Interreg CENTRAL EUROPE
European Union
European Regional Development Fund

niCE-life

IDENTIFICATION OF MOST SUITABLE CARE SOLUTIONS FOR MODEL OF HEALTH AND CARE SERVICES FOR FRAIL ELDERLY

Deliverable D.T1.3.1

CONTENT

Introduction

Within deliverable 1.3.1. a template was created, which was filled in by individual partners for their digital tool. The template was designed to first understand the individual digital tools based on the following criteria:

- Description of digital tool
- Used technologies
- Integration
- Use case description
- Technical requirements
- Piloting summary
- Components
- Cost effectivity
- Quality of life improvement
- Security
- Ethical aspects
- Installation
- Sustainability after project etc.

The questions were designed on the basis of the MAST methodology supplemented by the MOMENTUM 18 critical success factor. All this information was processed into a template for a specific digital solution that will be used in the region and therefore the lead partners for the solution in cooperation with the partners involved participated in the output.

- Subsequently, a technical search of available solutions within the EU was performed, which was again downloaded to the given technical solutions:
- Online monitoring systém
- AP- nurse
- YouBOS
- Patients dicharged from hospital
- GPS localization

- Monitoring grid

The outputs from D.T.1.3.1 were used as a basis for the design of a model for the provision of health and social care using the above-mentioned digital technologies based on the use of eCare good practice.

As a second part of this deliverable, according to proposal, designated partners PP2, PP3, PP4, PP5, PP7, PP10 made technical reviews - recherche/overview of existing digital solutions related to the digitals tools. For recherche/overview were used EIP AHA repository of good practices and each responsible partner prepared the list of digitals tools related to the defined tools from WP T2. It was also compared with pubmed research and result of this activity is this list of digital solutions which can be used as an improvement of Bologna´s GP. Overview can be used as a basis for WP T2. The set of needs and requirements are based on results from review of Bologna´s good practice.

Regarding the research of technologies that was similar in scope to each digital tool. It started from the EIP AHA repository or AAL, which are focused more on general information and on the system concept, so from technical point of view are used online libraries focused on medicine and social care like Medline / Pubmed through especially systematic reviews (EBM - evidence based medicine).

Also recherche/overview focused on current and completed projects across Europe (EU projects - Horizon 2020, Interreg etc.) were made. For recherche were used resources from the IEEE (Institute of Electrical and Electronics Engineers) and JMIR (Journal of Medical Internet Research) - JMIR with its subcategories focused on the scope of the project (Biomedical Engineering, mHealth, uHealth, Aging, etc.)

1. Digital tools descriptions

1.1. Online sleep monitoring system

Lead partner:

PP2 , Responsible person: Radim Burget, burgetrm@feec.vutbr.cz

Involved partners: PP5, LEPIDA SCPA, PP, LEPIDA,Responsible person: Annalisa Reggian: annalisa.reggiani@lepida.it, PP6, Local Health Authorithy of Bologna, PP, LHA

Responsible person: C. Malvi: c.malvi@ausl.bologna.it

Name of the regions involved (approx. number of affected population):

The online sleep monitoring system has wide range of applications (e.g. assessment of exploding head syndrome, sleep terror, narcolepsy, idiopathic hypersomnia, etc.), nevertheless, the frame of the niCE-life we will focus mainly on the rapid eye movement sleep behaviour disorder (RBD), which has been identified as a prodromal marker of Parkinson's disease (PD) (Postuma et al. 2019). Identification of RBD and consequently diagnosis of PD in early stages is crucial for the development of disease-modifying treatment since the neurodegeneration may be possibly stopped or treated before the pathological cascades start. Although the system will be evaluated on PD patients in the Czech Republic, it has a high potential in the whole EU, because PD is the most common neurodegenerative condition afterAlzheimer's disease affecting an estimated 1.2 million people in Europe alone. Incidence of Parkinson's is forecast to double by 2050 primarily as a result of the ageing population.

Description of digital tool:

The system will enable intelligent SW solution, providing advanced data-oriented services to health and care centres and communities to support virtualization of medical care and data-driven approach to medical centres (i.e. advanced data/driven analytics). It will imply secured data transfer and storage for uploaded data from medical centres, care centres or patients' home (the data will be uploaded from actigraphs) and state-of-the-art artificial intelligence algorithms (allowing execution of sophisticated data analysis also providing useful feedback as a result of analytics). The system will be scaled based on different accounts (for patients, doctors, administrators). It will enable users to make data parameterisation (i.e. descriptive characteristics of sleep), automatic processing (e.g. identification of sleep stages based on machine learning modelling), visualisation and

statistical analysis. The system will have a web-based interface which will enable users to securely access it from common devices connected to the internet. The concept will be in line with the GDPR.

What kind of technologies do you might to use?:

Wearables (actigraphs), server applications, signal processing (e.g. time-frequency analysis), machine learning, artificial intelligence, statistical analysis, cybersecurity

How do you plan the integration of the solution? (What tools will you use?):

The successful integration requires specific hardware, i.e. actigraph GENEActiv Original, computational server and data storage. Regarding the software, it will require VMware Workstation and Python installation.

Use case description:

Doctor: A doctor will provide a patient with an actigraph and some instructions regarding wearing it. The patient will wear the actigraph during sleep. After some certain number of days (depending on the kind of analysis) the patient will upload the data from the actigraph via the online web interface, or he/she will send/bring the actigraph back to the doctor (who will upload it on the behalf of him/her). The doctor will be able to create a patient's profile in the system and to manage/edit this profile. The profile can be shared among several doctors. After the data are uploaded, the doctor can visualise them, compare (e.g. among several days or patients), parametrise (extract sleep measures) and process by machine learning models (e.g. to detect sleep stages, specific sleep disorders, etc.). The system will also enable export of the data into commonly used formats.

Patient:

The patient will be able to upload the data into the system via his/her profile. If allowed by a doctor (who will manage the rights), he/she can see a part of or the whole results of the analysis.

Administrator:

An administrator will have the same rights as the doctor or the patient. In addition, he/she will be able to create/manage profiles of doctors/patients. He/she will be able to manage the user interface, processing pipelines, etc.

Main goals of used technology (What do you expect?):

The new system will enable us to comfortably (in comparison to the polysomnography) perform complex and advanced (when utilising the machine learning approaches) diagnosis,

assessment and monitoring of sleep disorders, that are associated with many diseases, e.g. with Parkinson's disease.

Technical requirements :

The new system will enable us to comfortably (in comparison to the polysomnography) perform complex and advanced (when utilising the machine learning approaches) diagnosis, assessment and monitoring of sleep disorders, that are associated with many diseases, e.g. with Parkinson's disease.

To achieve the goal of GP, the system development, evaluation and adaptation will require a cohort of healthy controls and people with sleep disorders (i.e. an involvement of hospitals, clinical centres, care centres, and patients organisations is considered).

To be able to train the machine learning models, we will need hundreds of subjects in both groups, i.e. healthy controls and patients. They should be transmitted continuously so that the models can be continuously improved.

From the signal processing point of view, the following signals from the actigraphs will be processed: time series from a temperature sensor and x/y/z time series from an accelerometer.

The server and data storage part of the system requires periodical maintenance (to check/improve capacity and physical condition). Nevertheless, maintenance is not considered to be frequent.

The actigraphs can continuously log data from sensors up to 45 days (depending on the sampling frequency). Then, they have to be recharged. The need for battery exchange is individual. It is supposed that the battery exchange will be required after several years.

Piloting summary (Description of Pilot Activity): The system is currently in its beta version. The main parts (excluding the machine learning one) have been designed, implemented and tested in laboratory conditions. After the machine learning part is finalised (by half of 2020), the system will be ready for large testing.

Testing description:

Resposnible partner: PP2 (Brno University of Technology)

The accuracy of the machine learning models will be tested on a publicly available data set that contains references based on the polysomnography.

As soon as the machine learning models are ready to be deployed, the system will be providedto at least 80 subjects who are in a risk of having Lewy body diseases. After this, we fill follow these steps:

1) We will prepare online questionnaires, where we will get feedback from patients and experts. We will ask whether the system is intuitive, user-friendly, what would the respondent change, add, etc.

2)In cooperation with the stakeholders, we will evaluate the ability of the system to support diagnosis of LBDs. For this purpose, we will use gold standard references, that are commonly used in the field of neurology.

Components (Involved Digital Solutions):

Actigraph device, Application server, Artificial intelligence engine

Will you develope mobile app for digital solution?:

Since the system interface can be approached by any web browser, the development of a specific mobile app is not necessary.

Cost effectivity of the solution?:

Although polysomnography is the gold standard for sleep quality assessment, it can be invasive, disruptive to sleep and much more expensive than remote actigraphy. The price of one actigraph is approximately EUR 300. It can be used repeatedly while requiring battery exchange after several years. Nevertheless, we see the biggest impact in the machine learning part of the system which will enable diagnosis of e.g. RBD and consequently early diagnosis of neurodegenerative diseases which is important because of higher efficiency of treatment when administered early. The costs linked with neurodegenerative diseases management are very high and the earlier we diagnose them the more we can reduce these costs.

Equipment and Infrastructure Available:

10 actigraphs, computational server and data storage provided by the Brno University of Technology.

What kind of data do you want to obtain?:

Actigraphy data from people with sleep disorders, people in a high risk of having Lewy body diseases, and gender- and age-matched healthy controls. If possible, the actigraphy data with the polysomnography reference are warmly welcomed (they could improve the accuracy of the machine learning models).

Partners:

CEITEC, St. Anna Hospital.

Subject profile (who are the users of the technology and of the whole system?):

Neurologists, psychologists, experts in sleep medicine, researchers.

How it will improve the quality of life of elderly people or family members?:

The actigraphy is much more comfortable than polysomnography. In addition, the participants can use this technology at home (they do not have to stay at a hospital). Thanks to this, the technology can be widely used. The machine learning part can identify sleep disorders which can be consequently used to diagnose neurodegenerative diseases in their prodromal stage, to start early treatment, slow down the process of neurodegeneration, i.e. to improve the patient's quality of life.

How is the digital solution related to the good practice from Bolona?:

The scope of the project adopts good practice recommendations from Bologna. The developed digital tool uses modern wearable sensors together with artificial intelligence, which will monitor patients during their sleep and will recognize potential early markers of brain diseases.

Project focuses on the overall quality of life where during the medical examination part it has minimal impact on patients behaviour - the data are measured during their sleep and sensors can last up to 45 days. In case a brain disease is recognized, the upcoming treatment will be more effective.

All the data transmissions are encrypted and secured. Do you want certificate the digital tool within/after the project?:

Certification is not part of the project but there is a plan for the future.

Security of whole solution:

Since the system will be dealing with personal and medical data, big attention is paid to the security part (i.e. data transfer, storage and access). Because of this, the Brno University of Technology hired an expert in cybersecurity who prepared a plan on how to identify and address possible issues.

Installation of tools (where and how many homes and tools?):

The server part can be installed at one central point (e.g. in hospital). The user part is accessed via a common web browser installed e.g. on a laptop or a tablet.

Ethical aspects (Do you need ethical approval?):

If used in clinical trials or clinical research studies, then yes.

Have you ever use tool in European project (if yes what is the added valu efor niCE-life project?):

No. This tool was not used in other EU/national project and is exclusively developed in the scope of the Interreg project.

Evaluation of technology (How will you evaluate and by which tools):

The system can be evaluated in several ways:

1) Based on feedback from patients and experts, we will evaluate whether the system is user-friendly and intuitive.

2) We will evaluate whether the system satisfies the needs of experts (e.g. whether it reaches desired accuracies of sleep analysis, whether it provides the necessary information, etc.).

3) We will evaluate the accuracy of sleep phase identification using publicly available data sets that contain data from actigraphy and reference from the polysomnography.

4)In cooperation with stakeholders, we will evaluate the impact of the system when diagnosing Lewy body diseases in prodromal stages.

Describe cooperation with stakeholders/target groups:

The Brno University of Technology is currently cooperating with the Applied Neuroscience research group of the Central European Institute of Technology and with the St. Anne's University Hospital Brno, Czech Republic. These institutions deal with movement disorders such as Parkinson's disease. In the frame of this cooperation, we are developing and evaluating the system.

Sustainability after project:

As soon as the system is in its release version, it will be used in the above-mentioned institutions for the prodromal diagnosis, assessment and monitoring of neurodegenerative diseases. We also expect a spread of the system into other clinical centres, hospitals, etc. Since we expect a high impact of this technology, we assume it will be further developed and adjusted after the project has finished.

Harmonogram and milestones:

A.T2.1 2020/03 - 2021/01

D.T2.1.1 2020/04 SYSTEM SPECIFICATION

D.T2.1.2 2020/03 COORDINATING MEETING

D.T2.1.3 2020/09 DESIGN OF PLATFORM

D.T2.1.4 2020/11 TESTING

D.T2.1.5 2020/12 FINALIZATION

O.T2.1 - 2020/12 SOFTWARE

A.T3.2 2021/01-12 PILOT TESTING IN BRNO

D.T3.2.1 2021/01 DESIGN

D.T3.2.2 2021/11 TEST PERSONS

D.T3.2.3 2021/11 FEEDBACK ANALYSIS

D.T3.2.4 2021/12 SUMMARY REPORT

O.T3.1 2021/12 PILOT TESTING IN BRNO

Additional comments & bibliography:

Postuma, R. B., Iranzo, A., Hu, M., Högl, B., Boeve, B. F., Manni, R., ... & Antelmi, E. (2019). Risk and predictors of dementia and parkinsonism in idiopathic REM sleep behaviour disorder: a multicentre study. Brain, 142(3), 744-759.

1.2. Advanced GPS-based tracking tool

Lead partner: PP7 ISRAA

Involved partners: PP2, PP3, PP4, PP5, PP6

Name of the regions involved (approx. number of affected population):

The instrument will be tested only in the pilot site of Treviso (Italy, Veneto Region) and will involve al least 20 people (30 target). They will come from both the nursing home, homecare and cohousing. It should be noted that after the pilot phase, the instrument will have a high level of replicability in different contexts. In fact, it tries to develop a concrete response to the diffcult challenge posed by the significant percentage of elderly people affected by cognitive decline problems. In fact, among older people in the European Region, dementia is the leading cause of dependency and disability. Dementia currently affects around 10 million people in the Region, and its prevalence is expected to double by 2030 (who, http://www.euro.who.int/en/health-topics/noncommunicable-diseases/mental-health/areas-of-work/dementia#:~:text=Among%20older%20people%20in%20the,expected%20to%20double%20by%202030.). In the Veneto Region, there are 66,147 people suffering from dementia. (https://demenze.regione.veneto.it/PDTA/dati).

Description of digital tool:

GPS-based tracking devices will be able to localize people and give automatic notifications once they leave certain area and enhance their mental alertness., The hardware that will be provided to older people will integrate with a platform that will be able to connect it with care providers and caregivers. In addition, the digital instrument will be able to integrate other information (falling detection, temperature, etc..) in addition to tracking that will be able to support the elderly person and their families even better.

What kind of technologies do you might to use?:

The technologies that will be used are the following: - werable (for example a smartwatch or a smart tracker; - Cloud datastorage; - a platform that will be declined both in a mobile version (application) and web based for the formal caregiver.

How do you plan the integration of the solution? (What tools will you use?):

An essential requirement of the technology that will be used will be interoperability. In addition, data could be extracted from the platform and shared with partners in order to achieve the project objectives.

Use case description:

Senior: elderly will wear the wearable device and move independently in their living environment. Depending on the implementation in the nursing home or at the cohousign and in relation to cognitive abilities, the elderly person will be able to carry out autonomously activities for which they previously needed support in presence.

Informal caregiver: Through a mobile or web based application the informal caregiver will be the first in the chain of care in case we consider elderly person not living in a nursing home. he will be able to receive further information on the situation and health of the elderly relative.

Care Manager (nurse): The care provider will make available to the care manager/nurse the monitoring station that will play a useful role in the monitoring: - Responding to requests from senior citizens; - Entering the rescue chain in the event of an emergency.

Main goals of used technology (What do you expect?):

The main objectives of the implementation of GPS tracking technology are:

- Increasing the safety of the person with dementia, while supporting the formal and informal caregiver in the care activity;
- Supporting orientation (Not survillance of persons, But the possibility to reach persons in case of emergency and Being able to offer help, if necessary;
- Preventing dangerous situations (Reducing the risk of severely disoriented people getting lost, Reducing those methods of restraint that limit people's freedom);
- Reduce caregivers‘ anxiety.

Technical requirements:

- What kind of networks are used/necessary to achieve the goal of the GP?
- What amount of data and how often they are transmitted to achieve the goal of the GP?
- What are the relevant biophysical or other signals that are measured to achieve the goal of the GP?
- Are any parts of the system in need of periodic mainthenance and why?
- How often do the additional sensors and other parts of the system needs recharging or batteries exchange?

The network functional to the project activities is the one established at territorial level with people with dementia and their families. There is such a network, governed by ISRAA. It is called "Alzheimer Network" and is organised by the specialist centre for dementia (CSD). Data on frailty and quality of life of elderly people will be collected by questionnaire. The survey will take place at the beginning of the intervention and at the end of the intervention. Biophysical data will be shared with PP2 on a regular basis. The data that will be shared concern: motor activity, sleep quality and heart rate (data will be anonymised as required by the European privacy legislation). There are no parts of the system that need regular maintenance; The frequency of recharging the GPS tracking device depends on how often it is sent from the device. In our approach the data will be sent every two hours and therefore we estimate a battery life of about 25 days. The beacons installed inside the care home have a longer battery life than the estimated life of the pilot site.

Piloting summary (Description of Pilot Activity):

The technology we will use will have already been validated and certified, so our pilot activity will concern the overall service model. The main activities foreseen by the pilot will be: -individuation of elderly in the nursing home and at the cohousing- discussion with informal caregivers and elderly about the articulation of the care model; -training in the presence of the care managers; -training to family members and informal caregivers ingeneral, on the use of the mobile app or web based app; -use of technology by elderly people; -collection of feedback and evaluation.

Testing description:

The test will mainly concern the overall evaluation of the functioning of the model supported by the use of technology. In fact, as pointed out in other sections, the technology is now widespread in the market at an acceptable price, while there is a lack of integrated models that provide for the use of technology as a key element of a model of care for people with dementia.

Components (Involved Digital Solutions):

Wearbles, application web based or mobile.

Will you develope mobile app for digital solution?:

It is likely that the mobile app will be acquired with public tender together with the hardware and platform.

Cost effectivity of the solution?:

We will acquire a low cost GPS tracking system dedicated to Alzheimer patients which relies in a mobile device with GPS functionality. Fortunately, in recent years the price of hardware on the market has fallen substantially, so the solution will provide important support to the elderly person, keeping costs low also in view of the sustainability of the project.

Equipment and Infrastructure Available:

Cloud platform.

What kind of data do you want to obtain?:

We would like to obtain data on the actual use of this technology by both elderly and informal caregivers. Morover, we will have data about number of alarms triggered, heartbeat, number of falls.

Partners:

PP2

Subject profile (who are the users of the technology and of the whole system?):

The subjects that will be involved in testing the technology will be:

- SENIORS: Persons with dementia, in particular with Mild cognitive impairment (MCI). Mild cognitive impairment (MCI) is a neurological disorder which involves cognitive impairments beyond those expected based on an individual's age and education but which are not significant enough to interfere with instrumental activities of daily living.
- CAREGIVERS: Usually they are the family members of the person with dementia, they can also be over 65, so it will be interesting to evaluate their use of the technology.
- CARE MANAGER: They will be those professionals, especially nurses, who remotely support the elderly and informal caregivers.

How it will improve the quality of life of elderly people or family members?:

The quality of life of older people will be improved because they will be able to: Going out alone; Contacting the caregiver or care facility actively and easily, Reducing the risk of getting lost and they will have in general more freedom.

Family members will benefit from a reduction in anxiety thanks to the support of technology.

How is the digital solution related to the good practice from Bolona?:

The project has similar objectives to the Bologna best practice as it aims to support the same target group, but with a specific focus on dementia in the implementation of GPS TRACKING solutions.

Do you want certificate the digital tool within/after the project?:

No.

Security of whole solution:

Security, as well as the protection of personal data, will be one of the elements of the tender that will be done for the acquisition of the technology.

Installation of tools (where and how many homes and tools?):

In cohousing flats and will be involved in the experimentation as well as a Retirement Home. People who adopt the technology as part of the homecare service will have the bracelet and the app, no installation at home.

Ethical aspects (Do you need ethical approval?):

No, we don't think an evaluation by the ethics committee is necessary.

Have you ever use tool in European project (if yes what is the added valu efor niCE-life project?)

Yes, this project intends to build on the important work already done by the SPES and FOLLOWME projects.

Evaluation of technology (How will you evaluate and by which tools):

We will evaluate the system as a whole thanks to the feedback from patients and experts.

Describe cooperation with stakeholders/target groups:

Stakeholders such as family members and caregivers will be involved thanks to the Alzheimer's Representation Organisation in Italy. Public actors will be informed thanks to the work of the associated partner ENSA (especially in the dissemination phase). Finally, senior citizens and informal caregivers have already been included in the initial phase of the project in order to identify the best solutions for their needs.

Sustainability after project:

If the results we achieve are consistent with our objectives, many other public service organisations will be able to adopt our approach and make it an ordinary service. It is also

interesting that for this niche product, a private market could also develop in the near future, where citizens can buy solutions from different suppliers. The challenge now is not on technology, but on the overall model that must guarantee adequate care for the elderly.

Schedule and milestones:

The implementation will follow the project gantt defined in the application form of Nice-life.

Additional comments & bibliography:

https://www.researchgate.net/publication/230580513_Low_Cost_GPS_Tracking_for_the_Elderly_and_Alzheimer_Patients

Sustainable Health and Long-Term Care Solutions for an Aging Population

Ben Fong (The Hong Kong Polytechnic University, Hong Kong), Artie Ng (The Hong Kong Polytechnic University, Hong Kong) and Peter Yuen (The Hong Kong Polytechnic University, Hong Kong).

1.3. You BOS

Lead partner: LEPIDA (Carla Fiori, Annalisa Reggiani, Teresa Gallelli, Gianluigi Amadei, Sabrina Raspanti)

Involved partners: LHA BO (Cristina Malvi)

Name of the regions involved (approx. number of affected population):

In the province of Bologna there about 880.0000 citizens. Over 65 seniors represent almost 30% of the population in some areas. City average is 27%. The majority of them are women (without relatives or friends living nearby); One-person households are > 51%, of which 33% are inhabited by people over 65 (about 10.000 men and 25.000 women).

Description of digital tool:

You BOS is a web platform dedicated to frail seniors and their caregiver not particularly able to the use of the digital. The objective of the web platform is to take care of the frail seniors, often isolated, and help them by using digital tools to discover new relational models.

Through the web platform we develop projects aimed to promote:

- virtual socialisation
- make them more active
- healthy lifestyle.

The platform is intended to create:

- a connecting Blog, moderate by an editor interact with the users.
- "The expert's corner area" which will transmit live on channel or in asynchronous mode uploading the video on the web portal, giving the possibility so far to collect the questions by the users and forecast the subsequent replies.
- creation of "thematic areas" such as for example the "Laboratory of making" where the users contributions are published, "Attivi per forza" there are loaded sweet gym videos, workout, "the word between us" in which are explained daily complex terms usually in a foreign language like english.

The role of the blog's entertainer and of the laboratory of making will be assigned to the project leader of the "contest of ideas".

What kind of technologies do you might to use?:

The YouBOS solution will use a combination of web technologies which provide:

- a website accessible according to the legislation, usable natively also from mobile devices;
- a YouTube channel for asynchronous publication of video content;
- profiles of the users available on the main Social Networks, also used for the real-time diffusion of video interventions

How do you plan the integration of the solution? (What tools will you use?):

YouBOS will allow an integration among the different technologies used in order to guarantee access to the greatest audience giving them equal access opportunity. To make an example, the "on air" video transmission delivered through Facebook or Youtube will be made available directly on the YOU BOS platform for seniors who do not have any account on those social media.

Use case description:

Frail seniors: they can access the You BOS platform, create an account and participate to the different sessions of contents.

Animator - volunteer: they play the role of connecting the resources on the territory virtually. You BOS will create virtual places where will be delivered projects and services addressed to the socialisation of frail group of seniors. Experts in different domains (health, food, culture, sport & exercise) will be involved for the production of contents and materials.

System administrator: management of the user profiles, roles and authorisations.

Main goals of used technology (What do you expect?):

Reduction of the digital divide and users social isolation.

Technical requirements:

The platform:

- requires connection to Internet (possibly even in the form of access via smartphone);
- does not collect data from the user, but allows a voluntary interaction (both in the form of sending questions in the transmission phases of live video content, and in the

form of sending / inserting self-produced material to be proposed for publication, or sending of reactions to contributions published on Social Networks);

- the system components possibly created *ad hoc* for the achievement of specific objectives are subject to maintenance and adaptation on the occasion of the updates provided.

Piloting summary (Description of Pilot Activity):

Map of the needs

co-creation meetings with the different stakeholders and frail senior themselves to identify main features of the digital tool and related contents

Design and development of the digital tool and test

According to the results of the co-creation process and in parallel Lepida is starting the design of the You BOS digital platform and will be in charge of the development and test.

Recruitment and engagment of frail seniors and their caregivers

The steady relationships with the local communities of volunteers and elderly and other associations will support the recruitments of the targeted frail seniors who will start to test and use the new functionalities of the You BOS platform

Creation of an editorial board:

An editorial board will be set up to start to work on contents thanks to the presence of persons skilled in communication, psychologist, nutritionist, IT experts, animators, sport associations… Producing and selecting contents and working them differently for each social media and technology used, thus provision of videos, infographics, thematic channels, on air broadcast.

Execution of the pilot

Provision of pilot implementation timetable

Creation of the network of volunteers and professionals

Communication of the You BOS platform

Manage contribution with projects coming from the “Bando di Concorso d’Ide”

Scheduling of thematic courses to be followed by volunners and frail seniors

Provision of specific contents

Evaluation

Surveys and questionnaires to measure the acceptance, usability and level of usage of the You BOS solution.

Testing description:

For the realization of the test, two phases are foreseen:

- in the first phase, a document of test cases to be conducted on the entire platform will be prepared, and the tests will be repeated until the expected results are achieved in all the tests provided;
- subsequently, a restricted panel of end users will be selected, to whom the platform will be subjected for a few days of intensive use. Their observations will be evaluated by the project's guiding group, and if considered valid, they will give rise to revisions of the platform (in terms of interface, interactions between components or operating rules).

Components (Involved Digital Solutions):

The YouBOS solution will be based primarily on the Drupal CMS open source platform (in its version 8, providing for the possibility of an evolution towards version 9 if a stable release of this is distributed within the deployment period of the project), integrating in it the necessary additional modules that will be considered useful to achieve the aims of the project (for example, to manage the functionality of the publication workflow, to authorize the authors, for better integration between the main platform and components present on the social networks used). Particular attention will be paid to use all the additional components necessary in order to ensure accessibility for users with disabilities, and the same attention will be paid to the interface design.

Any custom modules that become necessary will be created using PHP and JavaScript languages, intended for execution on the server side.

The installation of any component on the user's PC or smartphone is not expected.

Will you develop mobile app for digital solution?:

In the first phase, access from mobile devices will be guaranteed by the adoption - in the realization of the platform - of the principles of responsive design. It will then be possible to evaluate - also based on the number of users access, and the analysis of the prevailing access method - to develop an App that offers the same functionality as the web platform..

