A FRAMEWORK FOR RAPID PROBLEM ASSESSMENT IN HEALTHCARE DELIVERY SYSTEMS

A thesis submitted for the degree of Doctor of Philosophy

By

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ABSTRACT

Problems in healthcare are difficult to comprehend due to complexity, involvement of multiple stakeholders in decision making and fragmented structure of delivery systems. Major Problem Structuring Methods (PSMs) have been used to aid problem understanding which, in principle, can provide greater clarity to strategic problems and engage diverse decision makers using transparent representation that capture differing perceptions of problems. In reality, PSMs can be difficult in accurately representing problems, limited in highlighting improvement opportunities due to non-intuitive visual representations and requirements for facilitators and stakeholders to be experts in tools used.

This research aims to address this gap by developing a framework, taking into account characteristics of healthcare delivery systems, advantages and limitations of PSMs with an aim of providing accurate and holistic representation of delivery workflow, so as to promote problem understanding in a rapid manner. The framework, termed CARE, first establishes nature of problem and a commonly agreed problem statement along with an understanding of stakeholder involvement and operating regulations. It then sets specific guidelines for data collection, representation, verification and validation from stakeholders and provides methodology for data analysis which allows facilitator insight into possible flaws in workflow. A case study approach is used to test effectiveness of CARE across two different healthcare settings, each involving a different nature of problem. Implementation of CARE leads to improved participation and ownership amongst stakeholders, ease of facilitation during individual or multidisciplinary meetings, intuitive and informative representation of workflow, minimized time and effort for implementation and minimized dependencies on learning new tools and terminologies. A post mortem indicates the positive impact of CARE on services rendered to the patients, leading to an increase in patient satisfaction and workflow efficiencies. The research concludes by noting the contributions and lessons learnt from this research for healthcare practitioners and possible future work.

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PUBLICATIONS

JOURNAL ARTICLES

- Singprasong, R. and Eldabi, T. (2011) 'An Integrated Methodology for Process Improvement and Delivery System Visualization at a Multi-Disciplinary Cancer Center', *Journal of Healthcare Quality.*

- Singprasong, R., Bhatnagar, S. and Eldabi, T. (Revision for final submission) 'CARE Assessment via Rapid Execution: A novel approach for addressing wicked healthcare problems', *Journal of the Operational Research Society.*

ABSTRACT AND POSTER

- Singprasong, R. (2011) 'A Rapid Implementation Approach for Optimizing Care Delivery Systems and Improving Patient Satisfaction at a Multidisciplinary Cancer Center', In: *Proceedings of the 2011 Winter Simulation Conference, Phoenix, Arizona.*

PRESENTATIONS

- Singprasong, R. (2011) 'Care Assessment via Rapid Execution: A framework for problem assessment in a healthcare delivery system', Invited to Present at Veterans Health Administration Health Policy and Quality Program, Michael E. DeBakey Veterans Affairs Medical Center, Houston Texas, 23 November 2011.

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Improvement Seminar, Bangkok General Hospital, Bangkok Thailand, 2 March 2011.

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LIST OF ABBREVIATIONS

CARE	Care Assessment via Rapid Execution
Chemo	Chemotherapy
DoH	Department of Health
EMR	Electronic Medical Record
GI	Gastroenterology
MA	Medical Assistant
NHS	National Health Service
OR	Operation Research
PE	Physicians
P/E	Physicians / Extenders
PET/CT	Positron Emission Tomography – Computed Tomography
PSM	Problem Structuring Method
PP	Patient pathway
RACI	Responsible, Accountable, Consulted and Informed
SCA	Strategic Choice Approach
SLA	Swim-Lane Activity Diagram
SODA	Strategic Options Development and Analysis
SSM	Soft System Methodology
TRCC	The Regional Cancer Center
U.K.	United Kingdom
U.S.	United States
UNT	University of North Texas
UPMC	University of Pennsylvania Medical Center
WHO	World Health Organization

1. INTRODUCTION

1.1. Introduction

The term “Healthcare” (or “health care”), refers to the diagnosis, treatment, prevention and management of disease, illness, injury, and other physical and mental impairments in humans. It is offered by the medical, dental, pharmaceutical, clinical laboratory sciences, nursing, and allied health professions (WHO, 2000). The term “system” consists of interacting, interrelated, or interdependent elements that form a complex set of interacting objects or people that behaves in ways that individuals acting alone would not (Ryan, 2005) and the delivery system can be defined as a means or procedure for providing a product or service to the public. Together, healthcare delivery systems are responsible for good health, responsiveness to the needs of the population, and fair financial contribution (WHO, 2000).

However, healthcare delivery systems can suffer from large systemic problems that can make comprehending problems difficult and ultimately lead to inefficient processes. The major challenges presents in healthcare delivery systems which make problem understanding difficult are its complexity, the involvement of multiple stakeholders in decision making and the silo structure between the different units that make up the delivery systems (Thompson, Wolf and Spear, 2003; Tucker and Edmondson, 2003; Tucker, 2004; Reid et al., 2005). The first challenge, complexity, can be characterized as an exceedingly large number of entities, dynamic interaction, continuous unforeseen emergent conditions and a high degree of uncertainty (Keating, 2000). The healthcare delivery system consists of the involvement of a variety of health care organizations, caregivers, patients, state and federal government as well as other organization. These systems also involve a large number of interconnections between the components and the system such as multihospital systems and provider networks with linkages between hospitals, physicians groups, insurers and others (Reid et al., 2005). Change in any one element can alter the context for all other elements and can subsequently be influenced by them (Kernick, 2004). Further, some problems in healthcare can be clearly delineated and solved by experts who can produce workable solutions. However there also exist ill-structured and incompletely described problems with competing and changing requirements, which can add or trigger dynamic interactions between units. For example,

physicians know with some precision how to diagnose and treat certain acute diseases, but people who suffer from complex chronic conditions are associated with a high level of uncertainty, require much more individualized care and can have demanding requirements from multiple units. Management of such interactions can be complicated and unpredictable and require careful management of resources to ensure that necessary staff and equipment are in the right place at the right time (Ryan, 2005). These characteristics render the healthcare delivery system to be similar to complex systems (IOM, 2001; Berg, Schellekens and Bergen, 2005; Forsberg et al., 2011).

The second challenge for promoting problem understanding is the presence of multiple healthcare professionals in decision making who have diverse educational and professional backgrounds (Atkinson et al., 2001). For example, clinicians, healthcare managers, dieticians, phlebotomist, technicians, nursing, neurosurgeons, radiologist are few of the professions that exists within the healthcare delivery system. The decision making in this complex system is heavily influenced by individuals or groups in healthcare who pursue self-interest via personal power and influence mobilizing economic strategies (Eldabi and Paul, 2001). Each healthcare professional will have their own view of the problem and provide assessment and solutions to the problems uniquely. Sometimes the problem may arise as a result of misunderstanding amongst the problem owners with actually no real problem with the system itself. Due to the presence of multiple stakeholders, it becomes difficult to accurately understand and assess the real root-cause of problems (Bolch et al., 2005).

Another challenge that contributes to the comprehending problems is the fragmented interactions between the different operating units (Reid et al., 2005; Shih et al., 2008). According to one of the survey, 75 percent of patients describe the healthcare delivery systems as fragmented and fractured; a nightmare to navigate; and plagued by duplications of effort, lack of communication and conflicting advice regarding treatment (Picker Institute, 2000). Each care providing unit operates differently with lack of complete transparency and communication among the different functions that together make up the delivery system (Leichsenring and Alaszewski, 2004; Reid et al., 2005). Apart from disconnects in communication between the units, an increase in specialization in medicine has further reinforced the silo structure that is characterized by disconnected functions and specialization (Reid et al., 2005). Each clinician with their own specialization operates as independent agents. For example, of the approximately 700,000 clinicians in the United States (U.S.), who represents more than 100 clinical specialties, more than 80 percent practice medicine in groups

of 10 or fewer (Lawrence, 2005). This can have an impact on the overall comprehension of the system as a whole and can cause medical error especially for patients obtaining care from multiple providers. For example, a patient suffering from two diseases may be referred to two separate physicians and treatment processes, each having no visibility into the other treatment being imparted. Further, this can also leads to waste and duplications causing workflow inefficiencies leading to increase in operating costs (Shih et al., 2008).

1.2. Background: Problem Understanding, PSM approaches and Multimethodology

To address the challenges towards problem understanding, literature suggests that comprehension should be first and of paramount importance for decision making (Eldabi, 2000; Lebcir, 2006; Anderson et al., 2012). It is better to understand the exact nature of the problem and then select a suitable method for resolution than to start attempts at solving a poorly understood problem, only to discover that the proposed solution was not really relevant. In complex systems, understanding the problem can be tedious requiring specialized expertise and establishing a common understanding and reaching consensus amongst multiple stakeholders can be challenging. Traditional operation research (OR) (or hard OR) techniques offer remarkably little assistance in this matter (Rosenhead, 1996; Ackoff, 1999). In recognition of the need to assist diverse stakeholders in comprehending and addressing a problematic situation that involves differing perspectives or existence of conflicting interests, high levels of complexity and uncertainty, the use of soft OR techniques like problem structuring method (PSM) has been adopted (Connell, 2001; Mingers and Rosenhead, 2004). PSM provides decision makers with systematic help in identifying an agreed framework for their problem and takes the standard formulations of OR methodology, for example, formulate, model, test, solve, and implement, as their foundation (Rosenhead, 2006). The result is either a well-defined project that can be addressed using traditional OR methods, or a clarification of the situation that enables those responsible to agree on a course of action. In principle, PSM can provide greater access to strategic problems that is, those engaging multiple relatively independent decision makers and the transparent methods of representation can capture differing perceptions of the situation, to help generate a consensus or to facilitate negotiations (Rosenhead, 1996). Several PSMs approaches exists of which Strategic Options Development and Analysis (SODA), Soft System Methodology (SSM) and Strategic Choice Approach (SCA) are the key approaches (Eden and Ackermann, 2001 and 2006; Mingers and Rosenhead, 2004; Paucar-Caceres, 2010; Ackermann, 2011; Mingers, 2011; Gaspoz and Wand, 2012).

SCA manages uncertainty in strategic planning situations (Mingers and Rosenhead, 2004; Gaspoz and Wand, 2012) where facilitators assist stakeholders to model the interconnectedness of decision areas and compare the alternative decision schemes which will help bring key uncertainties to the surface. SODA uses cognitive mapping as a modelling device for eliciting and recording an individual's views and perceptions of a problem situation. SSM on the other hand, supports system redesign in building conceptual models while supporting various world views. These world views are compared with the perceptions of the existing system in order to generate debate about what changes are feasible and desirable. There is also an extensive literature available with regards to combining a number of PSMs, or PSMs with more traditional methods, in a single intervention—a practice known as multimethodology (Mingers and Gill, 1997). It is a term used to describe the combined use of two or more methodologies (or part thereof) within a single intervention. It can allow the practitioner to address both the quantitative and qualitative aspects of a complex situation (Mingers and White, 2010) and explain the characteristics of an intervention.

1.3. Research Problem

Despite advantages offered by the application of PSM approaches and multimethodology, there exist some limitations which do not address the challenges to problem understanding adequately. Firstly, in all PSM approaches, accurately representing the problem situation can be challenging and there can be a risk of not accurately representing the real world processes (Eden and Ackermann, 2001; Georgiou, 2007; Rodriguez-Ulloa et al., 2011). Further, there can be limitations in highlighting other improvement opportunities due to the choice or effectiveness of visual representation (Mingers and Brocklesby, 1997). Some PSM approaches (SCA and SODA) require that the facilitators and stakeholders are experts in the different tools, terminologies and methods of application (Bryant and Chin, 2000; Vidal, 2005; 2006; Sørensen and Vidal, 2008; Georgiou, 2007 and 2010). This can require significant investment of effort from the stakeholders. Literature also suggests that the PSM approaches have been found to be weak in providing specific mechanisms for systemic understanding and decision making along with an absence of process of implanting the proposed changes in the real world (Williams et al., 1995; Georgiou, 2007; Rodriguez-Ulloa et al., 2011). Additionally, there can be significant time and cost implications for application (Mingers and Taylor, 1992; Ledington and Donaldson, 1997; Lehaney, Clarke and Paul, 1999; Winklhofer, 2002; Hjortso, 2004; Georgiou, 2009). While multimethodology has allowed practitioners the ability to combine soft

and hard OR techniques for problem solving, there is no consensus on the selection criteria. Several papers found in the literature have led to a successful implementation of qualitative and quantitative techniques involving multimethodology in the healthcare domain. However each has followed a significantly different combination to achieve that. Further, the results are specific to the nature of problem at hand and the organizational context and may not allow for generalization across a wide variety of healthcare problems.

1.3.1. What May Help

This subsection discusses why an alternative approach of problem understanding may overcome the above mentioned limitations of SCA, SODA and SSM. Further, such an approach should also take into account the major challenges that exist in healthcare system such as those introduced in Section 1.1 that includes the complexity that exist in healthcare systems, the involvement of multiple stakeholders in decision making and the silo structure between the different units that make up the delivery systems.

The ability to represent the problem situation along with an accurate representation of the real world has been cited as a major limitation of current PSM approaches. There are also limitations in noting improvement opportunities in an effective visual fashion, so as to drive systemic decision making amongst stakeholders. Further, significant time and effort estimates are required due to extensive requirements for understanding tools and terminologies. It is possible that an alternative approach such as a healthcare specific framework can be developed to wholly or partially address such limitations of existing PSM approaches. For example, a graphical and easy to represent technique can be utilized to assess the problem situation which will minimize the need and the effort required for understanding by stakeholders. A holistic representation can showcase the interdependence of components that makeup the system which will help understand the relationships. This may be needed in order to bring together other relevant information such as resources and effort spent on each process, which can help provide a better insight of the roles, responsibilities and resource allocations within the healthcare delivery system. Firm guidelines can be provided for systemic decision making and an approach to identify problems and provide possible solution indicators can be adopted. Adopting these measures can lead to significant savings in time and cost of implementation. This discussion will be further expanded in Chapter Two which presents a literature review of the current approaches of PSM and attributes that can assist in problem understanding.

1.4. Research Aim and Objectives

This research is looking for an approach that will overcome limitations of PSM approaches (SCA, SODA and SSM) and aid in addressing the challenges that exist within the healthcare domain, to enable healthcare practitioners to understand the problems they face and efficiently evaluate the situation by identifying and studying the implications of their decisions. As a means for that the aim of this research is **to develop a framework which provides a holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner.** In order to fulfil the research aim, the following research objectives are summarised as follows:

Objective 1: Investigate the current state of research

The first objective of this thesis is to develop an in-depth understanding of the structure and challenges in healthcare delivery systems, problem understanding and solving and major PSM methods that have been applied to problems in healthcare. This will enable a clear understanding of their strengths and limitations and the context in which they operate, which can aid in developing the research focus. This will be accomplished via a comprehensive literature review.

Objective 2: Formulate the research focus

After developing a comprehensive understanding of the major PSMs approaches and its applications along with attributes that will help in understanding problem in a complex healthcare delivery system and the current state of research, the research focus will be derived. The research focus will enable targeting efforts towards developing the proposed framework to enhance the understanding of complex healthcare delivery system problems in a simple and rapid manner.

Objective 3: Establish the foundations of the proposed framework

The research problem represents the gap that there is a need for an alternative approach for problem understanding between healthcare practitioners. The research focus will aid in identifying the strategy and means to close this gap. On the basis of understanding and knowledge gained from the literature review, a basic structure and components of the proposed

framework capable of enhancing understanding healthcare delivery systems problems will be proposed.

Objective 4: Deploy the framework

Once the framework is constructed, it will be deployed in different and multiple real world healthcare delivery systems to assess its feasibility, limitations and understand the impact that can be gained from deploying this framework. Deployment in multiple healthcare delivery systems will allow evaluation of the framework in different healthcare settings and its capability to be adapted to different nature of problems. The deployment of the framework will follow the structure outlined in the previous objective.

Objective 5: Evaluate and refine the framework

The framework will be evaluated in detail to identify its effectiveness in achieving the research aim and bridging the gap identified in the current research methods. The framework will be evaluated theoretically based on the deployment of framework at healthcare domain. Reflections from this evaluation will provide the basis for refinement. The modified framework will be evaluated empirically using a case study. The purpose of implementation is to highlight the limitation of the framework which cannot be identified from theoretical evaluation alone. It is hoped that by achieving these objectives, the aim of this research will be realised.

1.5. Research Design

Research is a process that begins with a problem and ends with the problem either resolved or addressed (Brink et al., 2006). It helps create new knowledge and develop proper tools for the use of existing knowledge. All research approaches contribute to research outcome equally but the emphasis on which research approach to choose depends on researchers. There is also the possibility of merging different research approaches, depending on the issue at hand (Saunders et al., 2007). In this research, the method is selected and designed with the aim of answering the research objectives and ultimately fulfil the research aim – that is to develop a framework which address problems in the delivery workflow and promotes problem understanding in a rapid manner.

Generally, the framework of a research design consists of three major elements of inquiry:

(a) philosophical assumptions, (b) strategy inquiry, and (c) methods (Creswell, 2003). The first element is the philosophical assumptions which explain the assumptions on which the research design is based, meaning that it defines what constitutes knowledge claims. The second element is the strategy of inquiry or methodology which provides the choice or the use of method or the general research procedures, for example, survey research, ethnography and case study. The third one is the methods which are techniques and detailed procedures of data collection, analysis and writing, for example, questionnaire, interview and focus group. Other elements such as research approaches, time horizons and types of data or method can also be added to provide a richer picture of the overall research design. A research design framework by Creswell (2003) could be complemented by the research onion proposed by Saunders et al. (2007) to provide the additional elements mentioned earlier. A broad spectrum of the research design is depicted in Figure 1.1. The research design and methodology will be discussed in more detail in Chapter Three.

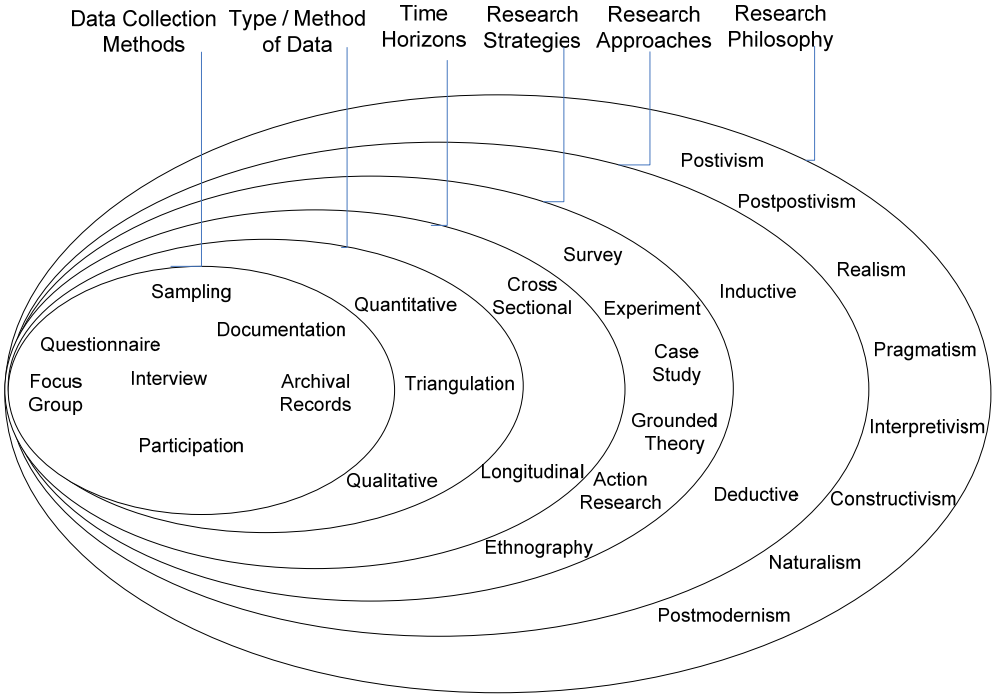

Figure 1.1 An overall picture of a research design

1.6. Outline of the Thesis

This section presents an outline of the dissertation. Figure 1.2 illustrates the mapping of the outline to the previously describe research objectives. The structure of this dissertation is as

follows:

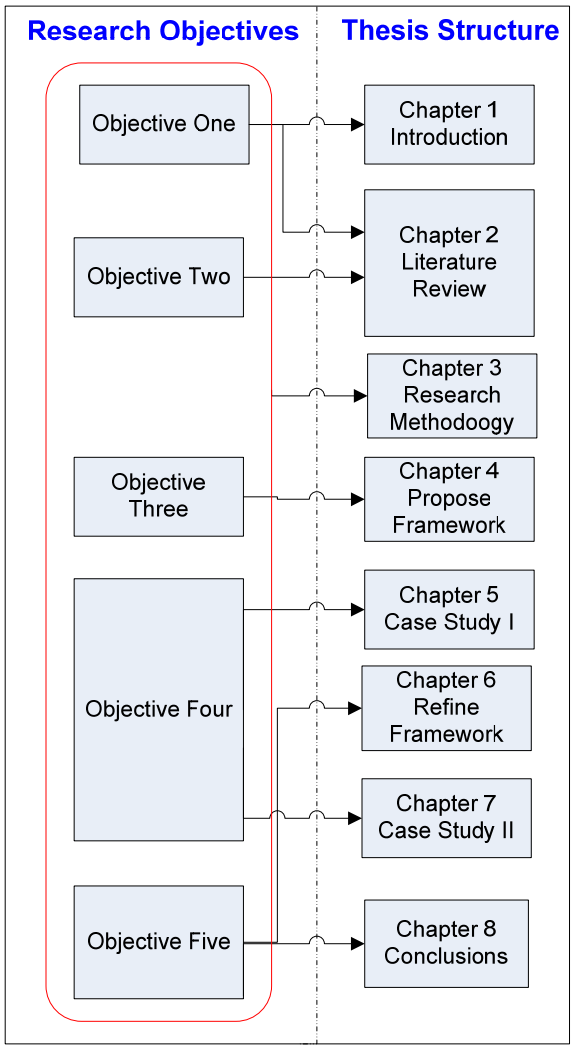

Figure 1.2: Overview of Research Objectives and Thesis Structure

- Chapter One (Introduction) provides the background to the problem domain, that is, major challenges in healthcare delivery systems, main problem structuring methods and their limitations. The research aim and objectives are formulated followed by a discussion on the proposed research methods and an outline of the thesis.

