e.g. filtering), by activating only the functions that are really needed, and by checking all the information, obtained from third parties. Unless cleaning functions are used, the LISP data plan has the same level of security as other IP-over-IP technologies. From a security perspective, the control plan remains the critical part of the LISP architecture. To mitigate threats to the mapping system, authentication for all messages in the control plan should be used. The current specification defines security mechanisms that can reduce threats in open network environments.

The LISP specification defines a generic authentication data field for control plan messages, which could be used for a general authentication mechanism for the LISP control plan, while remaining backward compatible.

LISP means a network architecture and a set of network-mapped and encapsulated protocols based on the requirements of the Internet Engineering Task Force (IETF) in RFC 6830 that documents IP address separation in two new numbering spaces: Endpoint Identifiers (EIDs) and Routing Locators (RLOCs). By introducing this separation, new capabilities for mobility, scalability and security are made available. This approach contrasts with the traditional practice of using a single numbered address - an IP address - to represent both identity and location.

Packets reaching ITR (Input Tunnel Router) or PITR (Proxy Ingress Tunnel Router) cannot be encrypted, which means that no data protection or privacy is added. When the source host encrypts the data stream, the encapsulated packets must not be encrypted by LISP.

Addressing in the LISP architecture:

A) Endpoint Identifier (EID)

An EID is an IPv4 or IPv6 address used in the source and destination address fields of the first (innermost) LISP header of a packet. In the case of IPv4 it has a value of 32 bits and in the case of IPv6 it is a value of 128 bits. These values are used in the source and destination fields of the first LISP header of a packet.

B) Routing Locator (RLOC)

A RLOC is an IPv4 or IPv6 address of an output tunnel router (ETR). An RLOC is the result of an EID-to-RLOC mapping search. The RLOC namespace is used in the kernel. RLOCs are used as infrastructure addresses for LISP routers and ISP routers and are routed globally in the core infrastructure, just as they are today. The hosts do not know about the RLOC, and the RLOCs do not know about the hosts.

Main components of the LISP architecture:

1. Ingress Tunnel Router (ITR)

An ITR is a device that is the starting point of the tunnel; receives IP packets from the final systems of the site on the one hand and sends LISP encapsulated IP packets, on the Internet to an ETR, on the other side. An ITR is responsible for finding mappings between EID and RLOC for all traffic dedicated to LISP sites. When the ITR receives a packet dedicated to an EID, it first searches for the EID in its cache. If ITR finds a match, it encapsulates the packet inside a LISP header with one of its RLOCs as the source IP address and one of the RLOCs in the mapping cache entry as the IP destination. The ITR then routes the packet normally. If no entry is found in the ITR mapping cache, ITR sends a Map-Request message to one of its configured map resolvers and then discards the original packet. When ITR receives a response to its Map-Request message, it creates a new mapping cache entry with the contents of the Map-Reply message. When another packet arrives,

such as a retransmission for the original packet and now discarded, the new mapping cache entry is used for encapsulation and forwarding.

2. Egress Tunnel Router

An EID is an IPv4 or IPv6 address used in the source and destination address fields of the first (innermost) LISP header of a packet. An ETR connects a site to a LISP-capable part of a core network (such as the Internet), publishes EID-to-RLOC mappings for the site, responds to Map-Request messages, and decapsulates and delivers LISP-encapsulated user data to systems - final the site. During operation, an ETR sends periodic map recording messages to all its configured map servers. Map-Register messages contain all EID-to-RLOC entries for EID numbered networks that are connected to the ETR site. An ETR that receives a Map-Request message verifies that the request matches an EID for which it is authoritative, constructs an appropriate Map-Reply message that contains its configured mapping information, and sends this message to the ITR whose RLOCs are listed in the Map-Request message. An ETR that receives a LISP encapsulated packet that is directed to one of its RLOCs decapsulates the packet, verifies that the inner header is intended for a final EID counting system at its site, and then transmits the packet to the final system using the site - inner routing. The ETR feature is typically implemented in the customer-premises equipment (CPE) router and does not require hardware changes on software switched platforms, such as a Cisco Integrated Services Router (ISR). The same CPE router will often offer both ITR and ETR functions and, in this regard, is referred to as xTR.

3. Proxy Ingress Tunnel Router (Proxy ITR)

A PITR is used for inter-networking between non-LISP and LISP sites. A PITR acts as an ITR, but does so on behalf of non-LISP sites that send packets to destinations on LISP sites. A LISP PITR implements database-based ITR searches and LISP encapsulation functions on behalf of non-LISP sites. PITRs are typically deployed near major internet exchange points (IXPs) or ISPs to allow non-LISP customers on those networks to connect to LISP sites. In addition to implementing ITR functionality, a PITR also advertises some or all of the EID prefix space that cannot be directed to the non-LISP Internet part that it serves so that non-LISP sites will direct traffic to PITR for encapsulation and redirection to LISP sites.

4. Proxy Egress Tunnel Router (Proxy ETR)

A LISP PETR implements ETR functions on behalf of non-LISP sites. A PETR is typically used when a LISP site needs to send traffic to non-LISP sites, but the LISP site is connected through a service provider that does not accept non-reusable EIDs as packet sources. PETR implements ETR functions on behalf of non-LISP sites. A PETR is typically used when a LISP site needs to send traffic to non-LISP sites, but the LISP site is connected through a service provider's access network

that does not support unrecoverable EIDs as sources of packets. A PETR can also serve as a method for EIDs and RLOCs to communicate in a LISP site that contains EIDs in a family of addresses and RLOCs in a family of different addresses. A dual-stacked PETR also provides multi-address family support for LISP EIDs within an address family so that it can communicate with non-LISP destinations in the same address family through a core network within an address family - families of different addresses.

1.2. The human centric approach challenge

To determine whether a design product can or cannot accommodate these human needs, designers must be aware of the target user characteristics, adopting a user driven approach. Commonly known as User Cantered Design (UCD), this approach is defined in the ISO standard on Human-cantered design for interactive systems (ISO 9241-210, 2010) as the iterative process of designing an item from the perspective of how it will be used and understood by users. This systematic procedure advocates strong adherence to a path during which:

1. a multidisciplinary and experienced team is engaged in the definition of the "user profile", tasks and the environment analysis,
2. an in-depth involvement of end-users is assured throughout design and iterative development process,
3. a user-cantered evaluation strategy is planned to face, drive and refine the design addressing the whole user experience.

Adopting a human centric approach implies that a multidisciplinary and experienced team is engaged to go beyond the cited gap between the user profile and the designer profile. Different viewpoints can strengthen the design approach, arising awareness on constraints, realties, enablers and barriers and defining the user profile in their needs, expectations and limitations/ barriers. Besides, geriatric medicine researchers are strongly recommended to be actively involved in ICT research projects to identify significant clinical outcomes, as well as to aim for cost-effectiveness of longterm care in different living settings (Lattanzio et al., 2014).
By answering some simple questions (Thielke et al., 2012), this experienced team can target technology and accomplish benefits for users (whether they are primary, secondary or tertiary users): which level of need does my device address? Will my device fully satisfy the users' needs? Are these needs addressed through my device? Not only has a deep focus on needs but also on limitations and barriers contributed to characterize the user's model.

The main barriers in applying AAL technologies for seniors depend on psychological resistance of elderly users, especially related to a deep bond to their memories and their previous lifestyle, which causes an apriori rejection of changing in behaviour or habits. This condition creates the perspective that technology is an interfering, invasive and troubling complication (Lee and Coughlin, 2015; Van Den Broek et al., 2010).
In order to overcome such problems, it is strategic to spread awareness and knowledge among end-users about benefits and utility ensured by technology. Several studies (Thielke et al., 2012; Walsh

and Callan, 2010; Arning and Ziefle, 2007), have effectively underlined that older adults make use of technology to reach and realize some desirable outcomes and refuse devices with an unclear evidence of real benefits. Furthermore, another limitation depends often on poor system usability and a lack of support throughout use: tools are often so complex, difficult to control, and error-inducing. Perception of friendliness, ease-of-use, clear instructional material and constant technical support are factors to face the aforementioned lack of familiarity with ICT devices, the cognitive differences, and the incoming age-related declines, thus avoiding the overwhelming features, options and information (Mitzner et al., 2010).

