Dispatching and Management Center for Optimizing Home Care Integrated Services

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Abstract: The paper summarizes the design specifications for a complex ICT platform for optimizing home care integrated services. It is based on the work involved in implementing the project with the same title – "Dispatching and Management Center for Optimizing Home Care Integrated Services". The project aims to create a network of centers that offer services to home care service providers (HCPs). The centers in the network should optimize the activity of the home care service providers and support them in offering quality standardized services through the usage of a complex platform that optimizes most of the activities involved in offering home care services. The proposed system does not focus on the home care system, but concentrates on the software and hardware components that will allow a home care services provider to perform in a very efficient way. It may be compared to an ERP (Enterprise Resource Planning) system customized and dedicated to HCPs. As far as we know, there is no such system implementation currently on the market. The main beneficiaries are the home care service providers along with their end-users (elders, chronic patients or people who need ambulatory treatment), who will ultimately receive better services.

1   INTRODUCTION

Population aging is a growing problem that needs to be addressed. The *2018 Ageing Report* (European Commission, 2018) shows projections of age-related expenditure on the basis of a new population projection by Eurostat. The report shows that the category of people aged 65 and over will become a much larger share, rising from 19% (2016) to 29% (2070) of the population, those age 80 and over will also become more numerous rising from 5% (2016) to 13% (2070). This is projected to happen while the active share of the population will become substantially smaller, declining from 65% (2016) to 56% (2070). The old-age dependency ratio (people aged 65 and above relative to those aged 15-64) in the EU is projected to increase by 21.6 pps., from 29.6% in 2016 to 51.2% in 2070. The EU would go from having 3.3 working-age people for every person aged over 65 years to only two working-age persons. Most of this increase is being driven by the very old-age dependency ratio (people aged 85 and above relative to those aged 15-64) which is rising by 14 pps (8.3% to 22.3%). This leads to new challenges in providing assistance for aging people

in maintaining an independent living, preferably at home. Solutions are sought in using ICT support for delivering care services at home to those that need it (due to age/ non-age-related problems).

Offering medical and social care services at home may be accomplished by the means of an integrated home care system aimed towards people with a high dependency degree or with low mobility for maintaining their autonomy and increasing their quality of life.

Home care services should be available and affordable for all the elderly and contribute to their wellbeing, in their living environment. The purpose of these services is to allow the main beneficiaries to live in their own homes as independent as possible, while maintaining their safety and enjoying social activities. The elderly should be able to choose the timing and the types of support services they wish to receive.

In the presented context, the paper describes the work involved in implementing the project with the same title – "Dispatching and Management Center for Optimizing Home Care Integrated Services". The project aims to create multiple partnerships for knowledge transfer in order to develop the ICT

support necessary for the implementation of multiple Dispatching and Management Centers for optimizing home care integrated Services (referred to as CDMS), as a support for offering medical and social services at home. A CDMS is designed to be a platform operated by a service provider for multiple Home Care Providers (HCP).

HCPs represent a field of activity with an increasing demand in the current years in Romania and also in Europe. Considering the increasing number of old people in Romania and the fact that
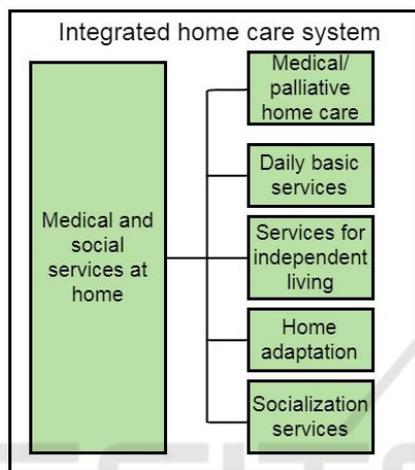

Figure 1: Medical andocial services at home.

the medical system struggles to handle the long-term hospitalization of people suffering from chronic affections, the role of home care services providers increases. HCPs may offer social and/ or medical services. Offering medical and social services at home can be optimized by using a support platform based on ICT integrated in a CDMS.

A CDMS may bring significant improvements in the management of technical, human and economic resources of an HCP as the project aims to solve the technical and organizational matters involved in the development and implementation of HCPs.

