AAL Information based Services and Care Integration

Alexandra Queirós[1], Sandro Carvalho[2], João Pavão[2] and Nelson Pacheco da Rocha[1]
[1]*Health Sciences School, IEETA,University of Aveiro, Campo Universitário de Santiago, Aveiro, Portugal*
[2]*Escola de Ciências e Tecnologia, Universidade de Trás-os-Montes e Alto Douro, Quinta de Prados, Vila Real, Portugal*

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Abstract: Health and social care systems are currently faced with a set of challenges that continually require more sophisticated responses. The integration of health, social and informal care and the care personalization are important issues in the organization of the care systems. This article aims to propose an information architecture for Ambient Assisted Living (AAL) environments that can contribute to integrated and personalized care.

1 INTRODUCTION

Information Technologies (IT) in health care have gained widespread usage. IT benefits include availability and accessibility of vital information, more effective and efficient treatments, reduction of the number of redundant procedures, lower risks for the patients, greater cost savings and, therefore, improved quality of care. In individual terms, IT based services empower the citizens to exercise control over their own health, by facilitating them the access to knowledge and adequate services and, consequently, allowing informed choices within the available options.

This paper discusses the possible contribution of Ambient Assisted Living (AAL) in the integration and personalization of care services. The paper also presents an information architecture able to integrate both user-generated and AAL services-generated data with institutional health and social care repositories of information.

2 CHALLENGES

The challenges faced today by health and social care systems are theirs sustainability: with public budgets at strain the systems can not afford to do less because demands and expectations are increasing, namely due to the demographic ageing. Therefore, both effectiveness and efficiency of the care systems should be increased (Codagnone, 2009).

Given the current pressure resulting from the cost of the health and social care systems, the interactions between different care organizations have gained significant relevance (Dias and Queirós, 2010): the availability of effective and efficient care services requires the involvement and coordination of multiple stakeholders. Therefore, the care systems must guarantee to the citizens' access to the type and intensity of care they actually need at the most appropriate time and place, depending on their specific situation. This is the aim of integrated care, which can contribute to a more personalized care and that must not be confused with continued care.

Continued care generally presumes that care is provided for long periods of time and that there are services that are delivered in addition to those ones which are provided within the walls of the care organizations. The provision of continued care requires the involvement of a diversity of professionals and organizations and the existence of coordination mechanisms, generally in the context of multidisciplinary team work (Dias and Queirós, 2010).

The provision of health care services is based on scientifically optimized standard procedures oriented to diagnosis-based needs and centred on diseases (Rigby, 2012). However, there are a range of activities that are essential for the maintenance of individuals' quality of life and that are part of the normal living of every citizen. Such activities include daily life activities (*e.g.* tasks at home,

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mobility, recreation or safety) and social participation.

The clients of home care services can range from persons with complex needs (*e.g.* 24 hours support) to those who only need help occasionally with relatively simple tasks (*e.g.* domiciliary support to some activities of daily living). Therefore, home care comprises a broad range of services, such as rehabilitation, supportive and technical nursing care, domestic aid, personal care or support to informal caregivers.

To adequately meet the new demand patterns, while ensuring equal access and care with sufficient resources, the health and social systems need to promote further decentralisation, shared responsibilities and increased integration levels of the provided services. This discussion is urgent in order to optimize both effectiveness and efficiency of the health and social care systems (Dias and Queirós, 2010).

Since the purpose of integrated care is to achieve a care that is less oriented by supply and focused on the actual needs of the citizen, it can contribute to the personalization of the services. The concept of personalized care can be understood as the individually customization of diagnosis and therapy. Personalized care can also mean the empowerment of the common citizen, allowing him or her to be actively evolved in his or her health and care pathway. This may contribute to the overall quality of the care services provision and its effectiveness and efficiency.

3 TECHNOLOGICAL SUPPORT

Within the contexts of continued care, integrated care and personalized care, the existence of *eHealth* services is essential to provide a better resources allocation management, in accordance with the citizens' needs and those of the organizations providing care services, considering its different levels (Dias and Queirós, 2010).

Although there are many different concepts associated to *eHealth* (Eysenbach, 2001), it can be understood as the individualised provision of care services independent of the time these services are delivered as well as the physical location of actors and resources involved in the care process (Blobel, 2010). It is commonly accepted that *eHealth* can contributed both to the sustainability of health and social care systems, and the empowerment of the citizens. The *eHealth* paradigm promotes an easy access to the existing resources and the knowledge sharing whenever and wherever is necessary. The existence of electronic records emphasizes the citizens centred care, improves the prevention, reduces the information redundancy, facilitates the exchange and sharing of information among the care providers (because electronic information can be consulted starting from any point by properly authorized users) and reduces the probability of errors in adverse situations, through the access to the complete patient record and the use of decision support systems. Nowadays, the essential electronic information associated with care providing is distributed by Electronic Health Records (EHR), Electronic Social Records (ESR) and Personal Health Records (PHR).

The usage of EHR information can be categorized as either primary or secondary: primary use is associated with encounters between patients and health care professionals, and secondary use is related with education, research and development, regulation and policy making.

The exchange and sharing of information requires the existence of interoperable protocols. This interoperability should facilitate the transfer of information automatically between different care sites. However, despite all the developments in terms of systems interconnection and interoperability protocols, the semantic heterogeneity of the information remains a difficult problem to solve, even if only EHR are considered. ESR and PHR introduce additional interoperability issues.

