

A Real-World Case Scenario in Business Process Modelling for Home Healthcare Processes

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Abstract: Organizations strive to improve the quality of provided services to their customers by making efficient use of Business Process Management (BPM). Home healthcare structures are considered as an enabler for linking daily life of patients with Information and Communication Technologies (ICTs). BPM relies first on business process model specifications that capture the desired workflows in the organization and how exceptional conditions should be handled. Home healthcare is still less developed in Tunisia than in other countries such as Canada, United States, Australia, France and Italy. This is due to many reasons, being one of the most relevant the expensive cost of hospitalization at home with no support from health insurances. In addition, it is badly organized, with many ad-hoc processes, making them hard to implement and improve. In this paper, we assess a real-world case scenario of home healthcare in Tunisia through interviews with involved actors in a private clinic. Also, we present the derived process models of home healthcare for this case. Our main goal is to have a sound starting point for the BPM cycle, by accurately modelling all business processes involved in home healthcare. With these models, we intent to: 1) optimize the processes by automating and rationalizing some activities, 2) implement them in a Business Process Management System (BPMS), 3) execute them, and 4) improve them through instance harvesting and remodeling.

1 INTRODUCTION

The healthcare domain holds one of the world's largest hybrid organizations (Ilahi et al., 2014). In fact, the increased life expectancy leads to a more than proportionate increase of people called "fragile", which may suffer from chronic diseases, are not autonomous and need assistance with the direct consequence of increased costs of care and hospitalization. Governments and health insurance companies are sensitized by such conditions. Accordingly, the establishment of an efficient logistics support for these people becomes a necessity. In this context, many economic, public and private actors are seeking solutions to maintain the quality of healthcare system ensuring lower cost. One of the options for that is the transfer of some hospital care to home (Zefouni, 2012 and FNEHAD, 2009). Indeed, this focus is interesting from both social (for instance, ensuring a degree of autonomy to the elderly and respect their wishes to be treated at home and close to their families) and financial

aspects (including the high costs of hospitalization or living in special homes).

However, continuity and collaboration problems of care remain and persist. These problems have already been emphasized by several works (Kun, 2001 and Bricon-Souf et al., 2005). We could observe them in our home healthcare processes case study, where continuity and collaboration are ensured in an unorganized manner, and need more improvements.

From 2014's demographic statistics (INS, 2014) about aging of Tunisian population, life expectancy is around 80 years. Tunisia now has 11% of the population over 60 years. People aged over 75 years already represent 8.6% of the population, and they will almost double in ten years.

As we have found, care collaboration is one of the major challenges of home healthcare. The technologies of Business Process Management (BPM) and, more specifically, the design (modeling) aspect, are known to typically offer collaboration support by information technologies. The aim of this

research work is to elicit process models of home healthcare in a Tunisian private clinic, since there is no supported home healthcare in the public sector. Also, we present some of Business Process Modeling (BPMo) challenges specifically focusing on home healthcare processes. This is in order to be able to begin the Business Process Management (BPM) cycle. For this, we performed interviews with involved actors to design main home healthcare processes carried out in Tunisia. We could also benefit from our previous experiences in modeling telemedicine processes (Ilahi and Ghannouchi, 2013 and Ilahi et al., 2014).

The remainder of this paper is organized as follows: Section II describes the basic concepts regarding home healthcare. Section III highlights BPM for home healthcare. Section IV describes our case study in Tunisia of home healthcare processes, along with the associated process models. Section V presents our next research steps and, finally, in section VI, we present main conclusions.

2 HOME HEALTHCARE

Home healthcare is a system of care provided by skilled practitioners to patients in their homes under the direction of a physician. Home healthcare services include nursing care; physical, occupational, and speech-language therapy; and medical social services (Bachouch, 2010).