The project proposes a platform that facilitates and optimizes the integrated (medical and social) services offered by home care providers. Figure 1 shows a quick overview of the proposed services to be offered by HCPs through the usage of a CDMS platform, ranging from medical/ palliative care, daily basic services (like toileting, aid in preparing and consuming food, etc.), services for independent living (e.g. shopping, cleaning, bill payment, etc.), home adaptation to specific needs that the user may have (accessibility adaptations for low mobility or for different impairments), socialization services.

The paper describes the design specifications of the CDMS platform, as developed by the project's team, which comprises engineers, as well as medical personnel, after multiple research meetings with direct beneficiaries (representatives of three HCPs). A market study related to the HCPs in Romania paved the way for the funding application for the current project, and the first results of the project comprised a number of studies concerning the possibilities of improving the functioning of an HCP.

There are multiple already-on-the-market platforms or research implementations for home care ICT solutions: software and/ or hardware platforms. In the traditional approach, these platforms usually only implement layer 3 – the "smart home" consisting of the components installed at the monitored subject's home and, possibly a supervising level that gathers data acquired from multiple home care systems and manages different situations. The proposed system does not focus on the 3rd layer, or on the home care system, but concentrates on the 1st layer of figure 2 – the software and hardware components that allow an HCP to offer home care services in a very efficient way. It may be compared to an ERP (Enterprise Resource Planning) system customized and dedicated to HCPs. As far as we know, there is no such system implementation currently on the market.

2 GENERAL DESCRIPTION OF THE PROPOSED PLATFORM

A CDMS is an entity that offers services to an HCP, in order to optimize and simplify the delivery of care services at home, by offering technical support at hardware and software level. A CDMS is designed to offer software modules that allow for an easier management/ deployment of different home care services and to minimize the required hardware so that an HCP can optimize most of its operation.

The services offered by an HCP are grouped in three categories:

- *Medical Services:* comprising all the health care delivered at home – aid in following prescribed medication, monitoring physiological parameters, palliative care, aid in performing recommended physical exercises, etc.;

- *Social Services:* various services for assistance with the daily activities or for maintaining an independent living like dressing, help in feeding or
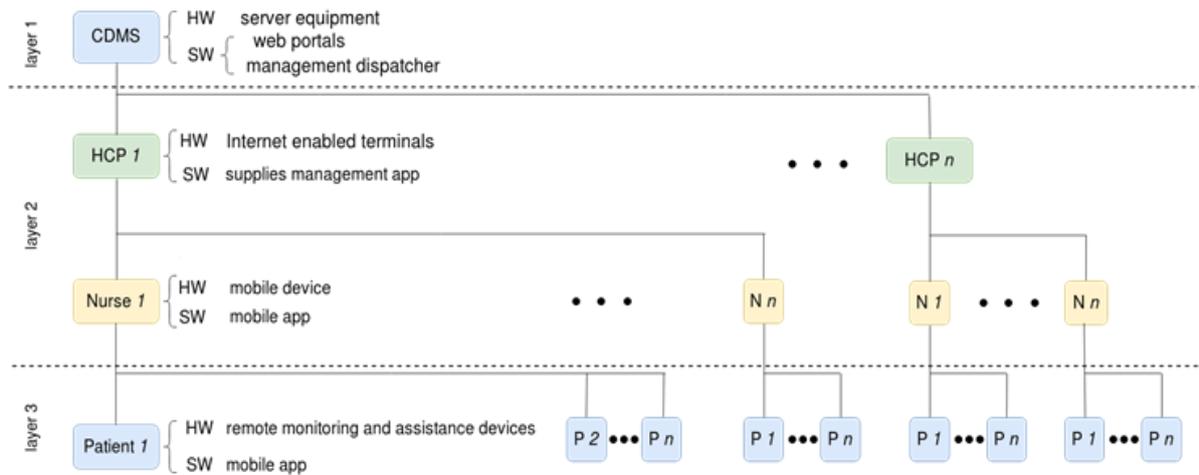
Figure 2: General architecture of the CDMS platform.

doing the hygiene activities, shopping, house cleaning, etc.;

- *Socio-medical Services:* mixt services from the above categories.