- Chapter Two (Literature Review) expands the concepts introduced in Chapter One by conducting theoretical review to understand the composition and complexity of healthcare delivery systems and its problem, the method for problem understanding and the problem structuring methods and its main approaches. It also presents the gap in the main PSMs

(SCA, SODA and SSM), the combined approaches (Multimethodology) and highlights the need for a proposed framework for problem understanding in healthcare delivery systems. In addition, the literature also includes discussion on framework development and approach to evaluating them. By completing Chapter One and Two, Objective One and Two (described in Section 1.4) will be met.

- Chapter Three (Research Methodology) describes the research design, explains and justifies the chosen research approach including the method of data collection. Moreover, it explains the selected case hospital and their background. This Chapter provides the foundation and direction of how the research will be conducted and hence help to achieve all the Objectives described in Section 1.4.

- Chapter Four (A Proposed Framework) is built upon the basis of understanding and knowledge gained from literature reviews presented in Chapter Two using the research approach outline in Chapter Three and proposes a framework (termed CARE) for usage by healthcare practitioners to address delivery system problems. Completion of this Chapter will fulfil Objective Three as described in Section 1.4.

- Chapter Five (Case Study I: The Regional Cancer Center) illustrates how the proposed framework introduced in Chapter Three is deployed via a case study at University of Pennsylvania Medical Center (UPMC) – TRCC. The chapter also presents a detailed analysis of the effectiveness in meeting the requirements of the framework outlined in the previous chapter.

- Chapter Six (Refinement of CARE Framework) reflects on the limitation of the framework encountered from the evaluation of Case Study I presented in Chapter Four, describes the modifications and presents the final framework which is the main output of this dissertation.

- Chapter Seven (Case Study II: The Gastroenterology Clinic) illustrates how the refined framework revisited in Chapter Five is deployed via a case study at University of North Texas (UNT) Patient Care Center – GI Clinic. The chapter also presents a detailed evaluation of the framework in meeting the requirements outlined in the previous chapter.

Completion of Chapter Five and this Chapter will fulfil the goal of Objective Four.

- Chapter Eight (Summary, Conclusions, Limitations and Future Work) includes a summary of this dissertation, highlights its conclusions, limitations and identifies possible areas of future work. Chapter Six and this chapter will fulfil the last Objective of this research.

1.7. Summary

This chapter provided an introduction to the problem context of this thesis, which relates to the challenges in understanding problems within the healthcare delivery system due to its complexity, the involvement of multiple stakeholders in decision making and the silo structure between the different units. An overview of the use of major PSM approaches including SODA, SCA and SSM in the context of healthcare is provided along with their limitations with regards to addressing these complexities. The chapter also highlighted the need of an alternative healthcare specific framework which can be developed to address the challenges in healthcare delivery systems and limitations of major PSM approaches. The chapter further discussed the aim of this research, that is, to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner. It further elaborated the objectives of this research which are needed to realise the aim and provided a description of methodology used along with an outline of the dissertation. In order to achieve the first two objectives, the next chapter will focus on review of literature.

2. LITERATURE REVIEW

2.1. Introduction

In the previous chapter, development of a framework which provides an accurate and holistic representation of the delivery workflow in order to promote problem understanding in a rapid manner has been proposed as the main aim of this research. The main objective of this chapter is to provide literature to support the aim and provide a comprehensive study of the domains of the research and established methods. An effective framework cannot be developed without a comprehensive understanding of the challenges and components in healthcare delivery system and an understanding of the nature of problems along with the appropriateness of major PSM approaches which are: Strategic Options Development and Analysis (SODA), Soft System Methodology (SSM) and Strategic Choice Approach (SCA). The chapter presents an examination with regard to their abilities to enable agreement and understanding of healthcare delivery system problem amongst stakeholders. The goal of this chapter is to achieve Objective One (investigate the current state of research) and Objective Two (formulate the research focus). The following paragraph presents a brief outline of the chapter.

This chapter begins with Section 2.1 providing a brief introduction to the chapter while Section 2.2 presents an overview of the structure of care delivery systems. Section 2.3 discusses the major challenges that exist in the healthcare delivery systems which include large and complex delivery systems, the involvement of multiple stakeholders in decision making and the silo structure between the different units that make up the delivery systems. Section 2.4 presents the nature of problems that exist in health care while Section 2.5 presents overview of PSM in healthcare and examines the main PSM approaches – SCA, SODA and SSM. It expounds the discussion in the areas of philosophy, core concepts, major strengths and weaknesses and evaluates with respect to their abilities to offer facilities for problem understanding. Further, it also presents a review of a combine approaches, Multimethodology. Section 2.6 examines the characteristics of facilitation and the different techniques that exist and section 2.7 presents the discussion on the development and evaluation of the framework. Section 2.8 presents the main research questions and hypotheses while Section 2.9 presents the summary of this chapter.

2.2. Components of Healthcare Delivery Systems

In order to understand the problem in a system as complex as the healthcare delivery system, it is important to first understand the generic architecture along with interactions and dependencies between the different components. There exist several categorizations of typical healthcare delivery systems in the literature which develop and provide a better understanding of the system, its components and functioning. Shi and Singh (2008) presented the quad-function model to describe the healthcare delivery system as incorporating of four functional components namely, Delivery, Financing, Insurance and Payment that are necessary for the delivery of health services. Figure 2.1 illustrates the organization of these components. The delivery components refer to the provision of healthcare services and the receipt of payments from insurance for those services. After the provision of care, the financing component is necessary to obtain health insurance or to pay for healthcare services. This can be the responsibility of an individual, employer or the government. Individual self-funding can be in the form of co-pay or personal financial responsibility in the case where the patient does not have adequate insurance.

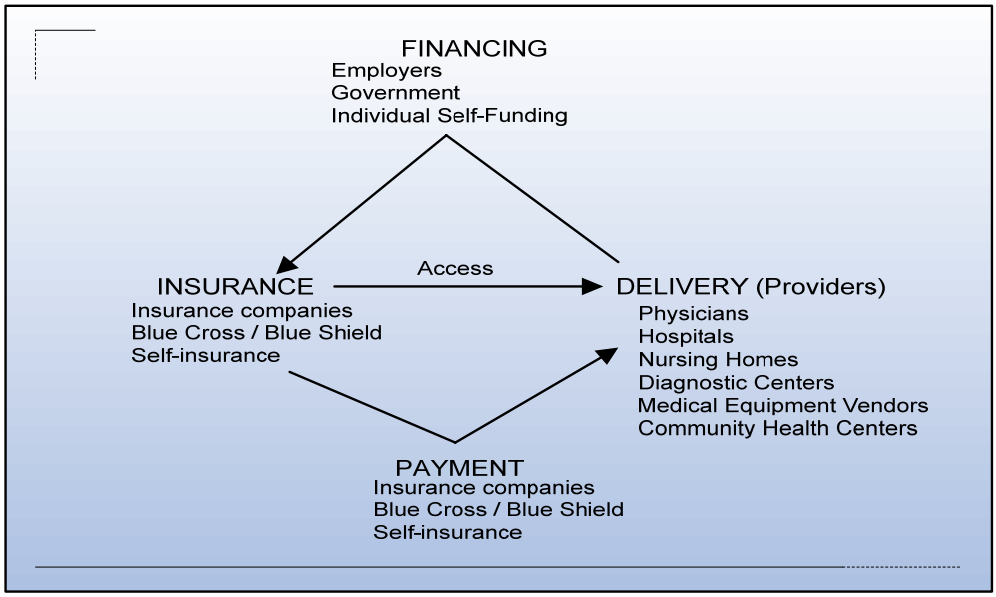

Figure 2.1: Basic healthcare delivery function

(Adapted from: Shi and Singh, 2008)

In the case of financing via employers or government, insurance companies are needed to review policy to determine extent of financial responsibility and the package of health services

the insured individual is entitled to receive. The insurance function protects the insured against catastrophic risks when needing expensive health care services and specifies how and where health care services will be received. They should also have access to the care providers to verify and validate details about the services provided to the patient. The payment function deals with reimbursement to providers for care provided to individuals. Reimbursement is the determination of how much to pay for a certain service, where funds for actual disbursement come from premiums paid to the insurance company. Healthcare delivery systems differ depending on the arrangement of these four components and these components generally overlap but the degree of overlapping differs between a private and government run systems and between a traditional health insurance and managed care based systems.

Dade (1973) categorized the healthcare delivery systems into three major components which are consumer (or patients), services and facilities as illustrated in Figure 2.2. These components interact with their environment which can consist primarily of social, political and educational elements. These elements are not part of the healthcare delivery system but changes in or inputs from these elements can produce changes to the system. The decision makers of the healthcare delivery system are defined as the consumers, health professionals, assistants and technologists. Their function is to allocate resources that make the system operates in an efficient manner.

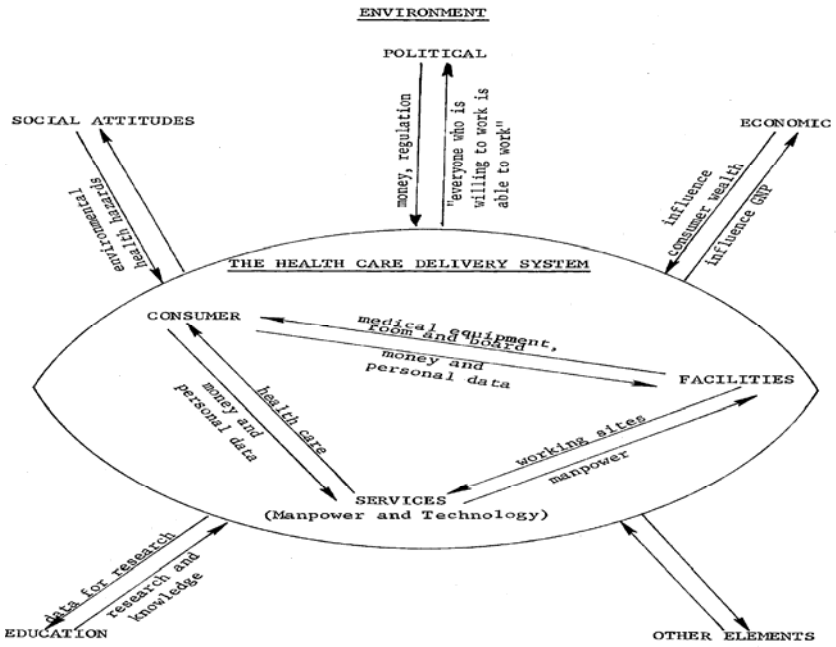

Figure 2.2: The healthcare delivery system and its environment

(Adapted from: Dade, 1973)

Consumers of healthcare services come from an environmental population which can be composed of individuals who could be either classed as well, worried well, early sick or sick, or some combination of the four. The services component can be further subdivided in two categories – manpower and technology. This distinction is made to indicate that services are performed by health professionals, people and that the manner in which they are performed, the technology, is not strictly dependent on the professionals who actually perform these services. The facilities segment contains physical facilities where services are provided and may be operated by public or private groups.

Ferlie and Shortell (2001) described the health care system comprised of four "nested" levels comprising of the individual patient; the care team; the organization; and the political and economic environment (as shown in Figure 2.3). The first level, that is, the individual patient, reflects an emphasis on "consumer-driven" health care where the focus is on individual patient needs and preference. The availability of information reflects an increasing expectation that patients will drive changes in the system for improved quality, efficiency, and effectiveness (Reid et al., 2005). The second level consists of professional care providers, for example, clinicians, pharmacists, and nurses, the patient and family members who are collectively known as the care team. The care team is the basic building block of a "clinical micro-system," defined as the smallest replicable unit within an organization or across multiple organizations that is replicable in the sense that it contains within itself the necessary human, financial, and technological resources to do its work (Quinn, 1992 cited in Reid et al., 2005). The third level is the organization for example, hospital, clinic and nursing home, that provides infrastructure and other complementary resources to support the work and development of care teams. The organization is a critical lever of change in the health care system as it provides an overall climate and culture for change through its various decision-making systems, operating systems, and human resource practices. The organization encompasses the decision-making systems, information systems, operating systems, and processes for example, financial, administrative, human resource, and clinical, to coordinate the activities of multiple care teams and supporting units and manage the allocation and flow of human, material, and financial resources and information in support of care teams. The organization is the business level, the level at which most investments are made in information systems and systems tools. Finally, the fourth level is the political and economic environment, which includes regulatory, financial, and payment entities that influence the structure and performance of health care organizations directly and, through them, all other levels of the system.

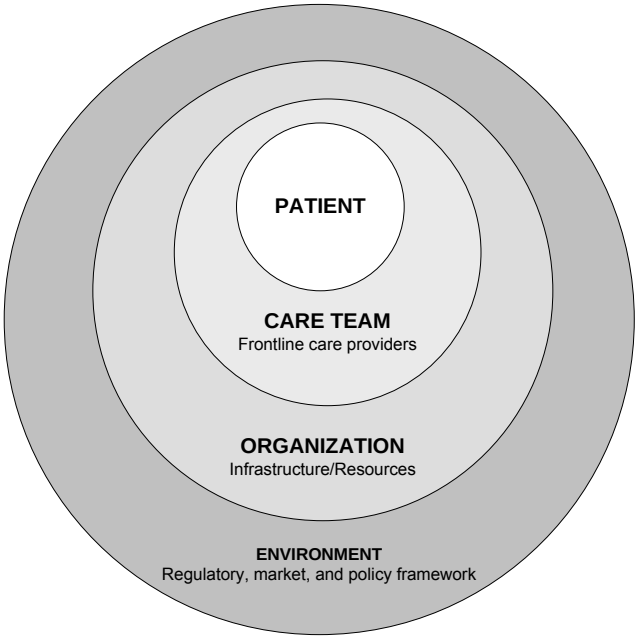

Figure 2.3: Four-Level of Healthcare Systems

(Adapted from: Ferlie and Shortell, 2001)

Coffey (2005) divides the healthcare systems into five different levels as shown in Table 2.1. At the first level lies the individual patient level. In this level patients interact autonomously with care provider for their diagnosis and treatment. At the second level is the department or unit level, such as operating rooms and cancer programs. The health care provider use facilities provided in this level to treat patient. In fact, these departments or units are all part of the individual hospital which is the third level of the health care model. The fourth level is the multi-institutional or multi-organization systems. In this level an interaction takes place between multiple health care sites or functions coordinating to provide effective and efficient care to the patient. The last level is the virtually integrated health system. It is the collaboration that takes place among multiple organizations to improve health (Coffey, Fenner and Stogis, 1997).

Table 2.1: A five-level model of healthcare system

(Adapted from Coffey, 2005)

Level	Explanation	Examples
Patient	Treatment of individual patient	Clinical practice Surgical practice
Department / unit	Specific systems within a program, unit, or department	Operating rooms Cancer program
Hospital	Interacting systems with a hospital	Multiple departments Multiple Settings
Multiinstitutional/ multiorganization systems	Interacting systems among institutions	Multiple sites Multiple hospitals Multiple functions
Virtually integrated health system	Medical care in the larger context of a community and environment	Integration among all systems affecting health and health care

While the model presented by Shi and Singh (2008) includes the care delivery process in the perspective of other functioning agents like financing, insurance and payment and their interconnectivities, the other models adopt a healthcare centric view with the other agencies described as external entities which influence the environment within the care delivery system. In general, all the models described in literature include multiple interconnected functions or levels with unique objectives. The models are not only associated with manpower and technology but also include environmental factors such as policy, standards, laws, social attitudes and regulations. Thus the healthcare system is described as an interconnected socio-political system which operates within the realms of society, government, healthcare infrastructure and technology. The next section discusses the challenges that exist within such healthcare delivery systems.

2.3. Healthcare Delivery Systems: Challenges to problem understanding

Problem understanding in a complex system like healthcare can be challenging (WHO, 2007). The major challenges presents in healthcare delivery systems which make problem understanding difficult are its complexity, the involvement of multiple stakeholders in decision making and the silo structure between the different units that make up the delivery systems (Thompson, Wolf and Spear, 2003; Tucker and Edmondson, 2003; Tucker, 2004; Reid et al., 2005). The in-depth understanding of each challenge will be further explored in the following subsection in order to understand its nature and how might it have affect in problem understanding.

2.3.1. Large and complex delivery systems

The first challenge is the complexity within healthcare delivery system and the term is often used in literature to define systems ranging from complicated to unsolvable. Definitions of complexity can be based on researcher's opinion and on the nature of problem at hand (Gell-Mann, 1995; Mainzer, 1997). The traditional view of complexity can be described in terms of one of the most commonly accepted notions - the interrelatedness of components of a system (Simon, 1962; 1965; 1973; 1996; LaPorte, 1975; Mindgley, 2006; Kannampallllil et al., 2011). Interrelatedness can be defined as a measure of the influence of system components which increases with number of components in a system, number of relations between them, and their uniqueness (Kannampallllil et al., 2011). This interrelatedness among components of complex systems results in non-decomposability and emergence, nonlinear behaviour, and in some cases self-organization. Several researchers (Rittel and Webber, 1973; Simon, 1962; 1965; 1973; 1996; LaPorte, 1975) have described these properties as identifying characteristics of complex systems. Non-decomposability means that the individual components cannot be understood in isolation but have to consider the challenges of interrelations and to be approached as a holistic system. LaPorte (1975) highlighted that because the variables in complex system are interrelated in interdependent ways, the traditional statistical methods inherently resistant to problem understanding since the methods assume that variables are unrelated. In systems where variables are systematically related to each other, inferring the behaviour of the whole from the behaviour of an individual part is impossible, in fact even inferring this behaviour from the behaviours of all of the parts becomes non-trivial (Simon, 1965). An important behavioural outcome of interrelations, suggested in literature, is that of emergence (Coveney and Highfield, 1995; Gallagher and Appenzeller, 1999; Johnson, 2001) where interactions between components often lead to unexpected behavioural properties for such systems. In additions to the interrelatedness, the introduction of different normative or subjective perspectives in a situation can also add to the complexity especially when people have to come to terms with new ways of seeing that different situation that they have taken ignored or taken for granted assumptions (Flood, 1987; Midgley, 1992; 2000).

Literature also suggests that some authors view healthcare as a complex adaptive system and uses the term complexity to signify complexity science (Fraser and Greenhalgh, 2001; Plsek and Greenhalgh, 2001; Plsek and Wilson, 2001; Wilson, Holt and Greenhalgh 2001; Mick and Wyttenbach, 2003; Barach and Johnson, 2006; Smith and Feied, 2006; Orr and

Shankar, 2007). This view has been proposed to reflect changes in the delivery of healthcare in terms of an introduction of a more evidence-based practice in diagnoses and treatment, and decisions made and implemented by multidisciplinary care management teams (Braxster, 2010). Plsek and Greenhalgh (2001) summarized the characteristics of this view, as complex adaptive systems, consisting of a collection of individual agents who are free to act in ways that are not always totally predictable and the actions of individuals are interconnected so that the action of one agent's changes the context for the other agents. The fact that complex systems interact with other complex systems leads to tension and paradox that can never be fully resolved, as the evolution of one system influences and is influenced by that of other systems (Hurst and Zimmerman, 1994). The organizational boundaries within healthcare are "fuzzy" and not clear. Systems within healthcare are embedded within other system and can adapt and evolve its behaviour over time (Holland, 1995). As each agent and each system is nested within other systems, all evolving together and interacting, it is difficult to fully understand any of the agents or systems without reference to the others. Such complexity characteristics can complicate problem-solving, lead to unexpected actions in response to change resulting in interaction with significant variability and continual emergence of new behaviours (Goldberger, 1996; Plsek and Greenhalgh, 2001; Wilson, Holt and Greenhalgh 2001; McDaniel et al., 2003; Barach and Johnson 2006; Orr and Shanker, 2007).

This view has not received universal support (Reid, 2002; Notcutt, 2002; Paley, 2007; Green, 2010) and while the alternative views of complexity agree with several of the attributes listed above, they do not go as far to conclude that healthcare problems are complex adaptive systems. Notcutt (2002) suggested that swapping the generally accepted view of complexity for complex non-linear systems and mathematics of complexity theory may not be right while others suggest that the key ideas of complexity theory used in healthcare are often distorted ideas ''trotted out in the guise of complexity'' (Paley, 2007) and are merely the ''emperor's new toolkit'' (Reid, 2002). Green (2010) suggested that before asserting a claim, it is important to show that phenomena not adequately explained by complicated linear models can be explained by the view of complex adaptive systems and that it provides answers that differ from those of linear models in meaningful ways.

The author views the healthcare complexity along the generally accepted view of complexity, where healthcare delivery systems consist of the involvement of a multiple components with different degrees of interrelations. Change in any one component can alter the context for all other elements and can subsequently be influenced by them (Kernick, 2004).

Table 2.2 illustrates this complexity with the involvement of multiple organizations and individuals in health care (Shi and Singh, 2008).

Table 2.2: The complexity of healthcare delivery

(Adapted from: Shi and Singh, 2008)

Academic	**Suppliers**	Insurers	**Providers**	**Payers**	**Government**
Medical Schools	Pharmaceutical Companies	Managed Care Plans	***Preventive Care*** Health Departments	Blue Cross / Blue Shield Plans	Public Insurance Financing
Dental Schools	Multipurpose Suppliers	Blue Cross / Blue Shield Plans	***Primary Care*** Physician offices Community Health Centers Dentists	Commercia l Insurers	Health Regulations
Nursing Programs	Biotechnology Companies	Commercial Insures	***Subacute Care*** Care Facilities Ambulatory Surgery Centers	Employers	Health Policy
Physicians Assistant Programs		Self-insured Employers	***Acute Care*** Hospitals	Third-Party Administr-ator	Research Funding
Nurse Practitioner Programs		Medicare	***Auxiliary Services*** Pharmacists Diagnostic Clinics X-ray Units Suppliers of Med Equipment	State Agencies	Public Health
Therapy Programs (physical, occupational, speech)		Medicaid	***Rehabilitative Services*** Home Health Agencies Rehab Centers Skilled Nursing Facilities		
Research organizations		Veterans	***Continuing Care*** Nursing Homes		
Private Foundations		Tricare	End-of-Life Care Hospices		
US Public Health and Other Associations			***Integrated*** Managed Care Organizations Integrated Networks		

There range from education and research institutions, medical suppliers, insurers, payers, government to health care providers. Multitudes of providers are involved in the provision of care ranging from preventive, primary, subacute, acute, auxiliary rehabilitative and continuity. For example, the US healthcare employed approximately 10 million in various health settings (National Center of Health Statistics, 2006) with vast array of health care institutions include

5,760 hospitals, 16,100 nursing homes, 4300 inpatient mental health facilities and training facilities including 150 medical school 56 dental schools, 91 school of pharmacy and more than 1,500 nursing programs (Shi and Singh, 2008). Also, there are multitude of public and private, insurance coverage with multitude type of plans and providers and multitude of government agencies are involved of the various aspects of the health care delivery system (National Association of Community Health Centers, 2006).

