

Real Time Patient Flow Management using Business Process Management, Location Tags, and Complex Events Processing

Co-Chairs: Omar Badreddin, University of Ottawa; Liam Peyton, University of Ottawa

Theme: Dynamic Business Process Management and Smart SOA

Abstract:

Introduction

Hospitals in North America are operating at near full or full capacity. Ageing populations are further increasing patients' inflows. These trends manifest themselves in continuously increasing patients wait time that can reach 20 hours at emergency departments [1]. Excessive wait time is both costly to patients and hospitals, increases risks to patients, and in many cases, is in conflict with medical guidelines standards.

Canadian healthcare organizations face challenges with patients' wait times, particularly in Emergency Departments (ED). By their nature, EDs face fluctuating and unpredictable inflows of patients, many of whom require immediate attention. According to a study by Canadian Institute for Health Information (CIHI) [2], a significant majority of patients whose condition requires urgent care end up in the ED. Ontario Ministry of Health made it its top-priority health concern to address the wait time issue by launching "The Ontario Wait Times Strategy Program" which commenced in 2008. This program requires hospitals to report on patients wait times, and to facilitate access to key procedures and services, such as X-rays and MRIs.

Patients' wait times

Wait times can result in difficulty in accessing care service, congestion, low patient satisfaction, adverse effects on patients health and safety, and inefficient resource utilization. Patients experience a variety of types of wait times [1,2]. Examples include wait for a routine care, wait for emergency care, wait for acute care, and wait for specialized care.

Managing patients wait times and flow requires insights into fine grained patients flow patterns, and the identification of key root causes of delays. Eventually, such knowledge can support hospital administrators to execute corrective and timely actions to avoid patients' excessive delays, or to address existing delays and congestions situations.

Care process management

A number of technologies have been proposed for the managing of patients' flows [3,4]. Business Process Management (BPM) is a suite of standards and tooling that support the modeling, monitoring, and enhancements of core business processes. In healthcare, BPM can be utilized to model, execute, and monitor clinical pathways. By modeling clinical pathways (or a care process) as a Business Process, stakeholders can identify areas for improvement, and can monitor executions of clinical pathways at run time.

Care providers' involvement

However, traditional BPM applications are human intensive by nature [5], and require extensive involvement from care providers. Administrative work consumes considerable amount of time from care givers. In one study that included 767 nurses, it revealed that nurses spend about 35.3% of their working

time on documentation and data entry, and 20.6% on care coordination [6]. Another study [7] finds that nurses spend less than one third of their time with patients. The rest of their time is consumed in coordination and administrative responsibilities. Other studies indicate that a significant percentage of care professionals spend their time doing tasks that can be performed by someone else [8]. This suggests that care professionals time is not being utilized efficiently.

Administrative tasks takes considerable amount of time that can better be spent with patients addressing more pressing care needs. In addition, there is evidence that administrative tasks at hospitals are associated with higher levels of stress, strain, and physical discomfort [9].

Extensive data entry and human involvement in traditional BPM applications represents a significant challenge in adoption in hospitals where care providers do not have the time, or are unable, to interact with the system. Consequently, a minimal invasiveness has been proposed to be key in adoption of information systems in hospitals. This, as well as other aspects of care institutions, has prompted a number of researchers to investigate the use of mobile devices and Real Time Location Tags (RTLS) as an approach to provide fine-grained data, without extensive involvements of the care providers.

Scope and significance

The use of Business Process Management along with Complex Events Processing of events coming from real time location tags to monitor patients flow is demonstrated. The workshop demoed an implementation using WebSphere Business Events, Lombardi BPM, and eKahao location tags. Hands on exercises illustrated the effort involved in the identification of key business events from fine-grained events collected from the location devices.

By collecting significant amount of fine grained and real time data, it becomes possible to create real time dashboards that presents current states of patients at the hospital. We illustrated to participants how to use IBM Framework Manager and IBM Cognos to create real time dashboards. These dashboards serve as part of a decision support system that can be used by flow administrators to enable them to take informed and timely decision to address excessive wait times.

The deficiencies of traditional BPM applications in the context of health care institutions is demonstrated. Care provides are unable to frequently interact with the system, especially in emergency departments where more pressing patients' care always takes precedence. We demonstrated an approach that minimizes care providers' interactions with the system by means of using location information. Location data is processed to infer care states and calculates wait time. Administrators can be alerted when excessive wait time is reached. This is particularly valuable to enable compliance to medical and regulatory guidelines.

Real time monitoring system

We have developed a system as part of a collaborative industrial case study with Osler Hospital and IBM. The system utilizes Real Time Location Tags (RTLS) assigned to patients and key care providers. These tags use wifi and infrared signals to reach location accuracy of about 10 cm. This location data, along with data coming from existing hospital system is triangulated using Complex Event Processing to infer the current patient state and wait time. The system also includes a set of real time dashboards that are displayed on wall mounted screen. These dashboards serves two purposes. First, flow administrators are able to better manage patients as they gain real time insights on current states and wait times of all patients at the hospital. Second, these dashboards help the admin staff identify the root causes of delays. In many situations, hospital staff are only able to have local view of their current patients flow. Therefore, it becomes hard to identify root causes of delays, if these causes lay outside the boundaries of a specific department.

Evaluation

The system was deployed at a large community hospital in Ontario, Canada. Hospital staff participated in this large simulation exercise. Actors took on different roles and simulated a number of patients being

admitted with chest pain. Patients are then assessed and some are admitted and go through specified clinical pathways.

A survey was conducted at the end of the simulation exercise to collect feedback from participants. The feedback was significantly positive and most participants speculate that such a technology can be in place at the hospital within a period of 5 years.

Conclusion and future work

The real time patient flow system and the simulation exercise suggest that location data can be used along with existing hospital information system to monitor patients flow in real time. Such monitoring can have significant impact on patients and hospitals. First, patients safety and well being is enhanced when they receive timely care services. Hospitals can ensure that medical guidelines are abided. For example, in Ontario, an ACS patient is expected to receive treatment within 90 minutes of admittance. Real time flow monitoring system can enable hospitals to ensure that such guidelines are enforced.

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