A Process Reference Model for Enhanced Medication Management

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Keywords: Business Ontology, Business Architecture, Business Process Management, Medication Management, Process Reference Model.

Abstract: A comprehensive management approach to improve quality and safety of medication management within a multisite health care organization is explored. The process-oriented approach integrates Business Ontology, Business Architecture and Business Process Management to develop a reference model for medication management. The model includes one hundred and sixty-four individual processes categorized in four process areas and twenty-five process groups. The business artefacts and methodology used in the development of this reference model are also presented. These artefacts were created and validated through workshops and working group meetings. The developed methodology could be used to create a similar process architecture in other organizations and service areas.

1 INTRODUCTION

The delivery of health care services is a complex operation in which care providers and managers are expected to deliver safe, high quality services within a resource constrained system. Patient safety is of paramount importance. The need for improvement in the medication management processes is evident based on the incidence of adverse medication events reported in the literature (Martins, Giordani, & Rozenfeld, 2014). There are a multitude of clinicians and support staff involved in medication management and there are numerous legislated requirements which both contribute to the complexity of the processes. There needs to be a shared understanding among care providers involved in medication management processes together with an understanding of how medication management processes fit within the larger health care system. Business ontology can be used to create a shared language and identify the relationships between business objects (Au-Yong-Oliveria & Ferreira, 2014). Enterprise architecture provides the structure in which the ontology can be used to show relationships between like objects across the organizational architectural layers or across domains within the same architectural layer (Hendrickx, Mahakena, & von Rosing, 2012). When combined with Business Process Management (BPM) (Bandra, et al., 2010) in a healthcare environment, this yields an integrated approach to design, evaluate and improve safety of medication management processes. The business layer of an enterprise architecture framework is at the core of our proposed model. The application and technology layers of the enterprise architecture are important when considering the automated processes particularly where technology such as infusion pumps and bar code scanners are used in the processes. (Singh)

A reference model is either a narrative or visual conceptual representation of the recommended (best) practices of a specific domain. A business process reference model can be used to inform and guide the development of a business process where no such model previously existed or it can be used to compare current business process to a generic reference model which has incorporated leading or best practices within the domain (Pajik, Indihar-Stemberger, & Kovacic, 2012). Since developing business process models is time consuming and expensive, reference models can be used to shorten the time to design or standardize process models across an organization. The medication management process reference model presented in this paper is a narrative

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Urquhart, B. and Haque, W.
A Process Reference Model for Enhanced Medication Management.
DOI: 10.5220/0008992705470554
In *Proceedings of the 13th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2020) - Volume 5: HEALTHINF*, pages 547-554
ISBN: 978-989-758-398-8; ISSN: 2184-4305

representation of the processes that we believe should be included in a process architecture for medication management.

The challenge with producing generic business process models is that they may be context specific; therefore, not necessarily transferrable to other organizations. It is possible that best practice in one organization or industry may not translate to best practice in another organization if there is a significant difference in the strategy of the two organizations (Ponsignon, Smart, & Maul, 2012). Despite these concerns there are many examples of reference models for business process in use and referenced in the literature. These include SCOR – Supply Chain Operations Reference Model (Supply Chain Council Inc., 2012), SAP R/3 reference model and the Process Classification Frameworks developed by the American Productivity and Quality Council (APQC) (American Productivity and Quality Centre (APQC), 2014).

In this paper, we present a process reference model for medication management which consists of the traditional core, support and management processes, and a fourth area (Clinical Training and Professional Development) as some included processes can be considered to be either support, management, or both. There were two sources of information considered for use in validating the proposed model: the APQC Process Classification Framework (American Productivity and Quality Centre (APQC), 2014) and The Supply Chain Operations Reference Model (Supply Chain Council Inc., 2012).