There exist several examples in literature regarding the study of complex healthcare systems such as the study of intensive care unit workflow by decomposing the workflow activities to that of individual clinicians (Malhotra et al., 2007), the association between the length of emergency department boarding and outcomes for critically ill patients (Chalfin et al., 2007) and the cognitive processes underlying decision making in a psychiatric emergency department using the theoretical framework of distributed cognition (Cohen et al., 2006).

To summarize, there exist differing views on how complexity is defined, characterized and solved for healthcare systems. Regardless, literature suggests that the view of healthcare system being complex is universally accepted. Further, complex systems can be considered in terms of functionally smaller components and their interrelations, based on theoretical and practical considerations. Such a decomposition results in a comprehensive understanding of the system, its components, and the extent of interrelation or dependence that govern the actions of the various components.

2.3.2. Multifaceted Decision-making

The second challenge is the presence of multiple stakeholders within the healthcare delivery system. A stakeholder can be understood as collective individual who work together in order to promote their common interest and act in a strategic fashion to influence the system (Kelner et al., 2004). The stakeholders in healthcare consist of care team such as individual physician and a group of care providers, including health professionals and healthcare support staff, patient and their family members and others whose collective efforts result in the delivery of care to a patient (s) (Nelson et al., 1998; Ferlie and Shortell, 2001; Reid et al., 2005). These individuals come from diverse educational and professional backgrounds and are involved in decision making (Atkinson et al., 2001). Examples include clinicians, healthcare managers, dieticians, phlebotomist, technicians, pharmacists, neurosurgeons and radiologists are few of the professions that exist within the healthcare delivery system.

Further there are a growing number of specializations of people involved in healthcare

delivery (Reid et al., 2005). For example, in the last half century, the number of categories of healthcare professionals in the U.S. alone increased from 10 to more than 220, roughly a 20-fold increase. Each clinician with their own specialization operates as independent agents. For example, of the approximately 700,000 clinicians in the U.S., who represents more than 100 clinical specialties, more than 80 percent practice medicine in groups of 10 or fewer (Lawrence, 2005). That is despite, existence of large multi-specialty group practices; the majority of physicians work in small single-specialty groups (Wilensky, et al., 2006). The increase in specialization implies that there are individuals in care processes and decision making with diverse backgrounds, which ultimately contributes to differing opinions. Employees from different functions often necessarily play competing roles. For example, while physicians seek to maximize the quality of care, finance people seek to minimize the cost of care. Decision making in this complex system is heavily influenced by pursuit of self-interest via personal power and influence mobilizing economic strategies (Eldabi and Paul, 2001). Some of them strive to influence those in power to protect or advance their position within a larger, interacting system (Boase, 1994; Rowley, 1997; O'Reilly, 2000). As a result, employees from different functions can tend to view each other with distrust and suspicion. Opposing parties often believe that the others' solutions will lead to nothing short of doom and they therefore demand that their points of view prevail. Which kinds of influence they attempt to exert depends on how they believe their interests will best be served (Gilmour et al., 2002; Kelner et al., 2002; Boon et al., 2003). Engaging a broad array of people and organizations in a successful collaborative process such as problem understanding can be extremely difficult (Lasker and Weiss, 2003; Manser, 2009). Since the health care system involves a myriad of interacting elements, it is difficult for any one individual to have a complete picture of the system. Each stakeholder will have their own view of the problem and provide assessment and solutions to the problems uniquely (Dougherty and Conway, 2008) and the problem definition is usually based on the stakeholders' understanding of the system (Eldabi and Paul, 2001). World Health Organization (WHO) (2009) reported that 70-80 percent of healthcare errors are caused by human factors associated with poor team communication and understanding. Thus, it is important for stakeholders to have a common ground, a shared vision, and increasing trust to actively participate in understanding and solving problem within healthcare (Dougherty and Conway, 2008). In summary, due to the presence of multiple stakeholders in healthcare, it becomes difficult to accurately assess the real root-cause of problems.

2.3.3. Silo Structure

Another challenge that adversely contributes to the quality of healthcare delivery systems is the lack of coordination or fragmented interactions between the different operating units (Reid et al., 2005; Shih et al., 2008). This systemic fragmentation is difficult to dislodge and is steeped in the history and culture of medicine. It is also embedded population-wide in the current system-operationally, financially, and in the clinic (Enthoven, 2009). According to one of the survey, 75 percent of patients in the U.S., describe the healthcare delivery systems as fragmented and fractured; a 'nightmare' to navigate; and plagued by duplications of effort, lack of communication and conflicting advice regarding treatment (Picker Institute, 2000). Care coordination can be defined as a function that helps ensure that the patient's needs and preferences for health services and information sharing across people, functions, and sites are met over time. It is the coordination that maximizes the value of services delivered to patients by facilitating beneficial, efficient, safe, and high-quality patient experiences and improved healthcare outcomes. Care coordination is often perceived only as interactions among different care providers (provider-provider coordination). However, it also involves interactions between providers and patients/families (provider-family coordination) (Bodenheime, 2007).

Loss of care coordination occurs when providing unit operates differently with lack of complete transparency and communication among the different functions that together make up the delivery system (Leichsenring and Alaszewski, 2004; Reid et al., 2005). It includes lack of access to medical records when multiple specialists are involved, which leads to duplication of tests and inappropriate treatments. This can have an impact on the overall comprehension of the system as a whole and can cause medical error especially for patients obtaining care from multiple providers. Further, this can also lead to waste causing workflow inefficiencies leading to increase in operating costs (Shih et al., 2008). Such inefficiencies ultimately cause potential harm to patients, is impediment to improving quality in healthcare and adversely impacts cost (Shortell et al., 1996; Fisher et al., 2006; Wilensky et al., 2006; Cebul et al., 2007; Shih et al., 2008; Kelly, 2009). The problem of care coordination can also occur when the tasks in the provision of healthcare are distributed cross competing units, each with its own objectives, obligations and capabilities. The market mechanisms, contractual arrangements, governance structures, and information technologies that enable coordination across organizations can tend to function poorly in health care setting due to competing objectives (Cebul et al., 2007).

The professional culture of medicine has also contributed to the fragmentation by revering

physician autonomy and infallibility (Steven, 1972; Starr, 1982; Mechanic, 2006). Education and training emphasize individual rather than team performance; physicians tend to practice as individuals (Mechanic, 2006). Predictably, solo or small single-specialty group practices have dominated the landscape, with unfortunate fallout: wide variation in practices and costs and relatively low accountability-a dearth of guidelines, utilization and quality management, collaboration, and peer review (Steven, 1972; Starr, 1982; Enthoven, 2009). About 40 percent of hospital based physicians are employed as full time staff and a vast majority of hospitals as a whole depend heavily on independent agents to provide the human and material resources for healthcare delivery (AHA, 2004; Pasko and Smart, 2004; Reid et al., 2005).

Examples of lack of care coordination include cases when caregivers duplicate tests because results recorded in a patient's record with one provider are not available to another, when medical staff provides inappropriate treatment because relevant history of previous treatment cannot be accessed and when patients are forced to use the emergency room for non-emergent conditions because primary care services are unavailable. Although the use of electronic medical record (EMR) can overcome such an issue, not all healthcare institutions have adopted the EMR and some others who have adopted them have not taken full advantage of its capabilities. According to combined data from the 2008 surveys (mail and in-person surveys), only 41.5 percent of physicians reported using all or partial EMR systems in their office-based practices (Hsiao et al., 2009).

From the review conducted in this section, it can be summarized that the healthcare delivery system is complex, along with the presence of multiple stakeholders and a lack of coordination between units in the delivery system. Nature of problems in such an environment varies and further understanding these problems can be difficult and challenging. The subsequent sections will review the literature the nature of problem that can exists in healthcare and approach to structuring these problems.

2.4. Nature of problems in healthcare

The word problem can be defined as "a problem exists when there is a discrepancy between an initial state and a goal state, and there is no readymade solution for the problem solver" (Bransford and Stein, 1993). There are at least two critical attributes with this definition of a problem. First, a problem is an unknown entity in some context that is there is the difference between a goal state and a current state. Second, finding the unknown must have some social, cultural, or intellectual value. That is, someone believes that it is worth finding the

unknown. If no one perceives an unknown or a need to determine an unknown, there is no perceived problem. Problems vary in the form they appear in, knowledge needed to solve them, and the processes needed to solve them (Jonassen, 1997). Multiple references (Simon, 1973; Rittel and Webber, 1973; Jonassen 1997; Glouberman and Zimmerman, 2002; Grint, 2005; Snowden and Boone, 2007) have been found in literature for categorization of problems. Table 2.3 presents the classification of the different problem types.

Table 2.3: Classification of problem types

<table>
<tr><th>Simon
1973</th><th>Rittel and
Webber
1973</th><th>Glouberman and
Zimmerman
2002</th><th>Grint
2005</th><th>Snowden and
Boone
2007</th></tr>
<tr><td rowspan="2">Well-structured</td><td rowspan="2">Tame</td><td>Simple</td><td rowspan="2">Tame</td><td>Simple</td></tr>
<tr><td>Complicated</td><td>Complicated</td></tr>
<tr><td rowspan="3">Ill-structured</td><td rowspan="3">Wicked</td><td rowspan="3">Complex</td><td>Wicked</td><td>Complex</td></tr>
<tr><td rowspan="2">Critical</td><td>Chaotic</td></tr>
<tr><td>Disorder</td></tr>
</table>

Simon (1973) described problems on a continuum from well-structured to ill-structured where well-structured problems are constrained problems with convergent solutions that engage the application of a limited number of rules and principles within well-defined parameters, while ill-structured problems possess a lack of agreement on solutions and solution paths, as well as a high degree of uncertainty about answers to problems. Rittel and Weber (1973) proposed that problems can be categorized as tame and wicked where tame problem have been usually focused upon and are those that are definable or well-defined where each mission of a problem is clear and may have solutions that are findable. Wicked problems, in contrast, have neither of these clarifying traits and are ill-defined; and they rely upon elusive political judgment for resolution and not "solution" as they are never solved but at best only resolved.

Grint (2005) applies the same topology of problem categorization as Rittel and Webber and added a third type of problem as critical problem. This type of problem such as crisis, is presented as self-evident in nature, encapsulating with little time for decision-making and action, and is often associated with authoritarianism. There is no uncertainty about what needs to be done – at least in the behaviour of the Commander, whose role is to take the required decisive action that is to provide the answer to the problem. Glouberman and Zimmerman (2002) distinguished problem into: simple, complicated and complex. Simple problems may

encompass some basic issues of technique and terminology, but once these are mastered carries a very high assurance of success. An example of this type of problem is following a recipe. Complicated problems contain subsets of simple problems but are not merely reducible to them. Their complicated nature is often related not only to the scale of a problem like sending a rocket to the moon, but also to issues of coordination or specialized expertise. Complex problems, also referred to as "wicked" problems can encompass both complicated and simple subsidiary problems, but are not reducible to either since they too have special requirements, including an understanding of unique local conditions. Snowden and Boone (2007) grouped problem into 5 categories: simple, complicated, complex, chaotic and disorder. Simple, complicated and complex problems are defined similarly to the distinction provided by Glouberman and Zimmerman (2002). Chaotic problems are defined as problems which involve an indeterminate and changing cause and effect relationship where no manageable patterns exist but only turbulence. The category of disorder applies when it is unclear which of the other four contexts is predominant and factional leaders argue with one another, and cacophony rules. The way out of this realm is to break down the situation into constituent parts and assign each to one of the other four realms.

A review of the literature suggests that the category provided by Simon (1973) and Rittel and Weber (1973), encompasses the categories suggested by the other authors. For example, complicated problems suggested by Glouberman and Zimmerman (2002) are difficult and challenging problems but are solvable provided the right knowledge, time and resources. Critical problems suggested by Grint (2005), apply mostly in a crisis situation and are a special case due to the time constraints and magnitude of impact. Complex and chaotic category suggested by Snowden and Boone (2007) have characteristics similar to ill-structured and wicked problems while disorder consists of parts which can belong to both well-structured or tame and ill-structured or wicked problem category. Subsequent discussion in this section will focus on these generic categories.

Tame and well-structured problems are simply defined and rooted in a tried and tested methodology that is relatively straightforward with a predictable set of results and will reliably occur if the directions are faithfully followed. While frequently difficult, tame can be clearly delineated and solved by experts who produce workable solutions using analytical approaches of their disciplines (Kreuter et al., 2004). A traditional linear process can produce a workable solution to a tame problem in an acceptable period of time, and it is clear when that solution has been reached. Tame problems have no or minimal changes to problem definitions over

time with minimum conflict over the desirability of potential solutions. Conklin (2002) characterized tame problems as: (i) relatively well defined and stable, (ii) having definite stopping points that is knowing when the problem is solved, (iii) having solution options that can be objectively evaluated as being right or wrong, (iv) belonging to a class of similar problems that can be solved in a similar manner, and (v) having solutions that can be tried and abandoned. A problem dealing with choosing the route of medical supplies to multiple hospital locations, deriving weighting factors for quality indicators across different units based on historical records and finding root causes for incorrect dosage for pain killers are examples of well-structured or tame problems that can be solved by seeking one or few persons with the right expertise.

On the other hand, ill-structured and wicked problems in healthcare delivery system are the kinds of problems that can be unpredictable and non convergent in everyday practice and profession (Horn and Weber, 2007). Conklin (2006) summarized such ill-defined problems as having the characteristics with (i) no definitive statement of the problem, (ii) open-ended search for a solution, (iii) complex interpretation of problem since resources and political ramifications are constantly changing and (iv) constraints that change particularly when a problem requires large groups of individuals to change their mindsets. A problem involving complaints received from several dissatisfaction patients regarding wait times in the treatment process, formalizing and standardizing a policy to be adopted across multiple health units for reporting healthcare quality, implementing new government and industry regulations for pathology results reporting are all examples of ill-structure problems. Table 2.4 summarizes the characteristics for wicked problems suggested by Rittel and Webber (1973) and provides an example of real world healthcare problem related to the issue of flow at the U.K. National Health Service (NHS) emergency unit. The example highlights how the conflicting aspects and perceptions are manifestations of wickedness.

Table 2.4: A real problem in healthcare, with its wicked characteristics highlighted
(Adapted from: Rittel and Weber, 1973; Koh et al., 2011)

Characteristic	NHS Emergency Flow Problem Description
Wicked problems have no formal definition or structure	Variables attributes to the emergency flow are not properly defined. Unsure what outcomes are actually necessary or useful. For example, there are some regulatory targets to satisfy but these may be contributing to the problem.
Wicked problems have no stopping rule	Previous methods of alleviating the problem have proven to be ineffective. For example money has been spent on increasing bed capacity. There is no way to tell if a particular intervention will be successful.
Solutions to wicked problems are not true or false, but better or worse	The emergency flow issue will never be eradicated - the aim is to improve the situation to a level that is satisfactory to all stakeholders. One can never eliminate all delays nor ensure zero patient influx.
Every solution is a "one-shot operation" and counts significantly	In resolving this issue, planners will not have the chance to test out solutions. Resources will have to be committed towards the best possible attempt.
Wicked problems do not have pre-determined solutions nor enumerable set of potential solutions	There is no pre-defined way to solve the emergency flow issue - for instance, what works at another hospital (for example, by increasing bed capacity) may not work here.
A wicked problem has multiple root cause. The choice of explanation determines the nature of the problem's resolution	Coming up with a solution involves first agreeing on the primary root cause(s). For example, if one believes the emergency flow issue is caused by a poor ambulance response, then the solution will inevitably focused on boosting ambulance services.
A possible solution created for wicked problem may generate unintended consequence.	Implementing a solution to address the emergency flow issue may lead to other unwanted effects, for example, increasing bed availability may lead to a greater tendency for patients to be warded for a longer period of time.

These ill-structured problems present a special challenge because they resist solutions offered by the expert-model or single-agency approach (Waddock, 1991; Rhodes, 1998; Pearson, 1999; Mitchell and Shortell, 2000). They often possess aspects that are unknown (Wood, 1983), and they possess multiple solutions or solution methods or often no solutions at all (Kitchner, 1983). As a result, there is no consensus on what exactly the problem is until after formulation of a potential solution. They have high uncertainty associated with the

outcomes as well as the potential causes and effects underlying the problems. The problems can be iterative in nature and are never solved completely (Conklin, 2006) but rather become better or worse (Rittel and Webber 1973). This makes problem understanding difficult with the presence of unknown and uncertainty (Koh et al., 2011). In addition to being overwhelmed by complexity and information, working groups fail to resolve these issues because they often fall victim to the bureaucratic silo effect: decision-makers fail to look beyond the boundaries of their own interest group, organization, department, and others, or they believe that it is the responsibility of someone in another unit to fix the problem at hand (Horn and Weber, 2007). By having only one discipline examines an issue; problems can actually be exacerbated, rather than ameliorated. When different factions stare at their pieces of the puzzle, and don't attempt to see the perspectives of others, problems are addressed in a piecemeal, not a holistic manner (Buchbinder, 2009).

Problem understanding has been proposed as an important step for tackling a problem (Polya, 1957; Jackson, 1975; Lyles, 1982; Garofalo and Lester, 1989; Francis, 1990; Mayer, 1992; Bransford and Stein, 1993). To accomplish that, Rittel and Webber (1973); Grint (2005) and Raisio (2009), among others, states that one needs to recognize the nature of the problem before proceeding to seek ways of resolving it in an acceptable manner. It is better to understand the exact nature of the problem and then select a suitable method for resolution than to start attempts at solving a poorly understood problem, only to discover that the proposed solution was not really relevant. Different kinds of problems have different semantic structures, so successfully solving these problems requires that decision makers develop semantic models of the deep structure of the problem as well as a model of the processing operations (Riley and Greeno, 1988). The analyst transforms the statements of the problem into a mental model that represents the problem-solver's interpretation of the problem (Mayer, 1992; Jonassen, 2004). Additionally, formal and informal knowledge about the content domain including facts, definitions, algorithmic procedures, routine procedures, and relevant competencies about rules of discourse has to be acquired (Polya, 1957; Schoenfeld, 1989; Geiger and Galbraith, 1998). This includes understanding the situation, what is wrong with the current state and what is the intended goal. The predominant behaviours in this step include sense making, organizing, and constructing of the problem definition (Carlson and Bloom, 2005).

For complex ill-structured problems, Eldabi (2009) states that traditional approaches, for example, identifying the issue, gathering data, studying all the options, choosing one strategy,

single-focused evaluation, cannot work and are insufficient for addressing wicked problems. Wicked problems require new ways of working and thinking, beyond the traditional approaches that have been found to be inadequate and inappropriate (Chisholm, 1996; Huxham and Vangen, 1996; Keast, 2001; Keast et al., 2004). The need for collaboration among stakeholders appears to be a common theme when addressing such problems. Eden and Radford (1990) suggest one of the attribute to understand complex problems is to engage key stakeholders as they will analyse and assists in decision making. Van Bueren, Klijn, and Koppenjan. (2003), Kreuter et al. (2004) and Westbrook et al. (2007) further state that resources to deal with wicked problems frequently exist among the different stakeholders, and these actors are interdependent on one another for problem resolution and it is important to find an approach so that they are able to share their perceptions of the problem. This process is participative and interactive. The purpose is to elicit relevant knowledge and to reflect it back in structured form in an iterative process of problem structuring. Thus, identification of solutions to wicked problems becomes as much a social and political process as it is a scientific endeavour (Kreuter et al. 2004). It is necessary not only to have many disciplines involved, but also to have interaction with those whose resources and cooperation are indispensible for tackling the problem (Van Bueren, Klijn, and Koppenjan, 2003) as they bring different values and perceptions to the dialogue and debate. Camillus (2008) recommends involving stakeholders in brainstorming sessions so that an appropriate strategy can be developed and to better align decision making throughout the organization. The aim of these sessions should be to create a shared understanding of the problem and foster a joint commitment to possible ways of resolving it. Ritchey (2005) also proposed important principles that should be followed for addressing wicked problems as: (i) accommodate multiple alternative perspectives rather than prescribe single solutions, (ii) function through group interaction and iteration rather than back office calculations, (iii) generate ownership of the problem formulation through transparency.

Kreuter et al. (2004), Goodman (1974) and Senge (1990) promotes the importance of following attributes that would help address complex and interdependent problem by: (i) focus on interdependencies, (ii) provides a visual representation, (iii) add precision to reduce ambiguities and miscommunication, (iv) allows examination and inquiry by fostering collective understanding of a problem and (v) represent a worldview that is a holistic view of problem showing the parts, and their interconnectedness. Ritchey (2005) also proposed the facilitating via a graphical visual representation for a systematic exploration of a solution

space, focusing on relationships between discrete alternatives rather than continuous variables, and concentrating on possibility rather than probability. Horn and Weber (2007) stressed that mapping processes can be used to represent, analyse, evaluate complex wicked problems and then to choose actions that ameliorate the complex problem at hand. Carlson and Bloom (2005) stated that a table, graph, diagram and text can be put forth to organize information.

To summarize, there are several existing types of categorization regarding problems and their distinction is often determined by the number of issues, functions, or variables involved in the problem, the degree of connectivity among those variables, the type of functional relationships among those properties and the stability among the properties of the problem over time. However, most problem categories can be considered as well-structured or tame and ill-structured or wicked problems. While well-structured or tame problems can be solved with the right tools, methods and expertise, the primary methods to tackle ill-structured or wicked problems include problem understanding, organizing and structuring (Carlson and Bloom, 2005). A discipline of problem structuring methods were originated, to help formulate and to resolve the wicked problems from a messy stage to a problem that has one or more known solutions (Rosenhead 1996; Mingers, 2004; Eden, 2006; Ritchey, 2006; Pidd 2007; Franco, 2009). In the next section, these problem structuring methods will be further examined.