Cost effectivity of the solution?:

The solution will be part of the eCare services, the cost-effectivity of the of the editorial board and IT maintenance of the platform in the long term will be evaluated according to the number of the users (frails, caregivers, associations) and the level of acceptance.

Equipment and Infrastructure Available:

A platform Bos ready to be implemented with new the described functionalities is running. The eCare network and the related Call Center is the central infrastructure that will be aligned with the new available tool in order to reinforce the eCare initiative among the local communities.

What kind of data do you want to obtain?:

Qualitative data: Satisfaction of the users and improvement of the quality of life.

Quantitative data: Number socialized users through the You BOS platform; Number of the subscribers to You BOS.

Partners:

LEPIDA: LHA BO, Associated partners (ASSR, ASVO) and local stakeholders.

Subject profile (who are the users of the technology and of the whole system?):

Elderly and their caregivers, volunteer associations.

How it will improve the quality of life of elderly people or family members?:

Reduction of digital divide and social isolation. Better access to the services available in the local contexts thanks to the improvement of the digital competences.

How is the digital solution related to the good practice from Bologna?:

You BOS will be an integral part of the eCare service.

Do you want certificate the digital tool within/after the project?:

Certification is not part of the project but there is a plan for the future.

Security of whole solution:

The platform design&development will guarantee compliance with the GDPR on the protection of personal data in line with the other systems delivered by Lepida for its institutional members. Privacy by design and default principles will be applied.

Installation of tools (where and how many homes and tools?):

You BOS would be a web service no installation would be needed.

Ethical aspects (Do you need ethical approval?):

No need of an ethical approval.

Have you ever use tool in European project (if yes what is the added value for niCE-life project?):

No. This tool was not used in other EU / national project and is exclusively developed in the scope of the Interreg project.

Evaluation of technology (How will you evaluate and by which tools):

Use of questionnaires to evaluate user satisfaction, acceptability and usability of the platform.

Describe cooperation with stakeholders/target groups:

The design of the platform and the creation of the support network is realised in collaboration with LHA BO, LEPIDA, the voluntary associations , the Social Services of the territories involved in the project.

Sustainability after project:

The web platform will become part of the e-Care project support by Ausl LHA BO. It will represent an added value of the service addressed to the improvement of the quality of life of the entire population of the area and is part of the regional prevention strategy.

Harmonogram and milestones:

A.T2.4 2020/03 - 2021/02

D.T2.4.1 2020/05 COORDINATING MEETING

D.T2.4.2 2020/05 IDENTIFICATION OF PERSONS WHO NEED SPECIFIC INTERVENTIONS

D.T2.4.3 2021/02 DESIGN AND DEVELOPMENT OF THE DIGITAL TOOL

D.T2.4.4 2021/03 TESTING AND FINALISATION OF THE DIGITAL TOOL

O.T2.4 - 2021/03 DIGITAL TOOL FOR MONITORING OF FRAIL ELDERLY

A.T3.5 2021/03-12 PILOT TESTING IN BOLOGNA

D.T3.6.1 2021/03 DESIGN

D.T3.6.2 2021/11 ENGAGEMENT OF THE TEST AND CONSIDERATION OF LEGAL ASPECTS

D.T3.6.3 2021/12 REPORT AND TRAINING

D.T3.6.4 2021/12 INSTALLATIONS

D.T3.6.5 2022/04 COLLECTION AND ANALYSIS OF FEEDBACK

D.T3.6.6 2022/05 FINAL REPORT

O.T3.5 2021/12- 2022/03 PILOT TESTING IN BOLOGNA

Additional comments & bibliography:

1. 2032: Idee per la longevità (Auser Emilia-Romagna), 2019;

2. Storie, parole, esperienze per condividere la cura delle persone fragili, C. Malvi, 2018.

1.4. Development of methods of care of frailty patients discharged from hospitals

Lead partner: University Hospital Olomouc, CZ (FNOL)

Involved partners:

LEPIDA SCPA, IT

Petrzalka Municipality, SK

National Institute of Public Health, SLO

Name of the regions involved (approx. number of affected population):

Petrzalka municipality

Olomouc municipality

CareCentre in Bratislava, SK

Description of digital tool:

The development of a model and methods of care of frailty or social care needing patients discharged from hospital (focus on hospitals in CZ and SK), inspired by successfully operated good practice for this purpose in Europe (Italian e-Care practice is the primary candidate for scaling up). Organizational, economic, technical and medical conditions for this innovation will be developed considering local context. A new digital tool will enable better coordination and support of health and social care of frailty and chronically ill patients and digital communication of all actors involved in the processes of care with them.

The aim of this digital tool is to create software supporting processes that take place when for patients are discharged from hospital because in CZ and SK the coordination, communication and information flow from one actor to another in the process is currently not digitalized, is inefficient in terms of fast sharing of critical information and is very challenging for the human resources in the involved institutions. The new tool is a SW platform capable potentially to support faster and efficient coordination of demands and available capacities and pertinent administration of health and social care providers in the whole region. Currently, the relevant information from various sources typically comes to the person ordering the services in very classic form (e.g. paper) and he may enter the data in his computer; besides fragmented ability to coordinate, there is a lack of any digital communication channel to general practitioners (GP´s) though they have key role in the process of care of such patients. To enhance efficiency of the processes, also other institutions involved in care and its reimbursement/payment will be connected to the

platform, with respective rights of access to the data they need. The platform will enable secure and credible management of each case of relevant patients discharged for hospital (frail, comorbidities, injury, older, alone, poor, mental illness) and data exchange between follow-up care providers either in care institutions or homes of the patients (formal or informal home care).

What kind of technologies do you might to use?:

The digital tool – SW platform running on computer with implemented security measures - will be developed together with technical partner from Brno (BUT) and with representatives from Municipality of Bratislava and it should ensure document sharing between health and social care providers and smooth coordination of their activities focused on the patient. The whole platform will be based on sharing the information and documentation that the patient receives on discharge from the hospital in paper form and then passes it on to a social worker, who must also share it with the general practitioner, which is currently administratively very demanding and time consuming. The digital platform will also have a function that allows for effective stratification frailty index of seniors as implemented Bologna´s Good practice. Additional solution that can be used to further enhance care of these patients will be based on a digital tool for video consultations between care specialist and chronically ill patients, combined with a telemedicine system that allows data collection about patient's health, for example blood pressure, body weight, fluids intake etc. and make them available to healthcare professionals involved in the care of the patients in question. The data will be collected and stored in the cloud. This video consultation facility is technically integrated with telemedicine system and will be reused in niCE- life project as it is under development in another project in 2020, possibly only minor updates will be done as necessary for this new function. GDPR requirements will be observed in all systems and services.

How do you plan the integration of the solution? (What tools will you use?):

The whole platform is composed from SW tools which will enable data sharing between health and social care providers in the structured form. For this platform a high level of cybersecurity is required as well as available HW elements (servers etc.). Integration and security tasks will be supported by special SW tools provided by another running project, which is focused on interoperability. Telemedicine system with video consulting tool is in an advanced development phase in July 2020.

Use case description:

The use case is based on the managed data sharing between hospital, coordinator, general practitioners and social and other health care providers. After the hospital discharge the patient (or his family member) receives medical report and form for agency if it is cooperating. As there is no EHR (and also clear specification for its sharing) available in the CZ, the use case cannot immediately offer exchange of health data, which obviously means more complicated communication between healthcare providers, while social care providers are even excluded by law. Provisions for sharing of health data between providers is therefore left for further study and not planned to be implemented from the beginning of the operation of the platform. Typical end users connected to the planned platform are as follows:

- patients with multiple comorbidities discharged from hospital
- coordinator
- case manager
- social workers
- general practitioner
- nursing home
- hospitals
- long term care facility
- hospice
- health home care

Management information content:

- Participating institutions & care providers profiles, including also updated contacts, working hours
- From hospitals (HC providers): set of needs and conditions of the patient compiled by Health and social specialist when discharging the patient
- Available capacities (e.g. beds, rooms, workforce)
- Management information of contractual grade – ordering (security, credible)
- Design of care at home: health or social or integrated care, cooperation between Coordinator and Healthcare homecare

- Determination of patient's location in institutions (HC, SC), name/contact to the responsible person for care there
- Capacities management in institutions (HC, SC)
- Approval procedures, in future interconnected with payers
- Statistics (esp. esp. regarding capacities usage and location of patients)
- Information about available care services for authorized users
- Reference information for informal carers and families about location of the patient

Main goals of used technology (What do you expect?):

The main goal of the digital tool is to create an effective digital platform that will enable digital communication between individual health and social care providers (different legal entities). The whole model will be complemented by a telemedicine tool that uses video consulting elements, which will facilitate the patients discharged from the hospital easier communication with their doctor as well as with social worker, especially in case of patients with limited abilities for travelling to the healthcare provider. The tool will allow the sharing of health-related data generated by the system in a structured and secure form and which will be used for subsequent processing using further digital tools for advanced data analysis.

Technical requirements

The project will create a platform for sharing information and documentation, which will be in a structured form and which can be securely shared with GPs and social service providers. The data will be shared when the patient is discharged, enabling coordination of early and smooth interventions supporting the frail patients, and then it will be possible to make a video call with various providers involved in the care to ensure continuity of care. The coordinator manages requests from hospitals and combine them with available capacities to locate the patient and assure HC and SC services for him as appropriate. It will be possible for the patient also to request a scheduled video call and the staff of the care provider confirms / sets the video consultation date. The whole system will be supplemented by enhanced call centre, which already exists in the Olomouc Region but this current service is not very efficient and is highly fragmented. The regional care managing authority synchronizes its activity with this project. As part of the innovation, the position of a case manager will be created. Case manager/care coordinator will help the patient with organizational needs after discharge. Further, in case of chronically ill patients, it will be possible to measure biosignals such as blood pressure and heart rate, weight, oxygen saturation, etc. and process this data and their development over time with the possibility of

detecting worsening symptoms of the disease. These data will then be processed together with BUT Brno using advanced analysis tools. From the point of view of determining the entire solution, it is necessary to regularly calibrate the devices used by the patients for measuring health related parameters; the devices should also be CE certified as medical devices. From the point of view of operation of the data sharing platform, maintenance is necessary regarding the load on the servers on which the platform will run. The devices assigned to such patients for defined period are fed from batteries, regularly charged.

Piloting summary (Description of Pilot Activity):

The pilot will be focused on testing and the functionality of the platform using transferable parts from good practice in Bologna. The pilot did not originally envisage with its verification with real patients, however, in cooperation with the City of Olomouc, the operation of the platform will be first verified with various actors and when possible also tested with a smaller number of selected patients discharged from the hospital. The total estimated number is 10 to 20 patients with various requirements depending on the severity of their diagnosis and condition.

Phases:

1. The design and development of technical solutions
2. Verification and pilot testing of the technical solutions and organizational health and care models
3. Local action plans, guidance and involvement of policy makers

The pilot action will also assess present methods of care of frailty patients discharged from the hospital in SK (Bratislava) will test the developed tool in WP T2 (O.T2.6) at the territorial level in the hospital in Bratislava. The pilot in Bratislava will probably have all the functionalities such as full spectrum of participating actors and telemedicine due to slightly different context in Slovakia, unavailability of the relevant technologies and human capacities there. The planned activities will focus on the testing of developed care processes and available technologies to be performed by multidisciplinary team under guidance of the Czech National e-Health Center in FNOL.

Testing description:

The entire solution for documentation sharing will be verified regarding the requirements for the secure data transmission, identification and authentication of employees and users, as well as regarding the valid legal regulations as part of the testing. Testing will take place in the following phases:

1. Design of organizational, economic and medical conditions for, the new service/practice:
   - Municipality Olomouc – Social care department
   - Social care providers
   - General practitioners
   - Health homecare providers
   - Social department of FNOL
   - Olomoucky Region
   - LEPIDA Bologna
   - Petržalka Municipality
2. Definition of platform from technological point of view
   - IT department of FNOL
   - VUT Brno
3. Platform development and interoperability
   - VUT Brno + IT FNOL
4. Platform verification + UIX
5. Pilot testing with health and social providers
6. Action plans preparing
7. Finalization of whole platform

Components (Involved Digital Solutions):

- Data sharing platform
- Telemedicine devices – weight scale, blood pressure monitor etc.
- Video consulting platform

SW will be designed:

- To support communication and information flow from and to various institutions providing HC and SC in the region, incl. connectors to other system; most of data entered and obtained by collaborating HC and SC providers will be done via portal of the platform, using distant access via internet
- Standards for interoperability incl. EU health Network deliverables, national, where available
- To support human coordinator but opting also for next automated BI and even AI based support to persons
- To maintain database containing available capacities of demanded services, patients and their profiles, destinations and assigned services

- To process and store information from various sources that typically come to coordinator in very classic form (e.g. on paper) and the coordinator will be able to enter the data in the platform
- To enable access via internet from and to the platform for all institutions included
- To enable measures supporting cybersecurity and GDPR.

Platform will enable secure and credible management of each case of relevant patient discharged from hospital (frail, comorbidities, injury, older, alone, poor, mental illness) between follow-up care providers either in institutions or homes of the patients.

Will you develop mobile app for digital solution?:

Mobile app for video consulting between care providers and patients and for gateway in the telemedicine system – both as part of another project, only minor amendments are envisaged if necessary, by this service in niCE-Life project.

Cost effectivity of the solution?:

The whole solution is expected to be cost-effective in terms of better organization of care for patients discharged from hospital, time saving with less unwanted situations in the journey of the patients through the HC and SC services. In current real world, many patients call the ambulance service to transport them to FNOL even in cases where it would be possible to resolve the situation with a general practitioner. The platform will use several functions and tools from the original good practice in Bologna. For example Frailty index calculation and the position of case manager keeping an eye continuously on the care of each patient are completely new elements, besides the concept of digitalized coordination and the platform for balancing demands and available capacities, and communication of various involved care providers.

Equipment and Infrastructure Available:

- Video consulting platform and telemedicine system, currently under development in FNOL in another project
- Servers

What kind of data do you want to obtain?:

- Participating institutions & care providers profiles
- From hospitals (HC providers): set of needs and conditions of the patient compiled by Health and social specialist when discharging the patient

- Management information of contractual grade – ordering (security, credible)
- Design of care at home: health or social or integrated care, cooperation between Coordinator and Healthcare homecare
- Determination of patient's location in institutions (HC, SC), name/contact to the responsible person for care there
- Capacities management in institutions (HC, SC)
- Approval procedures, in future interconnected with payers
- Statistics (esp. regarding capacities usage and location of patients)
- Information about available care services for authorized users
- Reference information for informal carers and families about location of the patient

Partners:

LEPIDA SCPA, IT

Petrzalka Municipality, SK

National Institute of Public Health, SLO

VUT Brno, CZ

Subject profile (who are the users of the technology and of the whole system?):

- patients esp. with multiple comorbidities discharged from hospital
- social workers
- general practitioner
- nursing home
- hospitals
- long term care facility
- hospice
- home care

How it will improve the quality of life of elderly people or family members?:

The quality of life of patients discharged from the hospital will be enhanced by offering them tailor made services supported by the solution that will allow easy coordination and sharing of documentation between providers and ensure easier continuity of care focused on

patients´ needs. The patients will not have to travel and/or wait in temporary location as often happens now due to administrative matters and will be served by as much as complete set of services designed to support him at home or in an institutional care setting. Similar positive impact is expected for family members, informal carers of the patient. The opinion on the whole solution will be collected from care providers via interviews and if the patients are involved even in the course of this project also by their quality of life questionnaire (SF-36) and technologies and patient acceptability questionnaire.

How is the digital solution related to the good practice from Bologna?

It is based on continuity of care for elderly (frail patients) discharged from hospital. Within the project several concepts from Bologna´s good practice will be used, for example:

- Frailty index
- Data documentation
- Organizational process
- Role of case manager
- Call centres for senior and its concept
- Evaluation methods
- Financing models

Do you want certificate the digital tool within/after the project?

No, the whole platform for data sharing but the conformity of telemedicine platform will be assessed for CE certification (subject of another project).

Security of whole solution:

- Record of selected data of all patients processed (administrative registration of the coordinators – GDPR)
- No health data is exchanged in the initial phase, but link to the body where the data is kept is typed within the record, sharing data only with authorized users. Later Layoff report and other health related data (patients summary, chronic care record) can be made available to HC providers as appropriate. Sharing selected health data with SC if left for further study.
- Transport of patients is not planned for coordination with support of this platform (by default it is matter of individual care institutions)

- Patients normally do not interact with the platform/coordinator, as it acts as support of the processes and workflow

Installation of tools (where and how many homes and tools?):

Existing video consulting platform and telemedicine system with all equipment provided by FNOL will be used during the pilot, where are no additional installations besides standard ones are needed. Expected target number of patients is 10 to 20. Whole solution is based on SW applications especially for providers so there is no need to install them at patients' homes.

Ethical aspects (Do you need ethical approval?):

For pilot testing, informed consent for patients will be prepared; it will be approved by ethical committee of the University hospital Olomouc and the Medical faculty of Palacky University Olomouc.

Have you ever used tool in European project (if yes what is the added value effort for niCE-life project?):

The telemedicine system (platform) is planned for operation also in another project called SHAPES - Smart and Healthy Ageing through People Engaging in Supportive Systems Grant agreement ID: 857159, but platform has been used for different cohort of chronically ill patients. The telemedicine system development is a task o an internal project of FNOL. The whole digital tool in niCE – life project is based on data sharing between care providers and this platform has not been used in another EU project where University hospital is participating or has participated in the past.

Evaluation of technology (How will you evaluate and by which tools):

The whole service will be evaluated by MAST tool or KPI and by evaluating methods from Bologna and compare with methods used in CZ and SK for evaluation of care.

Describe cooperation with stakeholders/target groups:

From the beginning of the project, professionals from Olomouc Municipality – Social department are involved and during the designing of the platform, cooperation with social care providers will start through the above mentioned social department from municipality. Similar involvement is planned also for health home care provider(s). During the mapping of needs has been made interview with representatives of Social department at University hospital Olomouc and interviewed frail people through municipality colleagues. Olomoucky region will be involved during the designing phase of the project.

Sustainability after project:

Sustainability of operation of the new service will be negotiated with representatives of the Olomoucky Region after the initial design of the model. Also, conceptual discussions with the Ministry of Health representatives will take place, esp. from the model of the integrated care point of view.

Schedule and milestones:

Activity A.T3.7 Activity title

Pilot testing of care methods for frail persons discharged from hospitals in Olomouc
Deliverable D.T3.8.1

Design of the pilot action in Olomouc

Delivery month 01.2021
Deliverable D.T3.8.2

Engagement of test persons and consideration of legal aspects

Delivery month 03.2021
Deliverable D.T3.8.3

Report from training of test persons, home care givers and nurses

Delivery month 04.2021
Deliverable D.T3.8.4

Installation and testing of technical devices and applications

Delivery month 04.2021
Deliverable D.T3.8.5

Collection of feedback from test and support persons in Olomouc and exchange with Bratislava

Delivery month 10.2021
Deliverable D.T3.8.6

Summary report from the pilot action in Olomouc

Delivery month 11.2021

Additional comments & bibliography:

C. Fiori: The eCare network in Bologna: no longer home alone, CUP 2000, S.c.p.A – Italy

1.5. AP-NURSE

Lead partner:

PP4-STU

Responsible manager: Branislav Vrban

Email: branislav.vrban@stuba.sk

Technical leaders:

AP-NURSE-HOME:

Filip Osuský, filip.osusky@stuba.sk

AP-NURSE-CARE (Waspmote):

Jakub Lüley, jakub.luley@stuba.sk

AP-NURSE-CARE (M5stack):

Štefan Čerba, stefan.cerba@stuba.sk

Involved partners:

PP2, PP3, LP

Name of the regions involved (approx. number of affected population):

Petrzalka municipality – min. 10 home caregivers

CareCentre in Bratislava – min. 10 residents

Social Care Home in Warsaw – min. 10 residents

Description of digital tool:

A simple and modular monitoring tool for patients suffering from Alzheimer's and Parkinson's disease for home and medical application encompassing ambient sensors, which can monitor activity patterns, gas, temperature and sound aspects. Its aim is to simplify the work of home caregivers or nurses by monitoring basic interactions of the patient with the environment during night or job duties and provide fast alert about possible dangers and support independent living of frail elderly.

What kind of technologies do you might to use?:

The main idea of the proposed tools is to bring a cheap and thus widely affordable solution that can monitor the basics interaction of the patient with the environment during night or

job duties and provide fast alert about possible dangers. The tools will not be in direct contact with patients to prevent detachment, damage and their dysfunction.

The tools being developed will encompass ambient contactless sensors to identify changes in temperature, air flow in a room, light, gas concentrations, movement etc. The setup of sensors will vary according to the target group.

In case of AP-NURSE-HOME a caregiver will wear a simple rubber watch/bracelet that will identify the incoming signal and warn a caregiver by vibrating. In case of AP-NURSE-CARE a caregiver will control the condition of patients from the nurse/control room on a PC or using a mobile device, visualizing the parameters of AP-NURSE-CARE utilizing the simple traffic lights logic.

Both configurations will make possible of securely sending anonymized measured data to dedicated data server for further analysis by artificial intelligence algorithms.

Appropriate batteries will be used in all proposed tools to enable safe and reliable operation also during a power loss at home or at dedicated care centres.

The proposed tools will comprise microcomputers as ESP8266 and EPS32 boards and associated shields, Wapsmote platform with necessary shields, WIFI and RF433 MHz radio communicators, raspberry servers, sensors, and specialized software.

How do you plan the integration of the solution? (What tools will you use?):

In case of the AP-NURSE tools just partial integration is planned. These tools are mainly planed as standalone devices with the opportunity to send data for further analysis. This partial integration will require specific hardware described above and specialized software dealing with registering and monitoring devices.

Use case description:

AP-NURSE-HOME

Set of simple and cheap small monitoring devices that monitor several environmental factors of patient surroundings are placed at home of frail elderly or a patient to ease their everyday life.

In case of any emergency detected by the monitoring devices a caregiver is notified by a simple rubber watch/bracelet. We assume that a patient lives with a caregiver (in this case family member). To ease the life and not to disturb the caregiver's partner (husband, wife) during night, the bracelet warns a caregiver by vibrating pattern (for communication RF433MHz module with hard encoded addresses is used). After the caregiver received this

notification, he needs to push a button on the device, which had sent the signal to assure that the necessary help was delivered to a patient. If needed, online measured sensor data under and above set thresholds may be sent to dedicated servers for further analysis.

AP-NURSE-CARE

Set of small monitoring devices that monitor several environmental factors of patient surroundings are placed at care canter to ease the daily and specifically nightly routine duties of caregiving personnel.

In case of AP-NURSE-CARE the caregiving personnel will control the condition of patients from the nurse/control room on a PC or using a mobile device, visualizing the parameters of AP-NURSE utilizing a simple traffic lights logic. The online measured sensor data below and above set thresholds will be sent to dedicated servers for further analysis.

If required, after a specified monitoring period, artificial intelligence could deliver results of analysis showing progress and health status of monitored patients. The registration and the setup of the monitor screen would solely be adjustable under administrator account.

Main goals of used technology (What do you expect?):

The main goal of both solutions is to increase the quality of the caregiving services by utilizing smart assistance. Monitoring of the patient´s living environment will minimize harmful events by fast notification of the caregiving personnel, can provide continual data for a health progress evaluation and will decrease the level of stress of the caregiving personnel.

Technical requirements:

- What kind of networks are used/necessary to achieve the goal of the GP?
- What amount of data and how often they are transmitted to achieve the goal of the GP?
- What are the relevant biophysical or other signals that are measured to achieve the goal of the GP?
- Are any parts of the system in need of periodic mainthenance and why?
- How often do the additional sensors and other parts of the system needs recharging or batteries exchange?

  Sensors and peripheral devices will communicate through the local Wi-Fi network (in case of data collection, the Wi-Fi router must be connected to the

internet, otherwise data are collected on the local PC or hub) or directly via RF433 MHz radio.

Low size data are transmitted. Two types of periodicity are available: periodical monitoring from milliseconds to minutes; change follow monitoring – if some parameter was changed or exceeded a threshold, a relevant information would be transmitted.

Location/position on the bed or in the room, quality of the air (pollutants, CO, LPG or CO2), temperature, humidity, light and noise intensity.

Yes, all sensors have limited lifetime, especially the gas sensors.

All devices will be equipped by batteries, but they have been primarily designed to be permanently connected to the grid. In case of the AP-NURSE-HOME solution, battery is just a backup for blackout or power interruption. Power consumption of the devices and battery lifetime will be determined during testing.

Piloting summary (Description of Pilot Activity):

In both centres the AP-NURSE solutions will be installed at least in ten rooms or flats according to home or care centre application. The long-term functionality, such as remote data collection, staff and patient interaction will be tested. Periodical feedback from the patients, nurses and home caregivers will be collected and evaluated.

Testing description:

Laboratory testing

- Prototype testing
- Functional test of each sensor, response to event, data transfer and reliability.
- Application tests of developed kits based on single events and combination of the events.
- Communication of the kits in local network and data transfer to the server.
- Data collection and visualization
- Testing of the data collection, processing and visualization.
- Data collection on the main server and local servers at testing sites.
- Documentation
- Development of the user´s manual.
- Development of installation procedures.

- Development of the training procedures and materials.
- Development of functional and feedback questioner.

Real environment testing

- Installation of technical solutions and their adaptation to the local network and environment.
- Individual testing of the functionality of basic sensor kits, communication with the gateway, visualization and response to the possible events and secure data transfer to server.
- Long term testing based on real measured data from the patients´ environment.

Evaluation

- Evaluation of the installation and training procedures. Preparation of the training presentations and user manuals.
- Regular evaluation of the collected data, periodical checking of the sensors' functionality and active communication with care centres stuff or home care givers.
- Evaluation of the feedback from nurses, patients and home care givers based on developed online survey and adaptation of a relevant suggestions to the AP-NURSE design.

Components (Involved Digital Solutions):

Sensors, microcontrollers, gateway, Wi-Fi router, PC/notebook/tablet/smartphone.

Will you develope mobile app for digital solution?:

Yes, if necessary or required.

Cost effectivity of the solution?:

One of the aims is to develop device or set of devices, which are cost effective and available to the general public.

AP-NURSE-HOME – less than 100 €

AP-NURSE-CARE – less than 500 €

Equipment and Infrastructure Available:

All components are available on the market and the compatibility of some of them was already tested. Software for data collection and visualization must be developed, some

alternative components have to be tested and the overall functionality and data evaluation have to be proved as well.

What kind of data do you want to obtain?:

In case of the AP-NURSE-HOME solution no special data gathering is foreseen. Based on the measurement of environmental parameters, AP-NURSE-HOME will notify the caregiving personnel wearing a vibrating and alarmed rubber bracelet. The bracelet provides two levels of notification (warning, danger). The most important data obtained are thus the frequency and the type of notification for a given patient over a specified monitored period. If required, the obtained notification data can be stored on a dedicated server and further analyzed to evaluate the progress of the patient over time.

In case of the AP-NURSE-CARE solutions, two methods of data gathering are possible. The first method is similar to the one in case of AP-NURSE-HOME. It represents a collection of notifications on a computer located in the nurse room or on a mobile app. The second method comprises the collection of environmental data on a dedicated server. The environmental data include changes in the ambient temperature, air flow, light intensity, gas concentrations, movement, crossing a barrier or opening-closing a specific device (fridge, window door, oven, etc.) These data together with the frequency and type of notifications may serve to evaluate the progress of the diseases of monitored patients and help in decision making regarding the treatment of the patient.