Home healthcare has grown into a vital source of healthcare, especially for older adults, who represent 72% of recipients (Redjem, 2013). It represents a very open term and may cover every treatment at home: from basic home healthcare to advanced home healthcare. The basic home healthcare consists at rendering health services to the aged or disabled individuals in their home. In this case, different persons and services are implied (medical and paramedical professionals, nursing services, physical, homemaker services, and social services). Also, family members are involved in the healthcare delivery. Concerning advanced home healthcare, it may comprise the introduction of technological solutions as e-mail consultations, clinical robots, advanced sensor surveillance (for collecting vital signs and physiological parameters), etc. In this case, the patient may be less frequently visited by involved actors than in regular basic home healthcare (Arbaoui et al., 2012). Our work focuses on advanced home healthcare and the use of Information and Communication Technologies (ICT), namely BPM technologies, to support and

improve it.

Unfortunately, home healthcare has to face several challenges, such as funding limitations, large geographic distances that make such resources often more costly for rural patients, and issues of clinical workforce distribution that impose access barriers to these services. It is a general premise that ICT can address these challenges and enhance home healthcare services (Arbaoui et al., 2012). In fact, advances in telecommunications have the potential to support healthcare delivery and education. The use of ICT can lead to a fundamental redesign of home care processes based on the use and integration of electronic communication at all levels (Ellenbecke, 2008).

2.1 Basic Concepts

Home care providers deliver services at the patient's own home. The goals of home healthcare services are to help individuals to improve function and life with greater independence; to promote the patient's optimal level of well-being; and to assist the patient to remain at home, avoiding hospitalization or admission to long-term care institutions (Demiris, 2010).

We may have recourse to home healthcare according to different types of care (Zefouni, 2012 and FNEHAD, 2009):

- Occasional care, especially in case of unstable state of disease. Technical and complex care for a predefined period (e.g. chemotherapy or antibiotics);
- Care rehabilitation at home, especially following the acute phase of a neurological or heart disease, or orthopedic treatment or early return after childbirth;
- Palliative care, especially intended to support long term diseases;

Home healthcare goals stem mainly from the degree of sector development in the government. Based on the reports of (Lasbordes, 2010 and FNEHAD, 2009), the main goals of home healthcare are:

- Ensure the safety of people dependent at home;
- Ensure care quality, accessibility and coordination.
- Keeping patients in their homes areas. This is in order to preserve the autonomy of the individual and to avoid the breakdown of social ties;
- Ensure the continuity of care, including keeping the records of care and interventions in person care at home;
- Minimize the cost of care at home.

2.2 Current State Worldwide and in Tunisia

Home healthcare structures have attracted a great interest in the United States, Canada, Scandinavian countries and the United Kingdom. Certainly, the approaches differ from one country to another (Polton, 2003), or within the same country (Abelson, 2004), but all seem to find a promising and interesting field to be developed.

Some countries have resorted to these new home healthcare support modes in order to free up hospital beds. Others aim to control hospital costs. The improvement of life quality of the patient was not a primary objective for the countries studied by (Raffy-Pihan, 1994).

According to a study by (Chevreul et al., 2004), the French home healthcare system is closer to the Australian one. This is from the point of view of partial or total substitution of the offer acute care hospitalizations in short-stay service. In the UK, the system is closer to the Canadian's, with oriented continuous care for maintain or return to home of the chronically ill or elderly patients. In Table I, we present country examples home healthcare structures studied by (Chevreul et al., 2004) and we added Tunisia to this table, regarding the same factors analyzed, namely the main reasons for recourse to home healthcare and the nature of delivered care:

Table I: Examples of worldwide structures (Chevreul et al., 2004).

Countries	Main reasons for recourse to home healthcare	Nature of delivered care
United Kingdom	The overcrowding of care beds at hospital due to not justified clinically accommodation and to deficiencies in ambulatory care.	Basic care, continuous, for maintain / return to home chronically ill or elderly patients.
Canada	Compression of hospital beds.	Basic care, long term care substituting for institutional care and acute hospital care.
Australia	Inadequate traditional hospital services	Highly technical care
France	The overcrowding of beds at traditional hospital	Highly technical care, acute or episodic care, continuous care, follow-up and rehabilitation care
Tunisia	No supported home healthcare in the public sector.	Basic care, continuous care for maintain / return to home chronically ill or elderly patients.