2.5. Problem Structuring Methods in Healthcare

Structuring and analyzing complex systems presents a number of difficult methodological problems as many factors are not meaningfully quantifiable, and as they inhibit strong social, political and cognitive dimensions (Ritchey, 2011). It is important to first understand the meaning of problem before embarking on problem understanding. Not understanding what the problem can result in management solving the "wrong" problem (Eldabi, 2000; Pidd, 2007). However, problem understanding in such situations can be difficult because: (i) the problem is interrelated, either being one of a number of problems which are facing different parts of an organisation, or the problem itself is made up of a number of interrelated problems, (ii) there is disagreement within the organisation over the objectives, the constraints or cause–effect relationships, and (iii) there is a large amount of uncertainty over the constraints or the cause–effect relationships.

To enable and promote understanding of the problem, 'problem structuring' is undertaken which can be referred to as work done in problem solving to formulate issues before detailed

analysis is conducted (Woolley and Pidd, 1981). It involves the understanding of the symptoms and dissonances which have led to the involvement of the analyst or team. Effort and energy is put forth to reading and understanding the problem (Carlson and Bloom, 2005). A number of non-quantified problem structuring methods (PSMs) have been developed during the past 30 years to handle ill-structured problems (Rosenhead and Mingers, 2001). Although the development of some PSM began in the 1970s, it was the publication of Rosenhead's Rational Analysis for a Problematic World (1989) which formally defined the field in the U.K. and acted as a catalyst for wider recognition of PSM, their application and their benefits. It provides a radical response to the poor fit of the traditional OR approach for complex unstructured problems (Woolley and Pidd, 1981; Rosenhead and Mingers, 2001; Franco et al., 2004; Mingers, 2004; Rosenhead, 1996, 2006; Ritchey, 2006; Shaw, Edwards and Collier, 2006). Most PSM are used in situations with large strategic issues rather than in tackling low-level, operational problems (Pidd, 2007). Literature has largely focused on the explanation, development, application and refinement of the PSMs (Eden and Jones, 1984; Friend and Hickling, 1987; Eden, 1988; Phillips and Phillips, 1993; Checkland and Scholes, 1999).

The concept of PSM takes the standard formulations of OR methodology (for example, formulate, model, test, solve, and implement) as their foundation with the uncontested representation of the problem situation (Rosenhead, 2006). PSMs are defined by a range of characteristics, briefly these are (Mingers and Rosenhead, 2004): (i) deal with unstructured problems involving multiple actors along with their perspectives, conflicts of interest, uncertainties and unquantifiable factors, (ii) enable the modelling of alternative perspectives, (iii) problems and models must be accessible to the actors involved to facilitate participation, and (iv) must be flexible and iterative. All PSM start out by seeking to attain somewhat comprehensive view of the issue within its wider context, acknowledging that factual comprehensiveness is difficult to achieve, or may not be required to obtain resolutions. The challenging element in addressing these situations typically is the framing and definition of the critical issues that constitute the problem, as well as understanding the systemic relationships between these issues (Shaw, Edwards and Collier, 2006). They can operate in such contexts because they are designed for deployment in a group format, allowing the simultaneous consideration of alternative perspectives. They are participative in nature that offers participants to clarify the problem converge on an actionable mutual problem or issue within it and agree to initiatives that will at least partially resolve it (Rosenhead, 2006; Shaw, Edwards and Collier, 2006). Several methods use specialized software to aid in the structuring process

and most of them require a facilitator, with sufficient training and experience in the method and with good interpersonal and negotiation skills. In general, PSM uses modelling to generate dialogue, reflection and comprehension about the critical issues in order to reach shared understanding and joint agreements (Woolley and Pidd, 1981).

There are many types of PSM approaches. Some of these include (along with the year of their origination): hypergame analysis (1980), metagame analysis (1960s), interactive management (1974), operational gaming (1950s), robustness analysis (1980), soft systems methodology or SSM (1975), strategic assumption surfacing and testing (1969), strategic choice approach or SCA (1969), strategic options development and analysis or SODA (1979), drama theory (1990), and the theory of constraints (1994). It was found in several literatures that SSM, SCA and SODA are the key principal approaches of PSM (Eden and Ackermann, 2001; Mingers and Rosenhead, 2004; Eden and Ackermann, 2006; Paucar-Caceres, 2010; Ackermann, 2011; Mingers, 2011; Gaspoz and Wand, 2012). Further, Paucar-Caceres (2010) indicated that of the PSMs method, these three approaches can be regarded as fully fleshed, proved and tested methodologies and also they are the most used in the U.K. (Eden and Ackermann, 2001). These methods are discussed further in subsequent sections along with the approach that combines the different types of PSMs together into a single intervention.

2.5.1. Strategic Choice Approach (SCA)

SCA was developed by Friend and Hickling (1987) to deal with the interconnectedness of the decision problems in an explicit yet selective way. It is an interactive planning approach with focus on managing uncertainty in strategic situations. The most distinctive feature of this approach is that it helps people working together to make more confident progress towards decisions by focusing their attention on possible ways of managing uncertainty as to what they should do next (Rosenhead and Mingers, 2001).

SCA commonly operates in workshop format where the participants are assisted by one or two facilitators to help represent their understanding of the situation. The facilitator uses four modes of decision-making activity alternated as the facilitator deems appropriate. In the first mode, shaping, decision makers are addressing concerns about the structure of the set of decision problems that they now face. They may be debating in what ways choices should be formulated, and how far one decision should be seen linked to another. The second mode, designing, the decision makers are addressing concerns about what courses of action are feasible in their current view of problem shape. They may be debating whether they have

enough options before them, or whether there are design constraints of either a technical or policy nature that might restrict the scope for combining options. The third mode, comparing, the decision maker is addressing concern about the ways in which the implications of different courses should be compared. It is in this mode that uncertainties come into sharpest focus where a comparison between the different decision schemes aids in bringing forward the key uncertainties. There are three types of uncertainties in the context of proposed decisions: uncertainties with the working environment, uncertainties with guiding values and uncertainties with related choices or decision fields. It focuses on decisions to be made in a particular situation and highlights the judgments involved in agreeing how to handle the uncertainties which surround the decision to be addressed (Heyer, 2004). The fourth and final mode is choosing, where course of action are selected and the remaining uncertainties are identified along with action to be taken. The group can then identify priority areas for further examination and design explorations and contingency plans (Friend and Hickling, 2005). Figure 2.4 depicts a process in which opportunities exist to switch from working in any one of the four modes to work in any of the others for a while, with feedback loops it allows for possible recursion to earlier stages in a more adaptive way (Friend and Hickling, 2005).

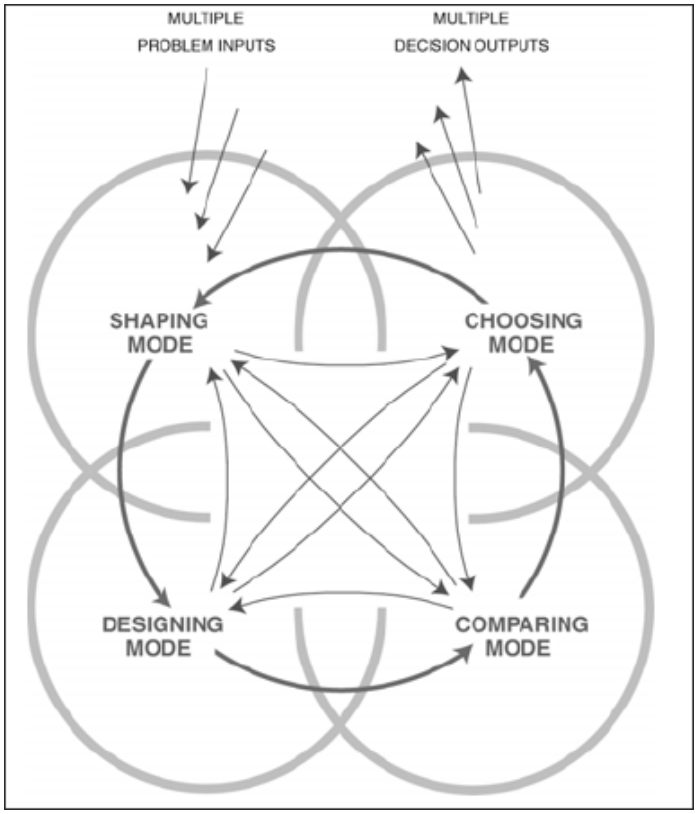

Figure 2.4: The Strategic Choice Approach
(Adapted from: Friend and Hickling, 2005)

There have been several instances where SCA has been adopted to help with problem understanding. Thunhurst et al. (2006) highlights that SCA has helped guide community health development groups from the undifferentiated assemblage of issues initially thrown up to clearly prioritised strategic options. Rosenhead (1996) along with three local community organizations highlights the use of the SCA framework to represent understanding of the health service provision situation at the Tower Hamlets Health Authority. Moulin (1991) helped women dissatisfied with health service provision to articulate their demands for better birthing facilities and used SCA to enable them to crystallize what they wanted and enabled them to influence the services provided. Thunhurst et al. (2006) used SCA in combination with traditional analytic methods, to develop the problem analysis capacity and competences of a community health development

Despite the advantages offered by the application of SCA, its limitations include a heavy dependence on stakeholder knowledge and facilitator who also must be expert in the approach and the different technologies that make up the approach (Vidal, 2005; 2006; Sørensen and Vidal, 2008). While SCA clearly identifies approach to planning which could stimulate actors

to move toward decisions, it lacks mechanisms for systemic decision making (Georgiou, 2007). The result of an SCA exercise is a narrowing down of choices until the right approach is decided upon by the stakeholders with the help of the facilitator. Unlike other PSM approaches, it does not result in multiple improvement opportunities or areas for further discussion. Further, it does not generate or promote a holistic and graphical representation of the system which can provide the stakeholders a complete picture while making decisions. Bryant and Chin (2000) suggested that SCA seems daunting to adopt as there are multiple concepts to grasp, managing representation can be challenging in a traditional flip chart based workshops and it can be discouraging for the client group from mastering the terminology.

2.5.2. Strategic Options Development and Analysis (SODA)

The SODA method is a framework for designing problem solving interventions (Eden and Ackermann, 2001). The method was initially developed in the 1980s (Eden, Jones and Sims, 1983) and more recently has been renamed JOURNEY making, a mnemonic for **JO**int **U**nderstanding, **R**eflection, **NE**gotiation of strateg**Y** (Eden and Ackermann, 1998). However, in this research the traditional name SODA will be used for discussion. SODA is a method used for people to put forward their different understandings of a situation and to develop an understanding that they can share with others. In other words, SODA develops a negotiated, action orientated and understanding of a complex problem that is rich and sufficient in detail. It is used for working on complex problems that uses cognitive mapping as a modelling device for eliciting and recording individuals' views of a problem situation (Rosenhead, 1989). It aims to provide a management team with a model serve to aid negotiation, working with individuality and subjectivity as the basis for problem definition and creativity and to achieve understanding and agreement among the group members regarding the problem under discussion (Heyer, 2004; Bryson et al., 2004). It tends to generate rich models and develop high levels of ownership for a problem through the attention paid to problem definition and negotiation. Main contribution is that the approach helps groups manage complexity inherent in messy complex problems-balancing the management of content with the management of process. (Reynolds and Holwell, 2010).

In SODA, the information is represented on cognitive maps to show relevant concepts and the linkages between these concepts (Eden, Jones and Sims, 1983; Mingers and Rosenhead, 2004). Cognitive mapping (Eden, 1988 and 1992; Ackermann et al., 1992) is a modelling technique used to represent a problem space by a series of interconnected causal maps and is

constructed through an interview where the planner creates the map along the way. The maps consist of 2-D directed graphs of nodes containing text that are linked together according to their causal relationship (Westcomb, 2002). The concepts presented in the map elicit from individual through interviews and are generally either goals (appearing at the head of the map) or options (appearing at the tail of the map). Strategic options are those that have no other options above them in the map. Figure 2.5 shows an example of such map illustrating goals, options and strategic options where 'A' and 'B' are the goals, 'C', 'D', 'E' and 'F' are options of which only 'C' and 'D' are strategic option since they have no other options available above them, only goals.

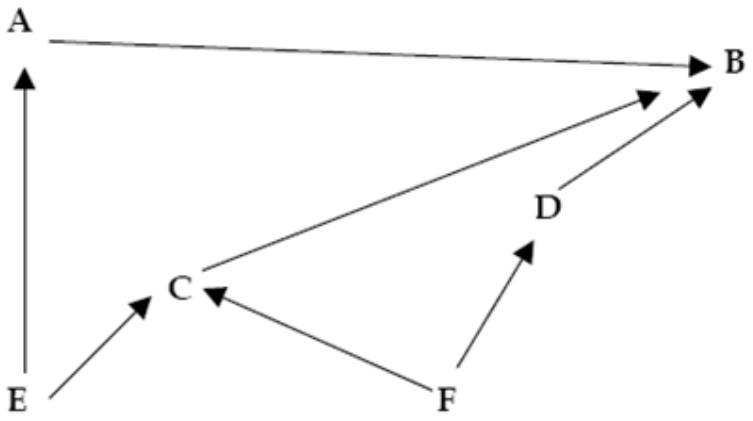

Figure 2.5: Example of SODA Cognitive Map

(Adapted from Heyer, 2004)

Group maps constructed through the aggregation of individual cognitive maps are used to facilitate negotiation about goal, problem content and key strategic issues and option portfolios (Eden, 2004; Ackermann and Eden, 2010). Each member of a group is believed to have his or her own view of that they regard as the 'problem'. Thus drawing off the knowledge and experience of participants is a key element in developing decisions about the problem. This map serves as a focus for discussion at a concluding workshop that involves: (i) analysis of the overview maps content and structure; (ii) identification of emerging themes and core concepts; and (iii) discussion of key goals, inter-related problems, key options and assumptions (Ackermann and Eden, 2010).

SODA has been used extensively with organizations public and private, large and small, at senior and middle management levels. Example organizations include: Shell International,

Reed Elsevier, the Northern Ireland Prison Services and Scottish Natural Heritage (Gibb 1993; Rosenhead, 1996; Agrell and Holmberg, 1998; Eden and Ackermann, 2004; Heyer, 2004; Shaw, Edwards and Colliers, 2006; Reynolds and Holwell, 2010). An example of its prior use in the health sector is that of Roginski (1995), who used SODA in working with senior management in the NHS. It was adopted because it offers groups a methodology through which they can share their individual perspectives and ideas of the situation effectively surfacing the diversity of views and the complexity of the situation. Edwards, Hall and Shaw (2005) used SODA to surface the diversity of views and the complexity of the situation when analyzing system vision of knowledge management in emergency care.

Although SODA has strengths in appreciating and analyzing individuals' patterns of belief and in gaining commitment to action through merging of cognitive maps, it is weak in assessing possible alternatives (Mingers and Brocklesby, 1997). Its literature lacks a clear-cut route to rigorous problem definition as well as a clearly identifiable approach to planning which could stimulate actors to move toward decisions (Williams et al., 1995; Georgiou, 2007). Facilitation can be challenging due to the stakeholder diversity, limited knowledge and exposure to the mapping process and the resulting cognitive maps. Also, an increased emphasis has to be placed on the facilitator's role (Sørensen and Vidal, 2008; Georgiou, 2007 and 2010). This becomes more important in situations involving stakeholders with diverse interest, backgrounds, motivations and personalities. Further, SODA would require for the case study to be mapped with the use of cognitive maps. However, basic situational structural assumptions are required in order to design the layout of the maps and it is not clear whether the limited data of the case allow for such assumptions (Eden and Ackermann, 2001; Georgiou, 2007). The cognitive maps can be complex and difficult to comprehend in a short timeframe (Hjortso, 2004; Georgiou, 2009) and a common language with an emphasis on simplification of the map has to be established. Also, it does not comprehensively identify or take into account issues associated with uncertainty and risk in decision making.

2.5.3. Soft Systems Methodology (SSM)

Initiated in the late 1960's, SSM evolved through an action research programme, as a reaction against the traditional management sciences' view of reality as being objective, neutral and value free (Checkland, 1972; 1981; Checkland and Haynes, 1994; Checkland and Scholes, 1990). SSM is a structured approach to help in understanding the real world by defining problems which are not clear-cut but fuzzy and ill-structured. The main aim of the

programme was to explore the contribution that system ideas could make on managerial real-world problems (Checkland, 2000). Recently, it has been identified as the primary PSM method for use in simulation and modelling in healthcare (Mingers and Rosenhead, 2004; Jun et al., 2011). This stems from its capability of understanding and incorporating diverse viewpoints, perceptions, expectations, requirements related to the service environment model (Siddiqui and Tripathi, 2011). It recognizes that there are different valid viewpoints: the central focus of the methodology is the search for a relevant view(s) which the analyst aims to extract through a debate on the main purpose of the organization (Allam et al., 2004). SSM works by defining systems of purposeful activity (the root definition), building models of a number of relevant systems, and comparing these models to the real world, in order to structure a debate focusing on the differences. The idea is that this debate should lead the group involved in the process to identify changes to be made, how they will be made, and motivate each other to make the changes (Travis and Venable, 2002). Figure 2.6 illustrates the seven stages in the SSM process, not necessarily followed in a linear fashion discussed below.

- Stages 1 and 2 (Confront the problem situation) - These stages involve entering the problem situation and identifying within it the people, culture and norms through interviews, discussions, observations and brainstorming. Rich pictures are also used to capture the essence of a situation and help to identify relevant themes and ensure a shared understanding of different perspectives.
- Stage 3 (Develop root definitions) - A root definition is created in this stage, a requirement of SSM. CATWOE is a mnemonic acronym used by problem owners to formulate a root definition by considering the following of the desired system:

  C (Customer): who are the customers, beneficiaries, victims of the system?

  A (Actors): who are the actors, participants in the system?

  T (Transformation): what inputs are transformed into what outputs?

  W (Weltanschauung): what is the worldview underlying the system?

  O (Owner): who is the owner or has the power to stop the system?

  E (Environmental factors) what are the environmental constraints?

  A series of root definitions are usually constructed from this process. Group discussions are then used to try and reach agreement on one applicable root definition or to decide on a few for further consideration.
- Stage 4 (Building a conceptual model) - A conceptual model is a diagram of activities with links connecting them and is developed directly from the root definition using action

statements describing the activities which are needed by the root definition.

- Stage 5 (Compare models with the real world) - This stage is designed to bring structure and substance to an organized debate about improving the current situation.
- Stage 6 (Identify changes) - This stage involves identifying systematically desirable and culturally feasible changes to the real world system.
- Stage 7 (Taking action) - This stage involves putting the changes identified in Stage 6 into practice, usually through the development and enactment of an action plan.

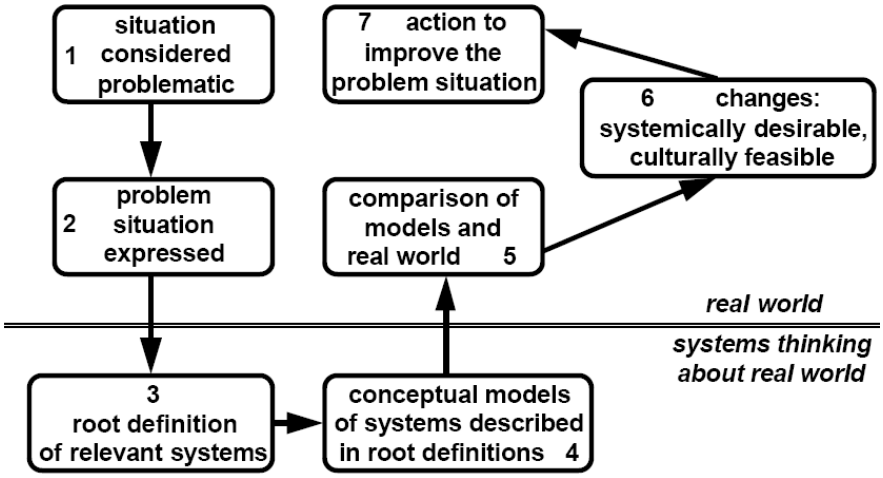

Figure 2.6: Seven stage model of SSM

(Adapted from Checkland, 1981)

SSM has found broad applications within healthcare and is one of the widely used methods within PSM (Heyer, 2004; Mingers, 2011). Examples of SSM application in various parts of the U.K. NHS has served as examples in the core texts on SSM (Kotiadis and Mingers, 2006). These include community medicine in East Berkshire Health Authority (Checkland and Scholes, 1990; Checkland, 2000) and information systems in Huddersfield Royal Infirmary, the Royal Victoria Infirmary and Hexham General Hospital, amongst others (Checkland and Holwell, 1998). Lehaney and Paul described (1996) and Lehaney, Clarke and Paul evaluated (1999) the use of SSM in the construction of simulation models for a hospital outpatient department. The use of SSM is not necessarily about producing a set of solutions which expert analysts impose on uncommitted users. Its intention is to produce debate among the participants in a situation so that they work out for themselves what changes are necessary and possible. SSM models are intended to aid that learning process and used as a problem-structuring tool. For example, Al-Karaghouli et al. (2002) use the SSM technique of rich

pictures to understand knowledge requirements. Fennessy (2001) use SSM to explore and define problems arising when knowledge is generated in searching for evidence-based healthcare while. Atkinson et al. (2001) explain how the soft and systemic approach employed in SSM may be used to create agendas for strategic and operational decision making associated with integrated approaches to health informatics research and development.

While there are advantages that have been derived from the application of SSM, literature highlighted several limitations associated with implementing SSM. Some of the case studies raise concerns about the time and cost implications of using SSM (Mingers and Taylor, 1992; Ledington and Donaldson, 1997; Lehaney, Clarke and Paul, 1999; Winklhofer, 2002). Also, it can be difficult to implement due to complexity, difficulty in explanation and usage along with extensive training requirements (Mingers and Taylor, 1992; Ledington and Donaldson, 1997). Time-consuming attributes is a drawback when accessing problem in healthcare because of the dynamic nature of healthcare which keep evolving can result in the exact nature of problem not being understood.

A continued criticism of SSM is in its ability to deal with relative views (Mingers and White, 2010) and its ability to define a single and accurate set of information needs. That is when taking into account the subjective views, it is often impossible to say for certain whether they are right or wrong. One perspective can be as valid as any other (Flood and Ulrich, 1990; Ivanov, 1991; Jackson, 1991). Since its models are not descriptions of the real world they are not normative; they are 'ideals' only faithful to one particular worldview (Lane and Olivia, 1998). Further, within healthcare there are multiple stakeholders operating in silo where individual has no or limited knowledge other than what they are responsible for. Hence, individual developing a worldview of problem can be challenging and possibly impracticable. Further, if they can represent the worldviews the accuracy of the view is questionable.

