Cascading Workflow of Healthcare Services: Transforming COPD Related Clinical Narratives from Discharge Summaries Into a Standardized Order Set

Phillip Osial, Lakehead University, Thunder Bay, Canada
Arnold Kim, Lakehead University and Thunder Bay Regional Health Science Center, Thunder Bay, Canada
Kalle Kauranen, Lakehead University, Thunder Bay, Canada

ABSTRACT

Despite rapid advancements in technology, the healthcare industry is known to lag behind when it comes to adopting new changes. Most often, when a new technology such as CPOE or EHR systems presents themselves in the healthcare industry, clinicians are left struggling to keep up with their workloads while learning to adjust a new workflow. Instead of disrupting the clinician’s clinical workflow, the authors propose a system for transforming clinical narratives presented in the form of discharge summaries from the i2b2 Natural Language Processing dataset into a standardized order set. The proposed system uses natural language processing techniques based on Scala, which extracts discharge summary information about a patient and is proven to be highly scalable. The goal of this system is to increase interoperability between CPOE systems by performing further transformations on the extracted data. The authors adhere to HL7’s FHIR standards and use JSON as the primary medical messaging format, which is used both in the US and international healthcare industry organizations and companies.

KEYWORDS
CPOE, Discharge Summary, EHR, Healthcare, HL7 FHIR, NLP, Scala, Scalding API, Slick

INTRODUCTION

Over the years, healthcare information technology has rapidly advanced, and with its growth, has led to industries shifting their business practices towards accommodating more clinical services connected to the mainstream of the electronic health records. Incidentally, as the industry moves towards solving the interoperability bottleneck between different clinical data formats and silos, more focus is given to the integration of the clinical workflow as a mean for solving this bottleneck. Workflows are made up of a sequence of tasks, consuming resources, and achieving goals. So, it makes sense that workflow interoperability requires task interoperability.

DOI: 10.4018/IJEACH.2019010108

Copyright © 2019, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.
When taking a step back and examine the movement towards workflow interoperability, studies indicate clinicians consider what sort of impact electronic healthcare records (EHR) will have on their typical workflow. It was found that if there is too much resistance by physicians due to the workflow being impacted too much, then the adoption rates will be poor (Bowens, Frye, & Jones, 2010). To mitigate this resistance, the authors use Cascading to extract, transform, and load (ETL) discharge summaries. The reason for using Cascading is that it is built upon the idea of streamlining workflows. What is meant by this is that Cascading offers the scalability of Hadoop but abstracts the complexities that come with MapReduce tasks. This creates an environment where developers adhere to new programming workflows, making it easier than ever to construct complex data processing workflows without knowing the underlying complexities of the MapReduce infrastructure. This is important to note because developers, just as clinicians, are hesitant to adapt to new technologies if their current workflow is disrupted. Using the proposed system, the resistance many clinicians may feel by adopting to EHRs and order sets can be removed.

As part of this research, the authors use Scalding, a Scala-based Cascading API, as the benefits of Scala and MapReduce can be combined to create an intelligent wrapper allowing seamless integration between a clinicians existing workflow and an EHR. A mix of Scalding and Scala is used to implement natural language processing (NLP) techniques such as Term Frequency-Inverse Document Frequency (TF-IDF) with cosine similarity to perform the extraction and transformation into a standardized medical messaging format developed by the Health Level Seven International (HL7) organization. In this article HL7’s Fast Healthcare Interoperability Resources (FHIR) along with JavaScript Object Notation (JSON) is used as the primary medical messaging format. Using HL7’s FHIR with JSON, loading the message into any EHR using Slick, a new database query and access library from Scala increases the interoperability of the proposed system.

In (Schnipper et al., 2008), researchers introduce the concept of smart forms, requiring the user to follow a set of standardized input fields meticulously. The authors implemented a similar concept, known as order sets, to showcase how inefficient the workflow becomes when a user must traverse pages of input fields manually. To overcome this inefficiency, and enhance the workflow, the authors bring forth the idea of transforming clinical narratives into a standardized format allowing full interoperability between systems. This allows population of the designed order set from semi-structured data, removing the requirement to fill out pages of data on a smart form or order set.

A workflow can be defined as an ordered procedure of tasks followed by an individual in the environment (Brixey, Robinson, Turley, & Zhang, 2010). In the context of clinical workflow, inferences can be made that the same definition applies to clinicians. In a chaotic live clinical environment, it becomes a challenge to adhere to every rule, regulation, and policy set in place. Clinicians are responsible for following a series of steps outlined by the organization they work in to ensure patient safety and health. Modelling an ideal clinical workflow becomes a complex challenge as structuring dynamic human behaviour is no easy feat. Analytical analysis of existing workflows can help prevent variabilities between clinical practices and improve patient outcomes (Rotter et al., 2008).

The increasingly high cost of healthcare, hospital inefficiencies (MacMillan, Slessarev, & Ettchells, 2016), and worries about patient safety have led to a renewed interest in researching clinical workflow (Born & Levinson, 2017). Clinical workflows provide an abundance of data ready to be mined and analyzed for inefficiencies and patterns. Using data generated by analyzing hospital workflow, researchers can determine patterns which may give an idea of how clinicians may go about their work to increase the interoperability of systems on a grander scale (Campbell, Guappone, Sittig, Dykstra, & Ash, 2009).

Taking an example such as chronic obstructive pulmonary disease (COPD), many clinical pathways can stem from COPD, which is typically well-known recommended practices or guidelines that a clinician may follow (Yao & Kumar, 2013). The lack of standardization creates a barrier to interoperability of systems. In (Aarts & Koppel, 2009), researchers conduct a study of how computerized physician order entry (CPOE) is implemented across seven countries including United
Operative Role Management in Information Systems
www.igi-global.com/chapter/operative-role-management-in-information-systems/138462?camid=4v1a