2 METHODS & MATERIALS

Qualitative design, in the form of researcher facilitated workshops and working groups, was used to develop business artefacts that were subsequently used to develop the process reference model. The research was undertaken in a multi-site publicly funded Canadian healthcare organization. The business architecture developed by the Global University Alliance (GUA) (Global University Alliance, 2018) and a standard of the LEADing Practice community (Layered Enterprise Architecture Design) was used together with the BPM Ontology which was also developed as part of the foundational business ontology by GUA (von Rosing, Scheer, & von Scheel, 2014). The architecture is designed in three layers: business layer, application layer and technology layer. The business layer has four sub-layers, namely, purpose and goal, business competency, business service, and business process. The BPM ontology includes meta-object groups that have been shown to apply to almost any process related object and artefact (von Rosing, Laurier, & Polovina, 2014). The sixteen meta-object groups are: Service, Business Competency, Purpose & Goal, Objects, Owner, Process Flow, Roles, Process Rules, Process Security, Application, Process Measurement, Channel, Data, Media, Platform, and Infrastructure. The activities involved during the design of process reference model begin by identification of the purpose and goals as defined by SBOs (Strategic Business Objectives), CSFs (Critical Success Factors) and KPIs. Business competencies are then defined and a value chain model is designed linking processes to each identified competency. Processes are categorized and results compared with known relevant reference model, if one exists, and validated with stakeholders.

3 RESULTS

To be useful, the process reference model for medication management should be generic enough for use as a starting point for the development of any health organization's process architecture. The proposed reference model used the process meta-objects of the BPMO included in LEADing Practice standards. The reference model created as part of this research includes one hundred and sixty-four individual processes categorized in four process areas and twenty-five process groups. Process Area is defined as "the highest level of an abstract categorization of processes". Process Group is defined as "a categorization and collection of processes into common groups". Process is defined as "a set of structured activities or tasks with logical behavior that produce a specific service or product" (von Rosing, Scheer, & von Scheel, 2014). The process steps and process activities were not included in the reference model as this level of detail is context specific at an organizational and/or department level and could be different for every organization.

A process can be categorized and tagged according to the role it fulfils within the organization. The core (or main processes) are defined as those processes that provide a service. In the case of medication management this includes the processes provided at the point of care. The individual roles involved in main processes are the clinicians and care providers who assess, diagnose, prescribe, dispense, administer, monitor and discharge patients. The support processes support the delivery of the main processes.