Although SSM has helped towards constructing a mental construct, there has been a lack of dynamic coherence between the behaviour and structure of the problem situation expressed within this methodology (Lane and Olivia, 1998; Rodriguez-Uloa, 2004). Some literature also suggests that there can be a lack of understanding towards the intuitive behaviour of complex systems incorporated in the SSM. (Lane, 1998; Sardiwal, 2010). It lacks firm guidelines to tackle the complexities (Lane and Olivia, 1998; Rose and Haynes, 1999; Jackson, 2001; Pala et al., 2003). Further, it does not offer a standard against which these different perspectives can be measured. When a standard is not provided there is confusion over which perspective should guide us. It may be that of those who are most powerful. Jackson (1992) argued that

SSM has no underpinning social theory, and this may leave SSM weak in being a useful approach in addressing power. Debate is a major mechanism utilized by SSM, and one might argue that the use of power could result in the closure of debate, which may lead to the conclusion that SSM can work to serve those currently in power, and thereby help preserve the status quo.

An additional aspect that seems to require further work in SSM is in the process of implanting the proposed changes in the real world in the Stage 7 (can be referred to in Figure 2.6) of SSM process (Rodriguez-Uloa et al., 2011). There is limited scope for evaluating the effectiveness of SSM (Rosenhead, 2006). There are no measurable evaluative criteria to assess the success of SSM (Zhou, 2004). Its critics claim that the problem with SSM is that it only proposes general and vague solutions to be implanted in the real world, because usually its propositions are expressed in a verbal language with no tool to measure whether the concrete change implanted in the real world was really the one proposed by SSM. Rodriguez-Uloa (2004) and Rodríguez-Ulloa et al. (2011) also highlighted that SSM posses a drawback in the modelling step as it does not offer a technological tool to help grasping consequences and sequels of the assumedly culturally and feasible models suggested. Hence the analyst could not realize about the real impact of the changes proposed. It may be argued that much within SSM is left to the judgment of the analyst regarding the degree of participation, the level of resolution, and the necessity for hard output. The style and ability of the facilitator and the participants will affect the intervention, and the organisation's culture will affect the process and outcomes. SSM does not address these issues satisfactorily which may result in a lack of commitment from participants and consequent expectations failures. Some have also questioned it is allegedly 'managerialist' perspective (Burrell, 1981; Jackson, 1982; Mingers 1984). While SSM has been used to deepen understanding of healthcare problems, in general, respondents subjectively perceive their use of SSM as successful even though their practical usage of the elements of the approach differs markedly from the definition of the approach (Connell, 2001).

2.5.4. Comparison of SCA, SODA and SSM

As discussed in earlier section, three PSMs have become particularly well known: SCA, SODA and SSM. In order to develop an alternative framework for problem understanding, it is appropriate to focus on their similarities since it is likely to be the similarities that have driven their success to manage complex messy problems (Eden and Ackermann, 2006). The first

similarity is the use of a model as a transitional object (Eden and Sims, 1979) to facilitate negotiation and agreement. The model for each method is populated with data collected that are specific to the problem situation and are amenable to analysis, based upon a unique approach. Secondly, each method increases the overall productivity of group processes with the underlying presumption that increased and equal participation from members is likely to be helpful in gaining consensus (Eden and Ackermann, 2006). Thirdly, they explicitly pay attention to the facilitation, with some accounting for the power and politics within organizational settings. It is not only natural for different people to have different perspectives on a problem, but also that organizations are designed to encourage this (Eden, Jones and Sims, 1983; Eden, 1989; Eden and Ackermann, 2004; 2006). The last similarity is an appreciation of the significance of facilitation skills in enabling effective model building and reaching consensus (Richardson and Andersen, 1995; Ackermann, 1996; Andersen and Richardson, 1997). To summarize the major differences between the three approaches, it is to be noted that in SCA, there is an explicit focus on decision-making and the 'commitment package'; in SODA, the process of mapping focuses on being 'action oriented', reaching agreements and on issues of implementation and project management; and in SSM, there is an emphasis on 'implementing 'feasible and desirable changes'. Additionally, due to lack of complete transparency different aspects of the methods find more popular application (Eden and Ackermann, 2006). For example, for SSM often the only aspect that gets used is rich picture and CATWOE; for SCA may be interconnected decision areas; and for SODA, cognitive maps with no attention to the formal structure. A summary of their major characteristics, which highlights their similarities and dissimilarities, is summarized in Table 2.5 .

Table 2.5: Summary of characteristics of SCA, SODA and SSM

Characteristics	SCA	SODA	SSM
Focus	Enable focus on decision areas by highlighting uncertainties	Stakeholder perception representation and structuring of a messy problem situation	Structuring of a messy problem situation
Method of Working	Collaboration and dialect between different individuals to formulate decisions	Dialect thinking comes from analyzing individual perceptions and developing cognitive model, where these are gathered in an aggregated model	Individual world views are developed and integrated, described and compared to real world in a collaborative manner

Organization	Workshop with interactive group participation	Individual interviews and group workshops	Workshop with interactive group participation
Model or Tool used	Different working phases with interactive participation	Cognitive maps	Rich picture and CATWOE
Consultant's Facilitation skills	High dependence on facilitator skills	High dependence on facilitator skills	High dependence on facilitator skills

2.5.5. Multimethodology

There is an extensive repertoire of methods available with regards to combining a number of PSMs, or PSMs together with more traditional methods, in a single intervention—a practice known as multimethodology (Mingers and Gill, 1997). It is a term used to described the combined use of two or more methodologies (or part thereof) within a single intervention. The highly complex and multi-dimensional nature of real-world problems makes multimethodology interventions a necessary development (Mingers and Brocklesby, 1997). It allows the practitioner to address both the quantitative and qualitative aspects of a complex situation (Mingers and White, 2010) and explains the characteristics of an intervention. The range of methodological choice is wider even than a simple listing of PSMs (Franco and Lord, 2011). The desirability and feasibility of multimethodology has been explored theoretically and philosophically (Midgley, 1990, 1997; Mingers and Brocklesby, 1997) and several case studies of application within healthcare and with different theoretical perspectives are available (Mingers and Gill, 1997). Several published papers reporting practical applications of multimethodology combining PSM techniques with other technique (Magidson, 1992; Gregory and Jackson, 1992; Bennett and Kerr, 1996; Coyle and Alexander, 1997; Ackermann, Eden and Williams, 1997; Pauley and Ormerod, 1998; Ormerod, 1998; Mingers and Rosenhead, 2004). By adopting a multimethodology approach, some authors have suggested that the interventions would be able to deal more effectively with the full richness of the real world (Mingers and Brocklesby, 1997). Multimethodology has also found applications in healthcare. For example the use of SSM before the development of a simulation model to evaluate outpatient services within healthcare (Lehaney and Paul, 1996), use of simulation with cognitive mapping to understanding patient flow within intensive care unit (Sachdeva, Williams and Quigley, 2007), use of SSM with simulation in resource planning an allocation within healthcare (Lehaney and Hlupic, 1995) and use of system thinking, queuing and

simulation in understanding problem at outpatient clinics (Bennett and Worthington, 1998).

However, Sachdeva, Williams and Quigley (2007) identified a gap in literature regarding lack of studies that demonstrated a successful implementation and acceptance of OR results in practice. The authors noted that, while there have been several attempts to combine OR methodology, they have had limited success due to the lack of buy-in by key stakeholders in implementation of results. This is due to the lack of clinical relevance of OR results as mathematically precise results may not be perceived as clinically valid. They further combined OR methodologies to study patient flow within the Paediatric Intensive Care Unit (PICU) setting with the purpose of increasing acceptance of results so as to promote successful implementation. A simulation model of the PICU was developed using direct observation and cognitive maps based on interviews of nine nursing staff. It was then adopted by attempting to capture and represent beliefs, values, and expertise of managers to investigate the problem. The key limitations identified by the authors for the study were: implementation of the study in a special type of ICU and not in a generic operation, raising doubts whether it was transferrable to operations that were not similar to the special ICU operation. Further simulation was unable to capture all the details and that only the nursing staffs was involved in creation of cognitive maps. *Key limitations identified so far are limited success due to limited buy-in from stakeholders due to improper perception and understanding of results and specific rather than generic application raising concerns on universal applicability.*

In another application of multimethodology within healthcare, Lehaney and Hlupic (1995) acknowledged that simulation has been used in several health sectors. The authors undertook an investigation to examine the extent to which simulation is used for resource planning in the health sector. Several case examples of use of simulation in healthcare were examined and the successes and failures of simulation in this context were explored. The cases in the paper cited have all demonstrated some success, but in many cases have failed. For example, implementation of modelling did not follow through, and communication seemed to break down between the analyst and client and important issues were not raised early enough in the development of the models, which rendered the simulations ineffective. In few cases, the interests of groups and individuals were ignored, and modelling was discussed in a way which gave little or no recognition to the 'human activity system' tradition of problem structuring (Lehaney and Hlupic, 1995). Many accounts were of unfinished studies. For example, often several alternatives were supposed to be studied, but the results of only one or two were mentioned. An explicit methodology for overcoming these problems will not be found within

the realms of traditional simulation modelling. In fact, some case authors have taken care to involve users in model development, they have utilised a variety of means, some unspecified, and some ad hoc. Those that do mention process tend to provide little guidance as to how the process was undertaken. The authors noted that and proposed the use of soft SSM in combination with the simulation modelling to improve the processes and outcomes of the study. The authors concluded that if modellers concentrate solely on the quantitative aspects of modelling, with scant regard for the process, simulation models may be seen to fail. Modellers who involve end-users at an early stage increase the chances of success by building client confidence in their models. The 'hard' and 'soft' aspects of modelling ought not to be seen as separate components, but rather as interwoven facets of the modelling whole. *Limitations identified giving little or no recognition to the human aspects during simulation modelling and more focus on the quantitative aspects of modelling.*

Lehaney and Paul (1996) combined SSM with discrete event simulation. They highlighted that the effective and efficient provision of outpatient services may be assisted by the appropriate use of discrete event simulation. However, in itself, it provides no means by which system activities may be identified. The authors explore use SSM in the development of simulations of outpatient departments and concluded that SSM has assisted in the identification of systems and the acceptability of the model has been enhanced by the participative nature of the SSM process. Staffs were involved in the model building process from the beginning, which has encouraged a sense of ownership of the model, and has therefore increased its acceptability. Acceptance of the conceptual model gives rise to the final simulation being credible. The clarification of the split between responsibility and authority highlights a major contribution of SSM to the modelling process. The authors noted that simply simulating activities experienced by patients would not raise all the important issues which are raised when a systemic approach is taken. The authors further concluded that the success of this approach in this single case cannot yet be generalised.

Bennett and Worthington (1998) undertook a study to improve operations in hospital out-patient clinics using traditional OR methods and patient flow models which revealed relationships between appointment and clinical staff. They further created a clinic build-up model and a spreadsheet model to reduce patient wait times and coordinate appointment times. By using a mixed qualitative and quantitative modelling approach to the study, the authors were able to identify and implement several changes to the existing system that lead to efficiency improvements. They further concluded that an initial mainly qualitative approach to

modelling the system can offer quick and useful insights into difficult problems and hence guide decisions regarding more intricate problems.

A survey conducted by Munro and Mingers (2002), focused on understanding how and why different methodologies had been combined in practice. Of 93 surveys sent only 47 responded while others were reluctant to give any explanation of their use of multimethodology. Of the 47 responses that were received three different categories can be identified characterised in terms of their increasing sophistication or extent of self-reflection. The most common explanation was that a particular technique or methodology was simply 'required'. It is also generally assumed that the nature of the problem determines a particular type of solution. In other words, that for these respondents choosing two or more methods was just as clear-cut as choosing one. The second most common form of explanation tended to be more open-ended and vague. These responses tended to use words like 'appropriate' when saying why they used a particular methodology. It is interesting to note that, whereas 'required' implies a set objective with no alternatives, 'appropriate' implies the possibility of choice and active decision making. Other commonly used, but vague, justifications were that of being 'useful' or 'familiar' or derived from 'experience'. For example, the choice depends to a significant extent on the particular experiences and competencies of the practitioners involved. In fact for these categories it is difficult and impossible, to provide an explicit account of a person's activities or skills, since they do not generally articulate why the method was felt to be most appropriate in a particular situation. Finally, there were a few respondents who attempted to give a full account of why and how they used a particular set of methodologies. These tended to be ad hoc combinations, tailored to the particular situation, which was often described as complex. These responses tended to involve a more detailed discussion of the how different methodologies were combined in response to the situation and what their relative merits were. Studies suggest that a combination of 'soft' and 'hard' OR methodologies may result in increased acceptance, which leads to greater implementation of results of healthcare OR (Lehaney et al., 1999). Mingers (1997) stresses that different types of methods require quite different skills and orientations in their practitioners for example, hard methods require a good analytical mind and background familiarity with mathematics and computing skills, while soft methods require people skills and the ability to facilitate often stressful and contentious workshops. Choices about which methods to use are affected by the knowledge, experience and skills of the particular practitioner, and to some extent the academic or organisational context, as much as by the nature of the problem itself. Many people do not

consciously reflect on or articulate their methodological decisions (Munro and Mingers, 2002).

While several papers found in the literature have led to a successful implementation of qualitative and quantitative techniques involving multimethodology in the healthcare domain, each has followed a significantly different combination to achieve that. Literature suggests that practitioners judge the combination of hard or soft methods as very successful. While undertaking the literature review, the author has not found a common and generic framework based on combining OR approaches which can be applied for solving specific set of problems.

2.6. Facilitation Techniques

This section describes a brief literature review of facilitation techniques. Facilitation techniques and their selection are often situation based, and rely heavily on the skills and expertise of the facilitator at hand (Kolfschoten and Rouwette, 2006). Based upon the expertise level, facilitators have been shown to use anywhere between 6 and 23 techniques, with experts using more than novices (Kolfschoten et al., 2005). Thus, this research provides a background and a resource of the facilitation techniques found in literature for the avid reader and practitioner but does not propose a specific facilitation technique for generic application due to inherent variability in group settings, dependence on skills and expertise of the end user and other situational considerations that can be specific to an application.

Facilitation is a means to support collaboration processes in groups that has developed over the years as a research field. It is a dynamic process that involves techniques to support a group in achieving their defined goals. Several tools and techniques are available in literature to apply facilitation in group settings (Zigurs and Buckland, 1998; Kolfschoten et al., 2004). One of the important tasks for the facilitator is to identify and select appropriate tools and techniques in order to support the collaboration effort (Andersen and Richardson, 1997; Zigurs and Buckland, 1998; Vennix, 1999; Dennis, Wixom and Vandenberg, 2001). Kolfschoten and Rouwette (2006) have provided choice criteria for facilitation techniques but note several complicating factors that make the selection difficult. Firstly, the number of facilitation techniques available to choose from, make selection difficult for the facilitator as many situational considerations can play a role. Secondly, classification of such techniques is difficult and limited in literature and thirdly, tools to support the choice are limited in some sense as well. A survey of 58 facilitators conducted by Kolfschoten and Rouwette (2006) indicated that the choice of facilitation techniques depended heavily on the group culture and capability, time frame for facilitation, facilitator's skill, preference or experience, predicted

outcome of the technique and stated goals by the client. However, Kolfschoten and Rouwette have noted that the choice criteria collected by the survey are abstract in nature along with not being specific. In a follow-up workshop conducted by the authors, 9 techniques were identified after discussion with the control group of facilitators, along with when it would be suitable and not suitable to implement them. These are listed in Table 2.6.

Table 2.6: Results of the workshop on choice criteria
(adapted from Kolfschoten and Rouwette, 2006)

Technique	When suitable	When not suitable
Round robin (participants each give one idea in number of rounds)	Need to control outputs High emotion Encourage all individuals	Brainstorming ideas generation
Generating 'negative assumptions' (why it won't work) before brainstorming	When participants are full of negative assumptions, doubts or pessimism	When participants are enthusiastic, this is unnecessary
For each idea in a list, generate considerations pro and contra	Have different elements Dimensions	When new ideas or alternatives are needed
Panel brainstorming	Participants hear different opinions and arguments 'Market' of ideas	Some participants remain silent
Profile tool (indicate and explain team role)	Simple, allow people to get a different perspective	If issues are not about relationships
Information introductions when in a formal setting (location)	Warming up of the group To put people on an equal footing	Short meeting Formal environment
Summarise observations of effective behaviour	Efficiency Affirmation	Too early in the meeting
Write down the problem that brought you here	When we want to understand each other's standpoint and need a base, a motivation for our panel activities need for a quick and easy starter	When we want to leave the past behind
Issue analysis	General process is fun Problem solving Takes maximum of one hour	Accuracy Flexibility

The authors then proceeded to analyze these 9 techniques to identify the choice criteria from this workshop as effectiveness, efficiency, task requirements, group need, context and future steps, facilitator's preference and pleasant process. The choice criteria obtained from the workshop were then reduced and integrated with the choice constructs found in literature (Kolfschoten and Rouwette, 2006) as:

- Predicted efficiency: Facilitators' choices are made on the basis of a predicted effect of use of a particular technique where efficiency is defined as the degree to which time,

effort and resources are optimally utilized. Effort can be unpredictable when the facilitator does not know the group. Hence, they often strive to achieve a low cognitive load of the process. Alternation of facilitation techniques might solve this where the effect of resources and the time required can be estimated or predicted based on experience with a facilitation technique.

- Predicted effectiveness: where effectiveness is the level of goal achievement and is measured as the extent to which a goal was achieved by the group. As some techniques may be more predictably effective than others, facilitators may be very careful or even reluctant to try new facilitation techniques, even when the effect is described by other facilitators (Kolfschoten and Rouwette, 2006).
- Task requirements: The task requirement set for the collaboration process is a major factor that influences the process (Zigurs and Buckland, 1998). Also, facilitators strive to comprehend facilitation requirements and achieve certainty regarding them before selecting a facilitation technique. The authors further suggest that using known facilitation techniques may allow the facilitator to adopt the process when things occur different than planned, leading to more flexibility.
- Group requirements: Group characteristics can give rise to different requirements. For example, group size dictates physical resources required for facilitation and influences the time taken for activities in which the participants cannot work in parallel, such as mutual discussion. The capabilities and diversity of the group are also found to influence the choice of facilitation technique. Homogeneous groups, comprising of members of the same discipline or same education level imply that the capabilities can be estimated. However, in heterogeneous groups comprising of varied and diverse groups, an estimation of the capabilities is more difficult to estimate.
- Context of technique and process: It is important to take into account the context in which the facilitation will occur, i.e. the placement of the facilitation technique in the sequence of activities in the collaboration process and the scope of the collaboration process itself. Sequence of activities is important in order to avoid confusion as the selected facilitation technique should create a logical sequence and thus match with the previous and next technique.
- Facilitator's best practices: Preference, skill or experience with a facilitation technique is also an important criterion in selection, as it allows the facilitator to be more comfortable in adapting to unforeseen situations.

Figure 2.7 framed by Kolfschoten and Rouwette (2006) provides an overview of the choice criteria for facilitation techniques, which can be used as a guideline.

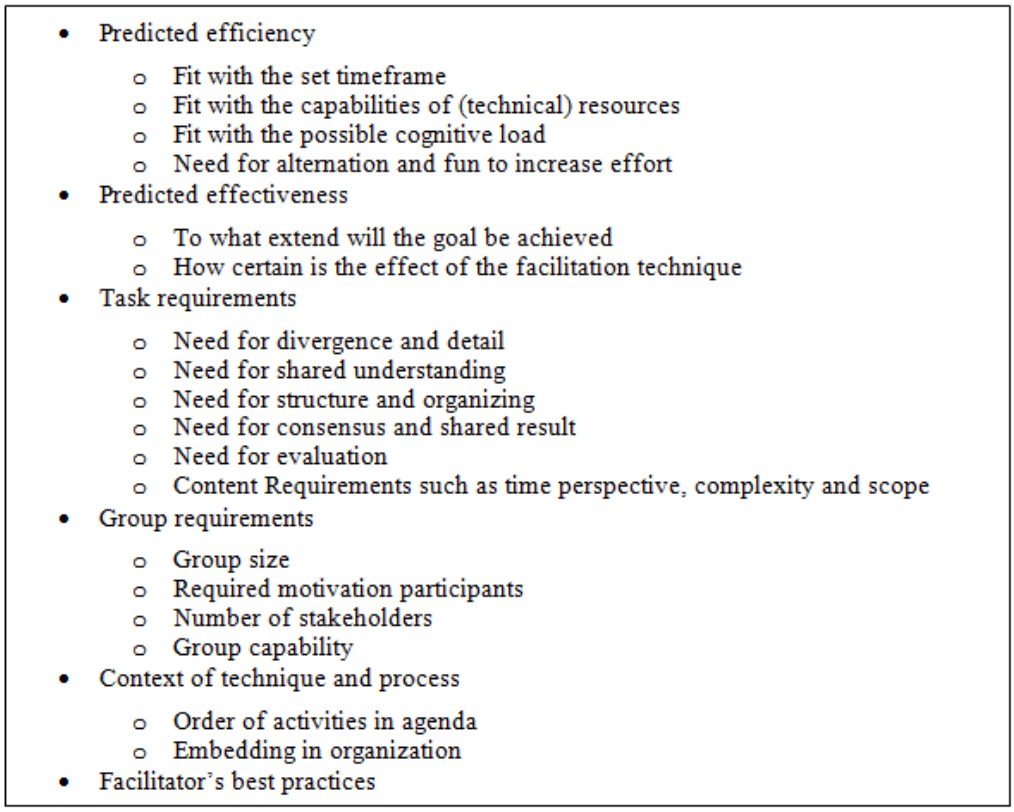

Figure 2.7 : Overview of the choice criteria for facilitation techniques

2.7. Framework Development and Evaluation

It has been established in the sections above that the major PSM approaches and multimethodology have been used to aid problem understanding which, in principle, can provide greater clarity to strategic problems and engage diverse decision makers using transparent representation that capture differing perceptions of problems. In reality however, PSMs can be difficult in accurately representing problems, limited in highlighting improvement opportunities due to non-intuitive visual representations and requirements for facilitators and stakeholders to be experts in tools used. Further, regarding multimethodology, there are no identified criteria for selection and implementation. This research aims to address

this gap by developing a framework, taking into account characteristics of healthcare delivery systems, limitations of PSMs with an aim of providing accurate and holistic representation of delivery workflow, so as to promote problem understanding in a rapid manner. It is worthwhile, therefore, to review the principles of framework and also the use of framework in helping problem understanding. This section provides a background to these areas which will later serves as guiding principles to development of the research aim.