Partners:

LP - Petrzalka municipality (Care Centre)

PP3 - The University Hospital Olomouc (UHO)

PP9 - City of Warsaw (Social Care Home)

Other unspecified volunteers

Subject profile (who are the users of the technology and of the whole system?):

In case of the AP-NURSE-HOME solution, the users are those individuals who are taking care of patients suffering from the Parkinson´s and Alzheimer´s diseases living in their home environment. These people could be the family members of the patients or professionals employed for such care giving. The users of the stored data could be neurologists, psychologists, general practitioners, specialists and experts in the treatment of Parkinson´s and Alzheimer´s diseases as well as data analysts.

In case of the AP-NURSE-CARE solution, the users are the personnel employed at care centers, either responsible for care giving or medical treatment of the patients. The users of the stored data could be neurologists, psychologists, general practitioners, specialists and experts in the treatment of Parkinson´s and Alzheimer´s diseases as well as data analysts, IT specialists and experts in machine learning and artificial intelligence.

How it will improve the quality of life of elderly people or family members?:

People, usually family members, responsible for patients suffering from Parkinson´s and Alzheimer´s diseases are generally exposed to a high level of stress. The most critical part of the day is the nighttime, when patients might wake up an perform activities potentially harmful for themes as well as for their environment. The AP-NURSE-HOME device will ease the life of these people, by accommodating multiple sensors in the patient´s environment (not attached to the patient) capable of monitoring the changes of environmental parameters and notifying the caregiver wearing a vibrational and alarmed bracelet. The caregiver is free to relax during nighttime, because the AP-NURSE-HOME devices gives him confidence that the patient or family member is under control.

In case of the AP-NURSE-CARE solution an extra benefit could be monitoring of multiple patients using a simple user-friendly computer environment or mobile APP. This device will decrease the stress from nurses or from other caregiving staff during regular errands or other work duties for not having the patient under control. AP-NURSE-CARE provides help and assistance to the professional staff during such indelible actions and warns them immediately, when any change of environmental indicators occurs. In addition, the AP-NURSE-CARE solution provides important generic data for doctors and specialist treating the patients without requiring them to be present at the caregiving site.

How is the digital solution related to the good practice from Bolona?:

The scope of the project adopts good practice recommendations from Bologna. The digital tool aimed to be developed uses modern sensors deployed in the monitoring environment without requiring them to be attached to the patients. It implements back-end software solution for data gathering that is robust to cope with cyber threats as well as makes possible implementing of machine learning and AI based principles. The AP-NURSE platform is designed to monitor patients suffering from Parkinson´s and Alzheimer´s diseases with potential to be applied also for frail elderly. The adaptation of the AP-NURSE-HOME and CARE solutions will generally increase the quality of life of patients and personnel responsible for their monitoring and treatment.

Do you want certificate the digital tool within/after the project?:

Since the AP-NURSE-HOME and CARE solutions are in development and a relevant operational experience is required to identify potential malfunctions of the devices, certification is not foreseen during the project implementation. Based on the gathered data and the feedback obtained from real users, decision will be made regarding certification of this platform in the future.

Security of whole solution:

Since AP-NURSE will gather data reflecting the conditions of monitored patients, special attention will be paid to secure the transfer access and storage of data. Data collected for analysis will be stored on the dedicated server of the Slovak University of Technology in Bratislava or locally at the monitoring site and no data will be provided to third parties. The used dedicated server of the Slovak University of Technology in Bratislava implements high standard of inherent safety and cyber security. The local servers will ensure communication only through local network without internet connection thus minimizing the risk of cyber threats. Although no personal data will be collected, all measures taking place in data management will be strictly in line with the EU The General Data Protection Regulation 2016/679. Principles of collection, transfer, access and storage of data will be thoroughly defined in the data management plan.

Installation of tools (where and how many homes and tools?):

The central data server is already in operation at the Slovak University of Technology in Bratislava. The back-end software for local servers will be installed regarding the specifics of the monitoring site. The monitoring software will be installed on computers located at nurse rooms and mobile devices of the caregiving personnel regarding the number and deployment of monitoring devices. It is foreseen that 10 monitoring devices, 2-5 PC and mobile APPs and one local server will be set up at each testing site. The monitoring devices will use in-house software developed at the Slovak University of Technology in Bratislava. The software will be installed to measurement nodes.

Ethical aspects (Do you need ethical approval?):

There will be no need for ethical approval, if AP-NURSE is used only for personal purpose at homes. However, if the tool is set up to send the measured data or behavioral patterns to medical professionals or other parties, ethical approval would be required. It is expected that the AP-NURSE tool will only be used by social-care service centers, where patients have

already approved the use of such devices. In addition, the patients for testing will be selected solely on voluntary basis.

Have you ever use tool in European project (if yes what is the added valu efor niCE-life project?):

The AP-NURSE tool was not used in any European project.

Evaluation of technology (How will you evaluate and by which tools):

Adequate monitoring and evaluation of the technology will be conducted in multiple phases to assure the quality of the final device. The evaluation of the first two phases will be conducted by the team at STU and the next phases will be evaluated by experts, medical professionals and patients:

1) Functionality testing of components that will be used during prototype testing and in deployed final solution. In this phase the applicability of the sensors will be evaluated.

2) The evaluation of the prototype based on testing of the monitoring physical variables and setting up appropriate thresholds of monitoring sensors to avoid generation of any false signal.

3) Prototype deployment and operation testing in the social-care service centers. Two forms will be prepared for the evaluation of the prototype functionality. The first form will be filled by the patients and the second by medical professionals at the social-care service center. Based on the feedback the protype will be modified.

4) The final device will be tested in real environment and the feedback will be gathered once again from the patients and the medical professionals.

Describe cooperation with stakeholders/target groups:

Online survey form will be sent to all relevant partners that have experience with patients suffering from Alzheimer's and Parkinson's diseases. The purpose of the form is to gather relevant information that are required by the patients and medical professionals to be monitored.

Regular meetings are planned with partners involved in the developing activities of the AP-NURSE technology. The purpose of meetings is to tailor the AP-NURSE devices to the needs of medical professionals and patients suffering from Alzheimer's and Parkinson's diseases and to inform relevant partners about the ongoing work related to the AP-NURSE development.

Several members of the STU team have personal experience with patients suffering from these diseases. Therefore, the development of the AP-NURSE technology is also influenced by this experience with the target group.

Sustainability after project:

The devices developed during the project will be divided between three organizations – Petrzalka municipality, Social Care Home in Warsaw and STU. We believe that the use of both variants (AP-NURSE-HOME and AP-NURES-CARE) will be beneficial for the Petrzalka municipality and the Social Care home in Warsaw. We also expect that in the future, the professional variant AP-NURSE-CARE will be distributed also to other social-care centers. Moreover, the AP-NURSE-HOME technology is being developed in a cost-benefit way and the device will be affordable for personal use by caregivers at home.

The STU team will use the devices after the project for future development of the AP-NURSE technology, to maintain the technology deployed at the partners and for possible medical certification of the developed devices.

Harmonogram and milestones:

Coordination meeting of the AP-NURSE tool development – April 2020

Design, procurement and construction of device and peripheral devices – May 2020

Construction of Data and Control Nursing Unit and software development – August 2020

Testing of integral parts of the modular tool and prototype construction – December 2020

Testing of the prototype and finalization of the tool – January 2021

Monitoring tool “AP-nurse” – January 2021

Additional comments & bibliography:

Mittelstadt, B., Fairweather, B., Shaw, M. & McBride, N. (2014). The Ethical Implications of Personal Health Monitoring. International Journal of Technoethics, 5(2), 37-60. Rohrauer-Näf, G. & Habl, C. (2016). Intersectoral cooperation in health promotion programs and activities to strengthen health equity in Austria: Gerlinde Rohrauer-Näf. European Journal of Public Health, 26(1), 144-145.

1.6. Monitoring Grid

Lead partner: **Samaritan Vienna**

Responsible person: Sylvia Lomosits, sylvia.lomosits@samariterbund.net

Involved partners:

PP2: Brno University of Technology, Radim Burget

PP5: LEPIDA SCPA, Teresa Gallelli

PP6: Local Health Authority of Bologna

Name of the regions involved (approx. number of affected population):

The Monitoring Grid will be testet and implemented in **Burgenland**. The Samaritan Department Burgenland is provider of assisted living homes. Therefore the Monitoring Gird shall be implemented in the assisted living homes. People lived there shall be the target group of testing. At the moment (May 2020) there are **61 residents** living in assisted living homes in Burgenland provided by the Samaritan Department Burgenland. **10 of them will be engaged in the project**.

Description of digital tool:

The Monitoring Grid is a software, which is based on the long-term experience of e-Care Network in Bologna developed in 2005.

The **Monitoring Grid** applies to people over 75 years old, who are living alone or with their spouses and are affected by so-called **frailty factors**. Theses factors are classified into 3 groups:

Functional frailty factors: feeding difficulty, difficulty in movement, falls, sensory deficits

Clinical frailty factors: respiratory and/ or cardiac diseases with complex therapeutic treatments, diseases with frequent clinical examinations and/ or referrals, chronic pain, hospitalization, depression

Social frailty factors: caregivers of people requiring ongoing care, people living in remote or derelict areas, with low income, inadequate housing, lack of help from framily or friends.

Depending on the types of frailty identified for each user, the Grid points out a series of „sentinel events“. If one ore more sentinel events are detected, the eCare Call Center reports and refers these cases to the eCare Networtk Health and Social Services, who will then take immediate action.

In the course of this project this tool shall be extended based on other EU good practices and adapted to the local conditions in Austria.

What kind of technologies do you might to use?:

The Monitoring Grid is a tool, which allows to detect early signs of deterioration of the health or social conditions of the elderly. Therefore the elderly shall be contacted regularly by well trained employees.

In this case you have to supply the residents with a mobile phone, maybe with video function.

Furthermore the employees also have to get a mobile phone and of course a computer, on which they can use the software and save the data.

One service of the Samaritan Department Burgenland is the „home emergency call“. If older people need help, they can use the emergency call to request it at the push of a button. The home emergency call shall be included in the implementation of the monitoring grid.

How do you plan the integration of the solution? (What tools will you use?):

Organisational Implementation

The person who will contact the residents will be the residential area manager. The Monitoring Grid will be added to the functional description of the residential are manager.

Technical Implementation

The Samaritan Department Burgenland uses a software, which is called „Care Center“. It is a software solution for the social economy and contributes to efficient administration,

comprehensive care documentation, therapeutic and medical documentation and a planning of activities.

The nursing and administration staff works with this program. This software saves all the datas of the residents. The Care Center shall be used as a component.

Furthermore the elderly shall also have the possibility to contact the residential area manager on her own. To ensure this, the home emergency call shall be connected with the Monitoring Grid.

Use case description:

In a first step a professional group (nurses, quality management, operative management, psychologists, ...) has to define rules of admission, a protocol to assess the condition of each resident and also an informed consent.

The Monitoring Grid concerns two actors, namely the residents and the staff, who contacts the residents (residential are managers).

Residents can be part of the project if they

- live in assisted living home
- have a care level
- use the home emergency call and
- have signed the informed consent.

The **residential are manager** will be identified and trained. The residential are manager will then contact the residents weekly.

Main goals of used technology (What do you expect?):

- To provide an objective und subjective sense of security
- To give the residents the chance of living a longer, independet life instead of asking for hospitalisations or nursing homes
- To manage and facilitate phone interviews with frail elderly people
- To regularly check the users‘ state of health
- To detect early signs of deterioration of the health or social conditions of the elderly and to then take immediate action
- Technical requirements:
- What kind of networks are used/ necessary to achieve the goal of the GP?
- What amount of data and how often they are transmitted to achieve the goal of the GP?
- What are the relevant biophysical or other signals that are measured to achieve the goal of the GP?
- Are any parts of the system in need of periodic mainthenance and why?
- How often do the additional sensors and other parts of the system needs recharging or batteries exchange?

It is planned to integrate the Monitoring Grid into the already available CareCenter, which is a software used by nurses and adminstrators to manage elderly data.

In addition the already available home emergency call shall be expanded so that it also can be used as part of the monitoring grid.

Piloting summary (Description of Pilot Activity):

The pilot testing will be held in assisted living homes in Burgenland instead of only Mittelburgenland as it is written in the Application Form. The reason for that is, that Mittelburgenland only have 9 residents in assisted living homes. However, at least 10 residents will engaged into the pilot testing.

After mapping the needs of the elderly and their family member and presenting the framework conditions of Austria, the digital tool shall be designed and developed. For this purpose the main objective, the requirements and concrete steps will be defined.

Thereupon the Samariterbund will organise meetings with the residents and their family members and explane the principles to them. At the same time the staff shall be briefed about scope, objectives and timeframe of the pilot action.

After installation and testing of the Monitoring Grid, periodical feedback from the residents and the staff will be collected and evaluated.

Testing description:

The functionality and security aspects of the Monitoring Grid will be tested in assisted living homes in Burgenland.

Components (Involved Digital Solutions):

Hardware

- PC/ notebook
- Smartphone for the residents and the residential area manager
- Home emergency call

Software

- CareCenter
- Server

Will you develope mobile app for digital solution?:

Not yet. If there will be a demand for the app, we will think about it.

Cost effectivity of the solution?:

The cost effectivity will be analysed according to the actual utilisation and the acceptance of the Monitoring Grid by the residents.

Equipment and Infrastructure Available:

CareCenter has to be expanded respectively adapted. Hardware like PC and mobile phones are available on the market.

What kind of data do you want to obtain?:

Qualitative data: Satisfaction of the users and improvement of the quality of life

Quantitative data: Number of detected early signs of deterioraton of the health or social condition

Partners:

PP2: Brno University of Technology, Radim Burget

PP5: LEPIDA SCPA, Teresa Gallelli

PP6: Local Health Authority of Bologna

Subject profile (who are the users of the technology and of the whole system?):

Residents in assisted living homes and the care givers.

How it will improve the quality of life of elderly people or family members?:

The regular contact between the residents and the residential area manager shows the residents that there is somebody who cares for them. Therefore the Monitoring Grid will provide an objective and subjective sense of security and will lead to a reduction of social isolation. Furthermore the residents get the chance of living a longer indepndent life instead of asking for hospitalisations or nursing homes.

How is the digital solution related to the good practice from Bolona?:

The Monitoring Grid is one tool of the eCare Network in Bologna.

Do you want certificate the digital tool within/after the project?:

Certification is not part of the project and have to be discussed with the government of Burgenland.

Security of whole solution:

Not sensitive information will be stored.

Installation of tools (where and how many homes and tools?):

The tool shall be implemented to the already available Care Center. Since it is not yet clear which residents from which localities are included in the project, it cannot yet be said how many homes are affected.

Ethical aspects (Do you need ethical approval?):

Regular calls of the residential area manager could be seen as an attack on privacy by the residents. Participants will receive information about the project and will be assured of confidentiality. Participation will be voluntary and written informed consent will be collected from all participants. Participants will have the opportunity to withdraw from the study or end their participation at any time without giving any reason.

A second point is data protection. The processing of the data will be based solely on the legal provisions. This will also be part of the written informed consent.

Have you ever use tool in European project (if yes what is the added value for niCE-life project?):

No. This tool was not used in other EU project.

Evaluation of technology (How will you evaluate and by which tools):

Use of questionnaires to evaluate residents‘ acceptance, satisfaction and usability.

Describe cooperation with stakeholders/target groups:

There is an ongoing cooperation with stakeholders and target groups. Different targets groups and stakeholder are involved in this project.

Sustainability after project:

- Involvement of the residential area manager in the development process of the project shall promote identification with the digital tool
- Implementation of the Monitoring Grid into the functional descriptions of the responsible employees
- Regular meetings and trainings
- Regular evaluations and analysis

Schedule and milestones:

03 - 12 2020 **A.T2.5 Development/ adoption of the „Monitoring Grid“ sepcific softwar for the management of „frailty**

05 2020 D.T2.5.1 Coordination Meeting

05 2020 D.T2.5.2 Review of the Monitoring Grid and EU good practice

09 2020 D.T2.5.3 Preliminary model of Monitoring Grid

12 2020 D.T2.5.4 Final version of the Monitoring Grid

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01 – 12 2021

A.T3.7 Pilot testing of the Monitoring Grid in Burgenland

01 2021 D.T3.7.1 Design of the pilot action in Burgenland

03 2021 D.T3.7.2 Engagement of test persons and consideration of legal aspects

04 2021 D.T3.7.3 Report from briefing and traingin of test persons, home care givers and nurses

04 2021 D.T3.7.4 Installation and testing of technical devices and applications

10 2021 D.T3.7.5 Collection and analysis of feedback from test and support persons

11 2021 D.T3.7.6 Summary report from the pilot action in Burgenland

Additional comments & bibliography:

C. Fiori: The eCare network in Bologna: no longer home alone, CUP 2000, S.c.p.A – Italy

Information about the Monitoring was in addition provided by LEPIDA , S.c.p.A and the Local Health Authority of Bologna.

2. Technical reviews

2.1. Technical reviews of YOU BOSS

2.1.1. Criteria for the identification of the digital tool for frail elderly in Bologna

The contribution of the team in Bologna aims to develop a new communication system (based on a technological/informatics networks and on the "local social resources"[1]), involving the social health services and the local social resources, addressed to the elderly people /and thir families.

This new communication system aims: to improve the quality of life and health conditions of the senior citizen (fragile/alone, or affected by pathologies); to keep him at his home for longer and so to contribute keeping him active; to guarantee a correct use of the social and health services so to limit the welfare costs.

This new solution called YOUBOS is in line with the eCare services delivered in Bologna. Several could be so the operative practical synergies between the two solutions.

You BOS is a web platform dedicated to frail seniors and their caregiver not particularly able to the use of the digital. The objective of the web platform is to take care of the frail seniors, often isolated, and help them by using digital tools to discover new relational models.

Through the web platform we develop projects aimed to promote:

- virtual socialisation;
- make them more active;
- healthy lifestyle;
- reduction of the digital divide and users social isolation.

Thus, You BOS has to answer to the following needs coming from older people:

- home support in order to avoid the useless movements of the elderly;
- entertainment in order to avoid loneliness;
- contact with other old persons in order to promote socialisation;
- information in order to assist in the socio-sanitary "map of services";
- ensuring continuity in the health care and follow up of elderly people.

Involvement of local resources

The "local resources" are important venues for resident senior citizens socialisation. These venues can be considered not only as important places for understanding elderly people needs and interests, but also as privileged places for promoting social cohesion, helping them to socialise and find new motivation and interests to life.

We suggest so to start from the above mentioned "local social resources" with a double aim:

1) to learn in deep the needs, resources and interests of senior citizens;

2) to understand the interest of the "local social resources" in Nicelife and consequently their concrete availability to be actively and operatively involved in some project's phases (i.e. feeding "YouBOS system" with information on services provided/help offered to the selected elderly people, home monitoring of some senior citizen involved, promotion of relations and best practices among the elderly people, running of thematic "video" channels offered through the YouBOS platform).

In relation to the point 1), the following actions are previewed:

1.1) periodical phone calls with elderly realised from the contact center operators;

1.2) interviews involving the senior citizens, organised with the active support of the local volunteers;

1.3) interviews with local stakeholders.

These activities will all preview a short "practical" presentation of YouBOS platform, so to better illustrate the future implication of the tool offered at the senior citizens and also for deepen the knowledge on elderly needs/resources/interests.

In this frame it is important to identify and involve the "local resources" available for supporting the provision of YouBOS services. To this aim it is previewed a first "political" contact and a second one more operative and practical addressed to a panel of pre-identified organisation. Some of the suggested organisations and stakeholders are the President of Bologna Area of AUSER, representatives of the Italian Retired Syndicate, the chief of mental health department, the chief of local mental support ambulatories, President of Bologna's ANCeSCAO Cultural and social centres for active ageing, the Director of the Centre for Voluntary Service in Bologna (VOLABo).

The local social resources and stakeholders that agreed to be involved in Nicelife project would be considered an "intelligent" local hub, useful not only for monitoring/knowing the elderly needs, but also for increasing/supporting the eCare call centre in particular for:

- monitoring elderly people;
- involving “active” senior citizens in good social practices;
- promoting YouBOS services.

2.1.2. Envisaged services offered by YouBOS

The services offered by YOUBOS can be numerous.

The short-term objective is to identify the feasible services and the means/methodology of provision (service description, its technicalities/characteristics, roles, functions, processes, target group, time and frequency….). After this first phase, once the feasible services will be defined, meetings with local social care workers, “local social resources” and senior citizens will be organised.

YouBOS system could broadcast images on the events and conferences realised in the city of Bologna and/or specific boroughs.

Actions addressed to promote health and quality of life in order to induce senior citizens to go out and take part or, in some of the cases, be the key player of events and activities on various domains, in line with the thematic channels proposed (good practices – elderly people health programme defined by LHA BO); the organisational aspects of the events could be supported by the “local territorial resources”.

Organisations of thematic transmissions via video/pc on issues identified taking into considerations the elderly people preferences and/or best practices followed (in terms of life style); the transmissions will be organised by the “local social resources”, previewing also the involvement of professionals in case of need. Maximum interaction with senior citizens has to be guaranteed.

Description of digital tool

The YouBOS platform is intended to create:

- a connecting Blog, moderate by an editor interact with the users.
- “The expert’s corner area” which will transmit live on channel or in asynchronous mode uploading the video on the web portal, giving the possibility so far to collect the questions by the users and forecast the subsequent replies.
- creation of “thematic areas” such as for example the “Laboratory of making” where the users contributions are published, “Attivi per forza” there are loaded sweet gym

videos, workout, “the word between us” in which are explained daily complex terms usually in a foreign language like english.

The role of the blog’s entertainer and of the laboratory of making will be assigned to the project leader of the “contest of ideas”.

YouBOS will allow an integration among the different technologies used in order to guarantee access to the greatest audience giving them equal access opportunity. To make an example, the “on air” video transmission delivered through Facebook or Youtube will be made available directly on the YOU BOS platform for seniors who do not have any account on those social media.

Use case description

Frail seniors: they can access the You BOS platform, create an account and participate to the different sessions of contents.

Animator - volunteer: they play the role of connecting the resources on the territory virtually. You BOS will create virtual places where will be delivered projects and services addressed to the socialisation of frail group of seniors. Experts in different domains (health, food, culture, sport & exercise) will be involved for the production of contents and materials.

System administrator: management of the user profiles, roles and authorisations.

Setup of the “test” environment

Installing the development environment for the YouBOS solution consists essentially of four steps:

1. creation of the domain "testyoubos.net", accessible only to developers from the internal network of LepidaScpA (for Lepida developers/designers/testers), or via VPN (for other partners)
2. installation of the Drupal CMS, adopting version 9 (released with "stable" certification on June 3) and MySQL database
3. installation of version 4.X of the Bootstrap graphical framework
4. installation of the "minimum" required modules for a “plain vanilla” Drupal configuration
5. creation of the categories of users necessary for project management, and subsequent creation of a test user for each category.

The “domain name”

The YouBOS prod.uction platform should theoretically be accessible by partners located in any participating country. For this reason, the choice of a ".net" domain is proposed, in place of the more obvious ".it", which would be the most natural option, being most users of the platform residing in Italy.

Starting from this assumption, the development domain will be defined as "testyoubos.net" (accessible via **https** protocol for all enabled users, and through **ftp** protocol for administrators and users in charge of development only), while the production domain - intended to be used in the deployment phase of the project - will be defined as "youbos.net". The configuration of the servers used for development and production must allow to reach the platform both by preceding the domain name with the prefix "www.", and with the domain name only.

An optional choice would be to use a ".eu" domain instead of ".net", thus emphasizing the continental character of the project.

2.1.3. Drupal Environment setup

Why Drupal?

Drupal is an open source platform for managing content on the web, a software that helps single users or large communities to publish, administer and organize large quantities and varieties of content on a website, simply and quickly.

Thousands of people and organizations are using Drupal to manage community web portals and discussion sites, like YouBOS.

Drupal offers the ability to enable all the functionality needed by the project:

- content management systems
- managed blogs
- collaborative writing environments
- newsletters
- image galleries
- video galleries
- uploading and downloading of files

- and much more, thanks to more than 28.000 modules developed to extend its base functionality.

Its graphical theming functionality allows total independence between content and presentation, i.e. the final graphic rendering.

Starting from one of hundreds of free installable themes it's possible to create full responsive sites, that comply with accessibility specifications and the most modern web standards.

Drupal is entirely developed in PHP, one of the most used languages on the web. It uses MySQL and PostgreSQL natively as a database but can be used with any type of database server. It is a solution adopted worldwide by a growing number of communities, associations and government agencies. Being maintained by a large, well-disciplined and active community of programmers and IT professionals, it's the ideal design / programming tool for the YouBOS development.

Supporting natively Unicode and Internationalization, and being translated into many languages thanks to the support of the various national communities, Drupal is the perfect tool for envisaging a development of YouBOS testbed towards other Countries involved in the project

Why version 9?

Currently, versions 7.X and 8.X of Drupal are supported, while on June 3 the release of the first supported build of the new major version 9 (9.0.0) took place, certified as suitable for use in production environments.

The "Bologna Solidale" portal currently in use was created on version 7. The choice to adopt version 9, skipping the current build 8.9.0 of Drupal core, is essentially linked to two considerations: first, versions 7 and 8 of the CMS will be maintained until November 2021 (date beyond which there will be no further releases, neither evolutionary nor corrective), therefore it would not seem a far-sighted choice to focus on a version that should however be replaced within 18 months, while Drupal 9.0 will guarantee forward compatibility with later releases. Secondly, the migration of existing content on the current portal to the YouBOS platform presents the same level of complexity in the transition from version 7 to version 8 and in the transition from version 7 to version 9, therefore it is considered more convenient to face this step by having as a final goal the most modern and updated build.

We should also consider that the global developer community is currently engaged in a program of certification of compatibility to version 9 of the extension modules available

today for version 8, which will immediately guarantee the availability of most of the modules that are deemed necessary for the project, pending the rewriting of those that are not compatible.

Server and database requirement

The choice of Drupal version 9.0.0 imposes some requirements that must be met by the server architecture that will host the development environment first, then the production environment. Drupal 9 requires PHP 7.3 or higher, and the version requirement for Apache has been increased to Apache 2.4.7 or higher. The 5.7.8 version of MySQL database is supported by Drupal 9 core.

2.1.4. The Bootstrap framework

The Bootstrap framework is a collection of free tools for creating websites and applications for the Web, developed at Twitter as a framework that standardized the various components that made up the web interface, and released as open source in 2011. It contains design models based on HTML and CSS, both for typography and for the various interface components, such as modules, buttons and navigation, as well as some optional JavaScript extensions.

Since version 2.0 it also supports responsive web design. This means that the layout of the web pages is dynamically adjusted, considering the characteristics of the device used, be it desktop, tablet or mobile phone. Starting from version 3.0, Bootstrap has adopted responsive design as its default setting, underlining its being born as a multi-device and multi-platform library.

Major version 4.0, published on 18 January 2018 (and currently – as 4.5.1 - the most recent in stable form) provides various changes compared to the previous major release and is lighter from the point of view of the code, among which some of the most relevant from our point of view are:

- support for obsolete browsers, such as Internet Explorer 8 and 9 and those integrated in the first iPhones (relevant considering the devices used by most of YouBOS targeted users)
- Faster and lighter JavaScript plugins
- Elimination of integrated Glyphicons icon font and facilitation for the use of external fonts, such as Font Awesome or Material Design Icons.

