Process Modelling of a large Family Medicine Teaching Facility

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***Abstract* —In previously reported work, the Health Informatics for Research, Education and Service (HiRES) team at St. Mary's Hospital Center (SMHC) presented the design for an electronic medical record (EMR) that would address the unsatisfied needs of the teaching, research and service mandates of the post graduate residency program. The design takes an existing commercial EMR product and adapts it to the needs of SMHC. The technology, in the context of a research project, is being developed through the integration of medical practice expertise and systems engineering methodologies. The first step in this integration involved the development of a formal process model of the Hospital's Family Medicine Centre (FMC) within McGill University's Family Medicine, using the US Air Force IDEF0 methodology.**

The process modelling was undertaken to establish the baseline set of processes by which the FMC services the community, teaches its residents and medical students and researches into primary care as required by SMHC's 'université affilié' status. Detailed interviews were conducted with a cross section of medical, nursing and support staff in key positions. The information gathered was then compiled into a collection of over forty models dealing with the entire breadth of activities of the FMC. The models were validated through follow-up interviews and presentation to the FMC at large during Grand Rounds.

The collection of models (the Model), is the first known example of the processes of a Canadian family medicine unit being represented in a systems engineering form. The Model has provided the team with a benchmark metric for evaluating the relative merits of various process optimization proposals. Using the Model, it is possible to determine the effect any given optimization or group of optimizations would have on operational parameters including staffing, patient interaction time (support staff versus actual treatment) and information flow.

The Model will play a key role in characterizing, both qualitatively and quantitatively, the environment in which a 'computable' patient record (CPR) is to be implemented. This is the next step in the HiRES team's investigation of the three mandates of the clinical teaching environment.

***Keywords* — Electronic Medical Record, Workflow, Modelling, Family Medicine, Teaching**

I. INTRODUCTION

There is strong pressure, provincially and federally to improve our healthcare delivery[1]. Despite its recognized role in other industry, system design and optimization is lacking in the health delivery field[2]. Descriptions of process models and a clear understanding of how different systems, personnel and processes interact is critical to success in other complex sectors [2]. Generally when a healthcare delivery system is modeled, it is limited to simple flow charts and does not conform to standard modelling techniques [2], [3].

A search through the medical literature of the term "process modelling" and its numerous variations highlighted how uncommon this practice is in healthcare. When limited results to any formal modelling process, many citations modeled a clinical reasoning process [4] or a particular subset of healthcare delivery within a clinic or hospital [5], [6]. Only three citations could be found which attempted to model an entire delivery system with any rigor [2], [3], [7]. None of these papers modelled a community family medicine practice. No paper could be identified which attempted to model, in any form, healthcare delivery within a residency program.

As a model is simply a description of a system, and by definition an incomplete description, different modeling techniques are useful for different viewpoints. In practice, this means that models from different perspectives need to be built independently, often in different environments and then an attempt to combine them must be made. Aside from the duplication of work, different models may be incompatible with one another and the entire system cannot be captured with sufficient detail. [8]

The US Airforce developed a methodology referred to as IDEF for ICAM (Integrated Computer-Aided Manufacturing) Definition Language.[8] IDEF0 is the 1981a iteration used for process modelling.[8]

Before implementing a major change in a process, such as integrating a new electronic medical record, it was felt that a good understanding of the baseline process was needed. The process modelling was undertaken to establish the baseline set of processes by which the FMC services the community, teaches its residents and medical students and researches into primary care as required by SMHC's 'université affilié' status.

When SMHC and the FMC decided to convert to electronic medical records using OACIS Clinical, the FMC began a process of modelling the clinic. Goals included identifying which areas OACIS Clinical can assist with, how the software would have to be modified to conform with the FMC processes and which FMC processes are poorly functioning and should be revisited.