At the onset, it is important to understand what a framework is. Miles and Huberman (1994) define framework as: 'a graphical or narrative form of the main things to be studied – the key factors, constructs or variables – and the presumed relationships among them. Frameworks can be rudimentary or elaborate, theory–driven or commonsensical, descriptive or causal'. A framework may: (i) represent an issue for a defined purpose, (ii) link various elements to show a relationship, (iii) enable a holistic view of a situation to be captured, (iv) demonstrate a situation or provide a basis for solving a problem, and (v) provide a structured approach to dealing with a particular issue. Management researchers make use of frameworks as a means of representing complex issues. There is, however, no universal agreement as to what constitutes a framework (Miles and Huberman, 1994). This is further complicated by the use of such terms as models, paradigms, tools, and techniques without clear definition. Another source of confusion is that frameworks are used within various disciplines, often with differing purposes and styles of presentation. The form of framework depends on particular purpose, and clear articulation of purpose supports framework development. Therefore, many frameworks may exist within the domain of a system. The key theme of framework found in literature is that it supports understanding and communication of structure and relationship within a system for a defined purpose (Shehabuddeen et al., 1999). Frameworks differ in their purpose, and style of presentation. The purpose of a framework can be to: describe how a particular objective can be achieved (Know-How), or depict what a particular situation is (Know-What) (Shehabuddeen et al., 1999) and the style of presentation of frameworks differs widely. A key variation is that some frameworks present a single-layer of analysis, for example, a strategic layer, whilst others present multiple-layers of analysis, for example, strategic and operational layers. It must be noted that some frameworks may not fit neatly into some of the above categories. For example, a framework may be developed with the purpose of partially describing know-how, and partly describing know-what. These frameworks may be termed hybrid-frameworks.

Frameworks are increasingly used within the management discipline as a way of translating complex issues into a simple and analysable format. In particular, their use has been to: (i) communicate ideas or findings to the wider community, (ii) make comparisons between different situations or approaches, (iii) define the domain or boundaries of a situation, (iv) describe context or argue validity of a finding, and, (v) support development of procedures, techniques, methods and tools. Most management frameworks are displayed in graphical or diagrammatic form. This is a highly effective means of communicating ideas. It is difficult to explain a concept or reason without having a visual understanding its constructs (Rodgers, 2000). As Rodgers (2000) puts it 'the first step in solving most problems…is to visualise the various components of the problem and their relation to each other'. He explains how a simple diagram that can be seen with the eye can focus the thinking and stimulate the development of a mental image of the problem. This is indeed what a framework facilitates, that is, abstraction and conceptualisation of a problem or situation. This notion is further supported by Gardner (1958) who discussed the benefits of logic diagrams as a valuable means for clarifying and solving logical problems. He predicted the contribution that such diagrams make in supporting problem solving and the truth of this prediction is now evident in the field of management where diagrammatic representation often used as an important means of communication. Some would argue that a diagrammatic form of representation, such as that of a framework, is not rigorous enough for communicating in-depth concepts or supporting formal arguments. Balbiani and Cerro (1999) dismiss this proposition and suggest that diagrams can be used for formal arguments so long as their purpose is clearly defined and semantics clearly understood. Rodgers (2000) explains that whilst diagrams support the understanding of words, words are necessary to describe the foundations of the diagram. In practice, most management frameworks are accompanied by some form explanatory text. Holyoak (1990) identify 'perception', 'language', 'categorisation' and 'sequencing of actions' or relationships, 'memory', 'judgement', and 'choice' as key ingredients for problem solving. A framework clearly represents categories and relationships, and is based on a particular perception or paradigm. The language of most management frameworks is in the form of symbols. The user of the framework applies memory, judgement, and choice, perhaps by the utilisation of a particular approach.

For framework development, generic steps for problem solving can be followed (Garofalo and Lester, 1989; Jackson, 1975; Polya, 1957; Francis, 1990; Lyles, 1982; Mayer, 1992; Bransford and Stein, 1993). The first step involves, *Structuring the problem*. Many of the

established frameworks propose problem definition and obstacle identification. This includes understanding the situation, what is wrong with the current state and what is the intended goal. The predominant behaviours in this step include sense making, organizing, and constructing of the problem definition (Carlson and Bloom, 2005). The problem-solver transforms the statements of the problem into a mental model that represents the problem-solver's interpretation of the problem (Mayer, 1992). Different kinds of problems have different semantic structures, so successfully solving these problems requires that decision makers develop semantic models of the deep structure of the problem as well as a model of the processing operations required to solve the problem (Riley and Greeno, 1988). Problem solving requires significant conceptual understanding of the problem class. Formal and informal knowledge about the content domain including facts, definitions, algorithmic procedures, routine procedures, and relevant competencies about rules of discourse (Polya, 1957; Schoenfeld, 1989; Geiger and Galbraith, 1998) has to be acquired. Eden and Radford (1990) suggest one of the attribute to solving complex problem is to engage key stakeholders as they will analyse and assists in decision making. This process is participative and interactive. Carlson and Bloom (2005) mentions in his framework that this step also includes organizing information and effort is put forth to make sense of information in a table, graph, diagram, or text.

The second step involves *Devising strategies to address the problem.* After comprehending the problem, the next logical step proposed in literature is to set objectives and devise one or multiple strategies to achieve that. In this step, the different pieces of this interpretation are combined into a coherent structure that will support a problem-solving plan (Mayer, 1992). The objectives and strategy could be related to only the problem at hand or can take into consideration the overall vision of the organization. Representing problem complexity graphically (rather than algebraically or in tables of numerical results) also aids participation. Trebble et al (2010) uses process mapping to “see” and understand the patient’s experience (by separating the management of a specific condition or treatment into a series of consecutive events or steps such as activities, interventions, or staff interactions.

The third step involves *Executing the strategy.* Once a problem is understood and the strategies for tackling the problem is selected, the problem-solver formulates a plan in the form of a sequence of steps for solving the problem and problem-solver carries out this plan, and solves the problem (Mayer, 1992). This step is concerned with the execution of the strategy in order to close the gap between the current and desired state of the problem. Given that

considerable effort has been invested in Steps one and two, strategy execution typically involves the skills to implement the strategy. However, it is necessary to validate the results obtained and the course of execution with the intended plan and expected outcome. The last step involves *Refining the strategy.* This step is concerned with the critical examination of the obtained solution and the path taken to achieve that. Results are tested for their reasonableness and decision is made about validity of answer (Carlson and Bloom, 2005). It is a look back at the outcome, whether success or failure, of steps that were undertaken and can be thought of as a verification of the initial hypothesis and strategy. This knowledge serves as an important aspect of the learning and refinement process for problem solving. Also, decision makers use this step to identify new problems or opportunities that may arise from their previous decisions and the courses of actions followed in order to implement such decisions and achieve the desired objectives.

While developing the framework, evaluation is important for benchmarking against the requirements set for development and compared to the performance of similar frameworks. While the use of several PSM discussed earlier has grown significantly over the past few decades, there exists a dearth of evaluation of these applications (White, 2006). There exists very little evidence of whether these methods are useful or better than others (Mingers and Rosenhead, 2004) and in general, there are not many evaluation criteria developed in literature that are applicable across a wide variety of application. Also, no consensus exists in the OR community on the evaluation of PSMs. White (2006) chose 13 papers, which reflect the types of publications of PSMs, to analyze the evaluation criteria, if any, presented by the papers. Only 7 were found to use evaluations of PSM and these are presented in Table 2.7.

Table 2.7: Evaluation of PSMs
(adapted from White, 2006)

Author (s)	Title	PSM used	Evaluation
Phahlamohlaka and Friend	Community planning for rural education	SCA, NGT	Single case study: Reflection by facilitator and a satisfaction survey sent
Hjortsø	Enhancing public participation in NRM using soft OR	SODA	Questionnaire and group discussion with 10 people
Joldersma and Roelofs	Impact of soft OR on problem structuring	SODA, OMT	Quasi-experimental data collection by observation and survey
Sørensen, Vidal, Engstrõm	Using soft OR in a small company	SCA, SWOT	Single case study
Franco, Cushman, Rosenhead	Project review and learning in the construction industry	SCA	CVF questionnaire (70% response rate) and group deliberation on effectiveness
Bryant and Darwin	Explore inter-organizational relationships in the health service	Drama theory and role play	Case study through process observation and questionnaire
Connell	Evaluating soft OR	SSM	Case Study, retrospective reflections

A review of the 7 papers established that there was no consensus on the evaluation approach used and there was no explicit discussion on how the results could be generalized beyond the case study setting. The position of several authors on evaluation has been described in literature as, essentially positivist versus interpretivist (White, 2006). While the former calls for insights into specific objectives and for a stronger focus on quantification of efficiency and effectiveness, the latter claims that facts and figures mean less without an underlying knowledge of the complex and possibly conflicting 'world views' and preferences of the stakeholders involved. Proponents of the positivist approach take a factual approach towards knowledge, asserting that facts and values are distinct and that they are the building blocks of knowledge base. On the other hand, the interpretivist approach claims that knowledge is subjective and is closely related to the process of comprehension and interaction. It is now generally accepted that a pure positivist approach is inadequate in evaluating PSM and that while interpretivist approach is more acceptable with the practitioners, it is difficult to apply a specific theory due to the complexity of any PSM application.

White (2006) further proceeded to propose and test a pragmatic theory based evaluation, which in principle, was based upon specifying explicitly underlying assumptions on how a PSM intervention was designed to work and then using it to guide the evaluation. This was suggested due to the complexity of PSM's and also due to their basis on explicit and implicit

theories of their functions. The proposed evaluation method relies on firstly, deriving a description of "what", "how" and "why" relating to the events that occur, secondly, on practical usage of methods of data collection and establishing reflections of the finding in order to provide insights which could possibly provide theoretical base to other practitioners regarding similar interventions, and thirdly, on the acceptance of the parties involved, that is, the practitioner and stakeholders. The author further recognized that problems could occur with this method of evaluation and identified two specific problems for discussion. Firstly, it would require a comprehensive experience and knowledge base for the practitioner to bring all the underlying theories and assumptions in an environment involving multiple perspectives. Further, the engaged participants would need to be willing and capable of working through these requirements. Secondly, as most evaluations are typically applied in a one-off setting over a short period of time, two interventions are not likely to be applied in a similar fashion and would never have a similar impact due to contextual differences. A series of evaluation to generate a reliable and replicable body of knowledge, while desirable, may not be possible due to restrictions in time and resources.

It is to be noted that a review of the literature has identified that firstly, evaluation criteria for PSM methods is seldom identified for many studies. Secondly, for case studies that do specify an evaluation criteria, no set criteria can be identified. The 7 papers evaluated by White use 7 different approaches for evaluation highlighting the difficulties in setting a standard benchmark across PSM methods. White has proposed a pragmatic theory based evaluation but identified that it would firstly, require practitioner to have comprehensive experience and knowledge base implementation and that in a multi-perspective environment, the participants would need to be willing and skilled in working through the evaluation criteria. Moreover, contextual differences are likely to affect two interventions in a period of time. In short, effort for standardizing evaluation criteria across PSM methods is fraught with challenges and uncertainties due to inherent process variability.

2.8. Research Focus

The main focus that can be drawn from the discussion so far is that to address the challenges in complex systems such as healthcare delivery systems, literature suggests that problem understanding should be first and of paramount importance for decision making (Eldabi, 2000; Lebcir, 2006; Anderson et al., 2012). As discussed in previous sections, major PSM approaches and multimethodology have been used to structure problems and have

distinct similarities and dissimilarities in principle and method of application. However, they also possess limitations and their effectiveness has been questioned when tackling complex problems in healthcare. As discussed in Section 2.5.1, the major limitations of SCA include a heavy dependence on stakeholder knowledge and facilitator expertise, inability to generate or promote a holistic graphical representation, lack of mechanisms for systemic decision making, lack of a clear-cut route to rigorous problem definition, excessive time and cost required for implementation, limitations in exploring improvement opportunities and inability to handle stakeholder diversity. Similarly, as discussed in Section 2.5.2, limitations of SODA include weakness in assessing alternatives and systemic decision making, limitations in designing layout of cognitive maps for ease of comprehension, weak method for problem definition, requirements for facilitation and stakeholder expertise, considerable effort required to develop a model and inability to take into account issues associated with uncertainty and risk in decision making. For SSM, Section 2.5.3 indicates high time and cost implications for usage; inability to satisfactorily justify perspectives and adequately represent operation workflows; limitations in evaluating its effectiveness, dependence on style ability of the facilitator and the participants, inability to take into account issues associated with uncertainty and risk in decision making, complexity in implementation and difficulty in explanation and usage. For multimethodology, Section 2.5.5 provides an overview of applications in healthcare with major limitations being the strong dependence of choice of implementation approach on the practitioners' knowledge, skills and experience. Further, each multimethodology application is specific to the problem at hand and generalization to other problems can be challenging. Table 2.8 summarizes these limitations.

Table 2.8: Major limitations of SCA, SODA and SSM

		Major PSM Approaches			Other Approach
SN	Major limitations	SCA	SODA	SSM	Multimethodology
1	Representation of situation can be challenging and does not represent real world	√	√	√	
2	Time and Cost Implications	√	√	√	
3	Stakeholder must be expert in different technologies / tool for maximizing value	√	√		√
4	Weak in providing specific mechanisms for systemic understanding & decision making	√	√	√	

5	Lack of clear cut route to problem definition	√	√		
6	Inability to handle stakeholder diversity	√			
7	Possible complexity in implementation, explanation and usage	√		√	√
8	Implementation strongly dependent on practitioners' knowledge and experience	√	√	√	√
9	Difficulty in generalizing implementation approach				√
10	Dearth of testing in a wide variety of healthcare applications				√
11	Inability to map multiple processes occurring in real-time	√	√	√	√

Based on the discussion presented in this chapter, direct research questions that can be derived and tackled in this research are:

a) How can healthcare practitioners use a comprehensive methodology to address interconnected socio-technical aspects and limitations of current PSM techniques and multimethodology effectively?

This question relates strongly to the 1st, 4th, 5th, 7th, 8th and 9th limitations identified in Table 2.8. It is further related to the possibility of developing a theoretical framework which can assists healthcare practitioners in addressing the limitations. Frameworks are a useful means within the management discipline to translate complex issues into a simple and analysable format (Shehabuddeen et al., 1999). They are particularly useful in communicating ideas, making comparisons, defining the boundaries and describing context or argue validity of a finding while supporting development of procedures, techniques, methods and tools. Most management frameworks are displayed in graphical or diagrammatic form which is a highly effective means of communication (Shehabuddeen et al., 1999).

It is difficult to explain a concept or reason without having a visual understanding its constructs (Rodgers, 2000). As Rodgers (2000) puts it 'the first step in solving most problems…is to visualise the various components of the problem and their relation to each other'. He explains how a simple diagram that can be seen with the eye can focus

the thinking and stimulate the development of a mental image of the problem. This is indeed what a framework facilitates, that is, abstraction and conceptualisation of a problem or situation. It is possible that possessing and representing this information will enable the healthcare practitioner to facilitate sessions with stakeholders and will ultimately result in effective utilization of the framework in leveraging their knowledge for problem solving.

Further, it is possible that this objective can be achieved with the usage of simple models rather than complex analytical or simulation models. Previous authors, in the discussion over the requirement for acceptance of modelling technique, have suggested that modellers should select the simplest model that describes the healthcare intervention adequately (Elixhauser et al., 1998; Sculpher, Fenwick and Claxton, 2000). Literature (Pidd, 1999), also encourages the researcher to "think complicated, model simple", arguing that building a complex model will be uneconomic, since a model would take as long to build as the system it represents and that it would be uneconomical to develop and maintain. Little (1970) argued that models should be simple to understand and should be easy to manipulate and control. As Pidd (1999) indicates, transparency is desirable so as to establish trust between the practitioner and client, which is easier to establish if the client can appreciate the overall workings of the model and understand its capabilities and limitations. Models that are simple or transparent are more likely to be understood and accepted by non-specialists. Further, the framework should strive to ensure that the implementation methods are not strongly dependent on the nature of the problem and the practitioners' skill, knowledge and experience and promote generalization and wider application. Addressing this research question will not only test the possibility of building such a framework but also provide information regarding constitutive methods and insights derived from real-life implementation.

b) What are the principles that can be followed to engage stakeholders, enhance problem understanding and promote a shared world view regarding problems and solutions?

This research question is strongly related to the 1st, 4th, 5th and 6th limitations identified in Table 2.9 and directly related to the possibility of developing a framework that builds on theoretical techniques to enable effective engagement of stakeholders along with facilitating problem understanding and a comprehension of mutual views

regarding problems and solutions. To achieve this, this research firstly provides a literature review of facilitation techniques and choice criteria for implementation, for the healthcare practitioner. Since, the selection of a facilitation technique is heavily dependent on situational considerations, which was discussed in Section 2.6; the framework will refrain from proposing a specific technique for generic application. However, it is anticipated that a real world implementation of the framework will utilize at least one facilitation technique for group facilitation. The effectiveness of this facilitation technique in achieving the desired objectives of the case study will then be assessed, which will consequentially evaluate the guiding principles for engaging stakeholders, enhancing problem understanding and promoting a shared world view regarding problems and solutions. The end result of achieving the above mentioned objectives will be a framework that employs facilitation techniques which are not only grounded in theory derived from literature but also have been deployed and tested in real life conditions. Since effectiveness of facilitation techniques is dependent on nature of problem, organizational structure and skill of practitioner, a real-life evaluation will test the theoretical principles of such techniques from a healthcare perspective.

c) What methods can be followed to ensure simple and rapid implementation to achieve desired goals?

This research question is strongly related to the 1st, 2nd, 3rd and 4th limitations identified in Table 2.9 and is directly is related to the possibility of developing and testing the theoretical framework in a manner which is easy and rapid to implement. This is important so as to minimize the investment in time and resources by the end user and client. In order to ensure rapid implementation, such a framework will be focused on pertinent data with less dependence on collecting a large number of data samples. The framework will focus on usage of general word processing applications so as to avoid usage of specialized software. This would minimize training requirements for the healthcare practitioner and promote ease of comprehension and usability for the end user in cases of knowledge transfer. Facilitation in group settings will be aided with the use of visual representation techniques and simple modelling techniques, which have been shown in literature to reduce time required for comprehension and analysis by the users (Kolfschoten et al., 2005; Kolfschoten and Rouwette, 2006). To ensure simple and rapid implementation of the framework, new

methods and tools would have to be developed or combined to address limitations of PSM methods and multimethodology.

The underlying research question that can be formulated from the three questions posed above is: **"In a healthcare delivery system, could a framework be devised to enhance the understanding of complex problems that have inter-connected socio-technical aspects, in a simple and rapid manner?"** This research question is addressed in Chapter Four through Eight, which attempts, firstly to develop a framework that addresses them and secondly to test and refine it via application at two healthcare settings. The next chapter describes the research design and methodology undertaken to fulfil the research aim and objectives to answer the overall research question.

2.9. Summary

This chapter provided a detailed theoretical review to support the aim of this research, that is, the development of a framework which provides an accurate and holistic representation of the delivery workflow in order to promote problem understanding in a rapid manner. The framework has been proposed to overcome limitations of the major PSM (SCA, SODA and SSM) and multimethodology whilst also to handle the major challenges that exists in the healthcare delivery systems. The comprehensive review started with the review of healthcare delivery system in order to understand the components of the systems and different models settings that exist. A detailed understanding of the major challenges within healthcare delivery systems was also conducted to understand how they affect outcomes and efficiencies of comprehending problem and decision making. These challenges within delivery systems that make problem understanding difficult are its complexity, the involvement of multiple stakeholders in decision making and the silo structure between the different units that make up the delivery systems. Together these reviews provided an insight to the domain of care delivery system. The literature review was also extended to include understanding of the nature and characteristics of healthcare problems since different types of problem posses different characteristics, hence the approach to understanding and tackle these problem differs. For example, tame and well-structured problems are simply defined and rooted in a tried and tested methodology with a predictable set of results, however, ill-structured and wicked problems are the kinds of problems that can be unpredictable and non convergent with no definitive statement of the problem, open-ended search for a solution and can be complex to interpret and comprehend since resources and political ramifications are constantly changing. PSM

approaches have been utilized to understand these types of problem. A detailed review and analysis of the major PSM approaches to address such problems were conducted. The major PSM approaches include, SCA, SODA and SSM. The review included a comparison, that is, similarities and dissimilarities between SCA, SODA and SSM along with their individual advantages and limitations. These attributes will be used as the attributes to formulate the requirements of the proposed framework which is the main aim of the research. Further, the review of Multimethodology, combining a number of PSMs, or PSMs together with more traditional methods, in a single intervention was also conducted to understand its characteristics and usage.

Based on the review conducted, the underlying research question was formulated as: "Could a framework be devised to enhance the understanding of problems in healthcare delivery system in a simple and rapid manner, especially regarding complex problems that have inter-connected socio-technical aspects?" Additionally, on the basis of literature reviewed and discussed in this chapter, the next chapter will propose a framework to promote problem understanding in a rapid manner to fulfil the research gap.

3. RESEARCH METHODOLOGY

3.1. Introduction

Chapter Two has recognized that there exist limitations in the major PSM approaches to understand problem in healthcare delivery system and identifies the need for a framework to enhance the understanding of problems in healthcare delivery system in an effective and rapid manner which is the aim of this research. This chapter describe the research design and methodology undertaken to fulfil the research aim and objectives and derives answers to the research question(s) noted in Section 2.8. Firstly, Section 3.1 provides the introduction to the chapter and Section 3.2 discusses the theoretical foundation and justifies the chosen research philosophy. Section 3.3 describes the research approach adopted while Section 3.4 describes the strategies used in this research. Section 3.5 present the explanation to the case studies selected in this research along with the background of the case hospitals. Section 3.6 presents the time horizons design for this research. Section 3.7 and 3.8 discuss the type and method of data collected respectively. Section 3.9 presents the discussion on the validity of the collected data and Section 3.10 presents the conclusion of this chapter.