Of course, version 4.X of Bootstrap provides many other features and changes, documented on the project website itself.

Therefore, the choice of adopting Bootstrap in YouBOS project depends on three factors:

- Core functionality
  - Responsive grid markup and CSS
  - Themable content and Javascript components
  - Readable tipography base
- Documentation
  - Standardization help teams to become more productive
  - Adding new developers to the team is quicker and easier
- Customizable
  - Completely customizable for large projects

The extension modules – Drupal base configuration

Modules are an essential part of the Drupal environment. A module is a compact set of PHP, JavaScript and/or CSS files that enhance the functionality of your website, and provide a framework to extend both the features and flexibility of Drupal in order to easily mold a custom digital experience for YouBOS users. The modules offered by the Drupal community come in three types: core modules, contributed modules and custom modules.

- core modules: are included in any Drupal installation. For example, Drupal comes with modules to manage user accounts, basic content fields and navigation menus; as well as make lists, grids and blocks from existing content
- contributed modules: can be download from the Drupal repository, but are not included in the Drupal core package
- custom modules: coded specifically for individual projects; the development of some custom modules is foreseen, according to project objectives.

Following, the list of the core and contributed modules to be installed and activated in order to create the base development environment (further modules will be installed to satisfy the needs that will arise during the development phase).

Core modules

- all standard core modules in the basic installation, except those classified as "Experimental"

Contributed modules

- Advanced Link
- Better Social Sharing Buttons
- Block Visibility Group
- Contact Block
- Content Export CSV
- Easy Breadcrumb
- Entity Type Clone
- Font Awesome
- Font Awesome Media Entity
- File Download
- Pathauto
- Quick Node Clone
- Sitemap
- Token
- Admin Toolbar
- Admin Toolbar Extra Tools
- Admin Toolbar Links Access Filter
- Admin Toolbar Search
- File Download Link
- File Download Link Media
- Contribute
- CAPTCHA
- reCAPTCHA
- CSV Importer
- Back To Top
- EU Cookie Compliance

- Simplenews
- Simplenews Content Selection
- Simplenews Content Selection Views Integration
- Image Link Attributes
- Imce File Manager
- SVG Image
- SVG Image Responsive
- Migrate
- Migrate Drupal
- Migrate Drupal UI
- Publish Content
- Metatag
- Google Analytics
- Chaos Tools
- Features
- Features UI
- Webform
- Webform Bootstrap
- Webform Image Select
- Webform Node
- Webform Scheduled Email Handler
- Webform Templates
- Webform UI

Contributed modules for multilanguage site (if / when needed)

- Configuration Translation
- Content Translation
- Interface Translation

- Language

To meet one of the project requirements, it will also be necessary to select from the public repository, or create, an expansion module that allows users authorized to insert content at lower level (Authenticated - Contributor users / see following chapter) to perform this operation from their personal page, avoiding having to grant them access to the Drupal admin interface.

User standard profiles and Access Control List

The management of users defined within a project that adopts the Drupal platform is based on three elements:

- the profile of the individual user
- the role
- the permissions assigned to the role or user.

Defining in detail the grid of permissions goes beyond the purpose of this deliverable, also because it is possible that during the development of the project - as in the deployment phase - new contents, new areas and consequently new roles, each of which would entail more or less significant changes in permits.

What we can define as of now are the fundamental roles that will be necessary for the development phase and for the test phase:

- Anonymous: Visitors to YouBOS who are not logged into the site
- Authenticated - generic: Anyone who has a registered account on YouBOS and logs in is authenticated. The Authenticated role also serves as the minimum set of permissions that is given to all logged in users. Each authenticated user will be profiled based on the information he has provided during the registration phase, and these will determine the type of content and the type of interface that YouBOS will present to him upon access. The “Generic” authenticated user will be allowed to vote and comment on the contents on the site, but the comments will only be published after their approval by a user belonging to the Authenticated – Editorial role
- Authenticated - Contributor: any authenticated user who has been allowed - upon his request, or upon proposal of the users belonging to the Editorial role - to insert new content in the areas of YouBOS open to texts produced by users (referring to the project, typically in the "Laboratorio del Fare ","Parole tra noi"and in the newly

created Blog areas); the texts will be entered directly by the user, but their publication must be previously validated by a user belonging to the Authenticated – Editorial role. The “Contibutor” authenticated user will be allowed to vote and comment on the contents on the site, but the comments will only be published after their approval by a user belonging to the Authenticated – Editorial role

- Authenticated - Association: any authenticated user who has been allowed - upon formal request from a representative of the association he belongs to - to insert new content in the areas of YouBOS reserved to associations: association description, permanent activities, events. The texts will be entered directly by the user, and no validation will be required for its publication. The “Association” authenticated user will be allowed to vote and comment on the contents on the site, but the comments will only be published after their approval by a user belonging to the Authenticated – Editorial role
- Authenticated - Editorial: Any user belonging to the group that routinely manages the publishing activities contained on YouBOS (the editorial staff – “la Redazione”); is authorized to insert texts in any area, has the responsibility to approve the texts entered by the "Contributor" users and the comments entered by any user, selects the contents that must be included in the Newsletter; is authorized to compose the Newsletter and to manage its shipment to the YouBOS mailing list on the established date.
- Administrator – Manager: Each user assigned to this group can - in addition to the privileges assigned to the Authenticated - Editorial role - create users and groups, block or remove users, intervene on the "low-level" structure relating to the appearance of the YouBOS platform: create and modify the structure of the content types, create and edit blocks and views. It cannot intervene on the graphic theme, nor on the code
- Administrator – Superadmin: Each user assigned to this group can - in addition to the privileges assigned to the Administrator - Manager role - modify the authorization grid and intervene on the "high level" structure relating to the functionality and appearance of the YouBOS platform: install and modify the graphic theme (at the CSS level or at the code level), install and update the expansion modules, update the Drupal core releases, both for functional and security reasons

For safety reasons, at least two users must be created for each role, already in the development phase. The profiles belonging to the "Administrator" roles must be set so that their password reflects the usual security rules adopted by LepidaScpA, and that the password itself has an expiration term no longer than three months.

As far as the content of the fields that make up the profile are concened, the need for user profiling requires that the standard profile proposed by Drupal be enriched by a series of fields: therefore, in addition to the usual general information and user picture, data relating to the age, municipality of residence (or neighborhood and area in the case of Bologna residents), availability of a smartphone. The approval of the shipment of the newsletter in electronic format must also be collected, as well as the willingness to receive it in paper format when distribution begins.

2.1.5. Design and implementation of a responsive and accessible graphic template

The sector of population that YouBOS addresses requires the platform that will be created to be easily usable using a smartphone, to respect strictly the accessibility criteria validated internationally, and to provide an easily readable design.

The adoption of the Bootstrap 4.X framework will guarantee the possibility to adopt a fully responsive design, which is the cornerstone of a good accessibility, while elements will be considered in the graphical theme customization phases, which will adopt a “mobile-first” design.

The responsive YouBOS

A responsive site makes use of a graphic layout with grids of fluid proportions, flexible structure and images, and, generally, of style sheets 3.0, applying an extension of the @media rule to adapt the graphic layout to the environment in which the site is displayed.

Media queries allow the page to use different stylesheets based on the characteristics of the device used; the flexible grid concept requires elements to be dimensioned by relative units such as percentages and ems, and not by absolute units such as pixels or points, flexible images must be able to be viewed in different sizes, so that they can adapt to the layout without overlapping the other elements.

As a result, users who use different peripherals and browsers have access to a single source whose contents, however, are arranged in a different way such that they are always easily

accessible, and without having to perform too many resizing, scrolling and moving operations.

The need to adapt the layout to the different screen sizes and resolutions, introduced the concept of "Resolution breakpoint", in order to establish thresholds at which to modify the graphic presentation according to the width device. These thresholds are generally expressed in pixels, even if the increase in pixel density in new generations of devices means that the viewing area cannot be considered only in terms of pixels, without considering their actual size.

The Bootstrap framework identifies (with reference to the "max-device-width") four types of devices and corresponding resolution breakpoints:

- extra small devices with a resolution of less than 768 pixels
- small devices with resolution up to 992 pixels
- desktop with resolution less than 1200 pixels
- large devices with a resolution greater than 1200 pixels

These types can be more generally traced to four main ones:

- mobile: for mobile
- narrow: for tablets
- normal: desktop or laptop computer
- wide: large screens

The design phase of the YouBOS graphical theme will adopt a *reflowing - mostly fluid* strategy as the screen size changes (multi column with wider margins on large screens, and on narrow screens the areas are aligned on a single column).

The accessible YouBOS

Accessibility is the characteristic of a device, a service, a resource or an environment that can be easily used by any type of user.

The term is commonly associated with the possibility - also for people with reduced or impaired sensory, motor, or psychic ability (i.e. suffering from both temporary and stable disabilities) - to access and move independently in physical environments (for which we speak of physical accessibility) , to enjoy and access cultural content independently (in

which case we are talking about cultural accessibility) or to use the IT systems and resources typically available through the use of assistive technologies or through compliance with product accessibility requirements.

The term has also found wide use on the Web with the same meaning. In this context, accessibility solutions are developed in order to encourage the reduction or elimination of the so-called Web Accessibility Divide, i.e. the gap between those who can independently access web resources and those who cannot (people with visual impairment).

The adoption of the Boostrap framework in the YouBOS project provides the environment and tools to deal with the problem of accessibility, but the overall accessibility of any project built with Bootstrap depends in large part on the author's markup, additional styling, and included scripting. However, provided that these have been implemented correctly, it should be perfectly possible to create websites and applications with Bootstrap that fulfill WCAG 2.0 (A/AA/AAA), Section 508 and similar accessibility standards and requirements.

Bootstrap's interactive components—such as modal dialogs, dropdown menus and custom tooltips—are designed to work for touch, mouse and keyboard users. Using relevant WAI-ARIA roles and attributes, these components should also be understandable and operable using assistive technologies (such as screen readers).

Because Bootstrap's components are purposely designed to be fairly generic, YouBOS interface designers may need to include further ARIA roles and attributes, as well as JavaScript behaviour, to more accurately convey the precise nature and functionality of their component.

Most colours that currently make up Bootstrap's default palette -used throughout the framework for things such as button variations, alert variations, form validation indicators - lead to insufficient color contrast (below the recommended WCAG 2.0 color contrast ratio of 4.5:1) when used against a light background. YouBOS designers will need to manually modify/extend these default colours to ensure adequate colour contrast ratios.

Content which should be visually hidden, but remain accessible to assistive technologies such as screen readers, can be styled using the **.sr-only** class. This can be useful in situations where additional visual information or cues (such as meaning denoted using colour) need to also be conveyed to non-visual users.

Bootstrap includes support for the prefers-reduced-motion media feature. In browsers/environments that allow the user to specify their preference for reduced motion,

most CSS transition effects in Bootstrap (for instance, when a modal dialog is opened or closed, or the sliding animation in carousels) will be disabled.

YouBOS graphical theme design guidelines

The YouBOS graphical theme design process will start from a “plain vanilla” Drupal 9 theme – such as “Bootstrap” or “Barrio” (with SASS subtheme) – which will serve as a basis for the application of the graphic design principles known as "Material Design".

Material Design is a design developed by Google, first announced in 2014 and re-released in 2018. Its rules focus on making greater use of grid-based layouts, animations and transitions, and depth effects such as lighting and shadows.

Natively supported from Android version 7, the Material Design has been gradually extended to the whole range of Google, web and mobile products, in order to provide a coherent experience on all platforms and applications.

Most of Google's applications – mobile or for the Web - have applied the new design language, including Gmail, YouTube, Google Drive, Google Docs, Google Maps, Inbox, all Google Play applications, the Chrome browser and Google Keep. It has also been incorporated into the Google Drive, Google Docs, Google Sheets, Google Slides, Google Analytics, Google Developers and Inbox desktop web interfaces.

By adopting the Material Design for the interface of YouBOS, we will obtain a double advantage: to guarantee the project a "look and feel" already well known to all users, and making the user experience on smartphones as similar as accessing a native App.

2.1.6. Migration of still up-to-date content from the “Bologna Solidale” site to the new platform

The last - but no less important - operation to be carried out for the installation of the platform on which YouBOS will be managed, is the migration of the contents currently present on the "Bologna Solidale" site, and which are still considered valid as starting material for the activity of YouBOS.

We will use the expansion modules Migrate, Migrate Drupal and Migrate Drupal UI previously installed, in order to migrate content types, field definitions, user roles, contents and users from “Bologna Solidale” (on Drupal 7) to YouBOS (on Drupal 9). Although we have these automated tools available, setting them up can still be a complex process, and in some cases could be easier/faster to manually create the content in YouBOS.

Additional resources

- Bootstrap framework
- Web Content Accessibility Guidelines (WCAG) 2.0
- The A11Y Project
- MDN accessibility documentation
- Tenon.io Accessibility Checker
- Colour Contrast Analyser (CCA)
- “HTML Codesniffer” bookmarklet for identifying accessibility issues
- Material Design documentation

2.2. Technical review of the GPS tool

2.2.1. Selection criteria for gps tracking devices

In order to identify the criteria for choosing the best devices that could be implemented to support people with dementia and their families, a first analysis has been carried out among the scientific approaches available in the literature. Among the most relevant publications that have influenced our methodology it is necessary to mention in advance, the recent study entitled "*What do we require from surveillance technology? A review of the needs of people with dementia and informal caregivers*", from which the most relevant variables for understanding the level of effectiveness of GPS tracking technologies were identified. But above all, what we consider crucial in our approach is the assumption of the point of view of end users. Many European projects focused on technological solutions for seniors have in fact failed to develop effective solutions because technological development did not take into account sufficiently the point of view of seniors.

The variables we have put at the centre of our assessment are the following:

- EFFECT. the impact of technology on the elderly and the caregiver is the first dimension to consider. In fact, from our point of view the questions we have to ask ourselves are: how does this technology increase the safety, independence and confidence of the elderly? Secondly, what impact does this technology have on the quality of life of the elderly and of formal and informal caregivers?
- PRODUCT CHARACTERISTICS. The characteristics offered by the various products are another important variable to consider. On the market there are many solutions, ranging from simple gps tracking to smartwatch that can offer multiple features, such as cardiac beat detection, Oximeter, falls detection, emergency button, etc.. The number of functions also has a direct impact on the cost of the device. Finally, the battery life of the device is also a crucial element, because if it needs frequent recharging it could affect the effective level of effectiveness of the instrument
- USER- FRIENDLINESS. This element is essential so that the elderly person and their relative can use the technology. If it is complicated, its effects are less significant and in some cases negative.
- USER – CONTEXT. From this point of view, there are certain factors that may impact on the effectiveness of the technology. For example, the ability to locate accurately varies greatly among the devices available on the market. Precision is important, but so is effectiveness within buildings. Another key feature that connects the elderly

person with the contest is geofencing. (safety area is set up using GPS so that when the person with dementia leaves this area, the caregiver receives a notification). Finally, consideration must be given to the possibility that the tool can guarantee constant communication between the elderly and the informal or formal caregiver.

- PRIVACY. The last fundamental variable for the evaluation of the tools proposed below is the respect of the European legislation on privacy and personal data protection. In addition to this, we must consider the ethical dimension, in fact people that will be involved in the pilot activities could feel embarrassed as the caregiver would know their location (especially in relation to people affected by MCI who will be involved in the trial).

2.2.2. Technical review of known solutions

- **VITA**

Vita is born from the needs of remote monitoring of critical parameters: it is able to detect the presence on the wrist, without depending on the smartphone. The device performs remote tele-diagnostics of vital parameters, combined with certified localization. VITA is a system based on a wearable device designed to enable remote monitoring and localization of people with a complete set of sensors. The approach is to have a modular sensor platform that can perform different kind of measurement of vital sign and can be configured to get the parameter directly from the device without depending on smartphone connection.

Fig. 3 – VITA

Monitoring sensors:

- • heart beat
- • oxygen saturation

- skin temperature
- electrocardiogram
- indoor positioning

Activity detection:

Lifesaving alerts - instant alerts for wandering to unexpected places

Late departure and arrival alerts

Geo-fencing safe zones

Pricing: 150€ (to be confirmed)

- **GPS SmartSole - Commercial**

GPS SmartSole is a smartphone, hidden and sealed within a water-resistant, trimmable shoe insert. It uses GPS and 2G cellular technology. It is charged approximately every day and requires service plan, just like other smartphones. Sole fits into most shoes and allows the caregivers to track patients from any smartphone, tablet or web browser. The shoe insert is equipped with GPS technology and allows real-time syncing, gathering of a detailed report of location history and allows the users to set up a safe radius for patients.

Monitoring sensors: GPS Tracking – continuously monitors the location of the patient in real time

Activity detection: Geo-Fencing safe zones

Pricing:

- Device price: $299
- Device activation: Free - $24.95
- Shipping: $19.66
- Service plan: $14.95 – $29.98 / month

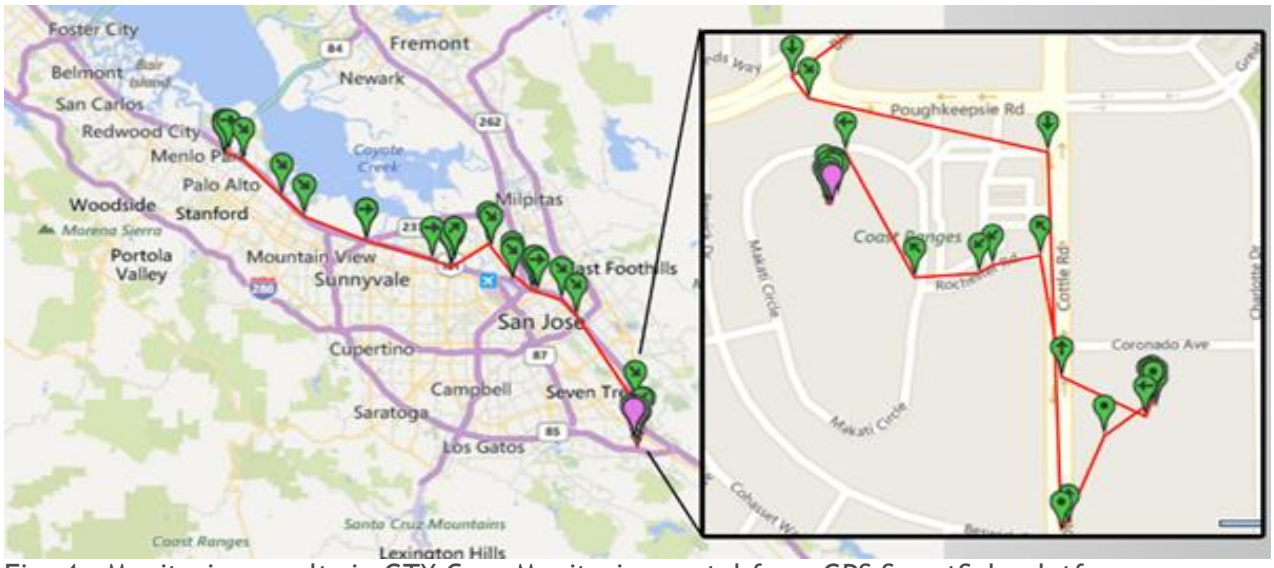


Fig. 4 – Monitoring results in GTX Corp Monitoring portal from GPS SmartSole platform

- **iTraq**

iTraq is a tracking device paired with an app on a smartphone to find the sought patient. The device includes a motion or fall sensor and sends an alert if patient's fall is detected. It also has a temperature sensor. The iTraq Nano is marketed as the world's smallest all-in-one tracking device that has global tracking, two months battery life, resistant to water and dust and is able to be charged wirelessly. The device also has an SOS button that instantly alerts a friend or a family member and notifies patient´s precise location.

Fig. 5 – iTraq Nano device

For the most frequent reporting, battery life typically lasts 1 day. For low frequency reporting, the battery can last for weeks.

Monitoring sensors:

- GPS tracking – continuously monitors the location of the patient in real time
- Motion sensor – fall sensor
- Temperature sensor – Reports the ambient temperature and can be triggered when it reaches a specified threshold.
- GPRS - comes with global SIM card that with 2G/3G coverage.
- Customize sensors – light.

Activity detection:

- Lifesaving alerts - instant alerts for wandering to unexpected places,
- Late departure and arrival alerts
- Geo-Fencing

Pricing:

- Main device: $129
- Wireless charger: $14.99
- Silicon case: $19
- Reporting plan: $59 / year

- **Trax**

Trax is live GPS tracker. The device sends position, speed, and direction through the cellular network directly to your app on a smartphone. Trax is attach to a patient. The app allows the caregivers to set “Geo-Fences” and will send an alert if a patient enters or leaves a predetermined area. Trax Geo-Fences have no size limit, the caregivers can create as many fence areas as needed and can schedule when the virtual fences are in effect. Trax offers 4G connectivity.

Monitoring sensors: GPS Tracking - continuously monitors location in real time

Activity detection:

Geo-Fencing

Time based Geo-Fencing

Pricing

- Device: 1600 kr (147€)
- Service plan: 900 kr (82€) / year

- **Jiobit GPS Tracker**

Jiobit is the first of its kind patented location tracking platform that uses Bluetooth, Wi-Fi, Cellular, and GPS. This is one of the smallest location trackers on the market for children and seniors and helps keep your loved ones safe. It's small and lightweight and will clip discreetly to clothing and shoes. Jiobit, which pairs with a smartphone to deliver real-time location information, will track in any location at any distance. Jiobit requires cellular data to track location. Plans are selected at activation in the Jiobit app with no separate cellular contract needed.

Monitoring sensors:

- GPS Tracking - continuously monitors location in real time

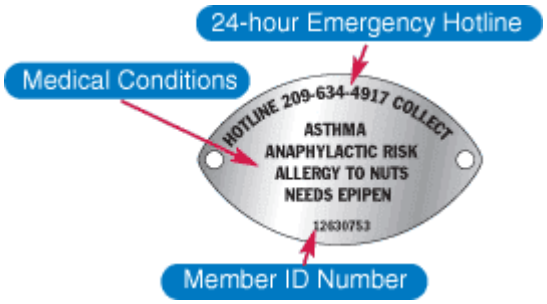
Fig. 8 – Jiobit GPS Tracker

Activity detection:Unlimited Tracking: Continuous & Live Notifications

Pricing: Devices bundle: 129,99$ PLUS Monthly Subscription Plan2

- **MedicAlert Safely Home**

This device was originally created to help emergency responders treat patients who could not speak for themselves. Today, the device also helps people with dementia who wander. The device is worn as a bracelet and when a loved one goes missing, caregivers can call the police and have the police call the 24-hour hotline to get the location of the missing person. Caregivers can also call the hotline themselves to get information. In addition to a tracking device, the bracelet has important medical information engraved upon it.



Monitoring sensors:

- GPS Tracking

Activity detection:

- Geo-Fencing

Pricing: 39$ - 2649$

2.2.3. References

Liu L, Miguel Cruz A, Ruptash T, et al. Acceptance of global positioning system (GPS) technology among dementia clients and family caregivers. J Technol Hum Serv 2017; 35: 99-119.

Yvette Vermeer , Paul Higgs and Georgina Charlesworth. What do we require from surveillance technology? A review of the needs of people with dementia and informal caregivers. Journal of Rehabilitation and Assistive Technologies Engineering.

Dahl Y and Holbø K. Value biases of sensor-based assistive technology: case study of a GPS tracking system used in dementia care. In: Proceedings of the designing interactive systems conference, Newcastle, UK

Bartlett, R., Balmer, A. & Brannelly, T. (2017). Digital Technologies as Truth Bearers in Healthcare.Nursing Philosophy, 18(1), e12161. https://doi.org/10.1111/nup.12161

2.3. Technical review of AP-NURSE

2.3.1. Database Sources

- https://www.ncbi.nlm.nih.gov/pubmed/
- https://ec.europa.eu/eip/ageing/repository_en
- http://www.aal-europe.eu/projects/
- https://cordis.europa.eu/projects/en
- https://www.interregeurope.eu/policylearning/good-practices/
- https://ieeexplore.ieee.org/Xplore/home.jsp
- https://www.jmir.org/
- https://aging.jmir.org/
- https://biomedeng.jmir.org/

2.3.2. Keywords

- Activity tracking and monitoring of patients with Alzheimer's disease
- Activity tracking and monitoring of patients with Parkinson's disease
- monitoring patients with Alzheimer
- Dementia Caregiving
- dementia patient monitoring systems
- wandering alarms for dementia
- geofencing
- Geofencing dementia
- Wandering Detection and Activity Recognition
- Binary sensors
- Non-invasive

2.3.3. Technical review of known solutions

- **AP-Nurse (Slovak University of Technology in Bratislava, niCE-life project initiative)**

A simple and modular monitoring tool for patients suffering from Alzheimer's and Parkinson's disease for home and medical application encompassing ambient sensors, which can monitor activity patterns, gas, temperature and sound aspects. Its aim is to simplify the work of home caregivers or nurses by monitoring basic interactions of the patient with the

environment during night or job duties and provide fast alert about possible dangers and support independent living of frail elderly.

The main ideas behind the proposing system are:

- Monitoring of basic environment indicators surrounding the patients during day and night.
- Evaluating these indicators and, in case of alarm situation, informing the caregiver or responsible personal. The best solutions in this case are vibrating bracelet notifiers.
- Widely affordable system, overall cost for development and later sales must be as low as possible, this also result in very simple system.

Monitoring the patient's environment:

By monitoring the patient´s environment, we understand monitoring surrounding common areas as:

- Bedroom
- Kitchen
- Adjacent hall or entry to the flat or house
- Other rooms in living area of patients

Basically, in most cases monitoring the closest room to the patient living space, the bedroom and kitchen, will be enough to build a digital monitoring area. This placement of peripheral devices is sufficient to observe basic habits and prevent potentially dangerous situations in those areas.