2.2.1 Description of the State of the Art in Other Countries

Based on two experiences in Tunisia and Portugal and some literature studies on related field (Raffy-Pihan, 1994, Chevreul et al., 2004, Wendt, 2004 and HAS, 2009), we present a description of home healthcare in some countries. In fact, hospitals are just one component in the overall organization of a care system which includes primary care, accessible during a first contact for unselected health problems, and responsible for ensuring the continuity of care. The responsibility of primary care falls mostly at the local level (region, municipality or department).

While the general doctor is considered as the entry point to focus on primary care, the direct access to a specialist in primary care settings is possible directly in Germany, Austria, Belgium, France, and Switzerland. In these countries, the number of specialists practicing in the primary care setting is important. In several countries (UK, Sweden, Portugal, Finland and Greece), primary care is provided by multidisciplinary health centers. In Sweden and the United Kingdom, the first contact with a health professional is often performed by a nurse. Finland has beds in its care center, making it truly an intermediary structure between outpatient care and hospitalization. In order to limit recourse to general hospitals, most countries recommend the primary care structure as the entry level of care, either in a partial (Germany, Austria, Portugal, Switzerland, France, Belgium, Finland, Spain) or total manner (Denmark, Great Britain, Italy, Norway, Netherlands).

To ensure hospital care, European countries rely on three types of structures: public hospitals, non-profit private hospitals and for-profit private hospitals. Only a few countries rely almost all of their hospital services in public hospitals (Denmark, Finland, Norway, Sweden) or a majority of private structures typically nonprofit (Belgium, Netherlands). Most rely on both the public sector and large private sector. The structures are often small, and the number of beds is generally more important in the public sector than in the private sector. Moreover, private structures are, in most EU countries, mostly non-profit hospitals (except Austria and France).

In some countries (particularly Germany), a part of the private institutions is providing care only to some selected patients. We may identify three groups of countries: those who had a lot of equipment of any kind (Finland, Switzerland, Austria, and Belgium), those who were poorly

equipped (UK, Spain), and those that were heavily equipped in some areas but weak in others (France, Germany).

The responsibility of primary care falls mostly at the local level (region, municipality or department). This is the case for Denmark, Spain, Finland, Greece, Great Britain, Ireland, Italy, Norway, Portugal and Sweden. In countries with social insurance systems (Germany, Austria, Belgium, France and Switzerland), the insurance of credit unions are responsible for supporting costs. While the general doctor is considered as the entry point to focus on primary care, the direct access to a specialist in primary care settings is possible directly in Germany, Austria, Belgium, France, and Switzerland. In these countries, the number of specialists practicing in the primary care setting is important (48.5% in Germany, 50% in Austria).

In many countries, primary care is provided by health centers. In this context, the access to a specialist in primary care is sometimes possible, particularly for obstetrics and gynecology, minor surgery and psychiatry (Spain, Finland, Greece, Portugal and Sweden). However for other specialties, access to a specialist when needed is done almost exclusively at general hospitals. Registration with a doctor or health center, for a time period and with limited choice, is the most common model (Denmark, Spain, Great Britain, Ireland, Italy, Norway, Netherlands, Portugal, and Sweden). In other countries and most recently, registration is encouraged by a financial incentive mechanism (Germany and France). The status of medical doctors is mostly liberal, but in health centers, medical doctors are sometimes hired employees (Finland, Portugal and Sweden).

Home healthcare includes home help (housekeeping, cooking) and nursing. Home help is not included in health care, but is considered part of social services. However, nursing is part of health care. They include rehabilitation care, support, health promotion and technical nursing care for sick people at home. Such care is provided in very different ways from one country to another. They vary depending on the chosen organizational model. In some countries the nursing at home have long been highly developed (Belgium, Denmark, Finland, Ireland, Netherlands and United Kingdom), while in others they are still developing (Austria, Greece, Italy, Luxembourg, Portugal and Spain).