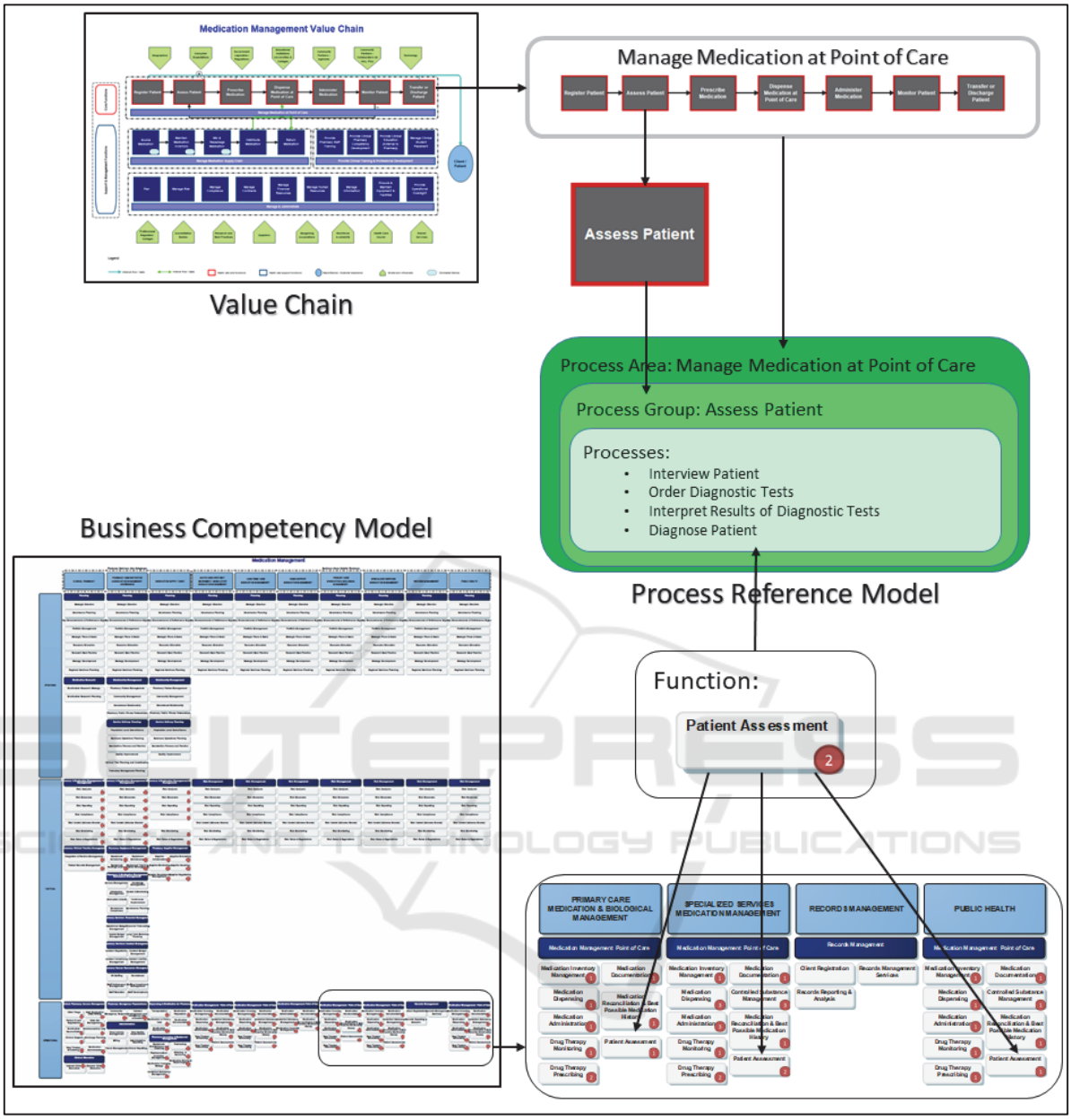

Figure 1: Relationship between Process Reference Model Meta-Objects and Business Artefacts.

In the proposed reference model, the support processes are categorized into two areas depending on whether the processes were related to management of medication supply chain, or provision of training and education. The recipients of training and education include both staff and external students who are placed in the organization as part of their formal education. A separate grouping of these processes was deemed appropriate since they could be considered to be either support or management processes depending on the recipient. The individual roles involved in support processes are the pharmacy staff with respect to medication supply chain and clinical pharmacist in respect to clinical education. Management processes include administrative processes and the processes required to manage the core and support processes. The process reference model for medication management further categorizes these into nine groups based on the business function. The individual roles involved in management processes are the Regional Director,

Pharmacy Managers, Anti-Microbial Stewardship Pharmacists, Drug Utilization Pharmacist and Administrative Assistants.

The Process Areas and the Process Groups used in the reference model were derived from the Value Chain. A total of four Process Areas were identified: 1) Manage Medication at Point of Care, 2) Provide Clinical Training & Professional Development, 3) Manage Medication Supply Chain, and 4) Manage & Administrate. In addition, a total of twenty-five Process Groups were identified. The complete listing of four Process Areas, twenty-five Process Groups and one hundred and sixty-four processes is provided in Appendix 1. Each process is associated with at least one business competency. The identification of processes was achieved through review of the functions included on the Business Competency Model for Medication Management services.

Each business competency was reviewed and the processes required to deliver the competency were listed and included in the process reference model. It should be noted that a single competency may require numerous processes to deliver it. Also, some processes can have a relationship with more than one competency. An example of this is the process to "monitor training effectiveness". This process is related to more than one competency because they are separated based on the recipient of the education. Figure 1 shows the relationship between the Medication Management Process Reference Model and the objects included in two business artefacts, namely, Value Chain and Business Competency Model.