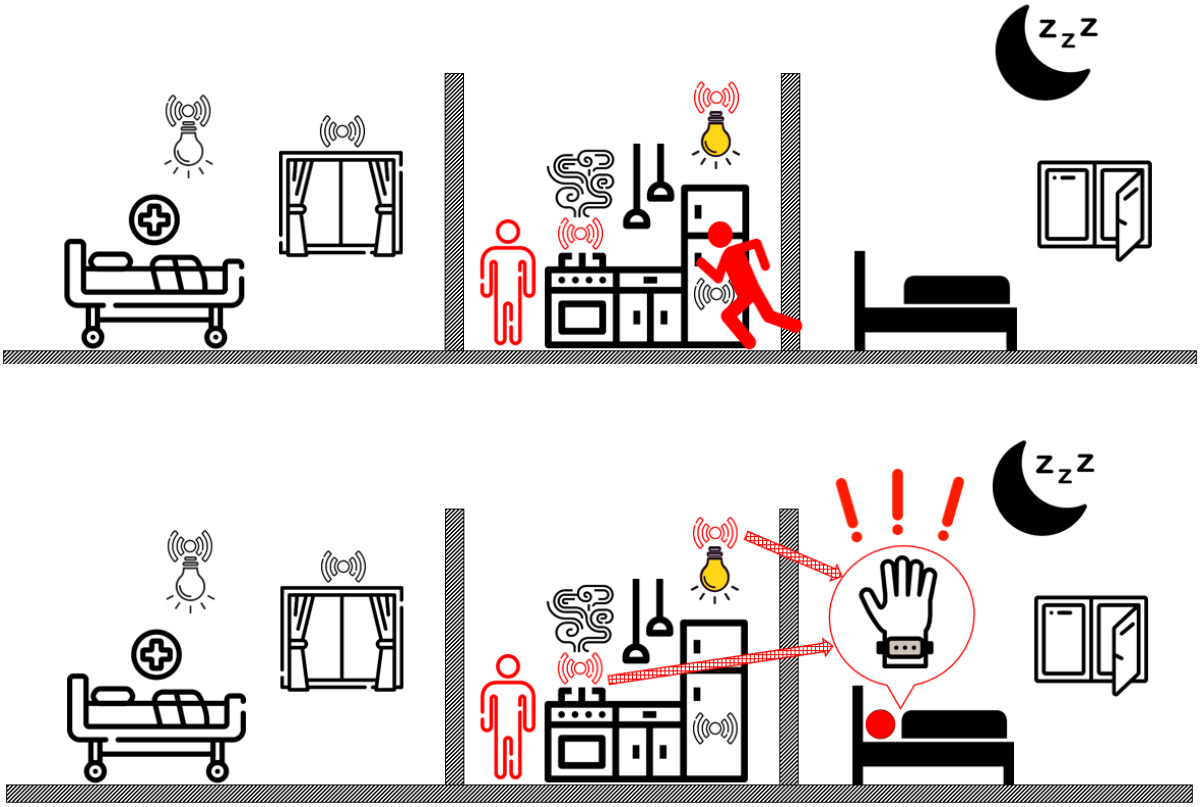


Fig. 1 – Patient environment with correctly placed sensors – avoiding hazardous situations

List of monitoring sensors:

- Light
- Sound
- Movement PIR
- Acceleration (movement of bed, door opening)
- CO2
- CNG
- Humidity
- Atmospheric Pressure
- Force pressure

AP-NURSE-HOME

Set of simple and cheap small monitoring devices that monitor several environmental factors of patient surroundings are placed at home of frail elderly or a patient to ease their everyday life. In case of any emergency detected by the monitoring devices a caregiver is notified by a simple rubber watch/bracelet. We assume that a patient lives with a caregiver (in this case family member). To ease the life and not to disturb the caregiver's partner (husband, wife) during night, the bracelet warns a caregiver by vibrating pattern (for communication RF433MHz module with hard encoded addresses is used). After the caregiver received this notification, he needs to push a button on the device, which had sent the signal to assure that the necessary help was delivered to a patient. If needed, online measured sensor data under and above set thresholds may be sent to dedicated servers for further analysis.

AP-NURSE-CARE

Set of small monitoring devices that monitor several environmental factors of patient surroundings are placed at care canter to ease the daily and specifically nightly routine duties of caregiving personnel. In case of AP-NURSE-CARE the caregiving personnel controls the condition of patients from the nurse/control room on a PC or using a mobile device, visualizing the parameters of AP-NURSE utilizing a simple traffic lights logic. The online measured sensor data below and above set thresholds are sent to the dedicated servers for further analysis. If required, after a specified monitoring period, artificial intelligence could deliver results of analysis showing progress and health status of monitored patients. The registration and the setup of the monitor screen would solely be adjustable under administrator account.

- **SmartMind - Academic prototype**

SmartMind is an activity tracking and monitoring system targeted for patients with mild Alzheimer's disease symptoms. These patients can live alone in a small room, at least during the daytime, and handle most of their daily activities, e.g., having meals and taking medicines. The main sensor adopted in SmartMind is Kinect, which captures the images and generates 3D posture data of the target (the AD patient) within his/her living environment. The tracked activity records can be reviewed by the authorized patient's relatives and medical professionals, e.g., community nurses, to assess his/her self-caring abilities (Fig. 2).

The daily activities of a patient captured from SmartMind can also serve as an important indicator to describe his/her normal living habit (NLH). By checking NLH, the patient's current health status can be estimated, using machine learning algorithms) on a daily basis.

SmartMind concentrates on tracking the activities of the target within the living room, since most of the patient´s living activities are performed within this area and the patient should not stay in other functional rooms, except the bedroom, for a long time. If the target enters a functional room for an unexpected long time, e.g., more than half an hour, an alert message may be generated to registered people so that they can take appropriate action to check the problem, e.g., make a phone call to the target to check his/her current status. Further monitoring functions can easily be performed in the bedroom by installing additional Kinect devices in the bedroom.

Monitoring sensors:

SmartMind, uses Kinect as the main tool for activity detection while smartphones are used to provide activity reminders. Since Kinect uses depth camera for posture detection, the camera has to be at least 1.5m away from the target, in order to capture the motion correctly. SmartMind applies machine learning techniques to improve the accuracy in detecting the posture.

Activity detection:

SmartMind detects the activities during certain day. If these activities are commonly performed every day at similar times, it can maintain them to be the normal activity habit (NAH) of the target. NAH lists out the schedule of the interested activities to be performed by the target on a daily basis. Some examples of the activities are:

- Getting up (Moving out of the bedroom): when the target moves the bedroom into the living room on a day for the first time.
- Having breakfast: when the target moves his/her hands to his/her mouth while sitting in the dining table and no NFC signals are generated.
- Taking medicines: when the target moves hands to mouth while sitting in the dining table and NFC signals are generated.
- Doing exercises: when the target moves his/her hands at a fixed region while he/she is standing.

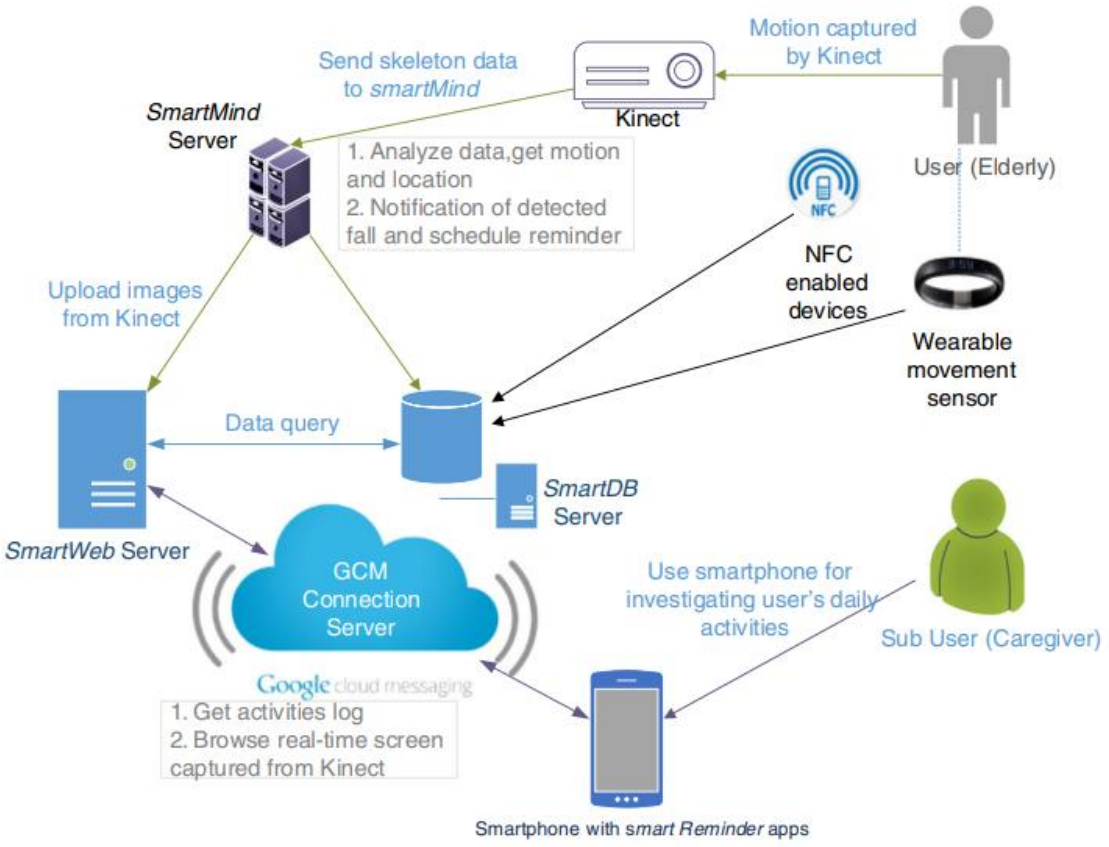


Fig. 2 - The system architecture of SmartMind

This information can be used as important references in assessing the patients and determining the activities that may be allowed to be handled by the patients and for analysis of their disease development.

- **SYMON-A - Academic prototype**

SYMON-A (SYstem for MONitoring Alzheimer's patients), was developed using the Java programming language. ContextNet1, a mobile-cloud middleware also written in Java, was used to establish the communication between network nodes. It implements discovery and connection functions with smart things and enables smartphones to act as intermediaries for sending and storing data from these things in the cloud. The prototype is transparent and scalable with respect to the definition of the devices contained in the environment, simply by receiving the states to configure the scenarios that compose risk situations.

Monitoring sensors:

Smart devices that can communicate their current state.

Activity detection:

Based on devices that are connected in the system and definition of their interaction that can cause alert.

Tab. 1 – Example of conditions leading to actions of SYMON-A system

Conditions	Actions
Fridge: Open Body Position: Lying Down Location: Bedroom	Alert: Caregiver
Stove: On Location: Kitchen Body Position: Lying Down	Alert: Caretaker Alert: Emergency Service Alert: Relatives
Heart Rate: High Body Position: Running	Alert: Caretaker
Kitchen Faucet: Open Location: Not Kitchen	Alert: Patient

- **AngelSense - Commercial**

AngelSense provides caregivers a comprehensive view of patient's activities, comings and goings. The device is attached to the patient´s clothing and can only be removed by the caregiver. It provides a daily timeline of locations, routes and transit speed and sends instant alert to caregivers, if the patient is in an unfamiliar place. Caregivers can listen, what is happening around their patients, can receive an alert, if their patient had not left for an appointment on time. It also allows the caregivers to communicate with their patients and sends alarm to locate the "loved ones", wherever they are.

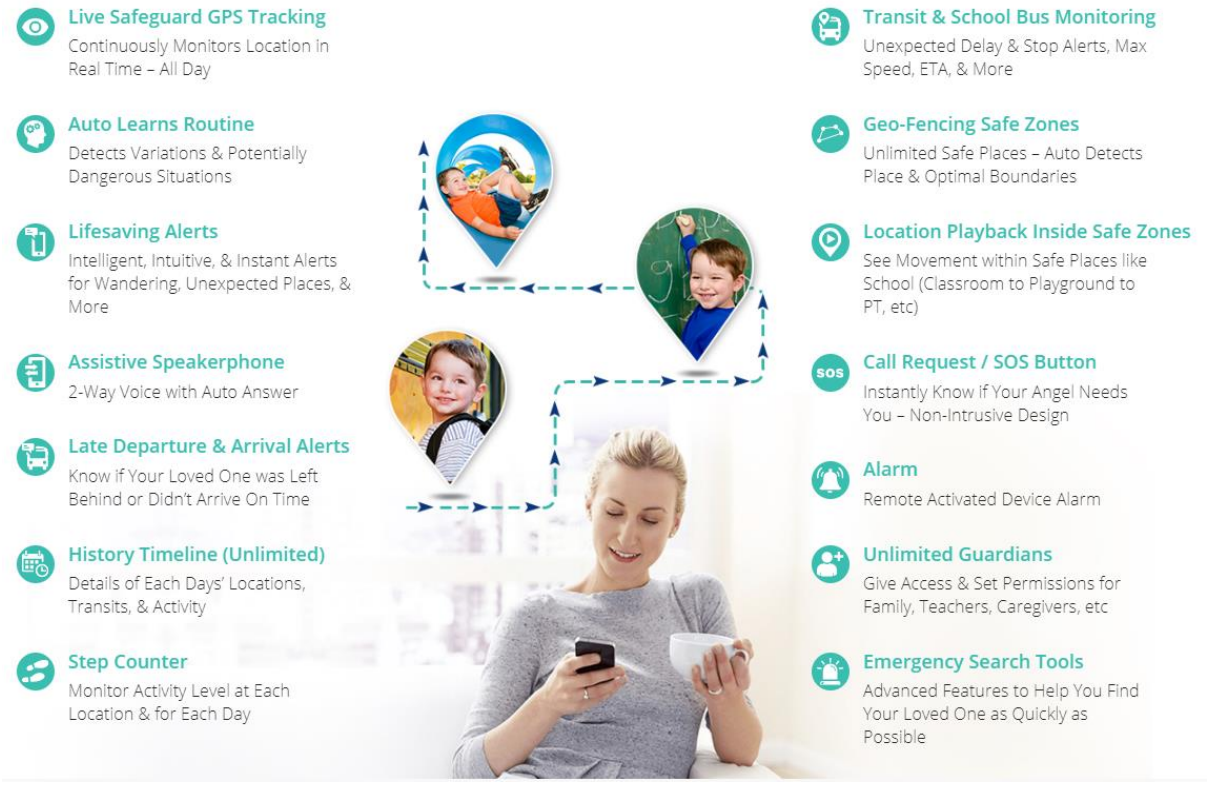


Fig. 3 – AngelSense safety features

Monitoring sensors:

- GPS Tracking - continuously monitors location in real time
- ALR (Auto Learns Routine) - detects variations and potentially dangerous situations
- Assistive speakerphone - 2-way voice with auto answer
- Step counter - monitor activity level at each location and for each day

Activity detection:

- Lifesaving alerts - instant alerts for wandering to unexpected places
- Late departure and arrival alerts
- Geo-fencing safe zones

Pricing: time-based subscription service ($33 – 52$ / month)

- **GPS SmartSole - Commercial**

GPS SmartSole is a smartphone, hidden and sealed within a water-resistant, trimmable shoe insert. It uses GPS and 2G cellular technology. It is charged approximately every day and requires service plan, just like other smartphones. Sole fits into most shoes and allows the caregivers to track patients from any smartphone, tablet or web browser. The shoe insert is equipped with GPS technology and allows real-time syncing, gathering of a detailed report of location history and allows the users to set up a safe radius for patients.

Monitoring sensors:

GPS Tracking – continuously monitors the location of the patient in real time

Activity detection:

Geo-Fencing safe zones

Pricing:

- Device price: $299
- Device activation: Free - $24.95
- Shipping: $19.66
- Service plan: $14.95 – $29.98 / month

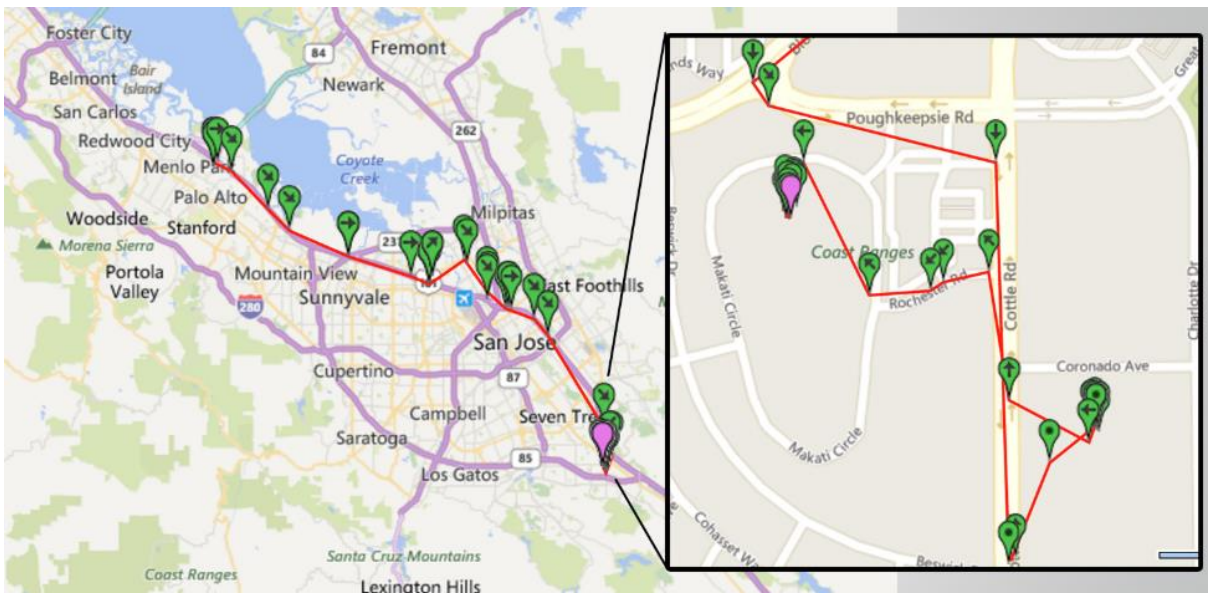


Fig. 4 – Monitoring results in GTX Corp Monitoring portal from GPS SmartSole platform

- **iTraq - Commercial**

iTraq is a tracking device paired with an app on a smartphone to find the sought patient. The device includes a motion or fall sensor and sends an alert if patient's fall is detected. It also has a temperature sensor. The iTraq Nano is marketed as the world's smallest all-in-one tracking device that has global tracking, two months battery life, resistant to water and dust and is able to be charged wirelessly. The device also has an SOS button that instantly alerts a friend or a family member and notifies patient´s precise location.

Fig. 5 – iTraq Nano device

For the most frequent reporting, battery life typically lasts 1 day. For low frequency reporting, the battery can last for weeks.

Monitoring sensors:

- GPS tracking – continuously monitors the location of the patient in real time
- Motion sensor – fall sensor
- Temperature sensor – Reports the ambient temperature and can be triggered when it reaches a specified threshold.
- GPRS - comes with global SIM card that with 2G/3G coverage.
- Customize sensors – light.

Activity detection:

- Lifesaving alerts - instant alerts for wandering to unexpected places,
- Late departure and arrival alerts

- Geo-Fencing

Pricing:

- Main device: $129
- Wireless charger: $14.99
- Silicon case: $19
- Reporting plan: $59 / year

- **PocketFinder - Commercial**

PocketFinder is designed to be the smallest tracker on the market and the device can fit in the palm of your hand. It has a battery life up to one week and allows the caregivers to track patients through a user-friendly app. The device includes three location technologies including GPS, Cell ID and Google Wi-Fi Touch and SOS button.

PocketFinder receives GPS location data from multiple satellites or triangulation of multiple Wi-Fi signals through Google's Wi-Fi Touch. The cellular carrier sends encrypted data to the PocketFinder servers. The customer logs into secure account using smartphone, tablet, or computer. The customer can manage all PocketFinder features through the app. When PocketFinder goes in or out of a specified zone, alert is sent via email and push notification.

Monitoring sensors:

- Positioning methods: GPS, GSM Cell ID, Google Wi-Fi Touch
- Certifications: FCC/CE/PTCRB pending, IP65 water and dust resistant, IPRoH5 compliant

Activity detection:

- Geo-Fencing safe zones

Pricing:

- Device: $99
- Service plan: $19.95

Fig. 6 – PocketFinder basic principles of operation

- **Project Lifesaver - Commercial**

The Project Lifesaver is providing timely response to save lives and reduce potential injury of adults and children who wander due to Alzheimer's disease, autism and other related condition or disorders. Seniors who are enrolled in Project Lifesaver are given a personal transmitter that they wear around their ankle. If they wander, the caregiver calls a local

Project Lifesaver agency and a trained team will respond. Recovery times average 30 minutes and many who wander are found within a few miles of their home. In addition to the location device, Project Lifesaver works with public safety agencies to train them on the risks associated with wandering.

Fig. 7 - The PLI-1000 personal locator system by Project Lifesaver

Monitoring sensors:

- Radio frequency motion monitoring

Activity detection:

- Geo-Fencing

Pricing:

- Device setup: $524
- Various optional accessories

- **Trax - Commercial**

Trax is live GPS tracker. The device sends position, speed, and direction through the cellular network directly to your app on a smartphone. Trax is attach to a patient. The app allows the caregivers to set “Geo-Fences” and will send an alert if a patient enters or leaves a predetermined area. Trax Geo-Fences have no size limit, the caregivers can create as many fence areas as needed and can schedule when the virtual fences are in effect. Trax offers 4G connectivity.

Monitoring sensors:

- GPS Tracking - continuously monitors location in real time

Activity detection:

- Geo-Fencing
- Time based Geo-Fencing

Pricing

- Device: 1600 kr (147€)
- Service plan: 900 kr (82€) / year

- **Just Checking - Commercial**

Just Checking provides activity monitoring services, mainly discreet door and movement sensors around an individual's home, which provide an overview of the daily activity to help professionals making proportionate care decisions. Just Checking uses discreet wireless sensors placed around a property to send an overview of daily activity to an online app. The family members and professionals can see whether an individual is visiting the kitchen to make meals, using the bathroom as expected, and getting a good night's sleep.

Monitoring sensors:

- Movement sensors -Small wireless movement sensors are placed around a property. They are easy to attach to walls. Using these sensors, Just Checking creates a chart of activity, where the user can see which rooms have been visited, when, and for how long.
- Door sensors - Just Checking shows when a door is used and how long it has been opened for. Sensors can be used on internal and external doors. In combination with the movement sensors, the user can tell when visits have been received, when an individual leaf or enters the property, and how long they have been out.

Activity detection:

- Movement in house
- Notification of caretakes
- Geo-Fencing

Fig. 8 – Monitoring interface of Just Checking service

Pricing:

- Devices bundle: £75 (86€) / month and a £250 (286€) deposit

- <u>Souza – Academic prototype</u>

Souza is an indoor localization and activity monitoring system for aged care workers to aid the prioritization of surveillance to the patients with dementia. The system uses Radio Frequency tracking combined with motion and heading sensors to track a person. The information from the motion and heading sensor are incorporated into a human activity classification model to determine the characteristics of a patient's walking activity. Authors conducted a month-long trial of localization network and activity monitoring system in an aged care facility.

Monitoring sensors:

- inertial motion sensors to determine walking/standing activity.
  small, unobtrusive mobile nodes that can be worn as a wrist watch.

Activity detection:

- Perform indoor localization using wireless inertial sensors.
- Determine which room a person was currently in.
- Provide a visual display for users to view current position and path travelled.

- **ONOS – Academic prototype**

ONOS serves for monitoring of patients inside complex buildings such as hospitals. The paper and the prototype propose techniques for making use of the SDN for secure and real time monitoring of the patients with wandering behavior in hospital environments. The device is wearable and is based on Arduino uno, ESP8266 and a voltage regulator IC. The purpose of the device is to send the RSS value of the nearest OpenFlow Access Point to the location tracking application. OpenFlow Access Points are placed at different locations within the layout with overlapping range.

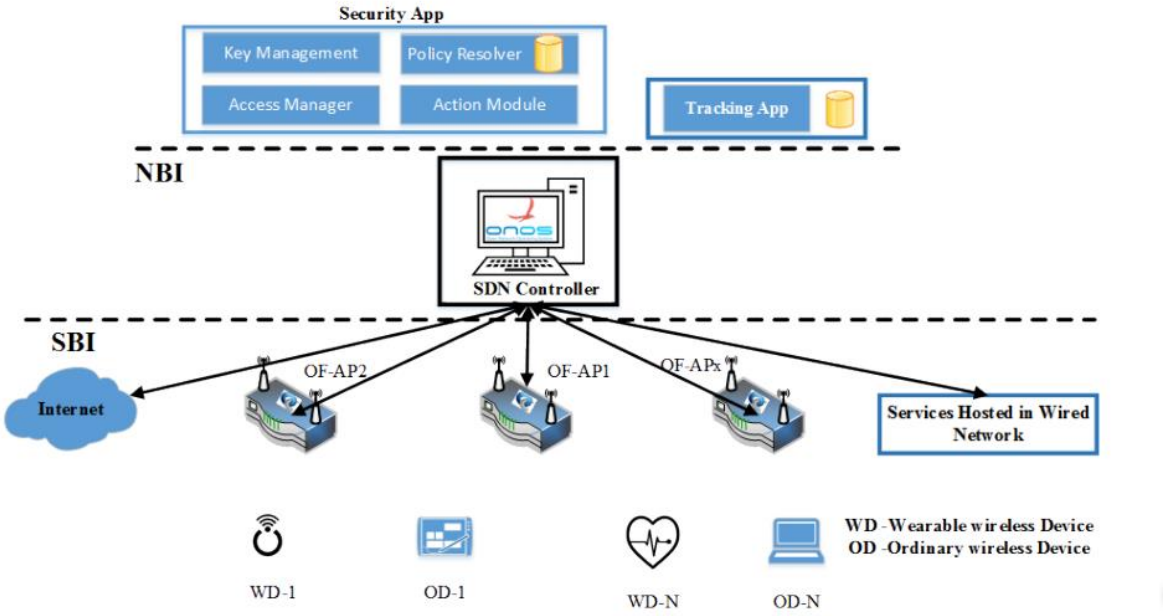


Fig. 9 – Monitoring structure of ONOS prototype

Monitoring sensors:

- Non-specified movement sensors

Activity detection:

- Geo-Fencing safe zones

- **Alzimio – Academic prototype**

Alzimio is a mobile app providing geofencing and activity-based alarms to help users with dementia, autism and Alzheimer's disease. It uses several threshold-based novel algorithms presented in the authors´ work (i.e., max-in-window). It was shown that Alzimio meets its design goals of accurate detection of activities (above 95%) with low delay (less than 30sec),

while running all day on a smartphone on a single charge. The optimal confidence threshold was found to be 65% confidence, to achieve the optimal balance/tradeoff between accuracy and delay.

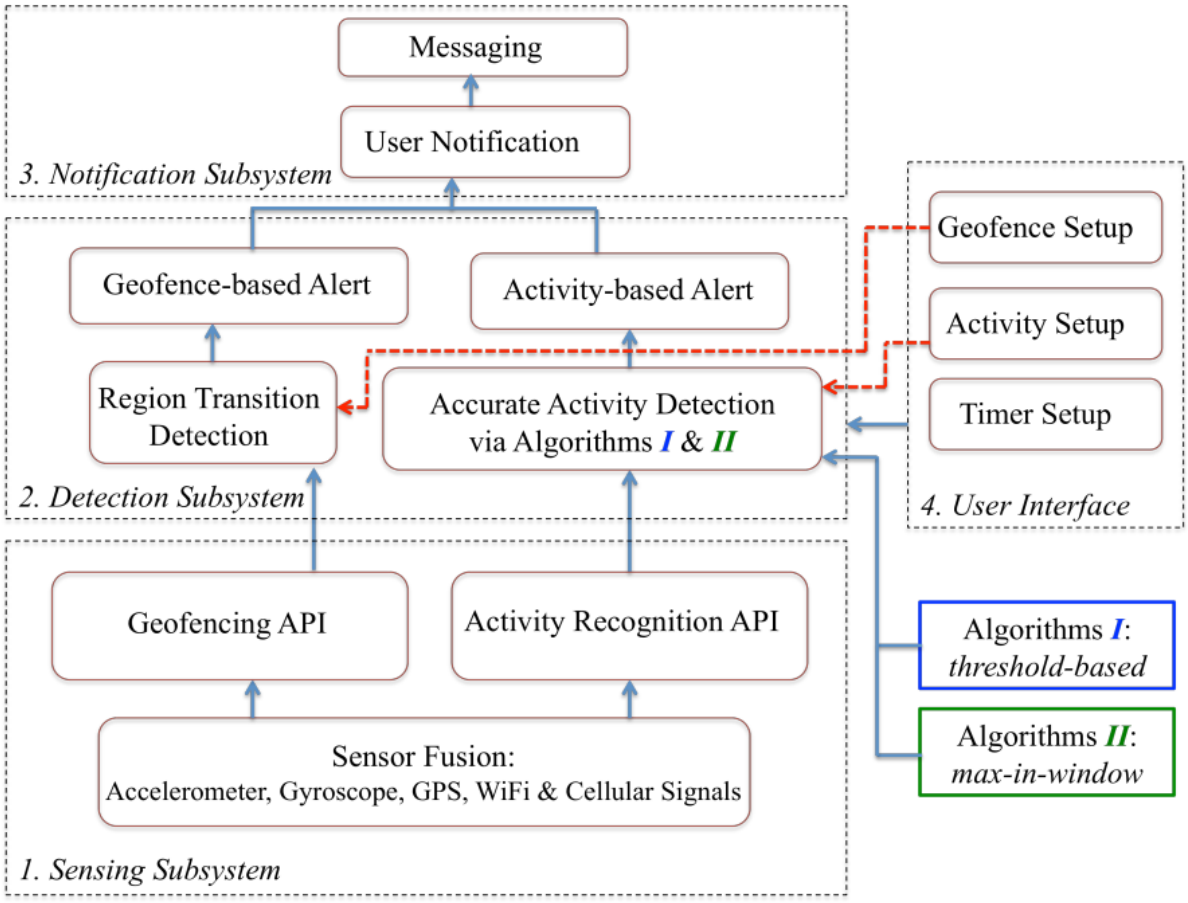


Fig. 10 – Main architectural components of Alzimio prototype

Monitoring sensors:

- Non-specified movement sensor

Activity detection:

- Geo-Fencing safe zones

- **POT – Academic prototype**

POT is a monitoring system, based on wearable and ambient sensors, which is designed to detect Freezing of Gait (FoG) using the spatial context of the user, establish a set of requirements for the application of position and orientation tracking in FoG detection, evaluate the accuracy of the position estimation for the tracking system, and valuate two different methods for human orientation estimation.