3 BPM FOR HOME HEALTHCARE

Some research works highlight the importance of the organizational aspects in the success of an ICT-home healthcare project (Arbaoui et al., 2012). Other works on home healthcare (Koch, 2004) have dealt more with developing technical-based solutions for home monitoring or home telemedicine, leaving process aspects questions unanswered (Arbaoui et al., 2012). Indeed, some observations (Hamek et al., 2005) show that the requirements of the home healthcare actors (nurses, physicians, home healthcare organizations, caregivers and patient's family members) are more oriented towards the improvement of the organization and management of the home healthcare system over a more intensive use of home telemedicine (Arbaoui et al., 2012).

BPM represents a valuable asset in the healthcare domain (Stefanelli, 2004), given the competitiveness, rapid advancement and especially the expansion of communication techniques and new technologies in all research areas, as well as the effectiveness of BPM tools to automate and better manage business processes of organizations. It relies on process models to identify, review, validate, represent and communicate process knowledge (Kunzle, 2011 and Müller, 2011).

Regarding several success stories on the uptake of BPMS in industry and the emergent process-orientation of enterprises, BPM technologies have not had a widespread adoption in the healthcare domain (Reichert, 2011 and Stefanelli, 2004). A main reason for this has been the rigidity enforced by the first generation of workflow management systems, which inhibits the ability of a hospital to respond to process changes and exceptional situations in an agile way (Dadam, 2000). Process-aware hospital information systems must be able to cope with exceptions, uncertainty, and evolving processes (Reichert, 2011). In this context, BPM represents a response to design, manage, automate and evaluate care processes. Another work of Arbaoui et al. (2012) adopts a process based approach to tackle home healthcare domain in order to highlight the importance of organizational aspects in the success of an ICT-home healthcare project. They consider that a home healthcare may comprise three sub-processes: 1) Organizational; 2) Organizational care and 3) Care sub-processes. In our work, we adopt a BPMN-based modeling approach to organize home healthcare processes and tackle associated challenges. Also, we adopt the

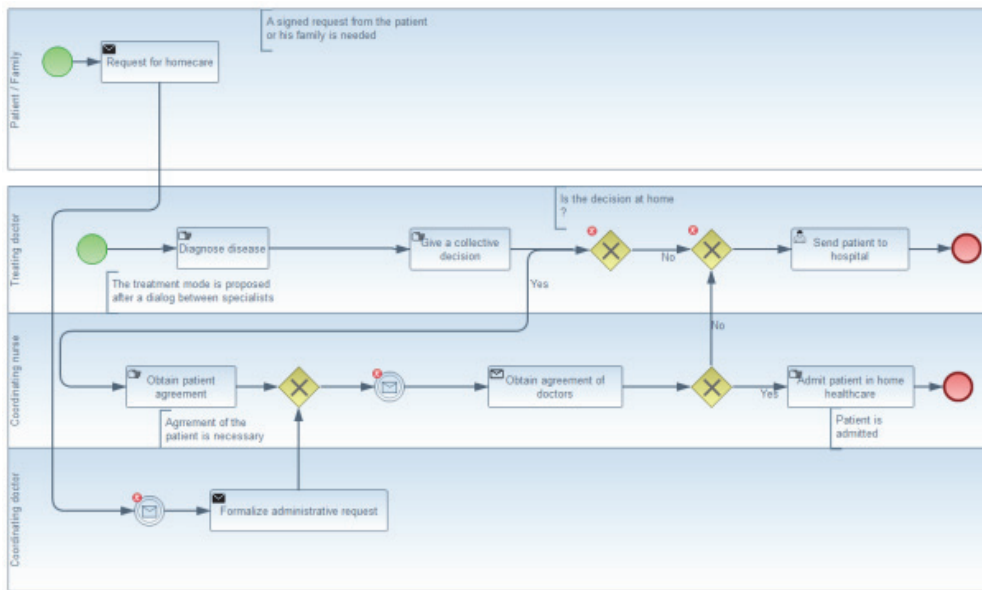


Figure 1: Organizational process model according to BPMN 2.0 Standard.