An HCP may choose to deliver one or more of these types of services and a CDMS will offer personalized services to an HCP, as per request. A CDMS is designed to offer the following support services to an HCP:

- *Human Resources Management*: management of the employees delivering home care services and of the employees performing administrative/ managerial tasks: management of the employees list, management of the home care services delivered by each home carer, the patients list and the work schedule assigned to each home carer, etc.

- *Patients Management:* managing the data for every patient – identification data, medical data, data about the assigned caregivers, of the desired/ received services, cost data, etc.;

- *Inventory Management:* managing the inventory of products used in home care services: automatic/ manual inventory management, creating alerts when inventory reaches specific thresholds, generating reports about used inventory, etc.;

- *Dispatching Services:* Two types of dispatchers are envisaged: *the management dispatcher* offering technical support for each HCP – this level manages the health status of the hardware equipment used, maintaining logs regarding the functioning of all the components of the system; *the teleassistance/ telemonitoring dispatcher*: This component offers the possibility for each HCP to organize its own telemonitoring dispatcher with minimum investment and has the main purpose of monitoring the data acquired from the teleassistance/ telemonitoring systems supervised by each HCP;

- *Reporting Services:* This component will support each HCP in generating reports, statistics on different activities, costs, information regarding personnel, etc.

- *Remote Monitoring/ Assistance Services:* This component will allow an HCP to offer the following services: physiological parameters monitoring; the detection and management of dangerous/ abnormal situations at home.

3 GENERAL ARCHITECTURE OF THE CDMS PLATFORM

The proposed platform has a layered architecture as provided in figure 2:

▪ layer 1: the actual dispatching and management center;

This layer consists mainly of web applications to be accessed by the employees and the clients of the health care providers and the needed hardware equipment to run these applications: server equipment.

A dispatching and management center is designed to provide services to multiple home care providers.

▪ layer 2: the hardware and software components that each home care provider must use at their main location;

As the purpose of this entire platform is to ease the burden on the home care providers, at this level there are very few requirements. The personnel of the home care providers only need to use terminals to access the web apps running at the higher level. These terminals don't need powerful specifications (neither concerning computing power nor storage),

as they can be implemented using any type of terminal with Internet connectivity capable of running a modern browser.

Two mobile applications are also implemented at this level:

- a mobile app for managing the supplies used in home care activities;

- a mobile app for aiding the nursing staff during field visits at the patients' homes.

▪ layer 3: the hardware and software components required in each patient's home.

Each patient and his informal caregivers (relatives, close friends, etc.) may access a web portal using an Internet-enabled terminal. The patients may also use a dedicated mobile app that offers information about the services they are receiving and allows them to make requests.

Also at this level, devices for remote monitoring and assistance may be deployed: medicine reminders, medicine dispensers, physiological and environmental sensors for activity recognition and for health status assessment, panic buttons, etc.

4 SOFTWARE ARCHITECTURE OF THE CDMS PLATFORM

The software components of the platform are presented in figure 3.

The main components are the web applications running at the CDMS center as most of the functionalities offered to HCPs are implemented as web applications. The management dispatcher is also running at the server level.

4.1 The Management Dispatcher

The management dispatcher offers technical support for the HCPs that it serves. It may be accessed by HCPs through a web portal.

All hardware is monitored and the resulting logs (information on health status of/ errors raised by each component of the system, etc.) are kept at this level.

4.2 HCPs Containers

Each HCP will access the CDMS servers only through the web apps. Each HCP has a dedicated software container that runs the required web apps and keeps the related database up to date.