FoG is a temporary, involuntary inability to initiate or continue movement lasting just a few seconds, or on some occasions, several minutes. FoG is experienced by approximately 50% of patients with advanced Parkinson´s disease.

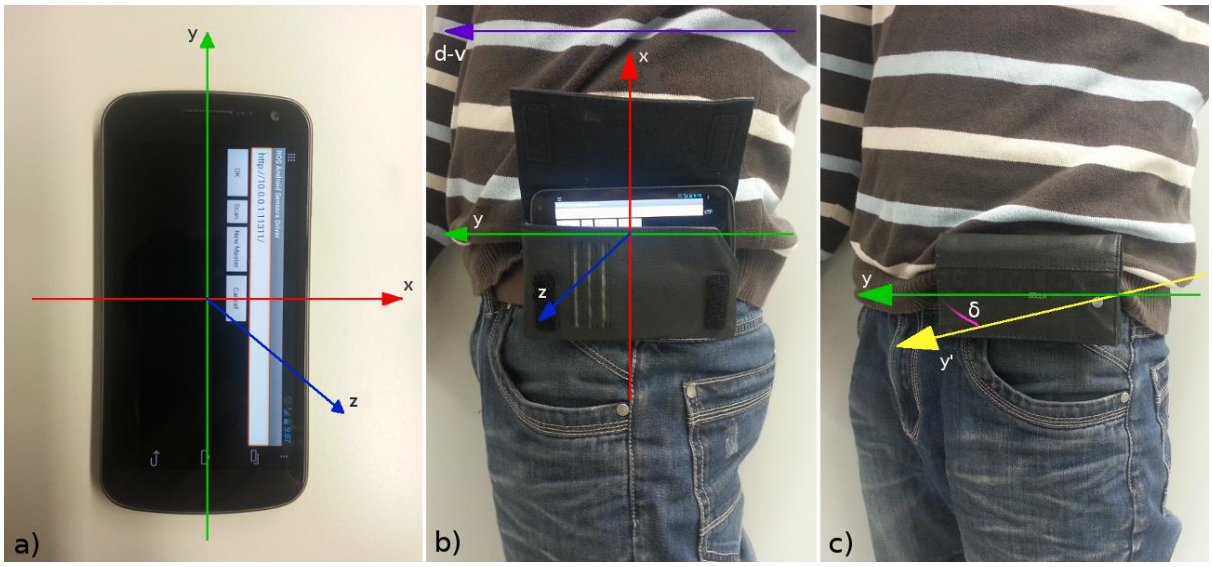


Fig. 11 - Frame definitions of wearable sensor. a) Smartphone reference axes. b) Smartphone in the correct predetermined orientation at the expected position and orientation on the waist. c) Smartphone in the non-expected position and orientation on the waist. There is an angle of error in the transverse body plane between the device's real (green arrow) and expected (yellow arrow) orientation.

Monitoring sensors:

- Kinect as the main tool for activity detection

Activity detection:

- Freezing of Gait

- **iWander- Academic prototype**

iWander, runs on several Android based devices with GPS and communication capabilities. This allows for caregivers to cost effectively and remotely monitor their patients. The data collected from the device is processed and the probability of wandering behavior is estimated. Upon evaluation, several courses of action can be taken, based on the situation's severity, dynamic settings and probability. These actions include issuing audible prompts to the patient, offering directions to navigate them home, sending notifications to the caregiver

containing the location of the patient, establishing a line of communication between the patient-caregiver and performing a party call between the caregiver-patient and patient's local 911. As patients use this monitoring system more, it will better learn and identify normal behavioral patterns which increases the accuracy of the Bayesian network for all patients. Normal behavior classifications are also used to alert the caregiver or help patients navigate home, if they begin to wander while driving, allowing for functional independence.

Monitoring sensors:

- GPS
- Sound sensor

Activity detection:

- Location detection
- Wandering detection

- <u>WDMS – Academic prototype</u>

WDMS combines wearable sensors with external static sensors for monitoring of the patient´s environment. Authors created an algorithm system to detect specific everyday task.

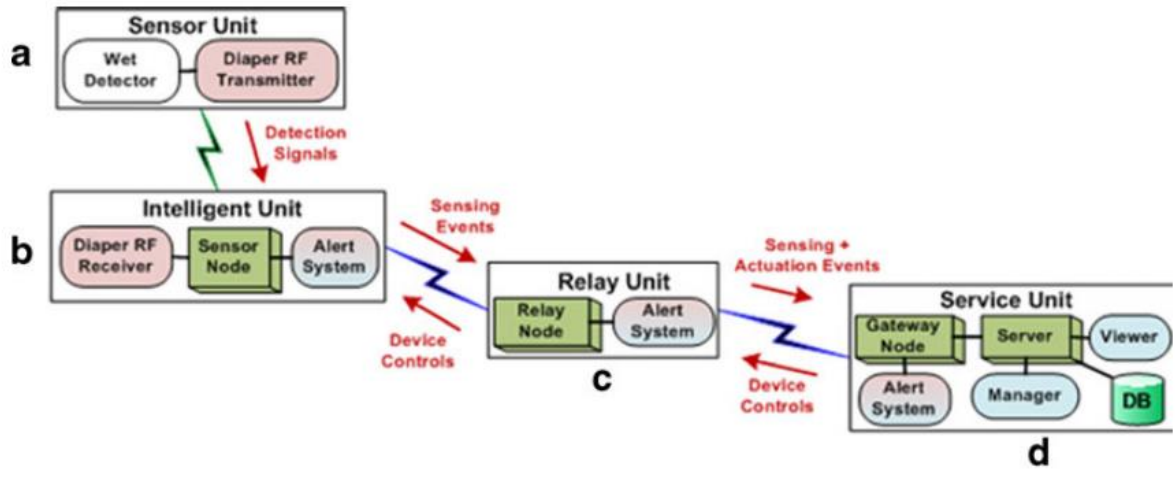


Fig. 12 – Various WDMS prototype system components

Monitoring sensors:

- Accelerometer in patient watch - monitoring hand movements
- PIR sensor

- Camera
- Microphone
- Pressure sensors in bed and sofa
- Connection with other smart devices

Activity detection:

- Every day routines (sitting, drinking, eating habits)
- Position in the house

- <u>Sang – Academic prototype</u>

Authors proposed a technique to detect patterns of wandering as an early symptom of dementia. They developed a system to digitize activity using acceleration sensors. They also proposed an algorithm using two schemes, location tracking and time graph, to detect wandering by applying the Levy-walk model for early assessment of the risk of dementia. They then performed experiments to verify their algorithm and hypothesis.

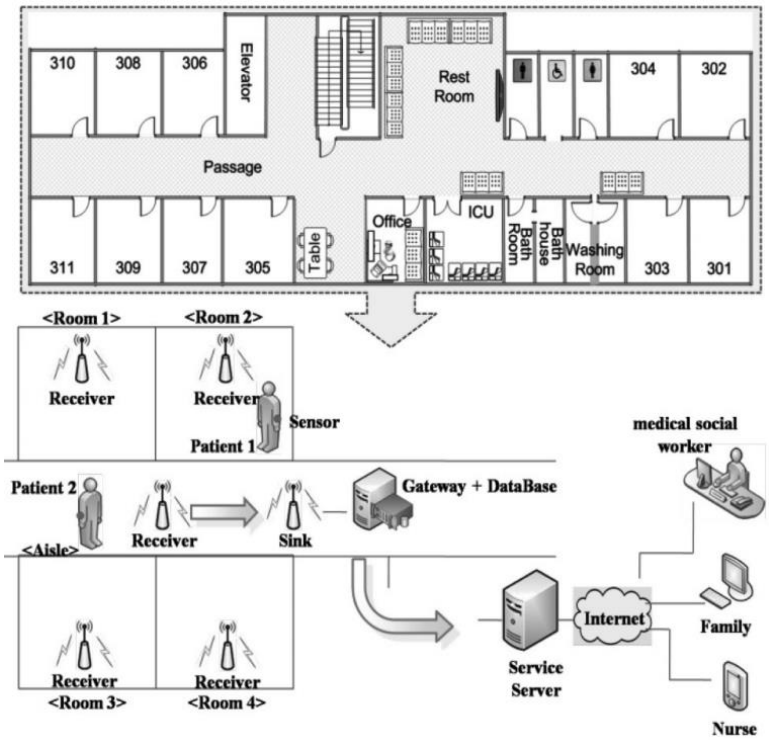


Fig. 13 – Sang prototype system architecture

Monitoring sensors:

- Accelerometers

Activity detection:

- Location detection
- Wandering detection
- Activity detection such as picking up, unlocking and locking buttons, etc.

- **DCNN – Academic prototype**

Authors present non-privacy invasive activity recognition which is preferred for long-term monitoring. Thus, they propose a deep learning classification method for elderly activities using binary sensors (PIR sensor and door sensor). In particular, they present a Deep Convolutional Neural Network (DCNN) classification approach for detecting four basic activity classes, which represent the basic human activities in a home monitoring environment, namely: Bed-to-Toilet, Eating, Meal preparation, and Relax. A real-world long-term annotated dataset is employed for evaluation of the activity recognition classifier. Dataset was offered by the Center for Advanced Studies in Adaptive Systems (CASAS) project, and was collected by monitoring a cognitively normal elderly resident by a binary sensors for 21 months. First, the authors converted the annotated binary sensor data into binary activity images for corresponding activities. Then, the activity images were used for training and testing the DCNN classifier. Finally, the classifiers were evaluated with 10-fold cross validation method. The experimental results showed that the best DCNN classifier gives 99.36% of accuracy.

Monitoring sensors:

- PIR - All binary sensors have a battery and a ZigBee wireless module and they are installed on the ceilings over the testbed. Any detected motion or no motion is an event, and events are logged chronologically in the server after received via wireless sensor network.
- Door sensor
- Smart devices

Activity detection:

- Daily routines

2.3.4. Summary

As can be seen from the review, there are already many possibilities how to track movement of the patients, how to partially monitor them and also how to process all the data and alert the right personnel. Most of the systems use GPS tracking combined with an attachable device to patient clothes / shoes / body as vital component, which is an advantage, when the patient has no intention to get rid of such devices and therefore can be monitored in limited way also outside the house. These systems are therefore designated for patients, or elderly people / children, with not so serious diagnosis. If considering strongly diseased patient with Alzheimer´s or Parkinson´s diseases, such devices are not sufficient to monitor the patient's behavior, such as opening doors, windows, turning on gas, or other hazardous situations. Although some systems offer similar peripheral sensors, they are expensive.

Also, many systems offer smartphone and computer applications for reporting / monitoring purposes. This approach has some advantages, but also some serious downsides. As advantage historical data and different data processing can be seen, which can point to critical times / places / behavior at some point, but as noted above, such systems have often only GPS tracking devices, which do not offer very complex analysis possibilities. Another advantage is visualization of data. The common disadvantages are:

- very complicated systems with many devices and synchronization necessity is more prone to errors as simple notification system,
- battery life of a smartphone is much shorter than the those built-in a single-purpose device (for example wristband), which can be charged for example only once a week,
- robust expensive systems are much more dependent on user settings, which can often be a problem
- the mentioned systems for visualization and application designs are expensive to develop, therefore such solutions are more expensive. The design of AP-Nurse-Care is flexible in the way of sending the collected data to further data analysis, which can be used for enhancing the effectiveness of the overall functionality of the system.

2.4. Technical review of Monitoring Grid

2.4.1. Development and Description of the Monitoring Grid

In Bologna over 65 seniors represent almost 30% of the population in some areas. In order to build a community around these people, the Local Health Authority of Bologna, LEPIDA and other actors has given and offered support through phone calls and toll-free numbers since 2005. Since 2012 annual projects to support frail seniors have been organized.

The Monitoring Grid is one of the tools of the eCare network in Bologna. It has been set by pooling together skills of individual specialists and refers to eligible elderly, who

- are over 75 years old,
- live alone or with their spouses and
- whose loneliness or depleted family and social networks are associated with frailty factors:
- functional frailty factors (feeding difficulty, difficulty in movement, falls, sensory deficits);
- clinical frailty factors (respiratory and/or cardiac diseases with complex therapeutic treatments, diseases with frequent clinical examinations and/or referrals, chronic pain, hospitalization, depression);
- social frailty factors (caregivers of people requiring ongoing care, people living in remote or derelict areas, with low income, inadequate housing, lack of help from family or friends).

For every type of frailty, targeted questions to be asked to users have been identified, intended to verify the state of health related to each specific disease, the degree of independent living of the elderly, unsuitable behaviours (improper diet, failure to report early warning signs) and critical situations that may trigger (social and healthcare) network actions and/or the provision of services (accompanying the elderly person to see the doctor, companionship at home, etc..).

Depending on the types of frailty identified for each user, the Grid points out a series of "sentinel events" to be kept under close monitoring by the Call Centre operator.

“Alerts” may be related to a deterioration of the patients’ clinical picture, or to the worsening of their social situation. Following the directions contained in the Remote Monitoring Protocol, shared with health and social services, the alerts (depending on the type) are handled locally by different social workers or nurses, who perform a general health check-up of the reported cared

persons and, only in case of necessity, may require medical intervention by the General Practitioner or, in situations of extreme seriousness, by the hospital Emergency services.

From the technological point of view, the Grid is managed automatically through a specific software, which translates the modalities for the identification of questions to be posed into informatics instruments, and transposes into algorithms the semantic rules that provide the activation of alarms, in case of a certain combination of sentinel events.

Aims of the Monitoring Grid

The Monitoring Grid focuses different aims:

1. First of all, it allows to detect early signs of deterioration of the health or social conditions of the elderly, by verifying the state of the user's psycho-physiological health and the consequential onset or worsening of frailty factors
2. Furthermore, it intends to manage and facilitate phone interviews with frail elderly people, thus constituting a true "guide" to handle phone interviews.
3. It allows to check the users' state of health and, if one or more sentinel events are detected, to report and refer these cases to the eCare network health and social services, that is, Nurses or Social Workers, who will then take immediate action to assess the situation reported by the eCare Call Center.

Reference

C. Fiori (2014): The eCare Network in Bologna: No longer home alone, p.284-313

2.4.2. Adaptation of the Monitoring Grid to the framework of Austria

The current development of a growing and aging population in Austria will continue in the future. On the one hand, migration gains of around 30,000 to 35,000 annually lead to an increase in population. On the other hand, in addition to the stagnating birth rate and increasing life expectancy, the strong birth cohorts, which are gradually changing into retirement age, are responsible for the aging process. According to this, the population of Austria will grow from 8.84 million (2018) by 7% to 9.43 million by 2040, by 2080 finally by 12% to 9.93. The share of the population 65+ will increase from 18.8% (2018) to 29.3% (2080) in the next six decades (Statistics Austria)

This demographic development has very important effects on the health and social system. One of the effects is the pressure on public spending.

It is therefore important to react to these developments as quickly and as early as possible. One way to reduce costs in this area is to introduce digital tools that enable older people to live a longer life at home. One of these tools is the just presented Monitoring Grid, which will be tested in the assisted living homes of the Samariterbund in the course of the present project. In order to initiate the test phase, the monitoring grid must first be adapted to the conditions in Austria and to those of the Samariterbund. This is described in the following:

Introduction of the Monitoring Grid in Austria

After developing the concept of how to implement the Monitoring Grid in Austria, the monitoring grid is to be tested on the residents of assisted living homes managed by the Samariterbund Burgenland. The needs which were worked out in Working Package 1 should be taken into account.

The monitoring grid in Burgenland will be linked as a documentation system to the already existing software "CareCenter". All data relating to residents is stored in the CareCenter. It contributes to efficient administration, comprehensive care documentation, therapeutic and medical documentation and planning of the activities. This means that the CareCenter can serve as a basis here.

The residents are to be contacted at regular intervals (planned is weekly) by the residential area managers and their mental and physical condition is to be assessed.

Based on the monitoring grid, which is already in use in Italy, a distinction should be made between clinical, functional and social factors in addition to the medical history. Since social isolation was identified in the needs assessment as a major potential threat to health status, special attention should be given to this issue. Therefore, the existing factors are to be expanded by the "activity factors".

The factors to be queried in the telephone calls were coordinated with the living area managers and will be evaluated and expanded or adapted as part of the project:

1. **Medical history**
   - Pathologie (Chronic Diseases like diabetes, heart and respiratory diseases, Mental diseases, …)
   - Previous falls in the past
   - Previous hospital stays in the past
   - Medication

- Etc.
- Data is already available in CareCenter
- has to be asked only once

2. **Clinical factors**
   - Chronic pains
   - Vital signs (zB blood pressure, sugar)
   - Hospital stays
   - Medication
3. **Functional factors** should be based on the 12 activities of daily living (ADLs)
   1. Sleep: e.g. sleep disorders, bed adapted to the patient's state of health
   2. Moving: e.g. falls, mobility restricitions known
   3. Wash and clean: e.g. clarify skin condition
   4. Eat and dring: difficulties in eating
   5. Excretion
   6. Breath
   7. Provide security: Supply of medical aids (bed, blood pressure monitors), supply of medication
   8. To keep oneself busy -> e.g. initiate ergo- or physiotherapeutic measures?
   9. Regulation of body temperature: feel feverish

   The following 3 ADLs should not be queried for the functional factors:

   - Find meaning: is considered in the course of clinical and activity factors
   - Communication: the call itself is the basis for communication
   - Feel lik a man oder woman – too personal for a telephone call

4. **Social factors**
   - Lives isolated: social isolation, support from friends and families
   - Low income – Exemption of prescription fee
   - Housing conditions: heating, cleaning
   - Support for everyday (shopping aids, meal deliveries) and official channels necessary

- Use of home nursing, homes visits from doctors
- Assessment for self-measurement

5. **Activity factors**

- Cultural interests: theatre, cinema
- Faithful
- Sporting interests
- Reading books, magazines
- Radio and television
- Creative interests: sewing, painting, cooking, …
- Pets/ Animals
- Other hobbies

This data should then be documented, evaluated and analysed in the CareCenter. For the analysis of the data, it is important whether a deterioration in the state of health can be seen or whether and which measures must be initiated.

Home emergency call

The monitoring grid shall be extended by the home emergency call.

In the course of working out the needs of the elderly, it turned out that the residents not only want to be called, but also want to be able to call the responsible people themselves. To make this possible, the home emergency call already in use will be extended by this function. The yellow button shown in Figure 1 shall then connect the user of the home emergency call to the responsible person of the Samariterbund.

Figure 1: Home emergency call of the Samariterbund Burgenland

Anyone who wants to have a home emergency call can order it from the Samariterbund Burgenland. There is a one-time connection fee of € 49.90 and a monthly fee of € 22.90 (for fixed network) or € 34.90 (for Samaritan Federation GSM SIM Card). In Burgenland, there are currently 198 people living at home and 4 people living in assisted living homes, who take advantage of the home emergency call (as at June 10th 2020).

The home emergency call helps people in crisis situations in the following steps:

1. A **transmitter**, worn on the wrist or around the neck, is connected to the control centre of the Samariterbund
2. In an emergency, the person who needs help presses the transmitter and thus **triggers an alarm** in the rescue centre of the Samariterbund. This is manned 7 days a week, 24 hours a day and is therefore always available.
3. The integrated hands-free facility of the base station can be used to **communicate** with the headquarters. The data of the calling person is immediately transmitted to the rescue centre and the situation will be evaluated. The rescue workers notify the contact persons specified and, if necessary, immediately take the appropriate measures.
4. Depending on the respective accident or emergency situation, all **appropriate measures will be taken**. Ambulances are ready 24 hours a day.

Technical Data

Fixed network: The devices can be connected to the telephone network, which requires a common post socket (PD3 telephone socket) and an adjacent electrical socket for the base station.

GSM: With a GSM module, a cell phone SIM card can be connected to the base station of the emergency call system.

Furthermore, the device is checked daily and regularly maintained and monitored. The battery lasts for 120 hours in the event of a power failure.

2.4.3. Review of“ EU good practise”

Overview

The monitoring grid is a tool of telecare and telemedicine and pursues the following goals:

- Early detection of a deterioration in the health of a patient
- Maintaining a self-determined and independent life at home for as long as possible

Therefore, the research of good practises is focused on projects in this area.

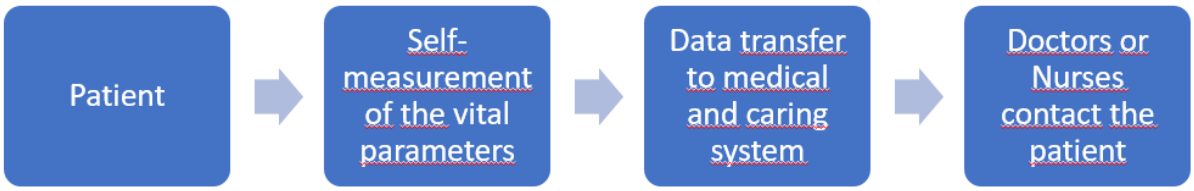
Monitoring Grid is a tool, where the nursing and/ or medical staff actively contact the elderly in order to prevent a deterioration of the health status.

In the course of Internet research, it has emerged that such projects are rare or that they exist, but information (in English) about them is rare. One of these projects is:

> Remote Care (Helsinki, Finland): Available information about this project is very poor too. Only newspaper articles and the website of the city of Helsinki provide some insights into this project.

Projects, where clients measure their vital parameters on their own and transfer the data to the mobile care, are more often and information about these is also easier to obtain.

This means that the communication goes from the patients to the nursing/ medical system.



Examples for this kind of projects are:

- HerzMobil Tirol (Austria, 2012 - 2017)
- AAL (Europe) and modular (Austria, 2012 - 2015)
- TELEASIS (Romania, 2007 - 2010)
- TeleCare North (Denmark, 2012 – 2015)

In the following the above-names projects shall be presented:

- **Remote Care Helsinki (Finland)**

Background

Like Europe, Finland is struggling with demographic change. 22% of the Finnish population is over 65 years old, a figure that according to Statistics Finland will continue to increase over the next few years. It is expected that in 2070 a third of Finns will be over 65 years old.

In addition to demographic change, Finland is facing a rapidly falling birth rate. The number of Finns of working age is expected to fall by around 200.000 by 2050. This means that demand for and spending on care services are increasing, while tax revenues, which primarily finance the health system in Finland, are falling.

For this reason, Finland had to reform the social and healthcare system. ICT and digitalisation are integral parts of the reform.

Telemedicine services

Beside smart medication dispenser and GPS trackers the virtual lunch group is one aspect of Helsinki's remote care. Elderly people are equipped with a tablet and contacted regularly by a healthcare professional. Remote care involves video- and audio transmitted care services. However, the client can also contact the professional specialists.

In 2019 there were 800 home care clients, and nurses carry out 24.000 remote care visits a month. To be part of this system, the elderly persons are evaluated by district's Social and Healthcare Services. The evaluation is based on patient's medical needs, instead of their technical abilities. The services make sure all the tech is as easy to use as possible. Reasons for participation are especially medication adherence and general wellbeing checks. The remote care service helps clients in their everyday life by, for example, reminding them to take their medication, test their blood glucose or have an exercise session. In addition, joint mealtimes for clients who wish to talk with other people like in a video call are organised.

Remote care is meant to be part of a hybrid structure, which includes in-person care. However, it is often the case that telemedicine check-in visits take place instead of a personal visit. Reasons for this lies primarily in cost savings - whereas a physical home visit costs the equivalent of around € 44,50; a remote care visit is just € 5,00 - and environmental friendliness. Remote care is primarily aimed at maintaining patient safety and wellbeing, but it is also an effective tool in helping fend off loneliness. Seniors are now able to access various group activities. The program also offers virtual group exercise programs, religious sessions and

cultural events In addition People who live alone get a feeling of security, face-to-face contact and the opportunity to discuss things.

However, it must be obvious that remote care will never fully replace physical care. People will need physical visits as well. It is important that the technology go hand in hand with the personal visit.

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https://www.mobihealthnews.com/news/europe/helsinkis-digital-services-create-tools-seniors-stay-their-homes

https://www.theguardian.com/society/2019/jun/26/virtual-visits-finland-remote-care-ageing-population

- **HerzMobil Tirol (Austria)**

Background

HerzMobil Tirol, which started in 2012 as a pilot project, is a project between federal province Tyrol, Tyrolean Municipal Association, Austrian Health Insurance Company, Public Servant Insurance Corporation and Social Insurance for self-employed persons. The telemedical solution comes from AIT – Austrian Institute of Technology GmbH.

In July 2017, the care program was transferred to regular care. A total of 450 patients have been cared for with HerzMobil Tirol. The average age of the patients is 70 years.

The main goals of HerzMobil Tirol are:

- optimization of drug therapy
- improve the patient's own competence
- safe handling of the disease
- better quality of life for patients AND relatives

Overall, these measures should lead to an improvement in the quality of life, a reduction in hospital readmissions and a reduction in the mortality rate.

Program description

The care program is scheduled for the first three months after discharge from the hospital. If, in individual cases, three months is not enough to achieve the goals agreed with network

doctors and nurses, an extension of another three months is possible. The HerzMobil Tirol program is largely taken over by the Austrian health insurance providers for a large number of the insured. For some insurance companies, the usual low deductible is charged.

Overall, the program is based on **3 pillars**:

- **Network**: The affected patient is at the centre of a care team (hospital, nursing staff, network doctors). This will create a care network that focuses on the patient, from hospital care to discharge to home care. The cooperation of the care team with the patient is supported by a telemedical system consisting of a balance, blood pressure and pulse monitor and a mobile phone. This enables the patient to transfer measured data (weight, pulse, blood pressure), current condition and medication intake quickly and easily. By examining the transmitted measured values, a worsening of the disease can be recognized at an early stage and reacted to accordingly.
- **Training** of the patient and, if necessary, his relatives regarding the illness: This training is provided by specially trained nursing staff who complete further training as a heart failure advisor. It is intended to improve understanding of the disease and the measures required. This understanding, in turn, is the prerequisite for regular medication intake, the consistent implementation of a lifestyle change that may be necessary, and the early detection of a renewed deterioration.
- Gradual optimization of **Medication**: In the first months after discharge from the hospital, the dose of each medication must be gradually adjusted in order to achieve the maximum treatment success. Communication within the network is a particularly important point.