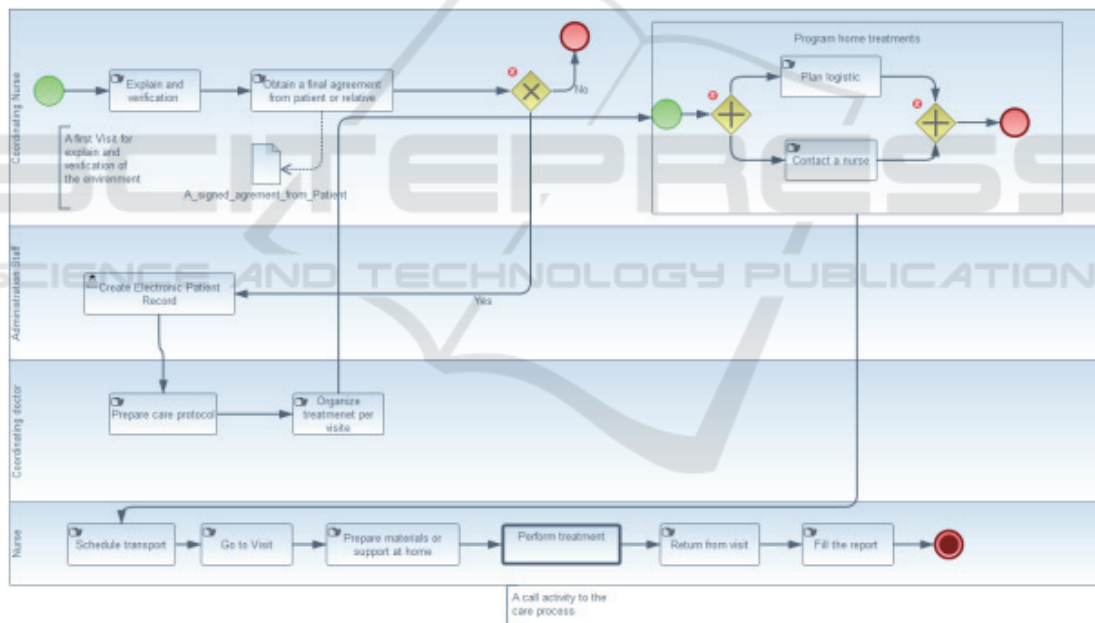


Figure 2: Organizational care process model according to BPMN 2.0 Standard.

division depicted by (Arbaoui et al., 2012).

4 HOME HEALTHCARE PROCESSES: A CASE STUDY IN TUNISIA

In this section, and following our interviews with the involved actors (2 doctors, 3 nurses &

administration staff), we describe how home healthcare is realized in Tunisia, who are the actors, which are the different tasks and how we can design all this information in a process model. We also identify particular problems of home healthcare processes concerning roles and task assignments observed during real-world care process execution in a home medical environment.

4.1 Collecting Home Healthcare Information

To study home healthcare processes, we led a field research in which we interviewed actors with different roles in the patient homecare (mainly nurse coordinators, health aides and medical doctors). We also followed the professionals in their daily work. These observations have given us an overview on the home healthcare management.

4.2 Proposed Models

The overall home healthcare process is divided into three sub-processes, namely: 1) patient admission; 2) organizational care; and 3) patient care.

4.2.1 Patient Admission Sub-process

This sub-process represents the result from multidisciplinary consultation carried out between different specialists. Once accepted to the home healthcare mode, it will only be possible to involve the treating doctor, the patient and her/his family. The later should give an initial agreement with a favorable opinion for the financial burden estimate.