1.2.1. The market of assistive technologies in Romania

Available assistive technologies for elderly in Romania:

Name of the company	Description of the service	Web page
IT Market SRL	Smart SOS bracelet, GPS, WIFI, elderly monitoring	https://www.emag.ro/bratara-smart-sos-gps-wifi-monitorizare-batrani-swsos-black/pd/DNJ5PNBBM/
Garmin	Drop sensor, as well as a GPS locator through an application, controlling in real time the location of the person wearing it.	https://itigic.com/ro/best-smartwatch-for-elderly-with-a-fall-sensor/
Samsung	Fitness and health features (including Sleep Score and Fall Detection)	https://www.samsung.com/ro/watches/galaxy-watch/galaxy-watch3-45mm-mystic-black-lte-sm-r845fzkaeue/
Twinkler TKY	Phone Function, GPS Location, Pulse Sensor, SOS, Pedometer, Route History, Fall Alert,	https://www.xkids.ro/ceas-smartwatch-pentru-adulti-twinkler-tky-d100-cu-functie-telefon-localizare-gps-senzor-puls-sos-pedometru-istoric-traseu-alerta-la-cadere-negru/
OMG solutions	Emergency system for elderly - location tracking, fall detection; 2 way communication; press SOS call button, mobile aps	https://omg-solutions.com/ro/emergency-device-for-elderly/

Red Button	Emergency button system for elderly Tele assistance platform for elderly	https://butonulrosu.ro/
Bocris	Location tracking	https://www.bocris.ro/dispozitiv-urmarire-localizare-gps-seka-ptn-de-mare-precizie-pentru-agenti-comerciali-copii-batrani-animale

1.2.2. The market of assistive technologies in Italy

Available assistive technologies for older adults in Italy:

Beghelli	Emergency button in different versiones	https://www.beghelli.it/salvalavita
Adamo	Wearable with monitoring and alarm system	https://www.adamo-vita.it/
Unirete	A provider that offer different products (form different producers) to support home safety of elderly: Fall detector Voice social alarm Outdoor and indoor localization	http://www.unirete.it/prodotti/telesoccorso.html

Neki	Offer a suit of (not integrated products) Fall detection Outdoor tracking	https://neki.it/index.html
aditech	Telecare and home monitoring solutions	http://www.aditechsrl.com/sport/attivita-e-gps/i-help-3g
Famil.care	Alarm botton	https://famil.care/per-anziani.html
Vero+	Emergency button	http://www.vebiro.eu/vero_plus/
Oplà AnteaMed	Emergency alarm and tracking	https://anteamed.it/telesoccorso/81571-oppla-sistema-con-chiamata-di-emergenza-e-telesoccorso-per-anziani-con-gsm-e-gps-fucsia-anteamed.html
Brondi superbravo+	Alarm button connected to home phone.	https://www.brondi.it/superbravo-plus-argento.html
Argo pro	Outdoor localization with alarm button	https://www.argopro.it/localizzatore-gps-anziani

1.2.3. The market of assistive technologies in Hungary

Available assistive technologies for elderly in Hungary:

Name of the company	Description of the service	Web page
Vivago	A call button to press in case of emergency, An automatic calling system that detects faintnesses and issues alerts, Monitoring the physiological activity, Available for connect sensors	https://sonaris.com/vivago-domi/
Spystore	GPS based location, SOS button, heart rate sensor, fall sensor	https://www.spystore.hu/gps-karora-ew100s-idoseknek-e124212.htm
Maxcom	SOS button with mobile phone	http://maxcom.hu/maxcom-mm715bb-mobiltelefon-idoseknek-sos-karpereccel
Kézenfogva	Call button to press in case of emergency	http://info.kezenfogva.hu/intezmenyek/20494-szemelyes-gondoskodast-nyujto-szocialis-alapszolgaltatasok-jelzorendszeres-hazi-segitsegnyujtas
Sorsközpont	Emergency button with fall sensor	https://www.soskozpont.hu/?gclid=EAIaIQobChMI-6XBrY_t5gIVFYuyCh1r7A5XEAMYASAAEgI_HfD_BwE
Vodafone-smart watch	voice calls with SOS message, GPS location, Heart rate and blood pressure measure	https://www.vodafone.hu/mobiltarifak/family/senior-okosora

2. Methodology for the definition of services

2.1. The user driven approach

As explained in the section before, user involvement is a significant aspect in system development. Typically, user involvement relates to participation in activities dealing with specifying, elaborating, prioritizing, reviewing and verifying the requirements, as well as testing the developed features.
Benefits derived from this strategy are copious (Damodaran, 1996): improved quality of the system arising from more accurately identified user requirements; avoiding costly system features that the

user did not want or cannot use; improved levels of acceptance of the system; greater understanding of the system by the user resulting in more effective use.
Consequently, a direct contact with potential users, enables designers to learn from older people what functionalities and attributes are important to them in new products, what motivates them, and what factors would hinder the usability.
The UCD approach is a process consisting of four fundamental activities related to user involvement (Figure 1):

a) user groups are specified and the context of use is described (Activity 1: understand and specify the context of use);
b) a set of specific requirements are defined in order to create a degree of fit between device and user (Activity 2: specify the user requirements);
c) the design prototype is produced on the basis of these specifications and it is presented to the user in the form of user testing (Activity 3: Produce design solutions to meet requirement);
d) once feedbacks from the user have been received, the process begins again until all user requirements have been met (Activity 4: evaluation).

As for its iterative nature, the process requires that information is gathered from the user at each step and actions are taken based on that, in order to interpret the information correctly. To this aim, the activities previously described, can be associated with a set of methods to be chosen and used on the basis of (Rekha Devi et al., 2012; Nedopil et al., 2013): type of users to be involved, context of use, nature of the product, constraints (such as time, effort, cost and access to users).

More than 200 methods coming from different areas of knowledge are used under the UCD framework, but in the context of the SAVE project the method of co-design will be adopted.

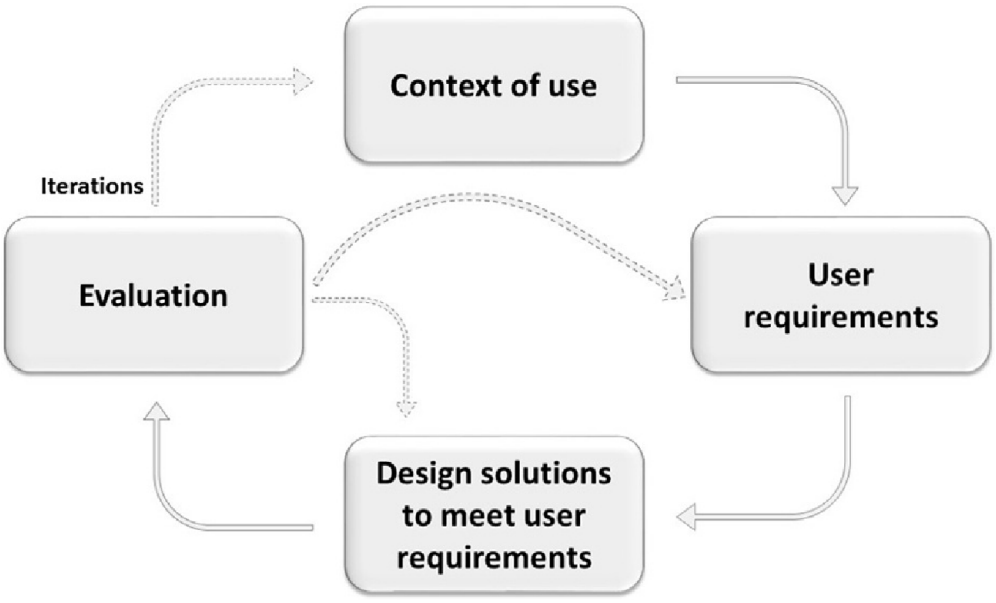


Figure 1. Interdependence of human-cantered activities (ISO 9241-210)