This design approach (each HCP may only access its own container on the server) has multiple benefits: it allows for the implementation of a strong security policy and it also allows for a modular implementation. A new HCP that joins the platform only needs a new container. Also, this approach allows for a clear delimitation between the data of
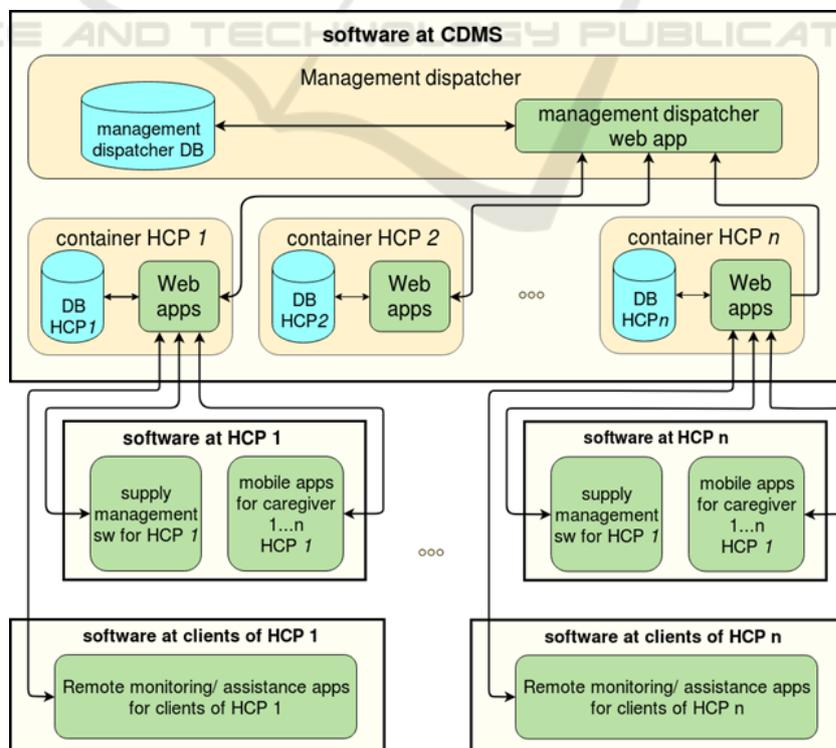

Figure 3: Software components of the CDMS platform.

each HCP client, so there is no concern about unfair competition. Each database may only be accessed through the web apps from the same container.

The web apps available for every HCP are described in the following paragraphs.

4.2.1 Web Portal for HCP (Administrative Portal)

The administrative web portal for HCPs is designed to offer the following functionalities:

▪ **Employees Management**

This functionality allows the HCP to manage the human resource, to schedule field visits for the nursing staff and offers a centralized view of the activities performed by each employee. It allows the following activities:

- manage employees list;
- schedule activities for the nursing staff (schedule the home visits);
- automatically estimate work hours performed by each of the nursing staff and the associated monetary retribution;
- generate reports regarding the field activity of the nursing staff.

▪ **Clients Management**

This section allows an HCP to access and organize the medical files of their clients and the field visits required/ requested for/ by their clients. This module must allow the HCP to:

- manage clients information:
  - manage the general and medical information of the clients
  - manage the information of their clients informal caregivers
  - manage requests/ feedback from clients
- generate reports on the provided services to a client/ group of clients
- send messages to clients (response to feedback/ additional requirements form or informing clients on news like: schedule changes, nurse change, etc.).

▪ **Inventory Management**

The inventory management component is designed as an integrated system for managing the supplies needed for the home care activities. This module must allow HCPs' employees to:

- manage the supply records for different products (syringes, band aids, etc.)
- generate alerts (manual alerts - generated by employees or automated alerts - system generated) when supply levels reach certain predetermined values.

- generate reports concerning the current levels of supplies, used materials in certain time intervals, for certain procedures or different custom reports.
- generate predictions/ estimations concerning the required supplied levels for certain time intervals/ procedures, etc.

▪ **HCP Management**

This module allows the HCP to:

- manage the offer of services: create subscription methods, create packages of services, etc.
- create reports concerning the functioning and the information collected by any of the modules presented above.

4.2.2 Web Portal for the Nursing Staff

The main purpose of this web portal is to offer the nursing staff support during their field visits.

The main support for a nurse will be the mobile app installed on a mobile device that is required during field visits. The web portal doubles some of the functionalities offered through the mobile app.

4.2.3 Web Portal for Doctors

The web portal for doctors is an application used for the management of the patients' medical charts.

In order to access the applications the doctor has to be authorized by the HCP or by the client/ patient. Authorized medics may:

- view the medical history of the patient;
- view the performed/ scheduled procedures;
- view the prescribed/ followed medication;
- view the recorded physiological data along with context information;
- recommend medical procedures or medication;
- recommend a visit to/ from a doctor.