3.2. Research Design

Generally, research design consists of three major elements of inquiry: (a) philosophical assumptions, (b) strategy inquiry, and (c) methods (Creswell, 2003). The first element is the philosophical assumptions which explain the assumptions on which the research design is based. That is, it defines what constitutes knowledge claims. The second element is the strategy of inquiry or methodology which provides the choice or the use of method or the general research procedures, for example, survey research, ethnography and case study. The third one is the methods which are techniques and detailed procedures of data collection, analysis and writing, for example, questionnaire, interview and focus group. Other elements such as research approaches, time horizons and types of data or method can also be added to provide a richer picture of the overall research design. A research design framework by Creswell (2003) could be complemented by the research onion proposed by Saunders et al. (2007) to provide the additional elements mentioned earlier. A broad spectrum of the research design is depicted in Figure 3.1. The words in bold in the figure represent the chosen elements

in this research study and a discussion on each element is explained in subsequent sections.

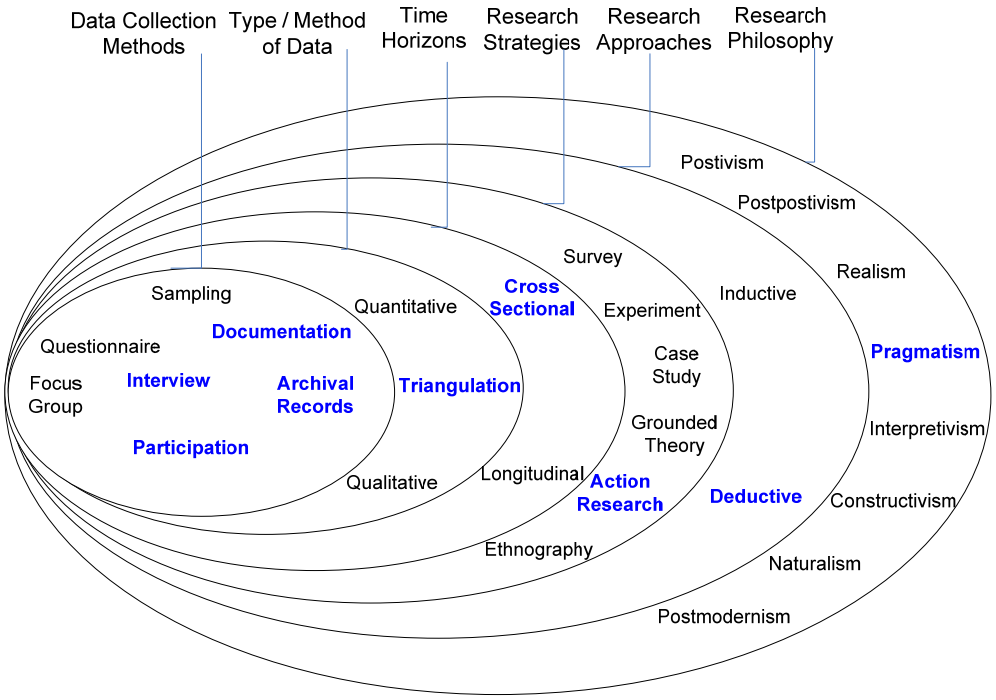

Figure 3.1: An overall picture of a research design
(adapted from Saunders et al., 2007)

3.3. Research Philosophy

Understanding and positioning oneself in a specific research philosophy directs the whole research process and hence the research outcomes and knowledge claims. Paradigms or philosophical assumptions provide the worldviews or belief systems and guide researchers to detailed modes of research (Tashakkori and Teddie, 1998; Easterby-Smith et al., 2002; Creswell 2003, 2007). The author's philosophical assumption is related to the area of Operations Management (OM) research and the research framework.

Research in the OM field is a strongly linked to the 'real world' and often produces cross-disciplinary work (Wacker, 1998). Researchers in this field frequently have an engineering background, and so they tend to believe in the usefulness and application of scientific principles. OM research is often judged good on the basis of being practically oriented (Handfield and Melnyk, 1998). Additionally, successful OM research must be accepted and applied by other researchers and managers in this field. Hence, empirical research is the

cornerstone for the development of scientific knowledge in the OM field (Eisenhardt, 1989; Flynn et al., 1990; Handfield and Melnyk, 1998). Philosophical assumptions or knowledge claims can be described from a high objectivism (Positivism) to the mixed mode (Postpositivism, Pragmatism or Realism) and finally to a highly subjectivism (Constuctivism, Interpretivism or Naturalism). Figure 3.2 provides an overview of research philosophy available and highlighted in bold is the choice the author has adopted for this research.

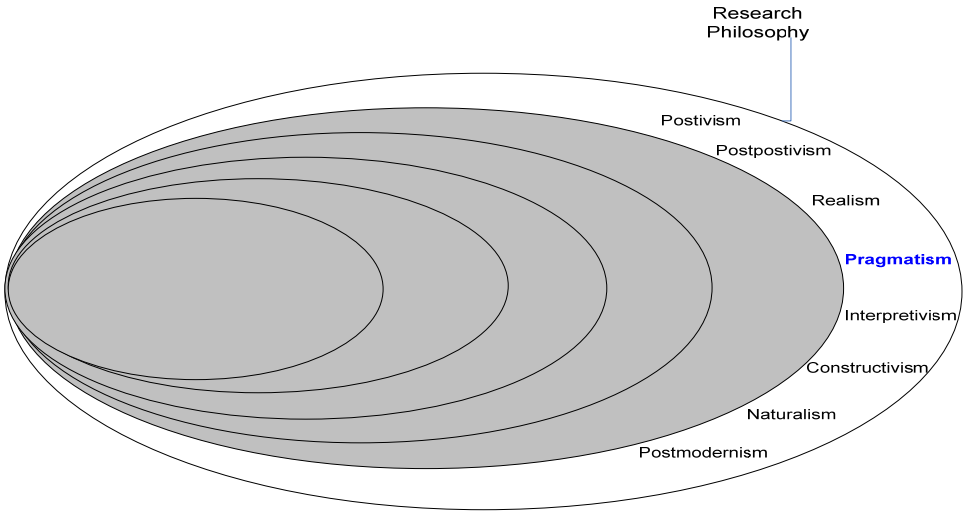

Figure 3.2: Research Philosophy and the choice adopted
(adapted from Saunders et al., 2007)

The author's choice of research paradigm is based upon the linkage between the nature of OM research and the aim of this research which results in the author's perception of the world as a combination of both subjectivism and objectivism, oriented towards practicality. Although hard science is often oriented towards positivism, OM, whose major role is to examine and solve business problems, needs to incorporate soft science or social science into it's the research inquiry. Hence, pragmatism seems to be the most appropriate paradigm to explain the authors' understanding of this 'real' world which will then shape the author's research design and knowledge claims. Cherryholmes (1992), Murphy (1990) and Creswell (2003) describe pragmatism as uncommitted to a particular system of philosophy and reality; with considerable freedom provided to the individual researcher in choosing methods and techniques of research that meet their needs and purposes. Pragmatists look for multiple approaches, quantitative or qualitative, for collecting and analyzing data rather than subscribing to only one way (for example, quantitative or qualitative). Truth is what works at the time and investigators use both quantitative and qualitative data to best understand the problem with the research always

occurring in social, historical, political, and other contexts. Ultimately, pragmatism allows the researcher to consider different worldviews, assumptions, as well as to different forms of data collection and analysis.

3.4. Research Approaches

Inductive and deductive reasoning are two logical approaches used to arrive at a conclusion based on information assumed to be true. Both are used in research to establish hypotheses. The research approaches in this study therefore included both theory building (inductive) and theory testing (deductive) to ensure the rigorous research process. In a deductive approach reasoning is funnel like; it narrows down from broader more general to specific. It is also known as top down approach. In the deductive approach, hypothesis is developed from the research and theory and research method is applied to test hypothesis (Bryman and Bell, 2007). The inductive approach is also known as bottom up approach. Compared to the deductive approach, it works in the opposite direction, diverging from specifications to broader generalisations. Inductive approach starts with specific observations while identifying patterns and formulating hypothesis that can be evaluated. It finally develops some general conclusions and theories.

At the onset, a deductive approach will be used to comprehensively study literature and understand the composition and challenges of healthcare delivery systems and its problems, the method for problem understanding and solving and main problem structuring methods. The outcome will achieve the first objective of this research. At this point, the approach will move the journey of the research from the general to the specific and would not allow for the element of chance or uncertainty (WHO, 2000). This effort will clearly identify problem areas and gaps in order to formulate a research focus which is the second objective set for this research. In this thesis, a number of publications from literature were reviewed in order to address the first and the second research objectives which lead to the development of a conceptual background. A research focus was then derived based on the developed conceptual background. After establishing the research focus, the deductive approach is used to derive the requirements of the proposed framework and its structure, keeping in mind the partial or absolute resolution of identified problem areas and gaps. This will fulfil the third objective of this research. The framework will then be validated and verified in a real world healthcare delivery system with the aim of descriptive and explanatory study of the effectiveness of the framework (Rowley, 2002; Stuart et al., 2002). Figure 3.3 presents the research approaches available and

highlighted in bold the approaches selected in this research.

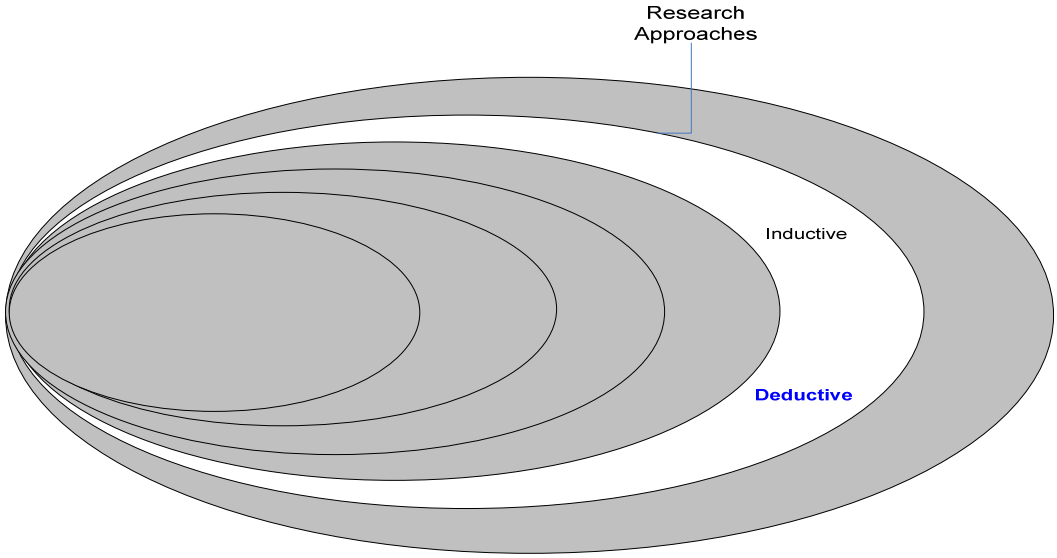

Figure 3.3: Research Approaches and the approach adopted
(adapted from Saunders et al., 2007)

3.5. Research Strategies

There are six research strategies identified through a review of the literature in standard research methods textbooks (such as Gill and Johnson, 2002; Saunders et al., 2007; Denscombe, 2007). These range from a positivistic standpoint to a radical structuralist standpoints and include the following: experiments, surveys, case studies, action research, grounded theory and ethnography. The process of making choices for the research strategies has been described as 'dilemmatics' in literature as there are no ideal solutions (McGrath, 1982). Although all the six research strategies have been identified in literature have a specific focus, they are also related to each another in certain ways. For example, experimental research is concerned primarily with precision, survey research with generality, ethnography with the character of the particular context, and action research with issues of utilization (Gill and Johnson, 2002).

The main research strategies employed during this research include action research (Platts, 1993) with the utilization of case studies. Figure 3.4 illustrates the different research strategies available and highlighted in bold the strategy adopted for this research.

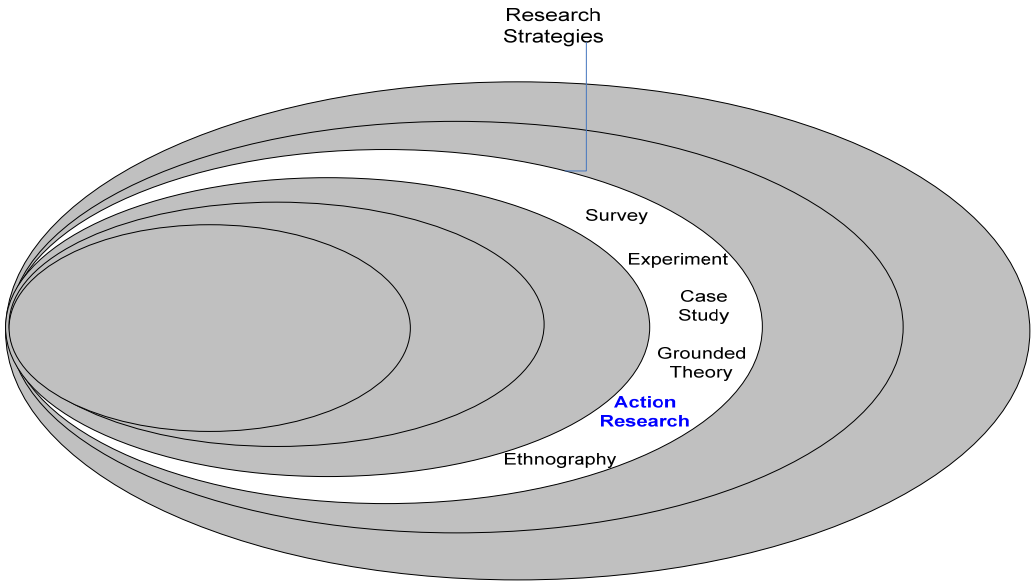

Figure 3.4: Research Strategies and the strategies adopted
(adapted from Saunders et al., 2007)

Action research, as defined by Reason and Bradbury (2001), is "a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It aims to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities." Further, action research practitioners recognize that beyond the responsibilities of theory informing practice, it can and should be generated through practice and that theory is most useful as it is focused on achieving social change (Brydon-Miller, Greenwood and Maguire, 2003). Action research is an approach aimed at taking action and creating knowledge or theory about that action (Susman and Evered, 1978; Holter and Schwartz-Barcott, 1993; Hart and Bond, 1995; Eden and Huxham, 1996; Greenwood and Levin, 1998; Gummesson, 2000; Coghlan and Brannick, 2001; Reason and Bradbury, 2001). It is a form of experiment that takes the research design of the experiment out of the laboratory and into the field (Gill and Johnson, 2002). It works through a cyclical process involving: (a) planning, (b) taking action, (c) evaluating that action, and (d) leading to further planning and so on. It is a spiral-like progress with alternating phases and cycles that evolve over a period of time (Hyrkas, 1997). Its main view can be expressed as follows (Argyris et al. 1985):

- it focuses on a particular problem and seeks to provide assistance to the client system;
- it involves iterative cycles of identifying a problem, planning, acting and evaluating;
- it involves re-educating individual or groups involving changing patterns of thinking and action. Effective re-education depends on participation by clients in diagnosis, fact finding and free choice to engage in new kinds of action;
- it challenges the status quo from a participative perspective, similar to the point mentioned above; and
- it is intended to contribute simultaneously to basic knowledge in social science and to social action in everyday life.

An action research study is likely to include cases but case study research can avoid using action research. The use of case studies allows usage of appropriate methods such as observation to explore naturally and deeply. Robson (2002) defines case study as a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence. Thus, case studies focus on specific examples of a social entity such as organizations, groups, communities, and events. Case studies have a considerable ability to help generate answers to the 'why?' as well as 'what?' and 'how?' questions (Saunders et al., 2007). The fieldwork of case studies may incorporate the analysis of records or documents, in-depth interviews, large-scale structured surveys, participant and non-participant observation, and the collection of all available forms of data (Gill and Johnson, 2002). Hence, case studies may be prolonged into longitudinal studies covering weeks, months, years or decades, or with periodic follow-ups (Hakim, 2000). Case study method can be divided into single case study approach or multiple case approaches (Yin, 1994). Single-case studies are ideal for cases where an observer is involved in investigating a novel phenomenon and unique aspects are revealed at the conclusion of the case study. Multiple-case studies follow a replication logic, where each independent case study is a "whole" study and relies on facts gathered from various sources and conclusions drawn on those facts.

This research utilizes action research because the theoretical framework can be developed internally based upon a comprehensive literature review and then tested and refined in the field via multiple applications. The process involves a spiral path involving planning, implementation, evaluation and refinement and leading to further planning and so on. Action research achieves outcomes by involving people in the planning and the action and by being flexible and responsive to situation and people. Compared to traditional research techniques

where a group of people decide what is to be done and others are then expected to follow, it can result in a lack of enthusiasm on the part of the doers. In contrast, action research relies and promotes participation from all levels of the organization for problem solving to provide a richer information (Dick, 2002). Further, in action research people are encouraged to seek out conflicting and disconfirming evidence - evidence which is counter-intuitive and does not match what is expected. Given the limitations identified in Table 2.9, Action research can be a powerful research strategy for stakeholder engagement taking into account stakeholder diversity and promoting systemic understanding of operation and problems.

In this research, as part of action research, a single case study approach will be adopted wherein the framework will be applied to multiple delivery systems with the focus on evaluating its effectiveness in two independent and different healthcare delivery systems. The effectiveness can be evaluated as a comparison of the performance and outcomes of each case study against the requirements that will be derived from a theoretical review of the literature. This effort will fulfil the fourth and fifth objectives respectively. The case study approach within the action research method will also be applied to test the preliminary framework, examine, and refine the model. The authors association with action research and the use of case studies within action research arises from firstly, the ability for the researcher to be an active participant and directly impact the operation with an additional focus on “How to” identify and implement that change. The author is also interested in receiving an active feedback from the situation that she is investigating and uses it to change the existing conditions in order to hopefully, improve. This is not possible solely by a case study research as the primary role of the researcher is an observer with more focus on descriptive rather than intervening nature. However, the researcher would act as a facilitator who guides and structures the process and does not impose his/her views on the decision-makers. That said, the researcher utilizes facts and data analysis to probe questions and promote thinking within the group. A feedback discussion with problem owners along with first hand observation is used as an instrument to evaluate and provide further suggestions for revision to the framework. The revised framework is then tested in the second case study to evaluate the effectiveness of the revision.

3.5.1. Case Study Selection

This section explains the reasons for selecting the case healthcare delivery system. ‘Case selection is determined by the research purpose, questions, propositions, theoretical context, and other constraints such as accessibility, resources, and time available’ (Rowley 2002).

Moreover, using well-known institution with good performance records will provide representative information and hence it is worthwhile for an investigation (Stuart et al. 2002). Most case studies seek to elucidate features of a larger population and represent something larger than the case itself, even if the resulting generalization is issued in a tentative fashion (Gerring 2004). In case studies of this sort, the chosen case is supposed to represent a population of cases that is often much larger than the case itself. Typically case selection is based on pragmatic considerations such as time, money, expertise, and access (Seawright and Gerring, 2008). It may also be influenced by the theoretical prominence of a given case. Miles and Huberman (1994) suggest the six different attributes presented in Table 3.1.

Table 3.1: Attributes for Case Study Selection Criteria
(adapted from Miles and Huberman , 1994)

Case Study Selection Criteria	Description
Sampling strategy should be relevant to the conceptual framework & the research questions	Whether sampling is intended to provide cases in categories which are pertinent to a pre-existing conceptual framework for the research, or how far the choice of cases might affect the scope for developing theory inductively from the data.
Sample should be likely to generate rich information on the type of phenomena which need to be studied	Whether the phenomena of interest in the research are likely to `appear' in the observations. Intensive research depends on the collation of `thick description' of the phenomena which are conceptually important.
Sample should enhance the `generalizability' of the findings	Concerned with analytic generalizability rather than statistical power to make statements about a general population on the basis of a sample.
Sample should produce believable descriptions /explanations (in the sense of being true to real life)	Whether it provides a really convincing account and explanation of what is observed.
Is the sample strategy ethical?	Whether the method of selection permits informed consent where this is required; whether there are benefits or risks associated with selection for and participation in the study, and the ethical nature of the relationship between researcher and informants.
Is the sampling plan feasible?	Feasibility in terms of the resource costs of money and time, the practical issues of accessibility and whether the sampling strategy is compatible with the researcher's work style. Additionally, competencies in terms of linguistic and communication skills, ability to relate to informants and their experiences, or the researcher's (or informant's) capacity to cope with the circumstances under which data collection may take place.

Further, selection of a case in case study research has the objective so as to obtain a representative sample and a useful variation on the dimensions of theoretical interest. Seawright and Gerring (2008) have further derived the seven case study types (summarized in Table 3.2): typical, diverse, extreme, deviant, influential, most similar, and most different

based upon research published over the past century (For example, Mill, 1872; Eckstein, 1975; Lijphart, 1971; Przeworski and Teune, 1970).

Table 3.2: Cross-Case Methods of Case Selection and Analysis

Method	Definition	Large-N technique	Use	Representativeness
Typical	Cases (one or more) are typical examples of some cross-case relationship	A low-residual case (on-lier)	Confirmatory; to probe causal mechanisms that may either confirm or disconfirm a given theory	By definition, the typical case is representative, given the specified relationship
Diverse	Cases (two or more) exemplify diverse values of X, Y, or X/Y	Diversity may be calculated by (1) categorical values of X or Y (e.g., Jewish, Catholic), (2) standard deviations of X or Y (if continuous), or (3) combinations of values (e.g., based on cross tabulations or factor analysis)	Exploratory or confirmatory; illuminates the full range of variation on X, Y, or X/Y	Diverse cases are likely to be representative in the minimal sense of representing the full variation of the population.
Extreme	Cases (one or more) exemplify extreme or unusual values of X/Y relative to univariate distribution	A case lying many standard deviations away from the mean of X or Y	Exploratory; open-ended probe of X or Y	Achievable only in comparison with a larger sample of cases
Deviant	Cases (one or more) deviate from some cross-case relationship	A high-residual case (outlier)	Exploratory or confirmatory; to probe new explanations for Y, to disconfirm a deterministic argument, or to confirm an existing explanation (rare)	After the case study is conducted, it may be corroborated by a cross-case test, which includes a general hypothesis (a new variable) based on the case study research. If the case is now an on-lier, it may be considered representative of the new relationship
Influential	Cases (one or more) with influential configurations of the independent variables	Hat matrix or Cook's distance	Confirmatory; to double-check cases that influence the results of a cross-case analysis	Influential case is not representative. If typical of the sample as a whole, it would not have unusual influence on estimates of overall relationship
Most similar	**Cases (two or more) are similar on specified variables other than X1 and/or Y**	**Matching**	**Exploratory if the hypothesis is X- or Y-centered; confirmatory if X/Y-centered**	**Most similar cases that are broadly representative of the population will provide the strongest basis for generalization**
Most different	Cases (two or more) are different on specified variables other than X & Y	Inverse of the most similar method of large-N case selection	Exploratory or confirmatory; to (1) eliminate necessary causes (definitively) or (2) provide weak evidence of the existence of a causal relationship	Most different cases that are broadly representative of the population will provide the strongest basis for generalization

Based upon the research presented by Seawright and Gerring (2008), the "Most similar" (also highlighted in) method was chosen so as to develop and evaluate the framework using two case studies. The "Most similar" method employs a minimum of two cases (Lijphart 1971, 1975; Meckstroth 1975; Przeworski and Teune 1970; Skocpol and Somers 1980) and in its purest form; the two cases are similar across all dimension that are relevant to the outcome of interest. The cases can however differ on one dimension and the nature of outcome. It generally proceeds by defining the relevant background of cases, while identifying major areas of interest that should be similar across the chosen cases and identifying one or more variables that should vary logically across the target cases, and selecting the desired number of cases that have the specified similarities and differences (Case selection via Matching: Rich Nielsen, 2012).