2.2. The co-design method

Co-design is often used as an umbrella term for participatory, co-creation and open design processes. In co-design, diverse experts come together, such as researchers, designers or developers, and (potential) customers and users—who are also experts, that is, "experts of their experiences" (Sleeswijk Visser, Stappers, Van der Lugt, & Sanders, 2005) to cooperate creatively. In this way, co-design becomes critical to service design since different perspectives are needed to understand both a service's demand side and its supply side in order to develop successful services. According to Steen et al. (2011) this method could lead to determine:

- benefits for the service design project itself, such as improving the creative process, developing better service definitions and organizing the project more effectively or efficiently;
- benefits for the service's customers or users, such as creating a better fit between the service offer and customers' or users' needs, a better service experience and higher satisfaction;
- benefits for the organization(s) involved, such as improving creativity, a focus on customers or users, cooperation between disciplines, and capabilities and enthusiasm for innovation.

Within the WP2 "End-user involvement and service feasibility" this method will be used to gather useful information for defining services of the SAVE platform by involved end users.

2.2.1. The target

As shown in Figure 2, at least 6 primary, secondary and tertiary end users will be involved in separate co-design sessions in each pilot site (Romania, Italy and Hungary);

- Primary end users are 65+ older adults suffering from moderate medical conditions or moderate impairments (mild dementia and/or disabilities),
- Secondary end users are formal and/or informal caregivers,
- Tertiary end users are stakeholders including care providers, public social service, end-user organizations, medical and nursing researchers.

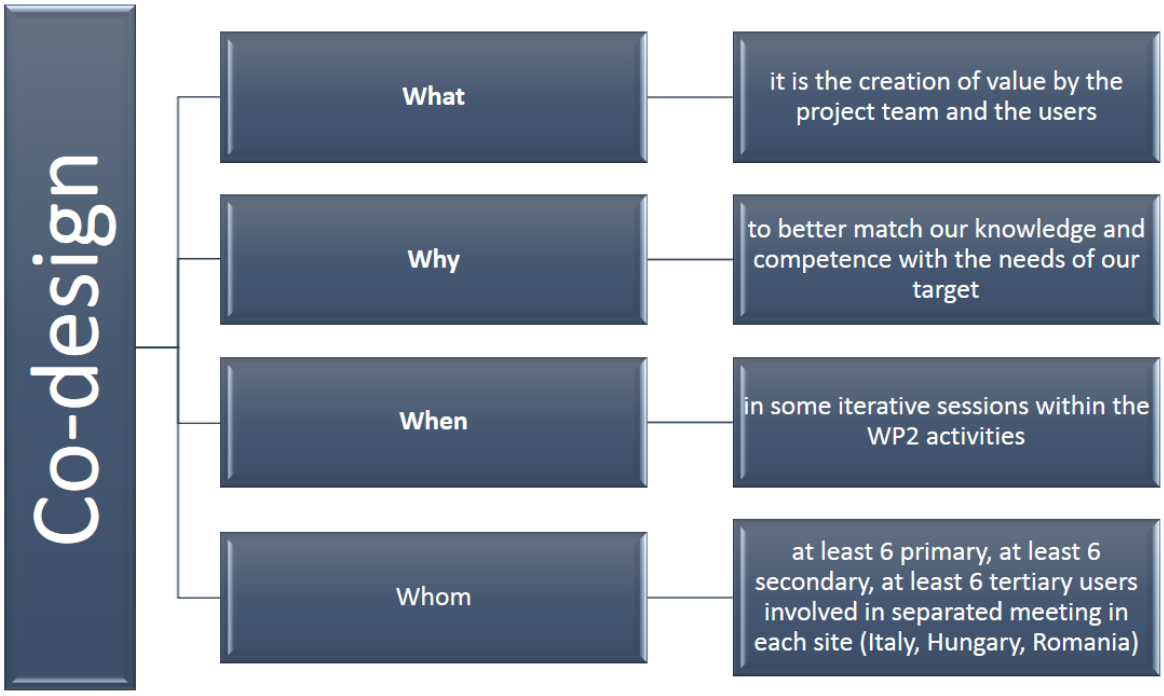


Figure 2. The rationale behind the co-design method

2.2.2. The tool

The tool used to show the concept idea of the services offered by the SAVE platform is the storyboard. Storyboards will be presented to the participants with some pre-defined elements such as drawing supplies and information that guide the participant without being prescriptive. A storyboard for each service has been created according to the template designed by Laboratorio delle Idee (Figure 3).

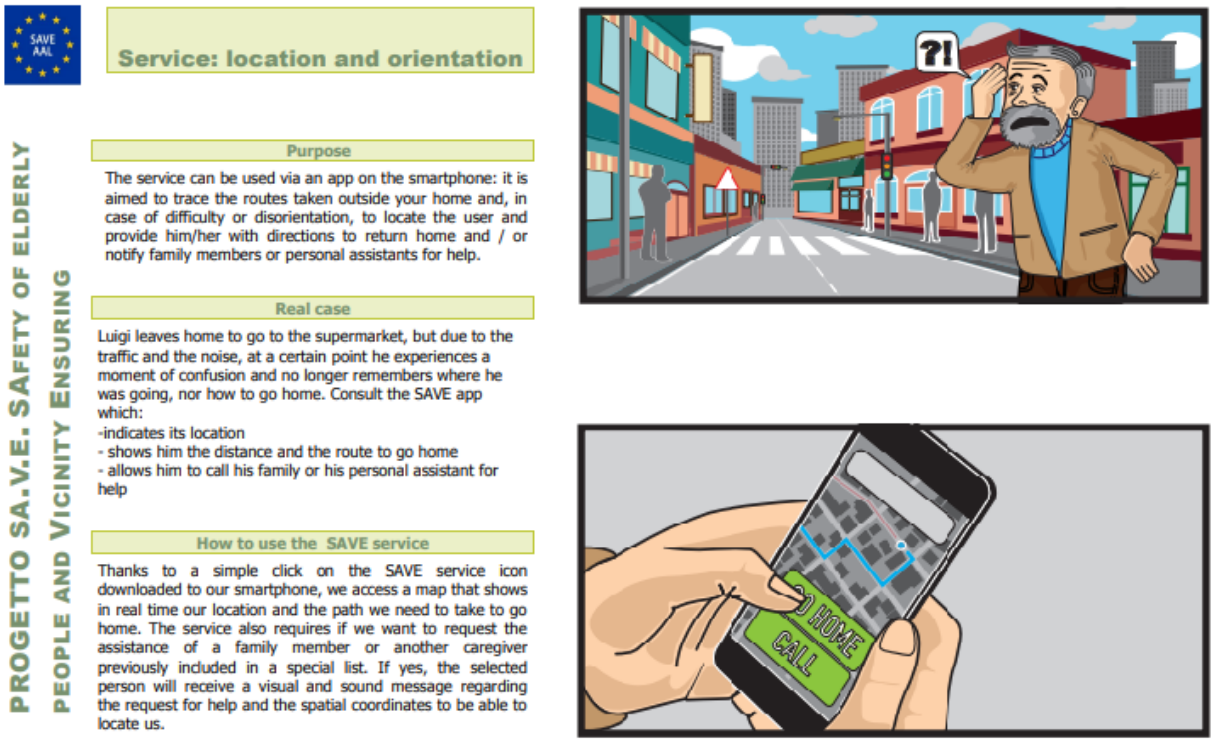


Figure 3. An example of storyboard used for the service location and orientation

2.2.3. Procedure to follow

After having collected the written informed consent (see Annex 1), the designers and/or the researchers will illustrate all the storyboards to the participants asking to feel free to think aloud about:

1) if and what is missing in the storyboard (features, services, or just suggestions to improve the system),
2) why it is interesting for them or not (which is the added value for them, pains and gains).