To address the EHR semantic interoperability issue, there are several standards currently under development aiming to structure and mark-up the clinical content for the purpose of its exchange and sharing. However, it is still difficult to foresee a common agreement. In parallel with the developments of the HL7 (*e.g.* RIM or Clinical Document Architecture - CDA), the European Committee for Standardization - Technical Committee 251 (CEN/TC 251) is being defining the *EHRcom*, which includes the *OpenEHR* Archetype methodology to support the interoperability of systems and components interacting with EHR services (Katehakis et al., 2006).

Considering the importance of the integration of health and social care services, the definition and implementation of ESR have been considered during the last years (SCDH, 2004). ESR should be composed by various types of information, namely, forms (e.g. nationally used forms or local assessment forms), coded data (mainly for management and statistical reporting purposes) or unstructured

information covering all other recording, including those ones originated outside the organization (e.g. letters, emails or notes of meetings).

Since the service models employed by health care providers and social care providers are different there are important differences between EHR and ESR: healthcare records are focused on a single patient, often with considerable details and depth, and the confidentiality of the individual is strongly protected, while social care records, on the other end, place the individual in their daily living context of family and other informal carers, including the attitudes and effects on each, so as to ensure mental support and understanding (Rigby, 2012).

Since the empowerment of each citizen also means that he or she should be able to contribute with documentation, namely observations of his or her daily living (Bos, 2012), PHR have, nowadays, an increasing importance. They include data and information related with the individuals' lifetime and individuals' care maintain by each individual.

Furthermore, PHR can represent more than a repository for the individual data, because they are able to combine data, information, knowledge and tools to help any individual to be proactive in their own care (Schloeffel, 2003). This stands in contrast with EHR, which are operated by organizations and contains data entered by professionals.

The information on a PHR might include patient-reported outcome data, laboratory results, and data from a broad range of devices. For instance, important data sources are wearable remote monitoring systems with sensors to capture physiological parameters such as electrocardiogram (ECG), blood pressure, body temperature or heart rate. These devices are particularly important for home care and are one of the research investments of the promising AAL developments (Queirós et al., 2012).

4 CONCEPT

The AAL environments can increase or maintain the individuals' performance in a broad spectrum of activities and participation. Furthermore, AAL systems should acquire context information and combine multiple sources of information and make pattern-based predictions to be able to track the individuals (*e.g.* localization, activities or behaviours).

Another range of AAL services are related with biomedical devices that can be implemented and used both in clinical settings and in persons' home, smoothing the transition between both environments (Blobel, 2010).

Since information is a requisite for high quality care services and also for the empowerment of the citizens', the potential of AAL services can be increased, if there is the possibility to create the conditions to integrate both user-generated data and AAL services-generated data with institutional EHR and ESR, so that care can be more integrated, personalized and useful for citizens. Consequently, there is the need that AAL infrastructures should support information architectures that enable the creation and maintenance of information objects, according to the requirements and needs of a wide range of users and care providers.

Due to the difficult to accommodate the development of new applications in poor structured contexts (Heeks, 2006), open management information paradigms (Yli-Hietanen and Niiranen, 2008) are required with robust and stable domain models separated from the implementations and able to specific adaptation. In this respect, we argue that AAL information architectures should follow an open management information paradigm, with two modelling levels for the information structure: the information model and the knowledge model.

The first level, the information model, embraces all data types that are required to record the pertinent information. It is the fundamental model required for the technical implementation and, therefore, must be stable over time in order to be maintainable. On the other end, in the second level, the knowledge model, domain and application specific concepts are modelled (archetypes) with constraint rules to specialize the underlying information model. According to this approach, archetypes are instances of an object oriented system implementation, which means they can be created and manipulated by adequate tools and alter as desired, without changing the underlying information technical specifications.

The concept was validated by defining a data repository (*i.e.* the information model), accordingly to HL7 RIM and a set of functions for the management of the archetypes, in order to shape the HL7 RIM to specific application domains (*i.e.* the knowledge model).

For the specification of the data repository we select the HL7 RIM. Thus, data repository is characterized by being a generic container and it is necessary to evaluate whether this container is adequate to accommodate all information objects that can be associated with AAL services.

The followed validation procedure consisted in the creation of scenarios, emphasizing not only the

use of EHR but also the use of ESR and PHR, and in the verification if all the information objects required by these scenarios were supported by the architecture.

In what respects PHR, it was considered the implementation of a PHR application with a specific interface to contribute with documentation related with observations of daily living, namely, nutritional and physical activities. The basic PHR structure was based in the Health Information Form for Adults of the American Health Information Management Association (AHIMA) and the required archetypes are compatible with the generic data container.

The ESR specification considered the requirements of supporting all the information that is essential for the care providing, reflecting on different organizational levels and different types of processes, namely in respect to observations, reasoning or intentions.

The validation has shown that the generic data container can support information structures not only of EHR but also of PHR and ESR. The created archetypes are compatible with the data container and allow answering six basic questions linked to each record: what, when, where, who, why and how.

Therefore, the information architecture is able to integrate both user-generated and AAL services-generated data with institutional health and social care repositories and presents adequate models to organize the information according to the requirements of care services.

5 CONCLUSIONS

The AAL systems ability to acquire and combine multiple sources of information to track the individual's activities and behaviours must be considered in terms of the provision of health and social care.

Therefore, it is required information architectures able to accommodate a wide range of information objects within the AAL environments. The proposed architecture follows an open management information paradigm, where the knowledge model adjusts the information model to the requirements of each specific domain application, which can contribute to the integration of EHR, ESR and PHR.

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