Two approaches were taken in an effort to validate the completeness of the process reference model. The first was to compare the listed processes to those recorded in other relevant reference models. The second was to review the initial draft of the process reference model with the stakeholders, including Regional Director of Pharmacy, within the host organization. Two reference models were considered for the purpose of comparison: 1) SCOR reference model (Supply Chain Council Inc., 2012) and 2) the APQC (PCF) Process Classification Framework (American Productivity and Quality Centre (APQC), 2014). SCOR is specific to supply chain operations and as such was mainly applicable as a comparator to the process area of Manage Medication Supply Chain. SCOR also includes management processes which were included in the Manage and Administrate process area. SCOR's six process groups were mapped to those included in the reference model. The groups which are not supply chain specific do not appear in the SCOR model. The mapping has been excluded from this paper due to space constraints.

APQC has developed numerous industry specific Process Classification Frameworks (PCF) including one related specifically to the provision of health care. This PCF does not differentiate pharmaceutical inventory management between centralized inventory or point of care inventory which have different processes and specific legislated considerations. Although it can be used as a general guide it was not specific enough for use as a medication management process reference model.

The Regional Director of Pharmacy, the process owner, reviewed and accepted the process reference model as a reasonable listing of the processes associated with medication management and safety.

4 DISCUSSION & CONCLUSION

The proposed Medication Management Process Reference Model could be employed as a starting point in other healthcare organizations initiating a process architecture as it is based on processes which are relatively standard across healthcare. The processes are derived from review of the medication management business competencies included in the Business Competency Model. These processes are then categorized into logical groups which are further categorized into areas.

A common approach to developing a process architecture is to separate the processes into one of three types: core, support or management and then assign these as the highest level of the architecture. The proposed reference model includes a fourth area (Clinical Training and Professional Development) because some processes contained in it could be considered to be support or management. The clinical nature of medication education and clinician's reliance on education being provided by clinical pharmacists warranted it as an area on its own. This area also includes a process group related to training of students and residents from academic institutions who complete practicums in the host organization facilities.

The literature review conducted prior to this research did not reveal a process reference model specifically for medication management. The methods and tools used to create the proposed process reference model could potentially be used to identify processes in other service areas or indeed across an entire organization. Further research could include testing of the proposed model in other healthcare organizations and also testing and refinement of the methods and

tools through application in other service areas or organizations.

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APPENDIX 1: THE REFERENCE MODEL

1 Manage Medication at Point of Care
1.1 Register Patient
1.1.1 Enrol Patient in Appropriate Information System
1.1.2 Confirm Patient Identification and Identify for Clinical Pharmacy Services
1.2 Assess Patient
1.2.1 Interview Patient
1.2.2 Order Diagnostic Tests
1.2.3 Interpret Results of Diagnostic Tests
1.2.4 Diagnose Patient
1.3 Prescribe Medication
1.3.1 Conduct Best Possible Medication History Interview
1.3.2 Conduct Medication Reconciliation
1.3.3 Order Medication
1.3.4 Triage medication orders
1.3.5 Perform Clinical assessment of medication order
1.4 Dispense Medication at Point of Care
1.4.1 Maintain Point of Care Inventory
1.4.2 Manage Patient Owned Medications
1.4.3 Dispense Medication
1.5 Administer Medication
1.5.1 Prepare medication if required
1.5.2 Administer Medication to Patients
1.5.3 Complete Medication Administration Record
1.6 Monitor Patient
1.6.1 Provide Pharmaceutical Care to Patients
1.6.2 Deliver Patient Education on Medication Therapy
1.6.3 Monitor Patient Response to Medication Therapy
1.7 Transfer or Discharge Patient
1.7.1 Plan for Patient Discharge
1.7.2 Discharge Patient
2 Provide Clinical Training & Professional Development
2.1 Provide Pharmacy Staff Training
2.1.1 Identify Training Needs
2.1.2 Develop Training Materials
2.1.3 Deliver Training