General guidelines to be followed by moderators in the three countries are listed below:

- Create a cosy atmosphere (introduction, information, get to know each other).
- Keep a neutral attitude.
- Stay focused, if the discussion deviates from the main theme.
- Define superficial terms precisely.
- Let people talk, let them finish speaking.
- Let some time for thinking, tolerate little breaks.

- Get involved into argumentation, if there is silence.
- Pay attention to body language of the participants (e.g. Why did you hesitate?).
- Ask if something hasn't been mentioned.
- Are there discrepancies in the results? Ask for them!
- Conclusion, thank you-gift and farewell

At the end of at least 30 minutes of thinking aloud, a service evaluation questionnaire will be administered (please, see Annex 2)

The questionnaire is composed by the following sections:

1. socio-demographic information
2. current use of modern technology
3. specific info about each service in terms of a) perceived utility/benefit, b) easy to use, c) availability to purchase

Users will respond on a scale from 1 to 7, 1 corresponds to the minimum value, 7 to the maximum value.

3. The pilot site profiles and their recruitment strategy

This section contains the information about each pilot site and the specific recruitment strategy that will be adopted.

3.1. Romania

Transilvania University of Brașov - UnitBv will collaborate for the Romanian pilot with the Direction of Social Assistance (DAS) from the Brasov City Council and from the Timișoara City Council and with "Hand to Hand" Association from Brașov. These 3 partners will host the Romanian pilot site (mostly WP2 and WP3) contributing to the psycho-social aspects of the project and, also, at testing scenarios and campaigns on the specific pilot. DAS is a public service for social assistance at local welfare providing social services for elderly especially for preventing social isolation.
Direction of Social Assistance is a public service for local welfare providing social services for elderly especially for preventing social isolation. DAS have different specific contributions for the elderly: safety elderly - tele assistance system; department for elderly social assistance; day program for assistance and recovery; service for home care and the most important "day centre for socializing and leisure club". The most important objectives for this organizations are:
- preventing and combating the risk of social exclusion - support for social reintegration and group membership, support for overcoming difficult situations.

- maintaining and improving mental, sensory abilities (training for cognitive functions, prevention of depression, cognitive decline and senile dementia and physical abilities (manual dexterity) - practicing different physical exercise.
- promoting the image of an active aging and social interaction between generations.

All these activities are inserted in group activities and occupational therapy supervised by social caregivers and psychologists.

SAVE Project responsibilities for Direction of Social Assistance:
- Ensuring the interface with the social caregivers of the end-users
- Providing the necessary data configuration of the equipment according to the needs of the end-users (walk program, physical activities, grocery shopping/market, visitors, etc.)
- Assuring the personnel who provides to the demanded extent: monitoring, intervention, care taking of end-users, communication with the users by sending notifications, messages.

SAVE Project responsibilities for Transilvania University of Brasov
- Installing the equipment at the customer's residence
- Configuration of the services in accordance with the end-users requirements and needs
- Training of personnel who is responsible for monitoring, intervention, care taking of the users
- Instructing the users regarding using services and system application
- Storing and processing of data, forwarding reports to the interested parties (caregivers, social service).

SAVE project obtained approval from the UnitBv ethics board for the requirements specification co-design study involving humans. The UnitBv recruitment strategy planned to recruit primary and secondary users from Direction of Social Assistance Brașov, from ”Hand to Hand” Brașov and DASM Timișoara associations for identifying possible participants according with inclusion/exclusion norms of the project in order to achieve target of the SAVE project. During this process, SAVE team will interact with potential users by explained and describe the benefits involved in the SAVE project. Furthermore, the participants will be informed about the purpose of the project and used methods in recruitment. All these activities were in accordance with the GDPR 2018 and the Romanian legislation on privacy and data protection.

3.2. Italy

INRCA is the leading Italian public Institute in gerontology and geriatrics, devoted to improve quality of life of older persons. It consists of five centres in Italy, comprising four geriatric hospitals, an Alzheimer day care centre, a nursing home and scientific and technology research units.

The objectives of the Institute are focused on successful ageing and the promotion of health of the older person and prevention. Social gerontology is one of the most important research fields, developed in both national and international sphere, cooperating with universities and other research institutes. Currently, there are four lines of research: (1) Biogerontology: cellular determinants, molecular and genetic aging, longevity and age-associated diseases; (2) Prevention and treatment of frailty: management of geriatric diseases and syndromes; (3) Aging and Medicines and (4) Multidimensional assessment and continuity of care. INRCA pursues its goal mainly in an interdisciplinary way, through clinical and translational research, training in the

biomedical field as well as in the organization and management of health care services, in particular by means of highly specialized hospitalization and health care.
For the SAVE project, the *Geriatrics Operative Unit* of INRCA will be involved. It aims at studying, screening, diagnosing and treating age-related diseases. In particular, this OU has a long-standing experience in the diagnosis and care of neurologically-based problems in adults and geriatric individuals (including MCI, mood disorders, etc.). The research activity is mainly focused on multidimensional aspects of aging, in particular by means of the use of Comprehensive Geriatric Assessment, including cognitive decline, quality of life, life-style, psychosocial and nutritional aspects in aging. It has a know-how on studying the multidisciplinary approach in aging. Moreover, for what concerns the research on the technology acceptance, the *Centre of Innovative Models for Ageing Care and Technology* aims at studying the needs of the elderly in the User Centred Design process, as well as the impact and acceptance of the technology to support everyday life, great emphasis is given to technological innovation, promotion and acceptance of technology for the elderly. The lab is indeed involved in various activities aimed at the study of usability and acceptance of smart environments to support the independence and autonomy of the elderly. This commitment is supported through regional, national and international collaborations with universities, research institutes and companies specializing in technology, home automation and artefacts from the house computer, without architectural barriers, with sensors that detect possible hazards, smart appliances and tools with communication interfaces easy for their remote control. For the analysis of Human-Machine and Human-Computer Interactions, and of the acceptability and usability of technology, the Centre benefits from the presence of the **Casamica Lab,** a smart home of about 60 square feet, located close to the Rehabilitation Unit of the INRCA hospital in Ancona. The intelligent environment consists of a kitchen, a bedroom and a bathroom, equipped with assistive devices and home automation technology. The Casamica lab was designed to enable greater independence of older people and to avoid their admission to care facilities. It represents a unique opportunity to directly test technology with the people in real life, thanks its strategic location.

The recruitment strategy at INRCA will be performed in the city of Ancona where a staff composed by a psychologist and a researcher will identify possible participants that met the target of the SAVE project within the organization and its wide network. The psychologist will contact primary and secondary end-users, ask them some screening questions for checking their inclusion characteristics, explained the study purpose and methods (i.e. co-design sessions) and propose them to take part in it. Individuals who accept to participate are provided with and asked to sign a written informed consent to data treatment in accordance with the GDPR 2018 and the national legislation on privacy and data protection.

3.3. Hungary

The Országos Orvosi Rehabilitációs Intézet (OORI) - in English the National Institute for Medical Rehabilitation (NIMR) - is the leading rehabilitation institute in Hungary. It was established in 1975. It has four hundred beds for in-patients, a day-time hospital, and several out-patient services. The main rehabilitation activities in the Institute are as follows: rehabilitation post-stroke, traumatic brain injury, spinal cord injury, other post-traumatic conditions, orthopaedic surgery,

and amputation. The Institute has an own chronic care department and cooperates with several nursing homes and home-care services.