Telemedicine services

The use of telemedicine services enables the patients to stay in his familiar home environment. They independently draw the health-related data and then make it available to the doctor for assessment. On the basis of this data, the doctor can initiate appropriate therapeutic measures. On a mobile phone there is preinstalled software, the so-called HerzMobil app. With help of the app, data acquisition and data transfer take place. The telemedical monitoring and care take place in several steps.

1.) The patients **measure** daily blood pressure and pulse with a special blood pressure monitor and his weight with a special electronic personal scale.

2.) This data is recorded using the mobile phone. The patient receives his personal HerzMobil Tirol patient card as the key to access HerzMobil Tirol. If you bring this card close to the mobile phone, the HerzMobil app on the mobile phone starts automatically. Blood pressure, pulse and weight can now be transmitted automatically. By simply touching the screen on the mobile phone, the patient documents his daily well-being and the use of the prescribed medication. On this way all **data are recorded and are automatically transmitted** to the telemedical data centre of the Tirol Kliniken GmbH. For this purpose, a protected Internet connection is established on the mobile phone and the sensitive data is securely encrypted and transferred to the database in the IT infrastructure of the tyrolean clinics.

3.) The HerzMobil Tirol care team **checks** the transmitted measurement **data of the patient at regular intervals**. Individual limit values are set for each patient. If the measured values are outside of these limit values, the care team is automatically notified and can react to them promptly. If necessary, feedback and therapy adjustments are made. Through the daily recording and transmission of vital data, the caring HerzMobil Tirol doctors, together with the caring HerzMobil Tirol nursing staff, can get an up-to-date picture of the patient's state of health at any time. This virtual picture is of course rounded off by home visits by the nursing staff and the network doctor. This enables the care team to give individual feedback to the patient and to ensure optimal medical care through timely therapy adjustments.

Conclusion

According to international studies, the readmission rate of patients with heart failure is 50% in the first six months after diagnosis. The evaluations of patient data from 2016 to 2018 clearly show that this readmission rate can be reduced by half. Readmission rate of HerzMobil Tirol patients is only 25%. Patients who are optimally cared for with HerzMobil Tirol are therefore less likely to be re-admitted to the hospital. Overall, mortality is also around 9% in the observation period of one year, far below the value given in the literature of up to 30%.

- **AAL Europe**

AAL is a European funding programme that aims to create better quality of life for older people and to strengthen industrial opportunities in the field of healthy ageing technology and innovation. Since 2008 (start of AAL) 220 projects have been funded.

AAL (Active & Assisted Living, sometimes also Ambient Assisted Living) combines age-appropriate assistance systems for a healthy and independent life. Among other things, this includes concepts, products and services that combine new technologies and social environment to improve the quality of life for people in all stages of life, especially in old age.

AAL Austria

On the initiative of the Federal Ministry of Transport, Innovation and Technology, the AAL AUSTRIA platform was founded in April 2012 with the aim of networking the heterogeneous stakeholder landscape in the area of AAL in order to expand an Austrian AAL community and to promote the visibility of the AAL topic at all levels of public awareness.

Innovative AAL solutions are currently being installed in around 600 Austrian households and residential units, tested in everyday use and scientifically evaluated. Different priorities and approaches have been chosen that are or have been carried out in so-called AAL pilot regions.

Figure 2: AAL pilot regions in Austria

One of these pilot-regions is the Middle and South of Burgenland, in which **ModuLAAR** was implemented.

Figure 3: Project map

Ort	Alt-/Neubau	Wohnungen	Ausgestattet
Eltendorf	Neu	8	8
Deutsch-Kaltenbrunn	Neu	3	3
Strem	Alt	17	5
Lackenbach	Alt	5	2
Draßburg	Neu/Alt	8	4
Weppersdorf	Alt	5	4
Olbendorf	Alt	9	5
Neufeld	Alt	44	5
Privathaushalte	Alt	14	14
		109	50

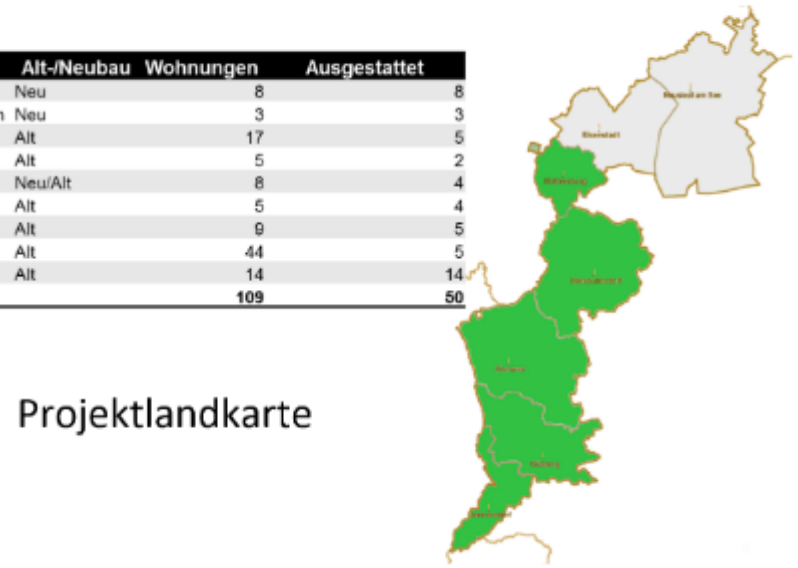

Figure 4: Burgenland in Austria

- **moduLAAr (Austria)**

= easier living

Project title: A modular, scalable AAL system as a lifestyle element for silver agers up to assisted living

Running time: 01.09.2012 – 31.12.2015

Funding agency: Federal Ministry of Transport, Innovation and Technology

Consortium partners: Samariterbund Burgenland as the social partner with other research institutes like AIT Austrian Institute of Technology GmbH, University of Applied Sciences and UMIT - Private University for Health Sciences, Medical Informatics and Technology GmbH

Project description

In the course of the "moduLAAr" project, 50 residential units were equipped with modular, standard-compliant AAL technology. The services offered come from the areas of comfort, safety, health and social interaction and should take into account the entire social environment of the residents. The technologies used were scientifically evaluated, especially with regard to user acceptance, usability and the benefit or acceptance of the public service provider.

A quasi-experimental longitudinal study design was chosen. A pre- and post-test was carried out to evaluate the impact of the different AAL modules. There were a total of five time-points at which information was collected: two preliminary surveys and three subsequent surveys.

In order to capture as many factors as possible, data was carried out not only quantitatively but also qualitatively. The qualitative data were collected in interviews that took place at different times.

Technologies used were developed by AIT:

1. **HOMER** (HOMe Event Recognition System) = Platform for the development of sensor data. This forms the "backbone" during installation in the test households and was installed on a fanless mini- or microcomputer. For the project, some of the relevant components from HOMER were further developed, especially modules for communication with the CareCenter and with the tablet computer.

2. **OwnCloud**: The cloud platform forms the interface of the moduLAAr system to relatives and care personnel. On the basis of the Open Source platform OwnCloud, plugins were developed for the project, which enable functions such as managing appointments, logging usage behavior for evaluation and creating the weekly menu plan. To ensure data security and protect privacy, a project-owned instance of OwnCloud was installed on AIT infrastructure. This means that there is no third party access to project data.

3. **Easier living app** = user interface: This was continuously developed and the range of functions gradually increased. The experiences and feedback from the test users have been incorporated into the development and the long test phase also allowed the test users to benefit from the further developments. At the end of the project, the following functions could be made available to the test users:

Figure 5: Screenshot of the app's home screen

a. Videotelephony
b. Weather report
c. Integration of games from third parties
d. Display of vital signs
e. Reminder function
f. Photoalbum
g. Simple web browser
h. Home control (only new buildings)
i. Integration of intelligence services
j. Menu plan

NFC-based system for vital data monitoring: A blood pressure monitor, a scale and a blood glucose meter were provided for this purpose. In addition, a commercially available mobile emergency call system was used.

The moduLAAr system was installed in 39 existing apartments and 11 new buildings. The majority of the households were looked after by the Samariterbund Burgenland. The remaining households were private apartments. The households were mainly in Burgenland.

Conclusion

The data clearly showed that AAL technology had a positive effect on the quality of life, especially in that age group in which a constant quality of life can already be considered a success. Above all, satisfying the need for security through supportive technology, but also dealing with one's own health through the regular recording and visualization of vital signs has been shown to have a positive impact on the quality of life.

- **TELEASIS - Integrated tele-assistance plattform (Romania)**

The project duration of this project was 2007 – 2010, which shows that the use of technological aids to support elderly was already known 13 years ago.

Motivation for the development of this project was:

- Increasing number of elderly
- High costs

- Long distances to receive care
- To increase life quality

The TELEASIS project is developing a pilot tele-assistance network with homecare electronic integrated services, allowing tele-assistance of the elderly, at their residence, based on the most recent ICT technologies, with a medical and as well, a social target. The system enables medical home services with no need for elderly to travel or hospitalize. It is mainly targeting 60+ years old people who suffer from chronic disease.

The general objective of a home tele-assisting system is to supply a bunch of integrated services for the users (Fig 1):

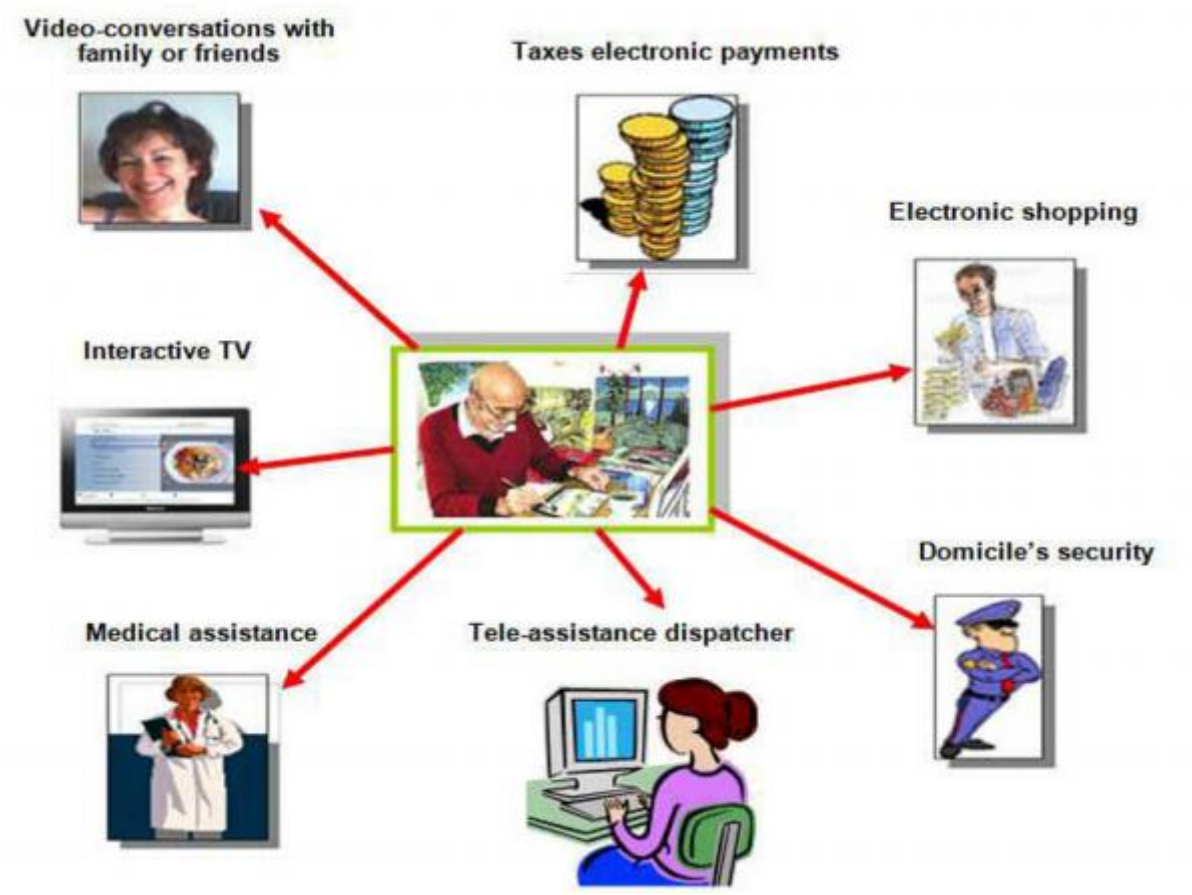

Figure 6: Tele-assistance home integrated services concept

TELEASIS Platform Architecture

The TELEASIS's architecture has specifically been designed to meet social, technical and economic user' stringent requirements. Therefore, the system is aiming to provide the elderly people with medical and social decent home assistance living the everyday live undisturbed. The appearance of the tools must be familiar, but medical oriented, so that the users recognise it quickly and the display must have large characters and also a good contrast. The IT menu must be friendly and intuitive, so that the training necessary for the utilisation to be reduced to a minimum. For using the TELEASIS Platform Hardware and Software components are necessary.

Hardware Platform:

- MITAS module (Home Tele-Assistance Integrating Module) is a complex electronic module
- providing interfaces to e.g. medical devices for remote healthcare services, to field sensors for home security services and to Internet
- processes the data collected from medical sensors to determine their classification in the predetermined limit, the exceeding of which generated an alarm
- insures automatic transmission of data collected at certain programmed time intervals to the Tele-assistance Centre, in normal operation conditions
- allows the transmission of alarms, collected from medical devices or sensors to the Tele-assistance Centre, in emergency condition.
- Medical devices for medical data acquisition for
- Cardiology – blood pressure, pulse
- Diabetes – blood sugar
- Pulmonary – peak expiratory flow
- Environmental sensors like water leak sensor, smoke sensor, gas sensor
- Display devices: MITAS module is designed to connect one of the devices: TV, PDAs and PCs, and to display information provided by the Tele-assistance dispatcher.

Tele-assistance Centre has the following functions:

- Retrieves requests from the user and/ or from the nurse who come to the user's home
- Analyses the requirements
- Provides optional services

Software Platform:

Software platform consists in a set of applications, serving system activity. Dedicated applications interact with support staff as well as the tele-assisted person with medical guides and general information. The platform provides the teleassistance centre with a complete set of information resulted from monitoring activity and also displays data from the centre to the patient, as a feedback.

The Server hosts Web services that ensure the support for communication between MITAS, databases and the local clients and an http server that allows appropriate data by a simple browser. A broker component is used to intermediate the dialog between the patients and/ or staff, and allows video streaming from the WEG cams located at the patient's home.

The dispatcher software is installed on the server unit of the Centre and consist of a role user oriented interface that facilitates the dialogue between all types of users. When starting the application, it requires user and password. At the level of the Dispatcher, a periodically activated software component ensures the visualisation of the signals read from the sensors and the alarms.

The TELEASIS experimental platform consists of two modules MITAS and one Tele-assistance Centre. MITAS module, placed in the patient's home and serves as intermediary between data collection devices and connect to the external tele-assistance network. The relevant information for user, such as medical data, indications of the doctor are displayed on a television screen.

Conclusion

Development of a "tele" – component for an assistance service, leads to optimization, reducing costs, performing more actions at low price and shifting the cost burden from hospital care to homecare. The system enables medical home services with no need for elders to travel or hospitalize. The system is mainly targeting 60+ years old people who suffer from chronic disease.

The system is confronting real barriers while implementing it such as

- A lot of elders lack digital skills;
- Specific elders needs are still off the mainstream products
- Legal shortage

- **TeleCare North (Denmark)**

Background

In 2012, the Danish government decided to launch the Action Plan to disseminate telemedicine nationally. The action plan included, among others, the TeleCare North trial, the purpose of which was to contribute to the generation of valuable knowledge about the use of telehealthcare for patients with COPD in the North Denmark Region. The TeleCare North trial was designed based on experiences from two Danish pilot studies, the TeleKat Study and the Nursing Consultations Study, which had both demonstrated positive effects of telehomecare and teleconsultations.

The TeleCare North trial (full scale), which was running from 2012 to 2015 has implemented home monitoring to support patients suffering from COPD (chronic obstructive pulmonary disease). The results of the project are now being implemented at a national level and must be fully implemented in Denmark in 2019 as part of the national ICT strategy for Health Care.

Telehealthcare

TeleCare North has designed a telehealth system called **Telekit** (Figure 6). This targeted all COPD patients in the North Denmark Region with the aim of empowering patients to retake more charge and responsibility for their own lives. 1.225 patients were enrolled in the trial.

Figure 7: The Telekit system

Patients in the **intervention group** received the Telekit in addition to usual practice.

The Telekit system consists of a

- Tablet containing information on how to manage COPD in general and software that automatically guides the patient in coping with their disease
- Fingertip pulse oximeter
- Health precision scale
- Digital blood pressure monitor

The devices can collect and (wirelessly) transmit disease specific data (blood pressure, pulse, oxygen, saturation, and weight). The patients were instructed to measure their vital signs, which were then sent asynchronously to municipality healthcare personnel who subsequently established if these data deviated from the normal threshold values. The communication between the healthcare personnel and the patient was one-way only. The patients were contacted if there were adverse changes in their values and responses. Patients were also contacted if the measurements were not carried out as agreed or the measurements were not received as expected.

Patients in the control group received their existing usual practice. This involved treatment, monitoring and care throughout the study period. The patients General Practitioner provided this treatment and monitoring, and the municipalities held responsibility for the practical help and care provided. For ethical reasons at the end of the study period they were offered the same Telekit system as the intervention group.

Conclusion

The project has established new cross-sector roles and procedures to support the regionwide implementation of home monitoring. This has paved the way for a new integrated care model, which allows the concept to be expanded to other patient groups. Since 2013, approximately 1,400 COPD patients in the North Denmark Region have accepted the offer of home monitoring. Research shows that patients with severe COPD experienced improved quality of life, and the number and length of hospitalisations were reduced by 11% and 20% respectively. Building on the positive results for COPD patients, the offer of home monitoring was expanded to include heart failure patients. This project was running from 2015 to 2018 – also full scale in North Denmark Region.

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2.4.4. Conclusion

As already mentioned, demographic change is also noticeable in Austria. Associated with this is the increasing pressure on public spending. It is therefore important to react to these developments as quickly and as early as possible. One way to reduce costs in this area is to implement digital tools that enable older people to live a longer life at home.

Tools that, among other things, have the goal of reducing costs in the long term and that should enable a self-determined life at home, were presented in this document:

Remote Care in Helsinki/ Finland has shown that using video lunches can save costs. Remote Care has also shown a positive impact on the environment and it is also an effective tool in helping fend off loneliness. Seniors are able to access various group activities, get a feeling of security, face-to-face contact and the opportunity to discuss things.

HerzMobil Tirol in Tyrol/ Austria has also pointed out some positive effects of digital tools: According to international studies, the readmission rate of patients with heart failure is 50% in the first six months after diagnosis. The evaluations of patient data from 2016 to 2018 clearly show that this readmission rate can be reduced by half. Readmission rate of HerzMobil Tirol patients is only 25%. Patients who are optimally cared for with HerzMobil Tirol are therefore less likely to be re-admitted to the hospital, but overall mortality is also around 9% in the observation period of one year, far below the value given in the literature of up to 30%.

The won data of **moduLAAr** in Burgenland/ Austria has clearly shown that AAL technology had a positive effect on the quality of life, especially in that age group in which a constant quality of life can already be considered a success. Furthermore, satisfying the need for security through supportive technology, but also dealing with one's own health through the regular recording and visualization of vital signs has been shown to have a positive impact on the quality of life.

TELEASIS in Romania is the only project, which in addition to the positive effects also indicates the barriers: Development of a "tele" – component for an assistance service, leads to optimization, reducing costs, performing more actions at low price and shifting the cost burden from hospital care to homecare. The system is confronting real barriers while implementing it such as a lot of elders lack digital skills; specific elder's needs are still off the mainstream products and legal shortage.

Like the other projects, **TeleCare North** trial in Denmark has also pointed out some positive effects: Since 2013, approximately 1,400 COPD patients in the North Denmark Region have accepted the offer of home monitoring. Research has shown that patients with severe COPD experienced improved quality of life, and the number and length of hospitalisations were reduced by 11% and 20% respectively.

In summary, it can be said that digital tools have a positive effect in many ways. However, the barriers such as legal shortage and lack of digital skills cannot be neglected. It is also important to note that digital tools, however effective they are, can never replace personal contact between people.

Platform for videoconsulting is a part of digital tool called „Methods of care of frailty patients discharged from hospitals" and is focused on the methods of care development for frailty patients discharged (main focus on hospitals in CZ and SK) enhancing on the basis of successfully operated good practice in Europe (Italian e-Care practice is primary candidate for scaling up). Organizational, economic, technical and medical conditions for new practice will be developed considering local context. The tool will enable to better coordinate health care of frailty and chronically ill patients, to monitor and communicate with them. Overview about data sharing platform between health and social care provider is a part od Deliverable 2.6.2 - Review of care methods of frailty patients discharged form hospital-eCare model and other EU models.

2.5. Technical review – Platform for teleconference as part of Methods of care of frailty patients discharged from hospitals

2.5.1. Platforms for teleconference

- **DOCTOR2U**

Source: *https://www.doctor2u.my/Home/*

About: DOCTOR2U is a multipurpose medical application available for Android and iOS. Which enable patients in Malaysia to order medication, call an ambulance (non-emergency UBER-like service to drive patients to the hospital) or arrange physician's visit at patience home.

A part of the application is also a feature of video consultation that allows real-time conversations between the physician (GPs and specialists) and the patient. Users may review each doctors! Credentials and their corresponding prices before the selection of a specific physician. It i salso possible to add a specific physician into the favourite list. Appointment booking is available as well. Physicians are enabled to sen dan electronic prescription to the partner pharmacy (Lovy Pharmacy) and deliver the medication to the patient's doorstep. Physician can also recommend a visit to see the patient face to face (House Call feature).

The service is currently available for Malaysia only. There is a plan to expand to Singapore and Philippines. Service is available 24/7. Physicians needs to be fully registered with the Malaysian Medical Council and must have at least 3 years of prior experience. Multiple patients (e.g. family members) can be consulted within the paid session. All data goes through encrypted system powered by Microsoft Azure.

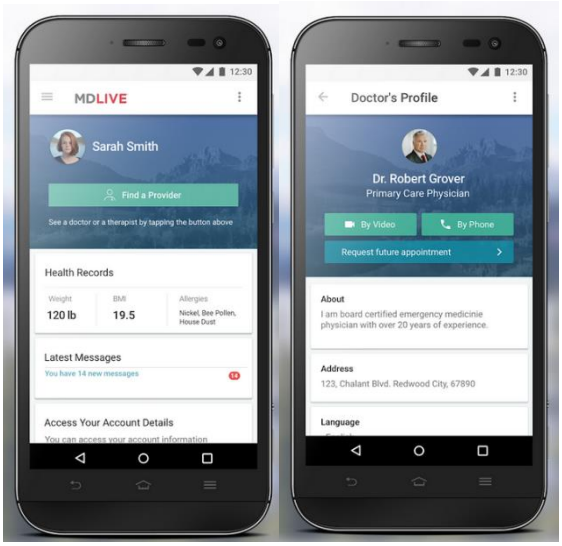
- **MDLIVE**

Source: *https://www.mdlive.com/*

About: Is an application available for both Android and iOS devices allowing virtual doctor visits from home or any other place 24/7. Physicians are board and state licensed with average 15+ years of experience. MDLIVE has two National Committee for Quality Assurance certifications and is accredited by the American Telemedicine Association. MDLIVE doctors treat over 50 non-emergency medical conditions (allergies, colds, ear pain, fever, migraines, pink eye, rash, sinus infections, sore throat). MDLIVE also offer treatment and support for a wide variety of behavioural health issues (addictions, anxiety, bipolar disorder, couples' therapy, depression, eating disorders, LGBTQ support, panic disorders, postpartum depression, relationships, social anxiety, stress management, PTSD).

MDLIVE should not be used for patients experiencing a medical emergency. In addition, MDLIVE don't treat sexually transmitted diseases, urinary tract infections in males, or urinary tract infections in females under 18 years of age. Children under 3 with a fever and children under 12 with ear pain cannot be treated by MDLIVE as well.

MDLIVE does not guarantee patients will receive a prescription, does not prescribe DEA controlled substances and may not prescribe non-therapeutic drugs and certain other drugs which may be harmful because of their potential for abuse.



Pricing: Counseling 108 USD per session, psychiatric session 284 USD for first visit and 108 USD for each follow-up appointment, dermatology 75 USD or less depending on patient's insurance

- **LiveHealth**

Source: *https://livehealthonline.com/*

About: LiveHealth Online provides live chat, phone calls, email messaging and video meetings through Android and iOS application. A typical video doctor visit using LiveHealth Online is about 10-15 minutes. The cost for an online medical doctor visit is 59 USD for patients without a health plan. In case of an emergency patient is strongly recommended to call 911 instead. Service can also provide child's condition assessment and provide a treatment plan and even send prescriptions to the pharmacy of choice, if medically necessary. The doctors at LiveHealth Online are focused on providing care for urgent care, common health conditions and cannot manage long-term or chronic conditions. Chronic health conditions should be managed by an in-person provider. That being said, the doctors at LiveHealth Online can provide short-term prescription refills if the patient is traveling and forgot his/her medication at home or haven't had time to get in to see his/her regular primary care doctor. Prescription refills are provided at the discretion of the provider with the understanding that the patient will get further refills from his/her physician. The doctors at LiveHealth Online can prescribe a short-term refill on an existing birth control prescription. However, some patients may not qualify, may need an in-person exam, or may need additional tests before the doctor could issue this type of prescription. Video visits using LiveHealth Online are available to anyone located in the 50 United States. The amount of information shared with the doctors is totally up to the patient choice. Sick slips may be also provided. Video consults can be paid by most debit and creedit cards. Charges for prescriptions are not included in the cost of visit.

Pricing: Free to sign up, no monthly fees, 59 USD per visit (medical issues), 80 USD per visit with a therapist, 95 USD per visit with a psychologist, 175 USD for an initial psychiatric evaluation, 75 USD for for each follow-up session

- **Patientus**

Source: *https://www.patientus.de/*

About: Patientus is a German teleconsulting service. Doctors of various specialties (e.g. general practitioners and dermatologists) have been able to look after their patients in the video consultation hours since April 1, 2017. The costs for the video consultation are covered by the statutory health insurance companies for many treatment cases. (e.g. a doctor can also check the healing process of a wound in the video consultation while the patient is sitting at the computer at home.)Doctors, however, are not allowed to make diagnoses in the video

consultation, but only care for patients who have already been treated personally. In addition, doctors are allowed to advise patients on medical topics in the video consultation. Doctors can e.g. provide general information about a disease or the advantages and disadvantages of treatment.