II. METHODOLOGY

Determining the baseline process that was employed at SMHC was undertaken with the understanding that different groups (e.g. staff, residents, nurses) had different perspectives, responsibilities and goals. The information was therefore first gathered through a series of 90 minute interviews (Nov 9^{th} to Dec 16^{th} 2010) with the Medical Director, and those with particular perspectives on the roles of Clinical Scheduling, Practice Secretary, IT, Archives, Reception, Billing, Nursing, Teaching office, Staff Physician, Resident Evaluation interface, Research, Medical students, Obstetrics, Resident program, and Patient encounters. From these interviews FMC process models were developed using IDEF0 and produced using Microsoft Visio.

Each process model consisted of a series of cross referenced diagrams and text representing functions and the data and objects which link the functions. Function inputs and outputs, consisting mostly of documents or people, were represented by links entering horizontally from the left and exiting from the right, respectively. People or equipment required for a function to operate (e.g. telephone systems, supervising staff physician) were referred to as "enablers" and entered from the bottom. Individuals or organizations responsible for the function were referred to as "Execution Authority" and entered vertically from the top. Processes which occurred outside the FMC were labeled as a "foreign process."

The models were validated through follow-up interviews and presentation to the FMC at large during Grand Rounds.

III. RESULTS

Some 40 models were produced representing the FMC research, teaching and service responsibilities.

With regards to research, the use of paper charts and inconsistent coding of diagnosis was shown to greatly limit research possibilities. The presence of separate FMC and SMHC charts, neither of which by themselves is complete, could result in the absence of vital patient information. The importance and role of systematic diagnostic coding was a key lesson from the modeling.

In the teaching domain, resident and students provide services that are enabled by the presence of a supervisor. The medical learners' and supervisor's availability are defined by a schedule that is communicated to the FMC teaching office. Strict scheduling and notification guidelines are often improperly adhered to resulting in a required three weeks of fulltime work by one secretary to arrange each four week period. Last minute cancellations, particularly of supervisors, often require a complete schedule overhaul. Learner evaluation is comprised of both an electronic evaluation system and a parallel handwritten file of "field notes" used to assist with the electronic evaluation. OACIS Clinical does not seem to provide support for these teaching office efforts.

OACIS Clinical provides support for some of the service responsibilities. Regarding the physician clinical encounter, an electronic prescriber, laboratory/imaging results viewer and a non-coded clinical note are all available. Appointments are communicated through HL-7 messages which should be able to integrate with the current MediVisit program used by the FMC. The requirement that medical learner's notes be countersigned by a supervisor, while not part of OACIS Clinical could likely be easily implemented. While multiple practice encounters between patients and nurses were demonstrated by the model, OACIS Clinical does not provide for these encounters. These encounters require a different set of coding standards and the production of Nursing Therapeutic Plans. Both nursing and physician encounters require a consistent coding standard.

One particularly problematic service process identified by the model was the handling of reports from investigations, particularly reviewing those ordered by medical learners. As a result of the model, the source of the problem was identified as the absence of a clear process owner, with the burden of timely management falling on a nurse without the mechanism to adequately discharge responsibility. OACIS Clinical can provide some relief and assist with document tracking, particularly for results ordered and provided by internal sources such as SMHC.

IV. Discussion

Without a top-down centralized model set up from the beginning, integrating a new electronic and computable patient record requires a cooperative or distributed model with a Message Passing Interface to maximize interoperability [9]. This archetype, requires a clear understanding of existing processes. The collection of models, is the first known example of the process of a Canadian family medicine unit being represented in a systems engineering form. By carefully defining and characterizing how information is transferred between units and sub-systems the team can properly evaluate various proposals. The Model provides a benchmark metric and shows how new systems would integrate with existing processes. The plan to implement a computable patient record requires an environment which is characterized qualitatively and quantitatively. The Model accomplishes this by defining operation parameters including staffing, patient interaction times and information flow. .

Acknowledgement

The authors wish to thank St. Mary's Research Center and the Family Medicine Center at St. Mary's Hospital for their support in providing the 'living laboratory' in which this research will be conducted.

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