In Hungary, the rehabilitation training of physicians and other professionals (physiotherapists, occupational therapists, nurses etc.) is based on NIMR. The Department of Physical and Rehabilitation Medicine (PRM) of Semmelweis University is located here. NIMR is an international training centre for PRM residents certified by the European Union of Medical Specialists (UEMS). The Institute has a new central building, the conditions for patient care and research are really excellent. It has a research programme for using advanced technologies in rehabilitation. In the scope of this programme NIMR took part at several European and other projects on the field of robotics and assistive technologies, among others in the DOMEO AAL-project (development and field test of a home-care robot), the iTOILET AAL-project (development and testing of an intelligent toilet for people with disabilities).

In the SAVE AAL project: NIMR contributes to WP2 End-user involvement and Service Feasibility and to WP3 Test and validation. NIMR takes care of the Hungarian pilot with 25 end-users, ensuring proper recruitment of end-users and pilot evaluation, providing service specifications and quality assurance, and contributing to end-user design and experience development (WP2), and will provide nursing service and quality care and its insights as care organisation.

The first testing of SAVE assistive technology is planned in a laboratory environment of NIMR. This can help identify potential issues and improvements even before the field inspection.

During the prototype field testing, communication with the user, technical support, tool evaluation is planned through an online communication interface, remote device access, or online questionnaire.

4. Mitigation actions after Covid outbreak

COVID-19 and the measures set in place to combat the pandemic have changed the way we plan the methodology previously described and therefore mitigation actions were agreed by the project partners. The main objective was to safeguard the end user's health and limit the risk of Covid-19 infection. In the following sections these actions are described for each pilot site and the data gathered are discussed.

4.1. Mitigation actions after Covid outbreak in Romania

All activities starting from the beginning of March until the end of May as well as in other countries were blocked due to SARS Cov 2. Circumstances were unpleasant for our potential end-users because their social contact was interrupted and our scheduled face to face meetings were suspended. Despite of new social rules and maintaining the safety rules, SAVE team decide to develop some cards/cartoons with services description on video or/and send them by post and they

should answer the questions by hand. The cards/cartoons containing the initial proposals for the possible services. The purpose of these cartoons was to kindle a discussion with the potential end-users and the caregivers on their real needs in the areas targeted by the project proposals. The answers to the questions were left in the postboxes, so one of the SAVE researchers collected them from each user. Our argument was that the share of the internet on Romanian elderly population is low 13% comparing with European elderly population 45%. (https://ec.europa.eu/eurostat/cache/infographs/elderly/index.html). Following the answers, each of the users was called to have their feedback and to understand their needs and the most important their expectation for our side according to SAVE proposal. Romania enrolled 8 elderly, 4 caregivers and 5 experts as stakeholders.

Table 1. Participants enrolled in Romania

Group	ID	gender	age	living condition	IT expertise
Older adults	1	F	78	single	yes
	2	F	78	single	yes
	3	F	69	single	yes
	4	F	82	single	yes
	5	M	75	single	yes
	6	M	90	single	yes
	7	M	89	single	yes
	8	M	83	with spouse	yes
Caregivers	9	F	49	With mother	yes
	10	M	58	With mother	yes
	11	F	50	With mother	yes
Experts	12	F	53	-	yes
	13	M	50	-	yes
	14	M	55	-	yes
	15	M	51	-	yes

4.2. Mitigation actions after Covid outbreak in Italy

Since the study was performed during the national quarantine imposed by the government of Italy after the growing pandemic of COVID-19 (March-May 2020), authors were obliged to reach users remotely by phone or using video conference platform.
For the same reason, prior to think aloud session, older adults and family caregivers watched a video that presented firstly the concept of the project and then the list of services offered by the SAVE system. The video took 15 minutes and was accessed through the YouTube platform. After the video, a researcher phoned each user to gather data.
Experts involved in the focus group checked independently a file received by email containing the list storyboards that represented the concept idea of services offered by the SAVE system and then joined the discussion within the group headed by a moderator. Italy enrolled 6 older adults, 6 family caregivers and 6 experts as stakeholders.

Table 2. Participants enrolled in Italy

Group	Participants n.	Gender	Age	Living condition	IT expertise
Older adults	P1	F	77	with spouse	yes
	P2	F	78	with spouse	no
	P3	M	77	with spouse	yes
	P4	F	67	with spouse	yes
	P5	M	75	with spouse	yes
Caregivers	P6	F	54	with mother	yes
	P7	M	39	with father	yes
	P8	F	47	with mother	yes
	P9	F	43	alone	yes
	P10	M	75	with spouse	yes
Experts	P11	F	35	-	yes
	P12	F	33	-	yes
	P13	F	39	-	yes
	P14	F	39	-	yes
	P15	F	38	-	yes

4.3. Mitigation actions after Covid outbreak in Hungary

NIMR first obtained the research ethics approval of the institutional ethics board for the requirements specification co-design study. NIMR planned to recruit primary and secondary users in pension clubs in Budapest and the suburban region. In February of 2020, NIMR scheduled personal meetings for March with the elderly with the support of the staff of the retirement clubs.

Due to the outbreak of the COVID-19 pandemic, the SAVE end-user participants had to find alternative ways to involve end-users in the co-design and co-creation actions. We asked the management of the pensioner clubs to contact and persuade some of their club members for the "non-presence" co-design session. For our luck, nowadays people over 65 are often using online communication tools, like Skype and Messenger (gently or less gently pushed by their children and grandchildren), hence we had the possibility to think about better, more interactive solutions than ordinary phone calls. This is a downside too, since only the technology literate, and cognitively intact volunteers could participate in the on-line co-design session. Large part of the primary and secondary users of the co-design session were members of the researchers' acquaintance.

Having received the contact details, the NIMR staff members called the candidates over the phone. NIMR then used the Jitsi meet web browser-based conferencing tool for the co-design session. The co-design sessions always started assessing the potential primary or secondary end-user meets the inclusion and exclusion criteria. Next, the participant gave his/her informed consent to the co-design session. The third part of the online co-design session focused on presenting the service cards, discussing the participant's question, and jointly filling in the questionnaire after each service presentation. The online co-design session lasted one hour on average which appeared to be quite exhaustive for the participant.

Coping with the restrictions imposed by the Covid-19 crisis in the SAVE project was in full agreement with the recommendations issued by the AAL CMU: „Delivering innovation during Covid-19 - How AAL projects overcame challenges caused by the pandemic". (http://www.aal-europe.eu/wp-content/uploads/2021/01/AAL-projects-and-Covid-19-final.pdf)

NIMR's online co-design sessions, therefore, were limited to study participants already possessing high performance internet access and IT devices in their personal environment.

Table 3. Participants enrolled in Hungary

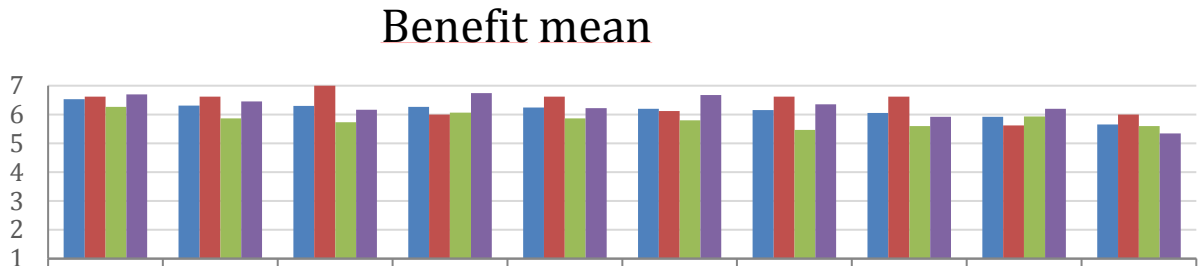
Group	Participants n.	Gender	Age	Living condition	IT expertise
Older adults	P1	F	75	Not asked	yes
	P2	F	73	Not asked	yes
	P3	F	88	Not asked	yes
	P4	M	70	Not asked	yes

	P5	M	69	Not asked	yes
	P6	M	81	Not asked	yes
Caregivers	P7	F	48	-	yes
	P8	F	58	-	yes
	P9	F	56	-	yes
	P10	F	41	-	yes
	P11	F	60	-	yes
	P12	F	44	-	yes
	P13	F	42	-	yes
	P14	F	44	-	yes
	P15	F	47	-	yes

