

Interacting agents through a web-based health serviceflow management system

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Received 18 July 2006

Available online 19 December 2006

Abstract

The management of chronic and out-patients is a complex process which requires the cooperation of different agents belonging to several organizational units. Patients have to move to different locations to access the necessary services and to communicate their health status data. From their point of view there should be only one organization (Virtual Health-Care Organization) which provides both *virtual* and *face-to-face* encounters. In this paper we propose the Serviceflow Management System as a solution to handle these information and the communication requirements. The system consists of: (a) the model of the care process represented as a Serviceflow and developed using the Workflow Management System YAWL; (b) an organizational ontology representing the VHCO; and (c) agreements and commitments between the parties defined in a contract (represented as an XML document). On the basis of a general architecture we present an implementation in the area of Diabetes management.

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Keywords: Health care; Knowledge management; Business process; Workflow; Chronic diseases

1. Introduction

1.1. Problem setting

In the past, acute diseases represented the major cause of disability for the world's population. Traditional primary care practice was largely designed to provide rapid access and care to patients with acute problems, with an emphasis on patient flow, short visits, diagnosis and treatment of actual symptoms and signs. In such a framework health-care professionals are the main actors while the patients are generally “passive subjects”.

More recently, with the progressive increase of life expectancy, the management of chronic pathology and

home-based care also became highly relevant problems for the health-care systems and because the associated costs now represent a relevant fraction of the total of health-care related costs.

Actual health-care systems are not adequate to meet this change [20] and the new derived issues, such as a patient management over a long period, the cooperation of personnel with different health-care skills, and the timely identification of side effects of long-term therapy. These issues result in discontinuity and fragmentation of care.

In order to cope with new needs, both practice and responsibilities are to be shared among professionals, patients and their caregivers (e.g., relatives, home assistants, etc.) [21]. In this way, far from still being a “passive subject”, the patient becomes one of the main actors and the main responsible for his/her own daily management and possible behavioral changes (self-determination) [22]. This leads to a sort of “assisted self-management”, a new

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way of care delivery that could be both efficient and effective if the organization succeeds in:

1. educational programs for spreading health-care-related knowledge among citizens;
2. retaining the patients to the institutions;
3. technology exploitation, providing patients with means for evaluating their status.

Self-management, of course, does not mean that patients take critical decisions by themselves: they will regularly need to interact with health-care organizations. Even more, the management of chronic and out-patients requires the cooperation of different actors belonging to different health-care organizations. Patients need several health services: specialist visits, instrumental examinations, therapies and prescriptions. Moreover, they may need to communicate their health status data from home or from wherever they are. The challenge is to lead them through this flow of services while hiding the complexity of the different structures.

1.2. Summary of approach

We designed and built a Serviceflow Management System, which is able to manage the overall care delivery process by establishing a tight link between different organizational units and professionals without mutual knowledge about their work processes. This goal can be archived only through an efficient and safe communication between the different actors and a synchronization of all the processes involved. The architecture proposed allows a single organization to deliver the required services and it fosters patient self-management supporting his/her journey into a complex net of services. In this paper, we describe a system that tries to meet these requirements and the corresponding implementation in the area of Diabetes management.

1.3. Outline of paper

The remainder of this paper is organized as follows. Section 2 presents the approach and the architecture model within a virtual health-care organization. Section 3 summarizes the technological solutions adopted in realizing the Serviceflow Management System (e.g., ontologies, contracts and YAWL). Next, Section 4 presents the clinical application. Conclusions are given in Section 5.

2. Approach

2.1. Virtual health-care organization

From the patient point of view there should be only one organization. All the actors involved in the care, both human and software agent, should seamlessly constitute the so called *Virtual Health Care Organization* (VHCO).

A VHCO is a partnership of different health care organizations (HCOs), which can be in different places, but cooperate towards a common goal (in our case the care process management).

To reach this goal, the involved *Organizational Units* (OUs) have to share knowledge, resources, data and fragments of processes [23]. An OU represents an HCO, or the divisions of an HCO offering different services. The VHCO processes are composed of several activities distributed across several organization units. Each OU performs a part of the overall care process, supplying the patients with the necessary services. We assumed that the whole care process is managed through both *virtual* and *face-to-face* encounters.

The fundamental part of the care management is represented by home-care activities carried out by patients: self-monitoring of clinical data and self-administration of drugs. On a regular basis the overall status of the patient is examined by health care providers through periodical control visits. For planning and adapting therapy, and in addition other specialist visits, exams and tests may be scheduled (*face-to-face* encounters).

In addition to this “classical” care delivery, patients can also communicate any useful information about their health status via the Internet. Software agents can also ask specific questions to patients, acting as automatic monitoring system [25], such as the *Multi Access System* (MAS) described in [26]. This information is examined by the health-care providers in a synchronous or an asynchronous way. So, thanks to the remote connection via the Internet, the patient is able to send data and receive recommendations (*virtual* encounters).

In our approach, every OU offers services not covered by any other OU in the VHCO. The initial VHCO’s composition must be approved by the patient, because she/he must trust the OUs in the VHCO and the way they offer the services. This composition must not change for a long time, and changes such as the integration of new OUs or the substitution of already integrated ones must be contracted and accepted by the patient and must be strongly motivated and necessary.

2.2. Architecture

The architecture of the proposed system, as shown in Fig. 1, involves three levels.

At the *Organizational Units* (OU) level, OUs manage their processes and activities using applications and/or workflow systems [30]. The overall care process involves the cooperation between the different OUs, but this doesn’t have to affect the way the activities are implemented. To obtain this, each OU implements its activities with private processes, without exposing its internal structure. Other OUs just know that certain activities are carried out, without caring about how they are implemented.

To allow the communication between different OUs, fragments of processes are published through *Service Pro-*

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