2.1.4 Monitor Learner Progress and Provide Feedback
2.1.5 Monitor Training Effectiveness
2.2 Provide Clinical Pharmacy Competency Development
2.2.1 Establish Clinical Pharmacy Competencies
2.2.2 Develop Competency Evaluation
2.2.3 Develop Competency Training
2.2.4 Deliver Clinical Pharmacy Training
2.2.5 Monitor Learner Progress & Provide Feedback
2.2.6 Monitor Training Effectiveness
2.3 Provide Clinical Education(External to Pharmacy)
2.3.1 Identify Training Needs
2.3.2 Develop Training Materials
2.3.3 Deliver Training
2.3.4 Monitor Learner Progress and Provide Feedback
2.3.5 Monitor Training Effectiveness
2.4 Manage Clinical Student Placement
2.4.1 Engage with Education Providers
2.4.2 Identify Potential Candidates & Make Selection
2.4.3 Develop Training Plan
2.4.4 Monitor Student Progress & Provide Feedback
2.4.5 Evaluate Effectiveness of Training Plan
3 Manage Medication Supply Chain
3.1 Source Medication
3.1.1 Establish & Maintain Supplier Requirements
3.1.2 Evaluate and Approve Potential Suppliers
3.1.3 Identify and Maintain Supplier List
3.1.4 Negotiate with Suppliers
3.1.5 Collaborate with Suppliers
3.1.6 Monitor Supplier Performance
3.1.7 Perform Analysis and Response to Drug Shortages
3.1.8 Purchase Medication
3.1.9 Receive purchased medication
3.1.10 Initiate Payment
3.1.11 Pay Suppliers
3.2 Maintain Medication Inventory
3.2.1 Define Inventory Strategies
3.2.2 Define Inventory Demand
3.2.3 Create Inventory Plan
3.2.4 Define Performance Metrics
3.2.5 Establish Standards for Medication Storage

3.2.6 Ship Inventory to secondary inventory locations
3.2.7 Store purchased medication
3.2.8 Monitor medication storage procedures
3.2.9 Perform Inventory Count
3.3 Mix & Repackage Medication
3.3.1 Issue components from inventory
3.3.2 Compound Medications Outside Laminar Hood
3.3.3 Compound Medications within Laminar Hood
3.3.4 Package Compounded Medication
3.3.5 Add Compounded Medications to Inventory
3.3.6 Remove bulk packaged goods from inventory location
3.3.7 Repackage into single use doses
3.3.8 Restore unit dose packages in inventory
3.3.9 Repackage medications for 24 hour Batch (patient specific)
3.3.10 Pick medication from inventory
3.3.11 Issue medication from perpetual inventory
3.4 Distribute Medication
3.4.1 Transport purchased medication to secondary inventory location
3.4.2 Document Patient Specific Medication Orders
3.4.3 Verify Patient Specific Medication Orders
3.4.4 Dispense Patient Specific Medication
3.4.5 Replenish Ward Stock
3.5 Return Medication
3.5.1 Identify expired medications in Pharmacy Inventory
3.5.2 Return Expired Drugs to Pharmacy
3.5.3 Return Expired Drugs eligible for refund to Suppliers
3.5.4 Dispose of expired controlled substances
3.5.5 Dispose of expired medications
4 Manage & Administrate
4.1 Plan
4.1.1 Develop Strategic Plan & Goals
4.1.2 Establish Portfolio Priorities
4.1.3 Establish Governance Plans
4.1.4 Allocate Resources
4.1.5 Develop Strategy for Pharmacy & Medication Management
4.1.6 Establish Population Level Surveillance Plan
4.1.7 Develop & Communicate Regional Services Plan
4.1.8 Plan Research Strategy