5. Results of the first co-design

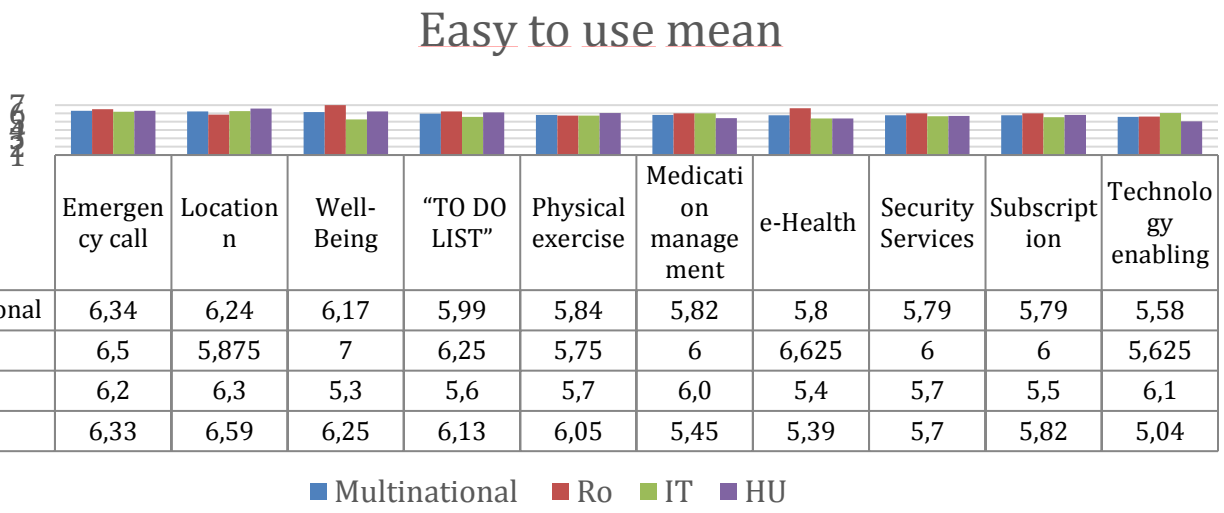
5.1. Cross-national analysis of the questionnaire

Form the analysis of the questionnaire filled by the sample, it emerges that the perceived benefit is quite homogeneous among the countries with an overall prevalence for emergency call, technology enabling and security services (Figure 4). Overall, after checking the cards that described each service, the sample perceived a feeling of good easy to use with the highest degree for emergency call and location services (Figure 5). Moreover, in terms of spend limit, the sample declared the willingness to pay for the majority of the services starting from the subscription and especially for the emergency call and e-Health (Figure 6).
From the analysis of the ranking, a top list priority of services (Figure 7) to be implemented is the significant result that this first co-design session put in the hands of the technical staff.



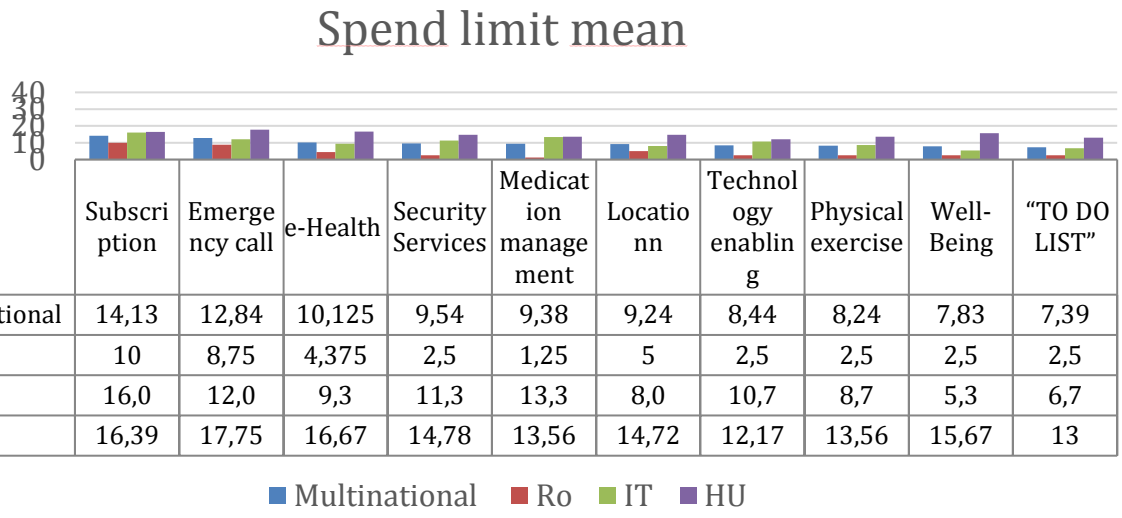
	Emergency call	Technology enabling	Subscription	Security Services	Location	e-Health	Well-Being	Physical exercise	Medication management	"TO DO LIST"
Multinational	6,53	6,31	6,3	6,27	6,24	6,2	6,15	6,05	5,92	5,65
Ro	6,625	6,625	7	6	6,625	6,125	6,625	6,625	5,625	6
IT	6,3	5,9	5,7	6,1	5,9	5,8	5,5	5,6	5,9	5,6
HU	6,694	6,45	6,17	6,74	6,22	6,68	6,35	5,92	6,2	5,34

Figure 4. Perceived Benefit of the services (Mean value)



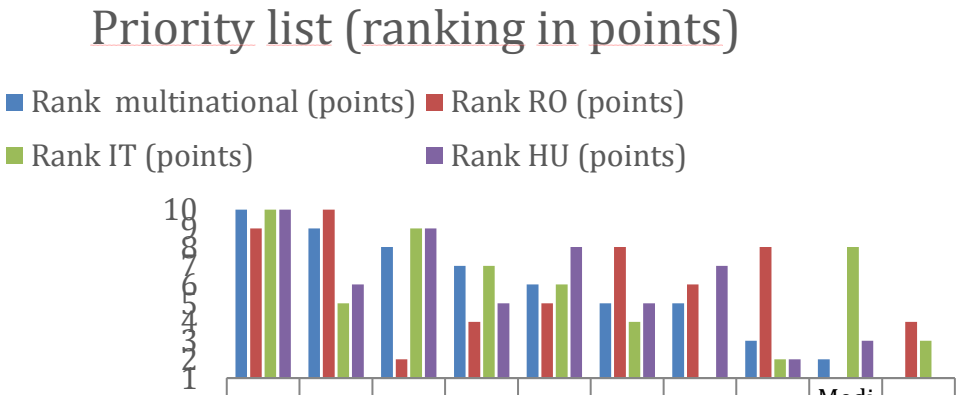
	Emergency call	Location	Well-Being	"TO DO LIST"	Physical exercise	Medication management	e-Health	Security Services	Subscription	Technology enabling
Multinational	6,34	6,24	6,17	5,99	5,84	5,82	5,8	5,79	5,79	5,58
Ro	6,5	5,875	7	6,25	5,75	6	6,625	6	6	5,625
IT	6,2	6,3	5,3	5,6	5,7	6,0	5,4	5,7	5,5	6,1
HU	6,33	6,59	6,25	6,13	6,05	5,45	5,39	5,7	5,82	5,04

Figure 5. Perceived Ease of Use of the services (Mean value)



	Subscription	Emergency call	e-Health	Security Services	Medication management	Locationn	Technology enabling	Physical exercise	Well-Being	"TO DO LIST"
Multinational	14,13	12,84	10,125	9,54	9,38	9,24	8,44	8,24	7,83	7,39
Ro	10	8,75	4,375	2,5	1,25	5	2,5	2,5	2,5	2,5
IT	16,0	12,0	9,3	11,3	13,3	8,0	10,7	8,7	5,3	6,7
HU	16,39	17,75	16,67	14,78	13,56	14,72	12,17	13,56	15,67	13

Figure 6. Spend limit for the services (Mean value)



	Emergency call	Subscription	Security Services	Technology enabling	e-Health	Locationn	Well-Being	Physical exercise	Medication management	"TO DO LIST"
Rank multinational (points)	10	9	8	7	6	5	5	3	2	1
Rank RO (points)	9	10	2	4	5	8	6	8	1	4
Rank IT (points)	10	5	9	7	6	4	1	2	8	3
Rank HU (points)	10	6	9	5	8	5	7	2	3	1

Figure 7. Priority list of services (Mean value)

5.2. Thinking Aloud results in Romania

The focus of the potential end-users and of the professional caregivers were on elderlies' safety and the prevention of dangerous situations and the ability to request help in certain situations. Based on real events encountered by the professionals, a service for locating a possible confused elderly would be welcomed.