Pricing: Covered by insurance

- **iCliniq**

Source: *https://www.icliniq.com/*

About: iCliniq is a Medical Second Opinion platform where users can get medical advice from doctors. Doctor panel consists of medical practitioners, physicians and therapists from US, UK, UAE, India, Singapore, Germany and other countries. iCliniq provides various channels to contact their doctors such as posting as a health query or booking a slot for real time face-to-face consultation over HD video and phone (it will be a private/secure call back). Users are ablet to share their previous history and consultations also with use of DICOM files. During a phone consultation, neither the doctor nor the user is be able to give the personal contact details of the other party. The call will be connected through an anonymous calling system. User can select a specific doctor for a query, chat or consultation. The user can choose their doctors in "Doctors" tab using on search functionality. Once the user books a slot for Phone or Video consultation, he/she will receive a confirmation email. Apart from this, he/she will receive an SMS to theiregistered mobile number 15 minutes before the consultation. English is a common language for all the doctors, so it will be a default setting in the consulting language field. Apart from English, doctors set also their native speaking languages and known languages. The website is GDPR compliant.

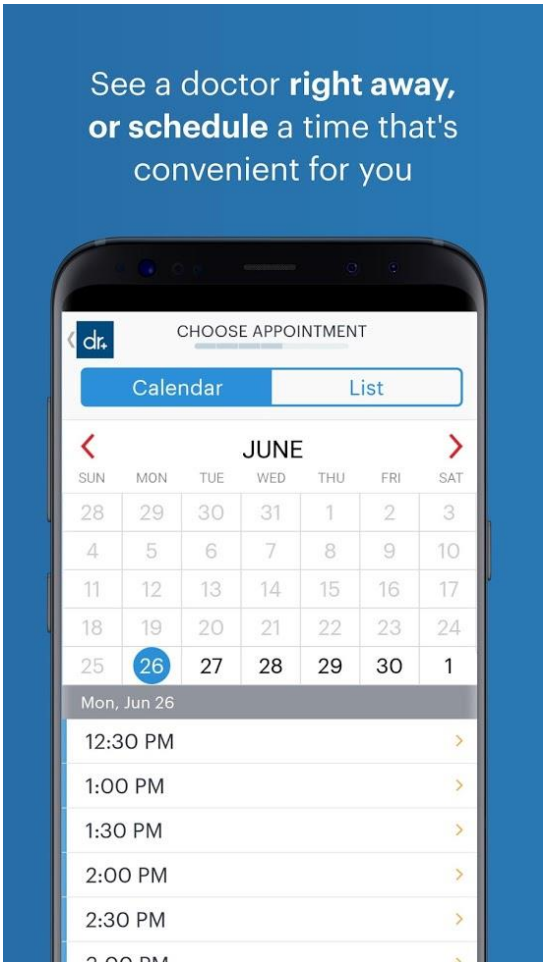
Payment: Users can pay through four different kinds of payment modes. PayPal Debit/Credit Cards (Of Any Bank) Netbanking (Of Any Bank) Wallets (iCliniq, Paytm, Freecharge). All new users on the site have the option to post their first query for free.

- **Dr. on demand**

Source: *https://www.doctorondemand.com/*

About: Patients visiting a psychologist or psychiatrist, are always able to choose the doctor. The list of providers populated will be based on patient's location and will present providers licensed in patient's state. If the patient is visiting with a medical doctor it depends on which type of appointment he/she selected. If the patient select to "Get Care," he/she will be

automatically connected with the next available doctor. However, if he/she schedule an appointment for a later time, you can select which medical doctor you would like to visit. Patient information is stored on encrypted servers inside encrypted databases. Only strong-encryption APIs may access the data via mobile application. System is also HIPAA compliant. Doctor On Demand is able to provide ASL (American Sign Language) interpretation and language translation for medical visits by appointment. These visits are completed via Google Hangouts where the patient is able to connect with a licensed Doctor On Demand physician and an interpreter. Patient can join a visit while traveling internationally but the provider will only be able to provide advice; no prescriptions will be written. The Doctor may advise patient on the medication he/she should try to obtain (if any is recommended). However, under no circumstances can dr. on demand provide a prescription- even for a US resident traveling abroad. Physicians are able to prescribe a wide range of drugs, which can be useful for infections, allergies and other ailments. It should be noted that the provider does not prescribe certain drugs, such as: Narcotics, or pain medications- including Gabapentin, that have been designated as U.S. Controlled substances as a Schedule I, II, III, IV or V drug.



Pricing: $75 for a 15 min consultation with a medical doctor, $129 for a 25 min consultation with psychologist, $299 for initial 45 min consultation with psychiatrist, $129 for 15 min follow-up session with psychiatrist. Some of the health plans are also eligible.

- **Westside Medical Centre**

Source: *https://www.westsidemedical.com.au/telehealth/video-consults*

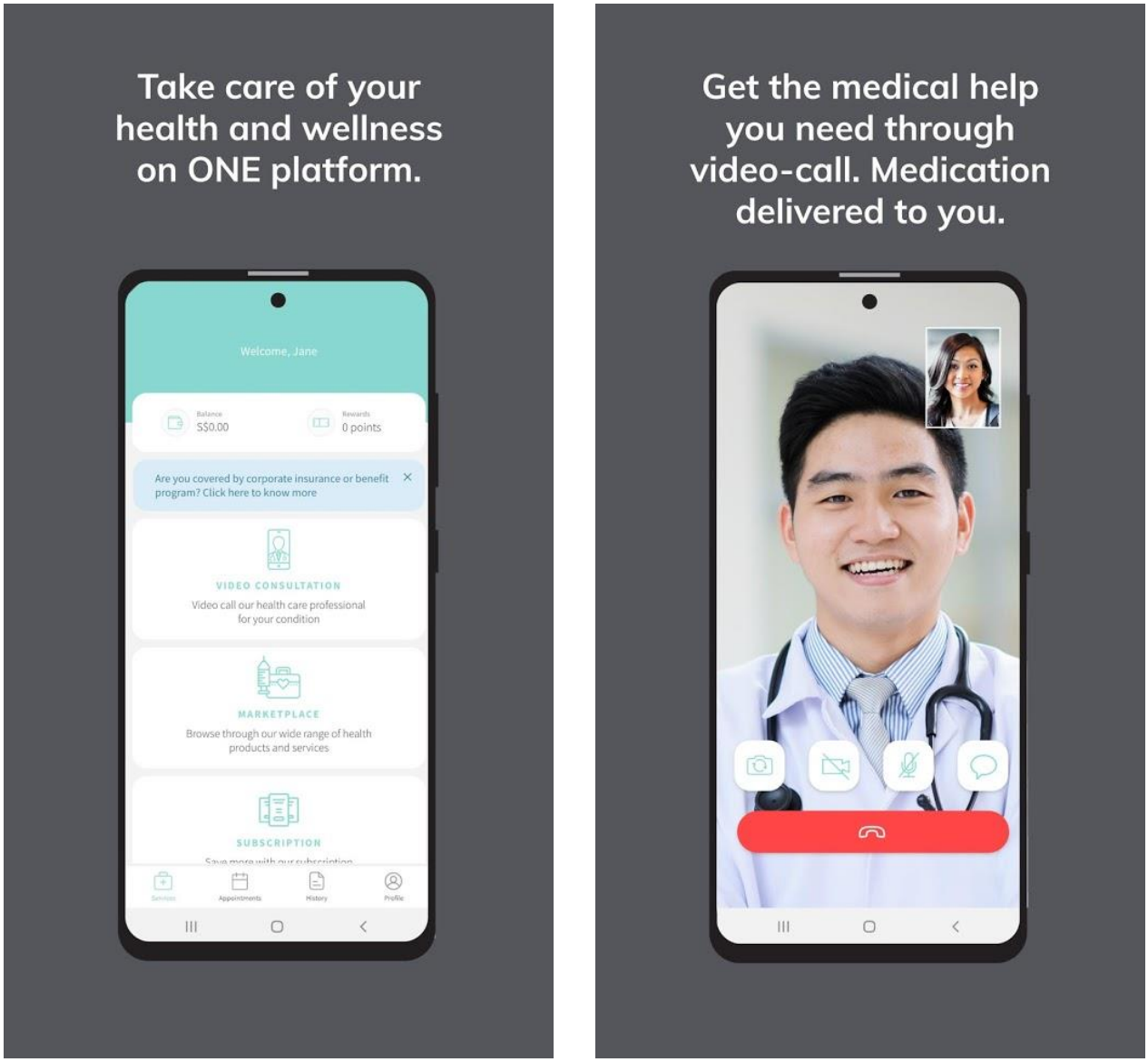
About: Funded by the Australian Government, and uses a large, well-established health videoconferencing program called Coviu. It does not retain any of patient's details, such as name or phone number. The consults are not recorded and no data is retained. If the patient need prescriptions, tests, or referrals to other health care professionals, provider will send these on his/her behalf directly where they need to go.

- **Doctor Anywhere**

Source: *https://doctoranywhere.com/*

About: Doctor Anywhere is part of the Ministry of Health Singapore's (MOH) regulatory sandbox for telemedicine providers. The telemedicine sandbox is the first initiative under MOH's Licensing Experimentation and Adaptation Programme (LEAP), introduced to enable innovative services to be developed in a safe and controlled environment. In addition, Doctor Anywhere's practices comply with National Telemedicine Guidelines (NTG) and SMC Ethical Code and Ethical Guidelines (ECEG), and partner clinics are regulated by Public Hospitals and Medical Clinics Guidelines (PHMC). Patients' data and medical records are also compliant with the Personal Data Protection Act (PDPA). All the practising medical doctors hold full registrations with the Singapore Medical Council (SMC), and all the providers constantly undergo a stringent screening and vetting process by Doctor Anywhere's qualified panel consisting of medical doctors and professionals. Users outside of Singapore can use the COVID-19 Medical Advisory Clinic to seek a doctor's professional opinion to identify symptoms, and advice on next steps or provide a memo to guide you on what medications patient can purchase from local pharmacy. Before each video consultation, patient need to fill in a pre-consultation survey which includes questions about his/her symptoms, health history and payment details. Provider's platform does not cater to serious conditions; such cases require urgent medical attention at the nearest A&E department of the hospital. Doctors can prescribe a wide range of medications, which can be useful for infections, allergies, skin conditions, travel or minor injuries. Provider

also offer medication delivery from the clinic right to patient's doorstep, within three hours from purchase. However, the doctors do not prescribe any narcotics.



Payment: Platform accepts online payment via all major credit and debit cards, including VISA and MasterCard. A video consultation on Doctor Anywhere COVID-19 Medical Advisory Clinic costs S$10, excluding medication. Major insurance companies may provide plans that cover medical consultations through video call. This needs to be checked by the patient.

S$20 for General Practitioner consultations, S$20 for Medical Aesthetics consultations, S$15 for Newborn Consultations

- **Zoom**

Source: *https://zoom.us/healthcare*

About: Is a general purpose communication platform. Originally founded in 2011 by a former Cisco Webex engineer. During the COVID pandemic the platform raised in popularity among users from corporate world, schools and even medical sector. Based on the zoom's webpresentation the platform is HIPAA, PIPEDA/PHIPA compliant. Zoom employs industry-standard Advanced Encryption Standard (AES) encryption using 256-bit keys to protect meetings. Zoom enables "Advanced Encrypted Persistent Chat" on HIPAA accounts and such encryption is irreversible by Zoom. Zoom's Advanced Encrypted Persistent Chat is a fully encrypted messaging system which utilizes public key cryptography with private keys generated and stored only on users' devices. Users authenticate their device to Zoom's key management system (KMS) with their Zoom account allowing these keys to then be registered and used to exchange messages through the Zoom platform without ever revealing their contents to Zoom's servers. Zoom encryption fully complies with HIPAA Security Standards to ensure the security and privacy of PHI. Medical professionals and authorized healthcare partners can use Zoom to meet with patients and other healthcare professionals to screen-share health records and other resources. Screen sharing transmits encrypted screen capture along with mouse and keyboard strokes only. Screen sharing cannot be recorded on a HIPAA account and, therefore, is not stored or otherwise accessible by Zoom in Zoom's environment. On the other hand zoom was recently banned for use in Taiwan due to serious cybersecurity issues. Significant weaknesses, security flaws and problems of the platform have been discussed in all the world's major media like BBC a the Guardian. It is also worth to mention that zoom was shutting down accounts of Chinese dissidents and activists.

- **Vitality**

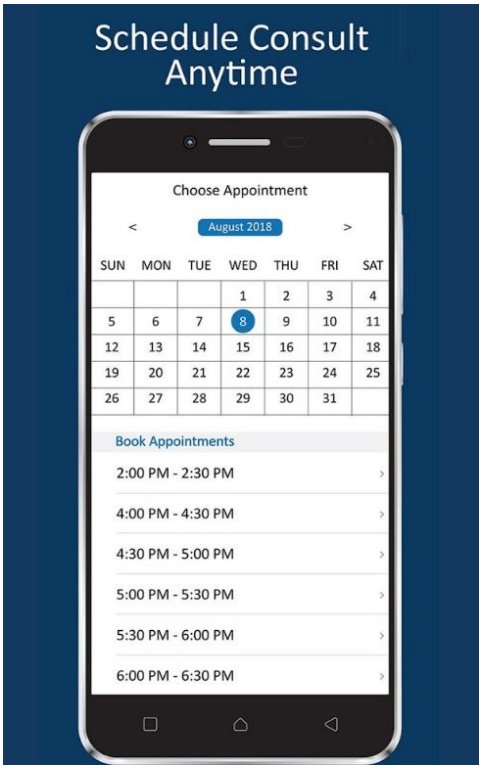
Source: *https://www.vitality.co.uk/health-insurance/core-cover/vitality-gp/*

About: End-to-end private treatment app to book video consultations within 48 hours, including evenings and Saturday mornings. Direct access to our Priority Physiotherapy Network - including for self-referral - on a range of muscle, bone and joint issues. Direct access to the Mental Health Panel - including for self-referral - on a range of treatments, such as counselling and cognitive behavioural therapy (CBT). There are some things the Vitality GP won't be able to help with, such as: a) hands-on examinations and treatment; b) emergency treatment e.g. chest pains, suspected stroke or bone fracture; c) routine or repeat prescriptions, including medication to treat cholesterol and diabetes. Patient can only use Vitality GP for consultations in the UK.

- **Docvilla**

Source: *https://docvilla.com/telemedicine-video-consults/*

About: DocVilla provides a HIPAA compliant telemedicine video consulting solutions for patients and doctors. Using DocVilla platform, the patient and doctor can securely video chat with each other for many non-emergency medical conditions. Most of the competitors such as AmWell, MDLive, TelaDoc provide only video consults. DocVilla also provides secure chat functionality between patient and the doctor besides an EMR. Use of Telemedicine is already approved by the medical societies. From the patient end the integration of such devices with DocVilla app seamless and can be done by one click. The provider can also such health data from the patient and the patient can allow access with a single click. The patient can also revoke the access of the health data to the provider using a single click. DocVilla allows Doctors to conference a third party during a telemedicine consult. This feature is useful if a doctor wants to conference a specialist in the call. DocVilla allows Doctors to record the telemedicine consult after getting patient consent. This recording is encrypted and securely stored as per HIPAA guidelines. DocVilla also has the provision to record audio only and save it corresponding to a consult. Doctors can share their screen with the patients and show the related documents such as X-Ray, MRI etc. The screensharing can be in a secure HIPAA compliant fashion during a video consult.



- **Doxy**

Source: *https://doxy.me/*

About: Unlike the majority of other providers there is no need to any download or registration for the patient (Jitsi-like behaviour). Physician needs to create an account. All data is encrypted, patient sessions are anonymous and no patient info is stored persistently. Provider use the AES cipher with 128-bit keys to encrypt audio/video, and HMAC-SHA1 to verify data integrity. Use of the platform is free (limited quality performance), cost of an appointment is decided between the physician and the patient. Doxy.me was originally created for a research study at a University. All versions (Free/Professional/Clinic) meets HIPAA, PIPEDA/PHIPA and GDPR requirements. Free version contains waiting room and patient queue. Features like photo capture, group calling, screenshare, file transfer payment and teleconsent are available only in paid versions (35 USD/month for individual providers).

- **Lemonaid**

Source: *https://www.lemonaidhealth.com/*

About: Lemonaid Health is a national telehealth company based in San Francisco, CA.. Patients may use the service only when they are located in the US. One of the provider's doctors or nurse practitioners will review the answers to patient's health questionnaire before your video starts. They'll discuss with you possible diagnoses and treatments. State regulations require that our medical providers see who we're treating, so that's why the provider may ask patient to take a picture of him/herself and his/her ID. Not for younger than 18 or older than 75.

Pricing: consultation fee for most services is $25

- **Babylon**

Source: *https://www.babylonhealth.com/*

About: Provider stores all patient's personal health data, including his/her primary care information, secondary care information, medication information and diagnostic information, on secure servers located in the UK. If the patient gives explicit consent at the time of booking his/her consultation his/her information can only be shared with his/her NHS GP or insurance company.

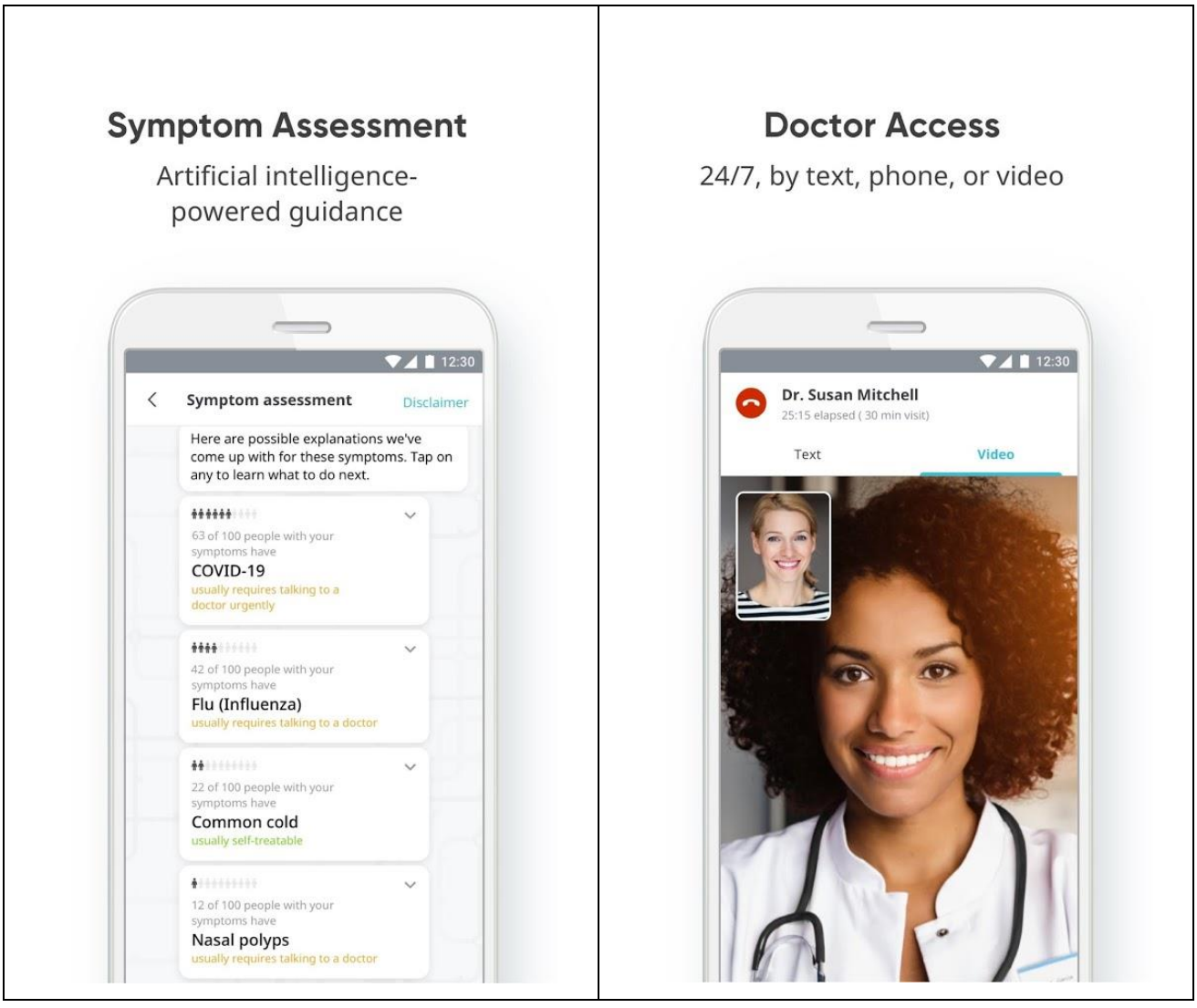
Pricing: A 12-month subscription for 149 GBP, a one-off consultation for 49 GBP

- **HealthTap**

Source: https://www.healthtap.com/

About: HealthTap is a virtual healthcare provider. HealthTap offers 24/7 access to information and board-certified doctors from any device by text or video. Virtual consultation can be requested from any device. Doctor can give prescription medicine and arrange its delivery to pharmacy or to the patient's home. Lab tests and their results can be also managed through HealthTap. AI symptom checker is also available when video consult is not demanded. Patient can also access a library of previously doctor-answered questions. Patient's medical profile including treatment plan, medical and lab record, prescriptions and even doctor's virtual consultation notes are available through the HealthTap.

Pricing: 10 USD/month (The cost of prescriptions, lab tests, or in-person doctor visits are not included in the cost of the subscription.)



- **Dialogue**

Source: *https://www.dialogue.co/en/patients*

About: Canadian based telemedicine provider. Providing video consults. Has ability to renew prescriptions.

Pricing: Undisclosed, for pricing plans provider needs to be contacted

- **Plushcare**

Source: *https://plushcare.com/*

About: Is a telemedicine provider operating in 50 US states that allows to speak with one of their doctors. Plushcare is HIPAA compliant. Application is available, however not neccessary.

Pricing: 99 USD per visit + monthly mmbership fee

- **Maple**

Source: *https://www.getmaple.ca/*

About: Canadian based telemedicine provider with 24/7 access. Requires registration. Provider is able to give a prescription or offer lab work.

Pricing: Visits start at $49. Some appointments are covered by insurance.

It is possible to pay via pay-per-visit, medical membership plans or credit packages. For pay-per-visit scenario during the weekdays it is 49 USD per visit, during weekends and holidays it is 79 USD per visit, overnight the cost is 99 USD per visit. For personal memberships it is possible to pay 30 USD per month, with up to 30 visits per year. With family memberships for 50 USD per month 50 visits per year are available.

- **Providence ExpressCare**

Source: *https://virtual.providence.org/*

About: ExpressCare Virtual is available in California, Alaska, Montana, Oregon and Washington.Service is available from 8:00 a.m. - 8:00 p.m. Pacific Time (PT). User account is required. Face-to face care through secure video chat on patient's smartphone, tablet or computer. Talk with them about symptoms, and diagnose and treat minor medical concerns patients are dealing with. They can also prescribe medication or lab work as needed. Patients of all ages can use ExpressCare Virtual, but parents/guardians need to start the process.

Pricing: Visits are $49, with some additional fees if patient have any tests or labs done. These can bereimbursed through insurance providers (Aetna, Cigna, Tricare, United Healthcare and more).

2.5.2. Selected literature

Even though the major popularity the video consultations gained during the current COVID-19 pandemic era, the topic itself is nothing new. For example there are recommendations [1] from 2012 made by the Medical Board of Australia regarding the "Technology-based patient consultations" - these includes also videoconferencing.

The web cam used as a substitute for a face-to-face physical interaction between physician and patient is also mentioned in [2]. Where it is described, that in the UK it is possible to use this approach to the patient under certain conditions. The situation in the US was rather doubtful during the time of the publication. Some criteria relevant to utilising a Web cam are described in this source are:

- Establish a dialogue with the patient, using a questionnaire;
- Adequately assess the patient's condition (which may include performing a physical examination of the patient as far as is practicable via video)
- Discuss alternative treatments;
- Assess any contra-indication effects;
- Have sufficient dialogue with the patient regarding treatment options
- Inform the patient's general practitioner.

Also ethical and social related questions are raised in this text. Among others trust and confidentiality. These topics remains actual to the present era as well.

In December 2014 NHS published a report on implementing Skype consultations into general practice [3]. Major motivation was increasing demand for more flexible and accessible services for patients, especially due to the aging population. Major issues and key learning points were in the field of time scheduling and user experience – use of two screens was recommended, or at least a split screen to have a simultaneous access to the patient's record. Security risks of local IT infrastructure are understood. Audio visual recordings of meetings are not to be made by the clinician. Only the outcomes of the online consultation will form part of the patient's records, in similar manner to face-to-face consultation. No specific standard is required to be fulfilled by the web camera.

The major driver in the change of video consultation services acceptance into the healthcare systems across the globe is COVID-19 pandemic [4]. It seems that the long-term bureucratic obstacles that made adoption of such technologies slow were erased. There are some challenges regarding e.g. the wound probing, however, there are secondary patient safety benefits like decreasing the risk of falling and injury during the transport. Also relative or friend are no longer inconvenienced by the need to drive the patient to the medical facility. Telemedicine visit use the same evidence-based medical skills that are being used during the usual office visit. Clinician takes patient's history and try to understand the patient's current state upon his complaints. Examination is limited to the active range of motion, observation and feedback from the patient's palpation of the body part. One of the concerns was a possible loss of physician-patient bond. Nevertheless, this was not the case.

There are several specific patient groups that were challenged even more because of the restrictions due to the COVID-19 pandemic. Among them are for example seniors, patients with heart failure (HF) [4] or patients in palliative care [5]. Major benefit is, of course, reducing the in-person exposure to potentially infectious patients and medical staff.

There are also plenty of benefits not directly connected to the current pandemic situation. So it should be stressed that the current situation only elevated the need for such an approach, nevertheless, the positive outcomes are undeniable also in the non-pandemic times. In the first major study [6] a use of Skype was assessed. It was found out that the Skype itself may be a valuable tool for wider social integration, therefore improving mental health of the patients. Virtual clinics via Skype have been used also for counselling and mental health consultations. Skype proved to be an effective medium to support independence and selfconfidence of teenagers. Participants reported that they felt more confident talking about personal issues via Skype rather than face-to-face. They also felt confident speaking about their personal issues without parents being present. Skype consultations were also found feasible for patients with social anxieties and depressions. It is also worth to compare „did not attend" rates in the group of diabetic patients – 13% among the patients attending via Skype and 28% among the rest of the patients. Of course, these were initial non-randomized studies. There are, though, some contraindications fot videoconferencing – typically: limited/no access to network, limited/no access to technology (smartphone, tablet, laptop, PC), lack of familiarity (by patient, or family carer), clinical inappropriateness (eg. need for physical examination), inability to give informed consent, comorbidity preventing participation like severe visual impairment.

2.5.3. Summary

There are two basic groups in which we can divide all the available applications and services: First group offers a communication interface or layer – liasing the relationship between the GPs and specialists with patient. Among these are general communication applications like Zoom, or a specialized telemedicine application, e.g. doxy.me. Second group creates the whole ecosystem which is created by a communication platform and a team of GPs and specialists that are working for the service provider.

For both types the GPs and specialists typically need to be registered within the system. From the patient's point of view not every provider requires patient's registrations.

Majority of providers supports medicine prescriptions. Some of them are even connected with local pharmacies. Of course, there are limitations on what can be prescribed. Limitations are always described on the providers' webpages.

Regarding the pricing policies the are two groups of providers – with monthly/annual memberships/subscriptions and without any subscriptions at all. Both provider types have typically fees for each virtual visit as well. Fees are being categorized into further subgroups depending on the specialization. Some insurance companies are able to support financing of these services. It was even shown [8] that such audio video visits are cost effective.

2.5.4. References

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