4.1.9 Develop Medication Research Strategy
4.1.10 Establish Formulary Management Plan
4.1.11 Establish Business Operating Plan
4.1.12 Establish Standards for Pharmacy & Medication Management
4.1.13 Establish Plan for Clinical Trials
4.1.14 Identify Quality Improvement Plan
4.1.15 Plan for long term business operations
4.1.16 Establish Performance Measurement Plan
4.1.17 Maintain Drug Formulary
4.2 Manage Risk
4.2.1 Establish Risk Analysis Framework
4.2.2 Establish Risk Measures
4.2.3 Establish Risk Monitoring Plan
4.2.4 Establish Risk Reporting
4.2.5 Establish & Maintain Response to Adverse Events
4.2.6 Establish & Maintain Risk Rules & Regulations
4.2.7 Establish & Manage Risk Compliance
4.3 Monitor Compliance
4.3.1 Manage and Monitor Progress related to Governance Plan
4.3.2 Establish Compliance Plan and Reporting
4.3.3 Validate medication orders adhere to Safe Medication Order Writing
4.3.4 Document receipt, administration and disposal of controlled substances
4.3.5 Document receipt, administration and disposal of controlled substances
4.3.6 Monitor & Control compliance with Policies & Procedures
4.3.7 Evaluate & Audit effectiveness of Policies & Procedures
4.4 Manage Contracts
4.4.1 Negotiate contracts
4.4.2 Manage contract Budget
4.4.3 Evaluate and monitor contract liability
4.4.4 Evaluate and monitor contract performance and compliance
4.5 Manage Human Resources
4.5.1 Identify Human Resource Requirements
4.5.2 Recruit Staff to meet Identified Needs
4.5.3 Recruit Staff to identified Needs
4.5.4 Orientate Staff
4.5.5 Schedule Staff
4.5.6 Manage Staff Performance
4.5.7 Manage Staff Recognition Program
4.6 Manage Financial Resources
4.6.1 Identify Operating Budget Requirements
4.6.2 Monitor Operating Expenditures
4.6.3 Initiate Operating Budget Remediation Actions
4.6.4 Identify Capital Budget Requirements
4.6.5 Monitor Capital Expenditures
4.6.6 Initiate Capital Budget Remediation Actions
4.6.7 Forecast operating and capital budget performance
4.6.8 Initiate Accounts Receivable
4.6.9 Collect Accounts Receivable
4.6.10 Manage Employee Travel Expenses
4.7 Manage Information
4.7.1 Establish Information System Standards
4.7.2 Manage Information System Access
4.7.3 Manage Patient Records
4.7.4 Monitor & Improve Data Quality
4.7.5 Maintain clinical pharmacy patient record
4.7.6 Maintain Medication information resources
4.7.7 Maintain Inventory Data
4.7.8 Manage Master Drug Library for Infusion Pumps
4.7.9 Develop and Maintain medication order sets
4.7.10 Develop & Maintain Performance Monitoring Reports
4.8 Procure & Maintain Equipment & Facilities
4.8.1 Establish & Manage Equipment Schedule
4.8.2 Procure Equipment through Renting or Leasing Option
4.8.3 Establish & Manage Plan for Equipment Maintenance
4.8.4 Establish & Maintain Asset Tracking Policies & Procedures
4.9 Provide Operational Oversight
4.9.1 Establish and Manage Partnerships
4.9.2 Establish & Manage Provincial Government Relationship
4.9.3 Establish & Manage Municipal Government Relationships
4.9.4 Establish & Manage Public Private Partnerships
4.9.5 Establish & Staff Pharmacy Hours of Operation
4.9.6 Promote continuous Improvement
4.9.7 Implement and Maintain Anti-Microbial Stewardship Program
4.9.8 Promote Integration & Practice Management
4.9.9 Develop & Maintain Community & Emergency Response Plan
4.9.10 Research Best Practice

4.9.11 Establish Emergency Response Policies & Procedures
4.9.12 Manage Fleet Vehicles
4.9.13 Develop & Monitor Administrative Reports
4.9.14 Develop & Monitor Clinical Reports
4.9.15 Develop & Publish Performance Reports