The potentials end-users would be willing to have a wearable device (as a bracelet/watch or a pendant) that they will always wear, if it gives them the opportunity to call for help (using a "red" button feature) in case of need or detect dangerous situations, as falls. The end-users expressed their concerns for the situations in which they could fall unconscious, so a wearable device that could detect this (e.g. fall) and make an automated call to several persons (caregivers, emergency numbers, etc.) would be useful for them and give them peace of mind that they will get help when they needed. Caregivers agreed with this idea but articulated the fact that some end-users could abuse this emergency button, so it would be wiser to limit the calls to the formal or informal caregivers. In case the button is pushed by mistake, an emerging idea, to avoid false positives, was to ask a cancel action from the end-user before starting the calls (audio and video warning from the wearable device). However, concerns were raised by the caregivers that this could be waste precious time to intervene in life threatening situations.

Also, a location feature is welcomed by both users and caregivers, so a wearable device should incorporate this feature and allow selected caregivers to access the location of an elderly in case of an emergency. Also, defining an area or a pre-established route for an elderly that can become disorientated was considered a good feature. In case the elderly strays away, a call can be made to a caregiver, but not before asking a cancelling action from the end-user (audio warning).

An algorithm for detecting disorientation in elderly could be of interest (a person starts walking in circles or in an unexpected pattern) for caregivers/end-users.

To assure the safety inside the home, a kit containing sensors for detecting smoke, flood and gas (although the current standards make a gas sensor mandatory in every kitchen) could be welcomed by the end-users. Also, a contact sensor for detecting the opening of the fridge can be used to test if the elderly is feeding himself, being an indicator of his/her well-being, but the focus was on safety features.

The key points about the eHealth device were related to mobility (if it can be moved) and a possible autonomy (if powered by rechargeable batteries), its weight and dimensions and the interfaces it could expose to end-users and caregivers.

The end-user expressed their opinion that the eHealth device should be mobile, so it can be moved regardless of the way it is powered. Also, the weight should be kept as low as possible, so it is possible to be moved around easily.

The eHealth device should offer a user interface for the caregivers and notifications/alerts for values that are outside a pre-defined range. The preferred way of offering this user interface is a mobile application (running on the caregiver's smartphone).

The end-users were not keen on getting a user interface, because it could stress them when some measurements are off. Some indication that the system works could be enough to make them feel safer. The caregivers agreed with this view.

On the aspects of enhancing the quality of life through physical exercise, the caregivers agreed it could be a very good way of getting the elderly to improve their well-being. Some end-users only

expressed the concern that some people have limited mobility or health problems that could forbid them into participating in physical exercises, but it is, in general, a good idea.
From the point of view of monitoring the well-being of the end-users, the eHealth kit proposed by the consortium was well received, sparking a discussion about what information could be collected, what actions should be performed by the system and how the users could use it in day-to-day life. The identified scope of this device is the monitoring of elderlies' chronic illnesses.
In the same well-being area, the end-user considered useful having some notifications (from a mobile or wearable device) with recommendations when the system detects a high stress level of the end-user or sedentariness.
An agenda with events or reminders also could be useful for end-users, but also for caregivers, and a way of checking that the end-user did some actions (e.g. took their pills), with alerts if the action was not performed; the end-user should tick the actions done in the agenda.
Overall, the end-users and caregivers believed that the objectives set by SAVE project are in line with their needs of safety and improvement of their quality of life through technology.

5.3. Thinking Aloud results in Italy

First of all, the older adults' group stressed the importance of emergency calls. Their greatest concern seemed to be to be able to enjoy the use of a direct and timely connection with the emergency services in everyday life, should the need arise. They also expressed doubts about the usefulness of the smartphone and the recognition of its apps and functionalities right in the moment of need, as described by an older lady: *"If I have a memory lapse, I will also probably forget to consult my smartphone seeking help"* (P1). Older adults also highlighted the importance to consider the link among "habits" and "culture" variables and technology, so not only the older persons' attitude and interest in technology, but also the environment in which they have always lived, as depicted below: *"I think it's important to consider the influence that "habits" and "culture" variables could have on the use of technology. In my opinion, Italy's ageing population is not very adept at technology, while the situation is quite different in other European countries. I am not very attracted to tech devices"* (P2). Moreover, the use of certain systems seemed to presuppose a basic knowledge of technology by seniors, as highlighted by an older woman: *"The skill to use/manage the smartphone would seem to be crucial for the access to SAVE services"* (P1). For this reason, older adults reported preferring the smartwatch to the smartphone, since the first would seem to be more helpful and of more immediate use, especially if the person is alone, wants to monitor his/her physical state and needs to be rescued very quickly: *"I think the smartwatch may be more useful than the smartphone for an older person, especially when he/she goes outside, and he/she is alone. In my opinion, older people are very stubborn, they are ashamed to feel sick and to communicate it to strangers. For this reason, in a time of need it can be useful to have the possibility to press only a button to be rescued"* (P3) and *"If I have an accident, I could not have the possibility to call for emergency help and in this specific case a sort of armband or smartwatch that monitors my vital signs is useful rather than a smartphone"* (P5). Older adults would appreciate a system that could understand if a person is sick or in a hard place without him/her doing anything, reducing effort to learn and use it to a minimum, as described by the following quotation: *"My suggestion to the project team is to develop this system making it as*

simple as possible because technologies are always very difficult for us and we usually spend a lot of time trying to understand how a technology is supposed to be used" (P4). In this regard, they pointed out the difficulty that users often have with technology and the great importance of technological assistance/setting-up services that could help and reassure older people: *"We need clear manuals and sometimes the help of our sons. Every activity related to instructions is really appreciated"* (P4). What emerged strongly from this group is the need for independence, understood as exaltation of preservation of older people's mental and physical capacities so long as possible, as highlighted by an older man: *"I am an independent person and I want to be active as much as possible"* (P5). Among older adults there would seem to be a belief that technological systems are designed with a purely welfare, protection and/or control function, without considering that certain devices could be especially useful even in the lives of older people still active and autonomous, as described by the following quotation: *"I do not need such a system because I am independent"* (P4). Older adults, in fact, strongly stated their need to stay dynamic for as long as possible, and it is precisely in this sense that technology should promote activities, empowerment, and self-management.

Regarding caregivers, they too expressed doubts about whether the smartphone can be a useful tool for older persons, especially those with initial memory problems, as pointed out by one of them: *"My wife has the first symptoms of dementia and what I see is that she forgets her smartphone everywhere, as well as other important things like keys and/or glasses. My concern is that this system may not be useful to her, not because the system isn't interesting, but just because my wife will forget it"* (P10). Caregivers also manifested doubts about the current design of the system and stressed the need for researchers and developers to specify the target for which certain devices are designed, in order not only to consider needs, expectations and capabilities of users, but also to avoid unpleasant errors: *"My first thought is that if a person gets lost in his/her neighbourhood needs more care and if another person is independent and active does not need these services. I think that you need to better specify your target and develop the system around the specific needs, intentions, and barriers of the group"* (P8). This group highlighted the importance of older people being able to remain active for as long as possible and that technology promotes their well-being and helps them maintain a state of autonomy both cognitive and practical. According to caregivers, in the design of the system the project team should add some cognitive exercises and/or games, which could be useful in supporting older adults in stimulating and maintaining their skills: *"My mom […] forgets things, events, appointments and so on. The system might be beneficial to her, but my wish would be for the system to support her in maintaining her capabilities, maybe with some cognitive exercises or games"* (P9). The design of a system should also include few services, so as to make it easier for older people to learn new technological knowledge. Such learning is often complicated and energy-consuming not only for users but also for carers, who need to provide technological help and assistance. In this sense, caregivers also suggested to consider the influence that "culture" and "education" variables could have on the development of a positive user approach to technology.

