

# Modeling the healthcare assistance process for comorbidity patients compliant with prEN12967

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**Abstract**—The increment of life expectancy in our society, and the consequent population ageing, anticipate that the health sector must face the challenges associated with a growing population group of elderly patients with numerous disorders, generally chronic. In this work we introduce a framework to support the communication and information management tasks involved in a coordinated care of this kind of patients. This framework has been developed in the European context, it is compliant with CEN's prEN12967, and follows ITU-T's ODP methodology, that facilitates its integration in any system following this standard.

## I. INTRODUCTION

A significant amount of patients who are assisted either in the hospital scope (at a specialized level), and in the extrahospital scope (at a level of general practice), suffer more than only one disease. In addition, many of the most frequent diseases affect several organs or systems.

In the hospital scope, within an Internal Medicine Service, the prevalence of patients with numerous disorders (comorbidity patients), is in the range between 21% and 75%. This group also includes patients showing special susceptibility and clinical fragility due to a progressive functional deterioration together with a gradual reduction of autonomy (frail elderly people), having professional and social implications.

In the extrahospital scope, comorbidity patients represent about 5% of the population assisted in Primary Healthcare Centers. This group requires over four times the average of patient resource allocation, due to their higher number of consultations, complementary necessity of home visits, tests, multiple admissions at the hospital, and higher drug prescriptions [1].

Furthermore, the high degree of the clinical complexity of comorbidity patients entails that in these cases healthcare is delivered by numerous specialists. Therefore their assistance is fragmented and accordingly the benefits of an integral vision of the patient is missed.

Although this problem is not new, the increment of life expectancy in our society, and the consequent population

ageing, anticipate that health sector must respond to the challenges of the new scenario.

The Council of Health of the Andalusian Government (Spain) has commissioned a group of experts to prepare a Guideline for Healthcare Assistance to the Comorbidity Patient, within a regional Framework Program of Quality and Efficiency [2]. The advisory committee is constituted by MD in Internal Medicine, General Practitioners, and other levels of the clinical staff. The aim of this guideline is to improve the quality of life of these patients.

The comorbidity patient forces, more than any other, to a cooperation between the specialized and general levels, as well as to the special consideration of the role of the carer in this process [3]. This Guideline is conceived as the procedure by which the suitable medical assistance is guaranteed to these patients, coordinating the professionals, services or centers, throughout the time, and within the Health Organization to which they belong. During this process a Shared Assistance Plan (SAP) can be activated, conceived to provide an integral care of the patient, avoiding dispersion and assuring the continuity of the assistance.

The coordination needed for the management of the SAP may be supported by Information and Communication Technologies (ICT) that could bridge the gap between the agents involved in the patient care and the effective management of the clinical information. This approach provides to the professionals with a better, up-to-date and personalized knowledge about his/her integral health state and may suppose a substantial resource saving.

In this work we introduce a framework to support the communication and information management tasks in the healthcare assistance of the comorbidity patient. This framework has been developed in the European context and it is compliant with CEN's prEN12967 [4], [5], [6], in order to facilitate its integration in any system following this standard. The ITU-T Open Distributed Processing (ODP) methodology [7], [8], [9] has been used, as this standard specifies.

## II. MATERIAL AND METHOD

### A. Distributed components architecture in the healthcare domain

Integration and interoperability solutions are often based on the decomposition of tasks inside the healthcare organization and the design of a specialized components-based architecture [10], [11], [12].

The purpose of the three-part draft European standard prEN12967-1,2,3 is to identify a set of information services

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used within healthcare information systems, supporting specific needs of the target organization, as well as being capable of co-operating and interworking according to the requirements of the organization as a whole. This allows describing the architecture of any generic healthcare information system as a federation of heterogeneous applications, interacting and co-operating through a set of components and information services.

On the basis of these considerations, the purpose of this standard is twofold:

- to identify a methodology to describe healthcare information systems through a language, notation and paradigms suitable to facilitate the planning, design and comparison among systems.
- to identify the fundamental architectural aspects enabling the openness, integration and interoperability of healthcare information systems.