Fig. 1 presents the organizational process model according to the BPMN 2.0 standard. In fact, when the disease is detected for a patient after diagnosis, treatment and mode of treatment are proposed after a dialog between different specialists. If the patient is not accepted for home healthcare, s/he will be treated in institutions or in traditional hospitalization. This assumption of home care management will be proposed to the patient under her/his agreement. As shown in Fig. 1, the written request of care is sent to the home healthcare structure accompanied with details of treatment for the patient. This request is then regulated by a doctor and a nurse coordinator according to geographic, medical, social and environmental criteria. In reality, very few requests end up with a refuse (Bricon-souf et al., 2005). Once the request is accepted, the type of support of home healthcare is defined for patient, which means the end of the admission sub-process.

4.2.2 Organizational Care Sub-process

Once the patient is admitted, a home visit is made by the nurse coordinator of the establishment. S/he aims to explain the full list of support programs for the patient and to identify her/his needs. Then, the patient may decide to be treated at home or to stay in the hospital. If s/he goes for home healthcare,

hospitalization at home is definitely confirmed and the record of patient will be created for a fixed period.

As shown in Fig. 2, the patient's final confirmation leads to a programming of home treatments respecting the sequence of predefined care prescriber and written by her/his treating doctor. It is insured by the nurse coordinator of home healthcare establishment. The next step of the organization is to inform the planning of care for logistics, nurses and treating doctor. Once the actors defined, the nurse coordinator has the mission to explain the care management and dates at which the patient will need their intervention.

4.2.3 Patient Care Sub-process

The care sub-process is the core of home healthcare. It is here where the various internal and external actors are involved around the patient to deliver care or services. This sub-process depends on the nature of the diagnosis. At this step, there will be the execution of care by appropriate actors and the immediate reporting of related information as follows:

Team providing care → coordinating doctor of home healthcare structure → treating doctor

According to the patient's diagnosis, the set of involved actors becomes revealed (e.g., nurses, physicians or other caregivers). In our care process model, we present a lane for a coordinating nurse which will notify all the needed actor(s) to be in charge of care execution at home. This process begins with a prescription from a treating doctor. After that, the coordinating doctor will prepare the care protocol in order to be organized per visit. Then, the coordinating nurse informs all involved actors. After treatment per visit is done, the nurse must follow-up the patient's health state and prepare a report. If the state is abnormal, the information should pass to a treating doctor urgently. At this step and according to received data from our interviewees, the treating doctor makes a decision either on an update of the care protocol or by making a visit before updating. This update may result into a new instance of the "Organize treatment per visit" task.

On the other hand, if patient health state is normal a conditional gateway takes place in order to control if current treatment is the last one or still other visits with other treatments should follow. So, if there is another visit, the process will return to the "Accomplishment of treatment(s)" task by the nurse. Otherwise, i.e. no other treatment, the nurse must