Regarding experts, they too proposed to the project team to focus on few services, two or three at most, designing these as best as possible and delete all the others based on the well-known "less is more" concept. Considering that each service requires a specific training, reducing services would consequently lead to a reduction in cognitive effort on the part of older adults. This group also stressed the importance of developing systems that can promote older people's empowerment

and self-management and not just provide a passive monitoring of the physical state of the users. It is necessary for the well-being of older adults that they can continue to feel active and useful in society, so in this regard experts suggested on the one hand to be careful in proposing the emergency calls service, as it could be perceived as a kind of stigmatization and therefore be rejected by the more dynamic and autonomous seniors, on the other hand to better define the target for which some devices are created, precisely in order to meet needs, wishes and expectations of users. In closing, experts proposed that the design team think about a motivational coaching to support users in interacting with the system providing them with a strong endorsement when they act in the right way, e.g., when they use the system daily.

Older adults, caregivers and experts agreed about two themes: Less is more-Reducing effort to learn/use the system and Promoting activities, empowerment and self-management. Older adults recognized the importance of a system that could understand if a person is sick or in a hard place without him/her doing anything, reducing not only the effort to learn something new and complex, but also the need to ask a relative and/or a friend for help. Caregivers and experts believed that too many services had been designed for a single system and that each service required a specific training, and therefore a great effort for older adults, as highlighted by a caregiver: *"There are many services in this system and for every service the older adults must learn and spend a lot of energy trying to remember how to use each functionality. Maybe it could be better to have fewer services but very well personalized"* (P8). In addition, experts proposed to the design team to concentrate on few services creating these as better as possible based on the well-known "less is more" concept. All three groups gave other interesting insights. They stressed the need for the system to be able not only to protect the fragilities of users, but also to support them in maintaining their abilities and to make them feel as active and determined as possible, as described below: *"I want to be active as much as possible so for me technology must promote my activity and not only offer "protection" against harms or accident or "control". I hate to be under control"* (P5) and *"If I think about my father, I really want that him stays active as much as possible and my concern is that this kind of service could lead him to be passive and put less attention in his daily activities"* (P7). Experts also suggested that the project team develop the empowerment and self-management shifting the services into a more specific and useful way to promote wellbeing, not only passive health monitoring.

Remembering the smartphone and its functionalities (which was the theme that showed the highest frequency), "Habits", "Culture" and "Education" variables, Technological assistance/setting-up services, and Medication management/dispenser were the themes reported by both older adults and caregivers. These groups reflected that if an older person has a memory lapse, he/she would also probably have difficulty recognizing the smartphone and remembering its own functionalities seeking help, as expressed by a caregiver: *"I am not sure that, if my mother is outside and gets lost, she is able to use the smartphone and the geo-localization function to come back home, most probably she's able to phone me but not to remember to have an app that could help her. In a stressful situation, persons forget everything, how could be possible to remember the app?"* (P9). It was also important for both groups to look at the influence of "habits", "culture" and "education" variables, so not only the older people's attitude and interest in technology, but also the surroundings: *"The first thought that I have is related to my personal habit: I am a retiree that loves agriculture and I have my land to cultivate"* (P5). On this point, both of them underlined the complex relationship between older users and technology and the importance of technological

assistance, which could not only assist older people, but also lighten the physical and emotional burden of caregivers, as depicted by the following quotation: *"Older adults are not so confident with innovations even if they use smartphone or tablet, some services are too much difficult for them and in this case, it is very stressful for a caregiver providing assistance"* (P8). According to the two groups, the medication management/dispenser service appeared useful and responsive to the older person' needs, especially if he/she is alone and must keep in mind meds' quantities and schedules.

The theme Emergency calls is mentioned by both older adults and experts that described two sides of the same coin. On one hand, older adults considered the service extremely useful, since older people need to maintain their daily life habits but are also aware of their frailties, which could put them in a position to ask for help at any time. On the other hand, experts stressed the importance of being incredibly careful in promoting SOS calls, because if the person is active and independent, he/she could see the service as a stigmatization and so refuse to use a system that is supposed to have been designed for a person in need of care.

In closing, a common concern within caregivers and experts was the need of better defining the target that would use the system, since the latter thus designed could not be beneficial either for users in good physical and cognitive health, nor for those with chronic diseases, such as an advanced stage of dementia: *"I really think that your work is very useful for person with initial dementia, but I do not see any beneficial for those who are still active and independent because for these individuals only the to do list or the physical activity reminder could be interesting"* (P7) and *"My mom lives alone and has early signs of dementia. […] For example, the geo-localization is a service that is not useful for her, but not even for a person who is at an advanced stage of dementia"* (P9).

6. Next steps and Conclusion

According to the UCD approach, a second co-design session is planned and it is now under definition among the pilot sites. This second activity will adhere to the practices and measures put in place by ongoing AAL projects (http://www.aal-europe.eu/wp-content/uploads/2021/01/AAL-projects-and-Covid-19-final.pdf): as tested for the first co-design, we will use alternative ways to involve end users such as video conferencing tools, one to one interview if conditions allow it or a mix between physical and online meeting,

Annex 1 - Informed Consent

INFORMED CONSENT		
Project title: SAVE		
Principal Investigators:		
Background: SAVE project aims to develop ….. The system is composed by …. The SAVE project requires two different sessions of co-design. During each phase, some voluntary participants will be recruited in Romania, Italy and Hungary. Participants will be introduced to the project and asked to check some pictures or other informative material, e.g. video demonstration to evaluate. This could last for no longer of 30 minutes and at the end a questionnaire will be filled		
Participant Declaration:		
I have read or have had the information about the project and I understand the contents.	Yes	No
I have been given an opportunity to ask questions and am satisfied with answers. I have had enough time to decide whether or not to participate.	Yes	No
I consent to take part in the study.	Yes	No
I understand that participation is voluntary and that I can withdraw at any time without having to provide any reason.	Yes	No
I understand that withdrawal will not affect my access to services or legal rights.	Yes	No
I consent to possible anonymous publication of results.	Yes	No
I consent to the use of pictures, and sound recordings containing personal data for research purposes.	Yes	No

- I know that for study monitoring purposes some individuals could have access to all my data. Those people are listed in this information letter. I consent to that access by these persons.	Yes	No
I give my permission to: Use the data obtained from you in other future studies without the need for additional consent.	Yes	No
Researcher Declaration:		
I have explained the study to the participant	Yes	No
I have answered questions put to me by the participant about the research	Yes	No
I believe that the participant understands and is freely giving consent	Yes	No
I guarantee the protection of natural persons with regard to the processing of personal data and on the free movement of such data according to the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016.	Yes	No

Participant's Statement:

I have read, or had read to me, this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction. I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights. I understand I may withdraw from the study at any time. I have received a copy of this consent form.

Participant's Name:

Contact Details:

Participant Signature:

Date:

The form needs to be signed by the consenter and dated.

Researcher's Statement: I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

Signature:

Date:

Annex 2 – Service evaluation questionnaire

This annex is described separately in the DELIVERABLE_2_1_Annex2 – Service evaluation questionnaire.pdf

Annex 3 – List of storyboards

This annex is described separately in the DELIVERABLE_D2_1_Annex3- List of story boards_Service cards.pdf

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