4.2.4 Web Portal for Clients

The web portal for clients (patients and their informal caregivers) is designed to offer the following functionalities:

▪ display complete medical file;
▪ view the data collected in the system;
▪ manage the services offered by the HCP: the client may opt for additional services (on top of the services recommended by a medic or the services included in his home care package);
▪ manage doctors: the client may allow a doctor to access his personal file;
▪ manage list of informal caregivers (users interested in the wellbeing of the patient like relatives, close friends, etc.) and their access to the clients medical file;

- manage general information about his account;
- initiate communications with employees of the HCP/ send feedback to HCP.

4.2.5 Remote Monitoring/ Assistance Dispatcher

The remote monitoring/ assistance dispatcher is an optional module, as, for the moment, not many HCPs offer remote monitoring/ assistance services. The designed functionalities for this module are:

- Management of data from remote monitoring devices;
- Management of medical alarms (e.g. when a value of a certain physiological parameter is outside predefined normal values, usage of a panic button, etc.);
- Management of alarms from home environment monitoring devices;
- Management of technical alarms (e.g. a remote device stopped communicating, a device sends corrupted data, etc.)

4.3 Supply Management Software (Installed at a HCP)

The supply management software installed at an HCP is designed as a mobile application for smartphones/ tablets that will allow users (HCP employees) to record supplies in their own database in an easy manner, by scanning the bar codes from the products using the camera integrated in the mobile device. The bar code identification number may also be manually inputted using the mobile app or directly in the web portal for HCP management.

4.4 Mobile Apps for the Nursing Staff

Each of the nurses performing home visits will use a mobile device (smartphone/ tablet) with an Android app installed that gives assistance in performing the activities during visits.

By using the mobile application, the nursing staff can remotely access, during visits, certain information related to visited clients (contact information, requested procedures to be performed, etc.)

The functionalities of this app are related to:

- management of assigned clients:
- access clients general information (name, contact information);
- access clients medical information;

- send messages to clients (responses to feedback/ additional requirements or send messages like changes in schedule).
- Management of the scheduled appointments
- access the list of procedures requested by / recommended for the clients;
- record information on each performed procedure: type of activity, date and hour, additional observations, supplies used;
- Management of the remote monitoring/ assistance devices deployed in the homes of the visited clients:
- program the devices with certain parameters, like: the schedule for taking medications, the schedule for monitoring physical parameters, alarm levels, etc.
- collect information for the devices (read measurements performed by the devices and send them for storage to a superior level of the platform).

4.5 Software for Remote Monitoring/ Assistance for Clients

The software installed in the homes of the clients will communicate with the remote monitoring component from the CDMS server.

The designed functionalities are:

- monitoring vital/ different health parameters at predefined time intervals or continuously;
- detect dangerous situations/ events, signal them and trigger the procedures for effectively manage the alarms;
- remote communication functionalities: send acquired measurements to the CDMS server for logging;
- monitor health status of hardware components and log hardware and software functioning parameters and anomalies.

5 CONCLUSIONS

The presented platform offers multiple benefits for an HCP:

- simplify the starting procedures in becoming an HCP by:
  - minimizing the necessary hardware and offering a list of minimal equipment needed along with their technical specifications;
  - supporting the HCP in offering complex services: medical, social services and teleassistance/ telemedicine services;
- simplify the running procedures of an HCP by:

- optimizing the administrative management activities;
- optimizing the home care activities of the nursing staff;
- optimizing the communication processes between the administrative staff, medical and nursing staff and clients.

The end beneficiaries of the project are the end-users: elders, chronic patients or people who need ambulatory treatment who may get a variety of services from an HCP. As the activity of an HCP is optimized it is expected that the prices for services for the end-users to be minimized while maintaining or increasing the quality of service.

The development of the presented platform is a work in progress, as the related project will end in September 2020. In the current development phase, the implementation of the proposed platform, based on the presented specification is ongoing, having already reached the phase of experimental platform. In the next phase, the experimental platform will be used to implement a pilot CDMS that will connect a number of HCPs, each with its own clients. The experimental results of the platform will be presented in following papers.

ACKNOWLEDGEMENTS

REFERENCES

European Commission, 2018. *The 2018 Ageing report – Economic and Budgetary Projections for the EU Member States (2016-2070)*