### B. Open Distributed Process methodology

An important basis for the production of prEN12967 is the methodology of ODP. The objective of ODP standardization is the development of standards that take advantage of the benefits of distributing information processing services in an environment of heterogeneous IT resources and multiple organizational domains. ODP provides a five-layered approach to the definition of information services. However, only the three upper levels, Enterprise viewpoint, Information viewpoint and Computational viewpoint are used to produce prEN12967. The two lower levels are certainly useful but should be considered in a specific implementation context.

- The enterprise viewpoint shall provide a guideline for the definition of the requirements for information exchange within a healthcare enterprise, with a focus on the purpose, scope and policies of the system.
- The information viewpoint is concerned with the kinds of information handled by the system and constraints on the use and interpretation of that information. It provides a methodology for detailing the semantics of the information to be processed and supports the solution of semantic conflicts in the integration of systems.
- The computational viewpoint shall give guidance on the distribution through the functional decomposition of the system objects that interact at defined interfaces. This is the basis for the solution of functional integration.

The specification of an architecture following ODP methodology shall start with a very concise, managerial-oriented document (the "Strategic Paradigm") that identifies (at a high level of abstraction) the overall requirements and strategic objectives of the envisaged system.

By evolving and refining the Strategic Paradigm the architecture shall then be described through the different viewpoints up to a complete and formal specification of the individual areas of concern.

Any architectural solution inside the European context should be compliant with prEN12967-1,2,3 and, consequently, with ODP methodology, hence carrying out the

specification can be accomplished in four principal steps: the design of the Strategic Paradigm and three other specifications, each related to one viewpoint.

### C. Distributed components for the management of comorbidity patient coordinated care

The set of components needed for the management of the SAP and the relevant clinical information involved in the comorbidity patient's care, must be integrated in the health organization system's architecture. This will facilitate the reuse of components and the future introduction of new ones, what implies an effective management of the knowledge stored in the organization systems, specially the clinical knowledge, but also that concerning to other issues.

Modeling the framework for SAP management following ODP methodology allows acquiring open results that could be developed over any middleware technology.

The design within prEN12967 context eases the integration of the results inside architectures compliant with the European normative, as well as the acquisition of the normative conformity certification, which will probably be mandatory in a few years.

## III. RESULTS

### A. The strategic paradigm

The strategic paradigm describes the assistance process to the comorbidity patient in a high level of abstraction.

In particular we have considered process issues closer to the use of ICT, analyzing the needs and improvements derived from the incorporation of these technologies. Those are:

- **Technical resources:** communication and information management tasks must be supported by specific technical resources.
- **Quality indices:** those susceptible of being improved with the use of ICT are considered, as well as the degree of desired advance.
- **Improvement of the quality of coordination in activities among healthcare professionals:**
  - Planned attendance: programmed hospital admissions, derivation to specialized centers, information management, ...
  - Tele-clinical sessions for professional coordination and SAP design.
  - Agile communication between professional agents belonging to different levels.
  - Integral management of SAP.
- **Improvement of the quality of clinical knowledge about a patient:**
  - Progress in the coherence and flow of the information between general and specialized levels.
  - Facilities for the detection of possible SAP activation.
  - Assistance to the management of a shared Electronic Healthcare Record.
  - Tools for the reports management.



- Reasoners can be used for the management of ontology instances, to make the publishing, discovery, invocation and composition of components functionality in an automatic way. The management of proactive behaviour in the architectural components is facilitated too.
- The mapping to existing languages for specification of services, like WSDL or OWL-S, is very easy and this simplifies the development of the lower viewpoints that are technology dependent.
- The extension of the ontology with domain-specific concepts is straightforward. Those concepts used for interface and service classification could be extended with the particular needs of the domain and this can ease the semantic management of distributed components inside a domain-specific architecture. This idea has been validated with the extension for prEN12967 -based systems.

#### IV. CONCLUSION

This work is centered in the development of a technological framework for the effective management of the comorbidity patient coordinated care. We have based our approach in European healthcare standards and in normalized design methodologies in order to obtain open and scalable results.

The developed framework could improve the care to this kind of patients providing a better coordination between the actors involved in his/her attendance and saving clinical and technological resources. This is finally translated into an improvement of patient's quality of live.

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