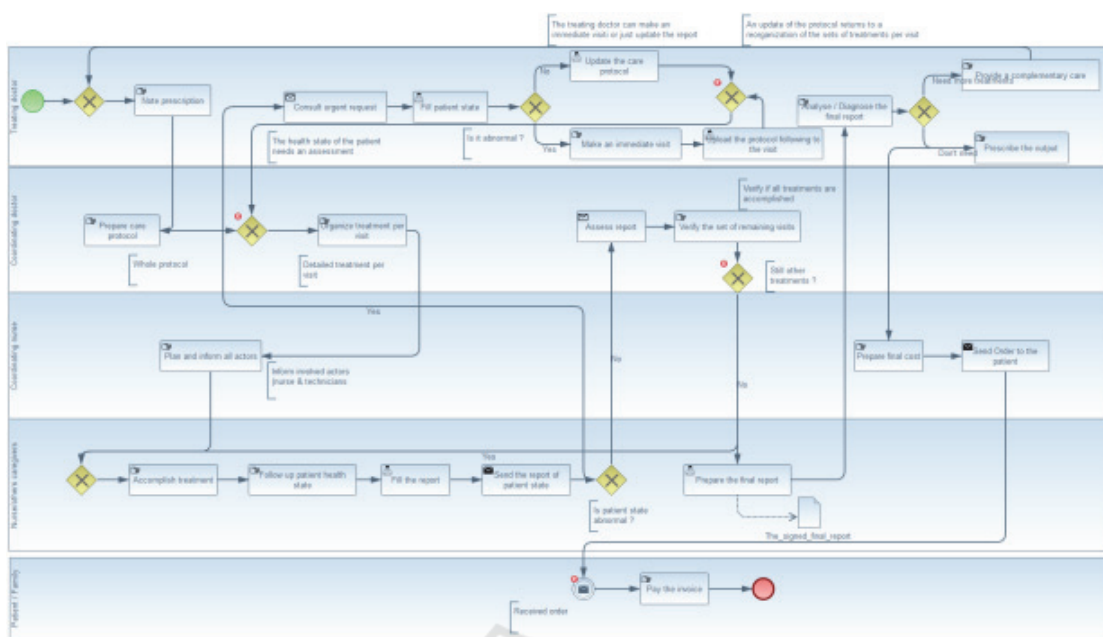


Figure 3: Care process model according to BPMN 2.0 Standard.

prepare a final report. It will be analyzed by treating doctor in order to make a decision about the patient: providing a complementary care or prescribing the output from hospitalization at home. This leads to preparing a final cost assessment. Finally, the pay of the invoice ends the process.

4.3 Identified Problems

In this case study in Tunisia, we have identified some related issues from the interviews performed. For instance, information about the collaboration between actors is often lost, e.g. when the patient's health state is critical an immediate intervention from the treating doctor at home is forced. This is due to the lack of a communication system between nurse and treating doctor. Currently, the only communication medium is the mobile. Also, the full process is mainly based on manual tasks e.g. treating doctor must go to the patient's home for frequent visits. This is due to the lack of ICT-based home healthcare (electronic records, telemedicine). Another related problem is the lack of support from health insurances and lack of home healthcare related culture. In addition, care coordination is a challenge. Health professionals need to coordinate care for a better and fast intervention. Another issue is that organizational processes (and patient-care processes in particular), change over time. This may be due to unpredicted (home healthcare) situations.

4.4 BPMN Coverage for Home Healthcare Processes

Proposed models describe the care tasks for the Tunisian home healthcare processes case. Also, while refining these process models with the involved home healthcare actors, they do not have difficulties in identifying the process activities and actors.

Modeling complex processes, such as those of home healthcare, has always been a continuous challenge. As an important factor in modeling, models must be easily understood by their target users. Also, an appropriate level of detail aims to fulfill their development purposes. In addition, healthcare systems have specific modeling requirements such as collaboration, understandability and flexibility.

Following interviews with involved actors, we assume that our proposed models follow a more imperative (prescriptive) modelling approach. This can be observed in the first and second models. On the other hand, regarding the third care clinical process, it requires a more declarative modelling approach, since there may be some tasks that are executed in a different order from instance to instance, and unforeseen exceptions may happen.

5 NEXT RESEARCH STEPS

In further work, we plan to optimize these models by analyzing which tasks can be automated or rationalized. Then we intend to implement these models of home healthcare processes within the jBPM BPMS (Cumberlidge, 2007). Then, and after registering execution instances, we will perform an analysis in order to identify bottlenecks and challenges reported from users of the implemented BPMS. After that, we expect to propose an improved business process, and again perform the BPM cycle.

Parallel to these steps, we are aiming to perform additional interviews on home healthcare processes, in order to assess the degree of similarity between business processes for home healthcare in other countries. From here, we plan to propose a group of home healthcare processes that can serve as template and guidelines to help normalize home healthcare in more than one organization/country.

6 CONCLUSIONS

In this work we have documented process models which reflect real-world scenario from a private clinic which provides home healthcare in Tunisia. Our proposed process models describe all care tasks in a Tunisian private clinic. We could also observe that, for these home healthcare processes, the BPMN language is mostly suited for the first two organizational and organizational-care processes, which are more static and rigid. Care (clinical) processes revealed to be unstable, requiring a different modeling approach. That is why we agreed with our interviewed personnel on a more generic care process, not only because it varies on the diagnosis, but also because real cases are not too much predictable.

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