

Business Process Management for the Crohn's Disease Clinical Process

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Abstract. Crohn's disease belongs to the group of inflammatory bowel diseases. The current process of disease management has significant weaknesses that cause high cost for health systems and a significant loss of quality of life for the patient. This paper shows a new approach to redesign process for the management of Crohn's disease based on Business Process Management strategy. This approach seeks to improve the patient empowerment and self-management, reducing costs and obtaining constant and updated information throughout the process.

Keywords: Business Process Management · Empowerment · Self-management · Crohn's disease

1 Introduction

According to World Health Organization (WHO), chronic diseases (CD) are by far the leading cause of mortality in the world, representing 60 % of all deaths. They are diseases of long duration and generally slow progression. In 2008, 36 million people died from chronic disease, 29 % were under 60 years old and half were women [1]. Crohn's disease produces inflammation of the gastrointestinal tract and it can affect any area from the mouth to the rectum. This article focuses on reducing problems associated with the current clinical process, with the clear objective of improving the quality of life of patients and reducing the cost associated. One of the most recent management strategies to reach this purpose is Business Process Management (BPM) focused on continuous improvement of business processes using information technologies (IT's) as one of its fundamental principles for the realization process [2].

2 State of the Art

Chronic diseases require special attention from a wide variety of medical specialists.

To improve the remote patient monitoring, some frameworks have been developed. They are based on data that come from sensors coupled to the patients in a non-invasive way (u-health services) [3]. In recent years, other devices based on artificial intelligence

have also been developed improving the access of the Crohn patients to the information. This is thanks to the development of Web services and their integration into mobile devices [4]. Business Process Management (BPM) consists on a set of integrated, closed-loop management and analytic processes supported by technology. The research works [5, 6] support the successful use of information technologies (ITs) on the field of health. However, they are not managed by the process, which turns them into partial solutions again. An integrated solution based on BPM that uses all the factors involved in a clinical process, such as Crohn's disease, will be useful for a continuous process improvement. Some parts of the process could also be automated, which will reduce the cost of the health service and increase the satisfaction of the patient.

3 Crohn's Disease Clinical Process

In this section, the clinical process of Crohn's disease is defined from its diagnosis until its treatment. The main goal is to understand how the process is currently developed (AS-IS view) and how many factors are involved in. The analysis carried out in this work is supported by some international clinical guides (Canada, United Kingdom) [7, 8]. The procedure starts with the first clinical evaluation performed by the medical and nursing specialists (see P1 in Fig. 1). In case of medium-high risk, the doctor will perform a physical exam supported by an abdominal X-ray, blood pressure values, heart rate and temperature (see P2 in Fig. 1). The third stage of the diagnosis implies the valuation of the specialist doctor in digestive system. He will carry out a complete analysis as well as the faecal calprotectin test. This test allows the specialist to discard false positive results (see P3 in Fig. 1). Finally, the patient is subject to several tests carried out by different health specialist. In the case that any of them are positives, they allow the doctor to confirm the Crohn's disease (see P4 in Fig. 1).

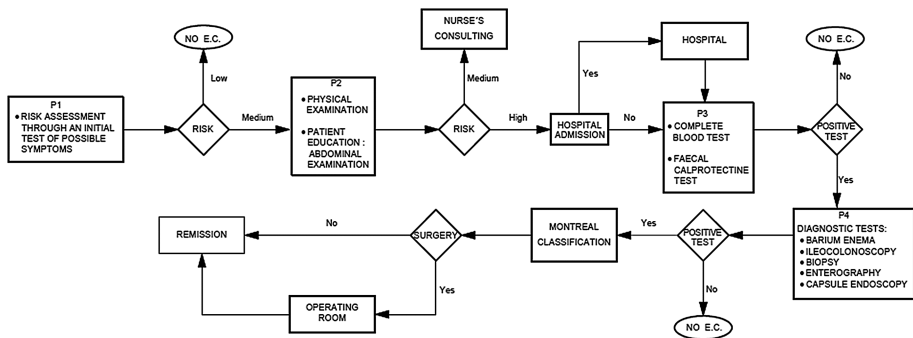


Fig. 1. Current diagnosis and treatment Crohn's disease process.

Once the patient is diagnosed with the Crohn's disease, it is classified in one of the disease phases. In that moment, it will decide if the patient needs a surgical intervention or he is derived to the induction stage, where he is monitored. In the case of the patient needs a surgical intervention, the possibility of deriving the digestive tract to a stoma is

studied. Therefore, whether the surgical intervention is performed or not, the patient will be continuously valued in the follow-up stage. In this phase, the tests related to the diagnosis are performed again with the purpose of looking for possible complications and re-classifying the disease degree of the patient.

4 Weaknesses in the Current Crohn's Disease Clinical Process

At present, the management of the Crohn's disease clinical process presents important deficiencies both in the diagnosis and in the treatment phase. In Spain, one of the main problems of the treatment is the lack of standardized clinical guidelines level and the time it takes to be diagnosed. Faecal calprotectine test is carried out only in the final step of the diagnostic phase [9]. The lack of psychological support during the process is among the most significant deficiencies [10]. From the point of view of the patient, factors such as the continuous visits to the primary care centres, absenteeism and the large number of tests to perform have affect the quality of life [11]. Another important aspect that negatively affects the quality of life is the lack of clear and updated information throughout the clinical process [12]. The annual cost of caring for patients with Crohn is one of the aspects that have more relevance throughout the process. The hospitalization rate is increased and this represent a significantly higher cost than keep the patient in remission. In [13] it was estimated that the costs related to surgery accounted for about 40 % of the total costs of the process. The BPM strategy will be used for the redesign of the clinical process, implementing the necessary improvements, and minimizing the most of the deficiencies identified, using ITs as a key element to achieve the objectives.

5 Redesign Process

The object of study of this article focuses on the redesign of clinical Crohn's disease process once it has been diagnosed and the implementation of improvements by business management strategy BPM. Its agile and flexible use allows the process to be adapted to unexpected changes. With the proposed development (see Fig. 2), a global model that integrates all processes involved in the treatment of the disease is obtained, including the phase of psychological support to the patient. Through specific user applications integrated with the system by means of web services, the patient can make self-assessment tests which will be integrated into the system in order to be analysed by the team of psychologist (empowerment action 1). Thus, a standardized clinical guideline is obtained and the psychological impact suffered by the patient is managed, two of the weaknesses previously identified.

Through web services, the patient can also send information related to various risk factors, blood tests values and other useful information referred to physical examination (empowerment action 2). In addition, data concerning about their blood pressure, physical activity and body mass index are incorporated automatically by communication between the expert system with a blood pressure monitor, a smart band and a digital scale respectively (empowerment action 3). To rule out misdiagnosis and shorten the

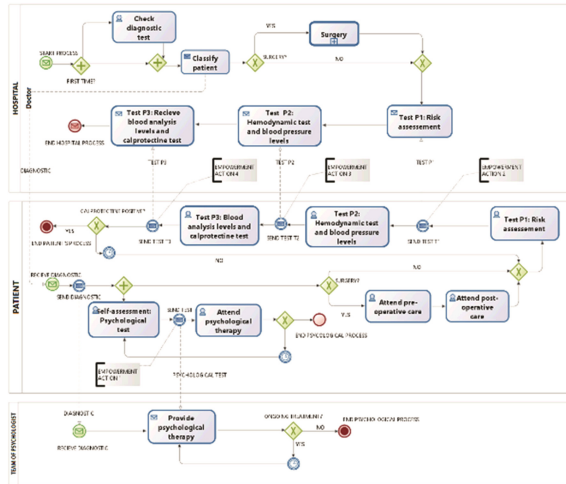


Fig. 2. Redesign model Crohn's disease process

process, a device measures the faecal calprotectin and this information is integrated into the system via Bluetooth (empowerment action 4). Thus, the medical team have an update medical history, reducing the number of visits to the medical centre that cause loss of quality of life for the patient and increase the costs borne by the health system.

Moreover, the expert system will provide recommendations based on information received by artificial intelligence algorithms behaving like a clinical decision support system. Thus, the patient participates actively in the process, promoting their empowerment and self-management of their disease and having updated information of its clinical status, overcoming one of the main deficiencies identified in the current process.

6 System Architecture

To carry out the above model, an architecture has been proposed (see Fig. 3) This architecture has three main areas: patient, medical team and data centre.

The area of patient is focused on data acquisition through wireless devices: smart band, blood pressure meter, digital balance and calprotectin meter. These devices will send automatically values of clinical interest to a smart device (mobile phone, tablet...) via Bluetooth. This information will be processed based on artificial intelligence algorithms offering, through User Agents (UA), customized recommendations based on patient's behaviour, predetermined goals and recommendations made by the medical team. Thus, a Decision Support System (DSS) is developed, improving patient empowerment. Data center will serve to store and manage data. BPMS allows us to model the clinical process developing task and processes. The DDS will made recommendations based on the data provided by the patient, collaborative filtering and the recommendations of the medical team. The transfer of data is bidirectional between different areas of the system using APIs Rest for communication between them.

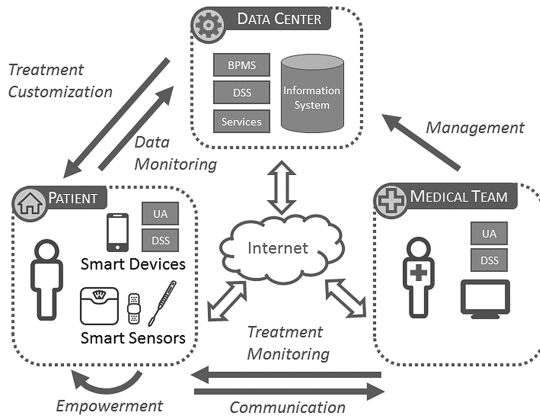


Fig. 3. System architecture for Crohn's disease management

A case study is described below to illustrate the proposed architecture: to verify whether the diet given to a patient is being effective, the patient control its weight daily with a balance. The balance collects the data (kg) and sends it via bluetooth to the mobile device, which synchronizes and resends the data to the center. The DDS data center evaluates the data based on the trend of the patient and the pre-set goals. If the results are within the pre-established limits informs the patient that its progression is adequate and should therefore continue with the diet. Otherwise, it proposes a series of recommendations to the patient (changing eating habits, increasing physical activity, readjusting the diet...) in order to correct their behaviour and achieve the pre-set goals. For more control, the data center will report the suggested changes to the medical team. This will allow them to monitor the patient's behaviour. Thus, the information is shared between the three areas defined in the architecture, obtaining an updated medical history and an increased supervision by the medical team.

7 Conclusions

Our proposal is focused on the use of BPM to the clinical process of Crohn in order to coordinate globally all elements involved in managing the clinical process of Crohn's disease. The main novelty of our approach is the use of Business Processes Management strategies and ITs together with artificial intelligence algorithms and different wireless sensors to allow the monitoring of the patient and provide information to the expert system. Thus, a dynamic model that adapts to the needs of the patient is achieved, improving the empowerment of the patient and overcoming the deficiencies in the current clinical process.

Conflict of Interest

The authors declare no conflict of interest in this article.

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