In most observational studies involving qualitative data collection, there cannot be an exact match for continuous variables (dimensions) because firstly, quantifying dimensions which are qualitative in nature may not be possible and even where quantification is possible, there are no two cases with exactly the same score on scalar dimensions. Also, the larger the number of matching variables employed, the lower is the likelihood of finding exact matches. In situations where such exact matching is infeasible, researchers can employ approximate matching, in which cases from the control group that are close enough to matching cases from the treatment group are accepted as matches (Seawright and Gerring, 2008). As highlighted in Table 3.3 majority of attributes between two cases are quite similar and a major dissimilar attribute is presented in Table 3.4. It is anticipated that using the "Most Similar" method for the two case studies that provide a broad representation of the population will enhance generalization of results to other case studies which have similar attributes as outlined in Table 3.3.

Table 3.3: Similar attributes between two cases

Similar attributes	TRCC	UNT
Stakeholders involved	Multiple (8)	Multiple (5)
Indicators for success	Reputation, Quality Reports, financial performance and benchmarks	Reputation, Quality Report, financial performance and benchmarks
Nature of service (catered towards patient treatment)	Treatment & well being of patient	Treatment & well being of patient
Patient Safety	Highly important	Highly important
Reputation	Leading hospital in the U.S.	Leading hospital in the U.S.
Accessibility and logistics	Good access to resources	Good access to resources

	needed for study	needed for study
Nature of problem	Not well understood by personnel accountable	Not well understood by personnel accountable
Workflow management	Little exposure and understanding of workflow	Some exposure and understanding of workflows
Organization Structure	Hierarchical, with physicians reporting to medical director and nurses (administrative or clinical) reporting to director of operations	Hierarchical, with physicians reporting to the medical head and nurses (administrative or clinical) reporting to director of operations

Table 3.4: Dissimilar attribute between two cases

Dissimilar attributes	TRCC	UNT
Type of delivery system	Multidisciplinary	Uni-disciplinary

The two case studies will be conducted at two separate healthcare settings of: (i) The Regional Cancer Center (TRCC) at the University of Pennsylvania Medical Centre (UPMC) and (ii) The Gastroenterology (GI) Clinic at the University of North Texas (UNT). The next subsection will provide a background to each of the case study.

3.5.2. Case I: The Regional Cancer Center

This subsection provides a brief background to the first case study. The Regional Cancer Center (TRCC) provides advanced cancer services to Northern Pennsylvania (TRCC, 2011). The cancer centre was established as a free standing out-patient cancer centre serving both major hospitals, Hamot and St. Vincent located in Erie, Pennsylvania. It is affiliated to the University of Pittsburgh Medical Center (UPMC). TRCC is one of the largest cancer treatment facilities of its kind in the U.S. where Chemotherapy (chemo) and Radiation Therapy is administered under one roof along with all necessary support services and has approximately one hundred and thirty employees.

TRCC has following departments and each is headed by an individual: Administration, Medical Oncology (six physicians), Radiation Oncology (four physicians), Physics and Dosimetry, Pharmacy, Clinical Lab, Diagnostic Radiology, Positron Emission Tomography – Computed Tomography (PET/CT), Clinical Research, Quality Management, Transcription, Medical Records, Tumour Registry, Information Technology, Billing and Financials, Building Maintenance and Media and Publication. In addition to using internal imaging resources such as PET/CT and CT, they also receive external images of all kind such as Magnetic Resonance

Imaging, Ultrasound, PET/CT, Previous Treatment plans and Lab Reports done on a variety of equipment. Some of these images come on a compact disc or by digital imaging and communications in medicine transfer directly in to the system for physician review. All of the TRCC patient records are in an electronic file and almost all information is entered directly by electronic means. The electronic medical record used at the TRCC is referred to as MOSAIC. Further at the TRCC, the treatment plans are delivered to linear accelerators electronically and all physics quality assurance reports is performed electronically. Such electronic medical record also poses workflow challenges for some staff and physicians who are used to looking at complete patient chart in a paper form.

Patients may or may not receive radiation concurrently with chemo; it may be subsequent to the completion of chemo or may never get it depending on the type of cancer. In addition, they may have surgery following chemo or radiation or may not get either and surgery might be their preferred option. There are hundreds of combinations when it comes to cancer care and a lot of it is intertwined with individual patient's general physical condition and desire to choose one option against another. In some cases, these choices are limited by what kind of insurance patient might have. It might complicate preferred course of action and it also depends on physicians. Some are more aggressive compared to others but there are several available guidelines developed for treating any number of cancers and physicians can choose to adopt such protocols.

Performance and effectiveness of the care delivery system is important aspects to be monitored since this can affect the functioning and the reputation of the hospital as a whole. Performance measurement is conducted on a monthly basis by an external independent agency, Press Ganey where patient satisfaction survey are administered, rated and published. Press Ganey is a recognized leader in healthcare performance improvement in the U.S. and works with more than 10,000 healthcare organizations to improve clinical and business outcomes (Press Ganey, 2011). The administered patient satisfaction survey set a benchmark scale for each service they provide, comparing the entire network cancer centre within the U.S. as well as ranking them according to the scores received. This information helps the care delivery system to monitor performance and focus on areas for improvement. Since the TRCC is affiliated with UPMC, performance measurement is also monitored internally to compare the centre services with other services affiliated with UPMC. Chapter Five will provide further details on the complexity of problems faced at TRCC and the case study itself.

3.5.3. Case II: The Gastroenterology Clinic

This subsection provides a brief background to the second case study. The Patient Care Centre at the University of North Texas Hospital (UNT) is the physician practice entity of the UNT Health Science Center in Fort Worth, Texas. The hospital is one of the area's largest multi-specialty group practices with approximately 240 physicians in over 43 clinic sites across Tarrant County. UNT offers a wide range of patient services to meet patient's health care needs. The specialties clinic that UNT offers includes Allergy, Asthma, and Immunology, Alliance, Centre for Sleep Medicine, Family Medicine, Internal Medicine, International Travel Medicine, Obstetrics, Gastroenterology Clinic, Orthopaedics, Osteopathic Manipulative Medicine, Osteoporosis Clinic, Paediatrics, Physical Therapy, Psychiatry and Surgery.

The quality management team at UNT has been accessing the quality report of all clinic and constant complaints have been received from patients regarding the delay in receiving services at the GI clinic. The GI clinic offers all endoscopic and gastroenterology services, complete evaluation, and management of gastroenterological diseases and comprehensive patient education services. The clinic operates five days a week with two sessions each day; the morning and the afternoon session. The timing session of each provider differs along with the hours of operation. The clinic has a total of four physicians. Each physician is assigned with a nurse; supporting them with liaison between patient and external entities. Other supporting personnel include two MA and one Clinical Staff Representative (CR). Performance measurement at the UNT is conducted by the American Group Medical Association (AGMA) for every clinic biannually and has several quality benchmarks in place. The three main categories of benchmarks are: (i) Quality and Clinical care (includes Quality, Patient Access, Patient Satisfaction and Staff Training), (ii) Financial (includes Financial Indicators, Revenue Cycle Key Performance Indicators) and, (iii) Provider Productivity (includes Relative value Units and Patient Encounters). The data are collected from various sources. This includes Patient Superbill (filled mainly by physicians to report high-level patient assessment, treatment and charges incurred for the clinic visit), patient satisfaction survey (filled by patient not a mandated form, sent via mail after patient's clinic visit) and patient complaints (filled by selective patient who has raise concern regarding the service, not a mandated form) which are also shown in Figure 3.5. Sometimes the data from electronic medical record (GOLD) and electronic health record (NextGen) systems are also referred. Chapter Seven will further

discuss the details of the case study.

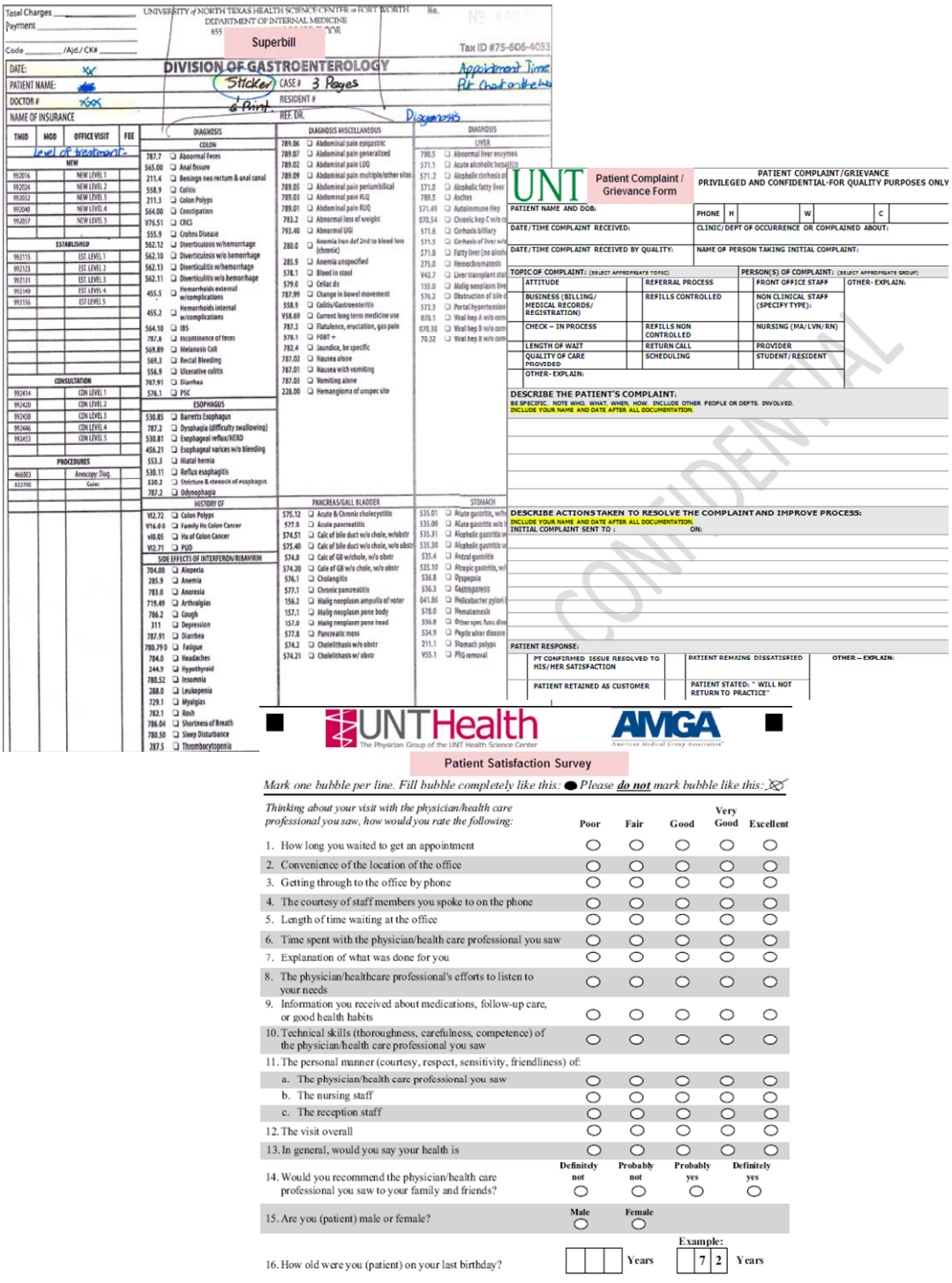

Figure 3.5: Form for Collecting Performance Benchmark Data

3.6. Time Horizons

Cross Sectional time horizons refers to a study that can be done in which data are gathered just once, perhaps over a period of days or weeks or months, in order to answer a research question (Saunders et al., 2007). For example, data were collected from hospital finance department between April and June of last year to study their concerns in increase in overhead cost. In this case data has to be collected at one point in time that is, between April and June of last year. Thus, it is a cross section design. On the other hand, longitudinal time horizons refer to studying people or phenomena at more than one point in time in order to answer the research question (Saunders et al., 2007). This is because data are gathered at two or more different points in time, the study are not cross-sectional kind, but is carried longitudinally across a period of time. For example, a marketing manager is interested in tracing the pattern of sales of a particular product in four different regions of the country on a quarterly basis for the next 2 years. Since the data are collected several times to answer the same issue, the study falls under longitudinal design. Longitudinal studies take more time and effort and cost more than cross sectional studies. For this research, study will be conducted based on cross-sectional design since the study focus on problem understanding that takes place at a single point in time. It allows the researchers to look at numerous things at once without having to manipulate variables (Wilson, 2010) and with an aim of looking at the prevalence of issues within the care delivery workflow. Figure 3.6 presents the time horizons available and highlighted in bold the design selected for this research.

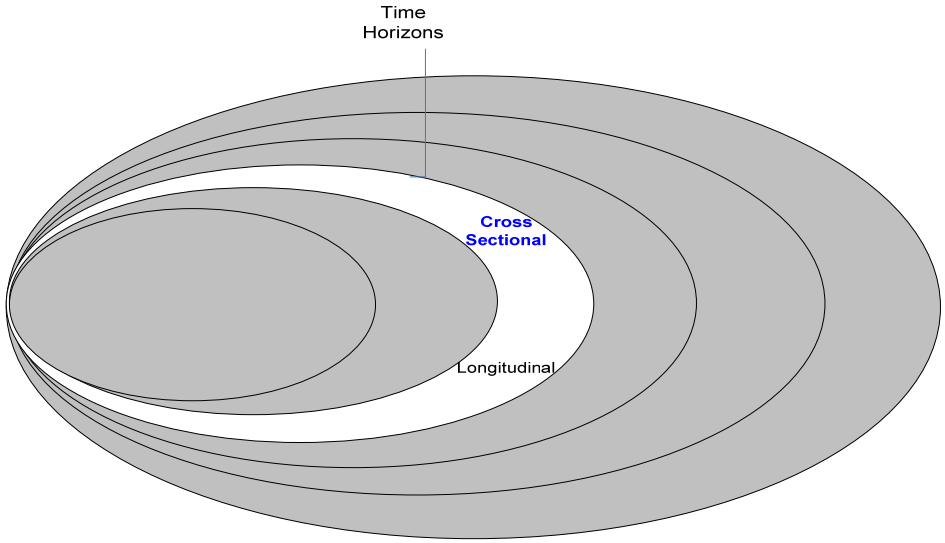

Figure 3.6: Time Horizons and the design adopted
(adapted from Saunders et al., 2007)

3.7. Type of Data / Method

Different approaches to research encompass both theory and method. Quantitative study is an inquiry into an identified problem, based on testing a theory, measured with numbers, and analyzed using statistical techniques. The goal of quantitative methods is to determine whether the predictive generalizations of a theory hold true. By contrast, a study based upon a qualitative process of inquiry has the goal of understanding a social or human problem from multiple perspectives. Qualitative research is conducted in a natural setting and involves a process of building a complex and holistic picture of the phenomenon of interest. The difference between qualitative and quantitative methods is generally described in terms of the type of data collection: the quantitative method involves numerical data and statistical analysis while the qualitative collects descriptive data for interpretation analysis. The qualitative method focuses on patterns of inter-relationships between a previously unspecified set of concepts, while the quantitative way narrowly looks through a specified set of variables (Brannen, 1992). The major advantage of qualitative data collection is that it enables the researcher to obtain insights and see unexpected patterns in the data (Maylor and Blackmon, 2005), while the major advantage of quantitative data collection can allow for greater objectivity and accuracy of results. Kruger (2003) confirms that quantitative methods allow us to summarize vast sources of information and facilitate comparisons across categories and over time. In triangulation, the researcher uses either a qualitative or a quantitative approach depending on the type of mixed method design being used. Triangulation is thus employed as a product of the pragmatist paradigm and supports the research philosophy adopted in this research, which combines qualitative and quantitative approaches within different phases of the research process. This research utilizes the triangulation method. The qualitative method will direct the quantitative and the quantitative method gives the feedback into the qualitative discussions for further validity improvement. Figure 3.7 highlights the type of data available and the method selected for this research.

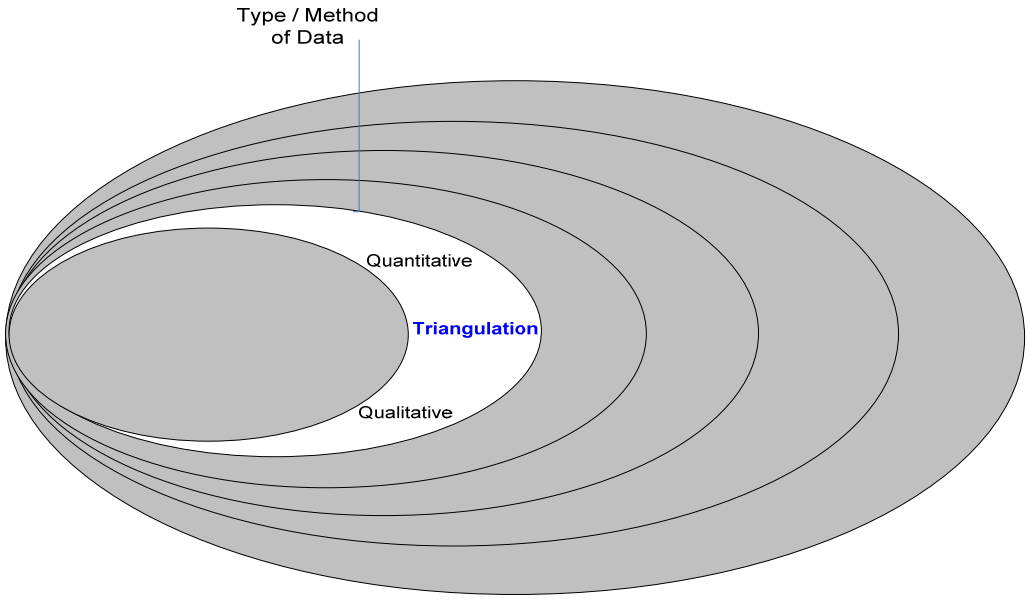

Figure 3.7: Type of data and the method adopted
(adapted from Saunders et al., 2007)

3.8. Data Collection Methods

Within the case study, multiple sources of data, both qualitative and quantitative, were triangulated and supported the analysis. The data collection approach adopted should allow information to be collected from all perspectives. Having this information will help in understanding the delivery system in a holistic and accurate manner. Methods of collection data depends upon (i) nature of problem, and (ii) time and money available. Mostly, data is collected through use of secondary source such as archives, historical records and reports. If no such data is available from archival documentation or on the internet, one has to collect primary data for which a number of methods are available such as observations, in-depth techniques, experiments and surveys. For this research, the primary data will be collected through interviews, observations and participation of stakeholders. The secondary data will be collected through electronic medical and health record, quality report, company website and internal documentation including archival records. Figure 3.8 presents the different data collection method and highlighted in 'bold' the approaches adopted in this research.

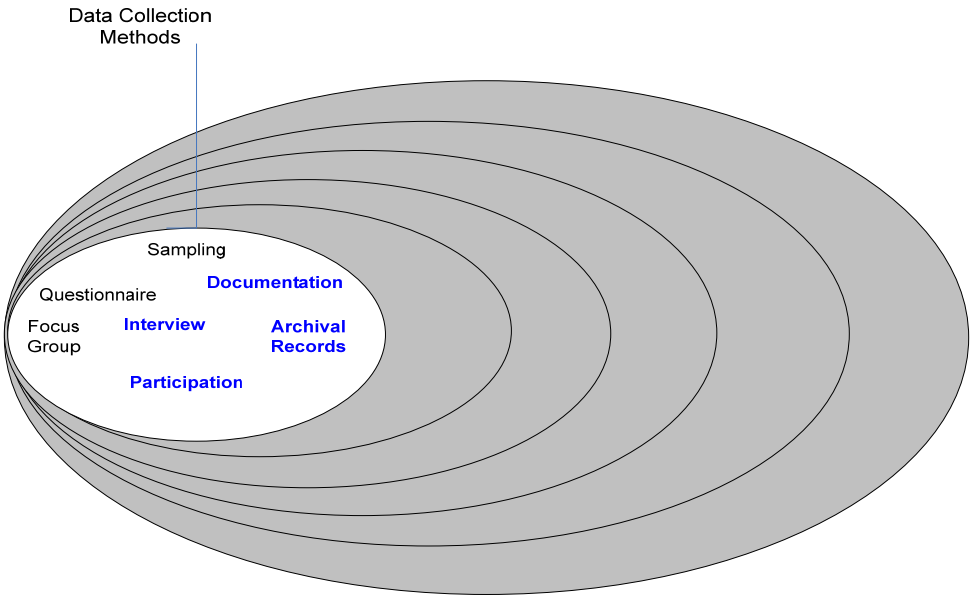

Figure 3.8: Different data collection methods and the approaches adopted
(adapted from Saunders et al., 2007)

An interview data collection method is a conversation between two people (the interviewer and the interviewee) where questions are asked by the interviewer to obtain information from the interviewee. Interview data enables the researcher to seek in-depth understanding about the perceptions of the problem situation, their possible causes and proposed solutions from stakeholders and enabled them to explain their views openly. The interview format is important to guide the collection of data (Eisenhardt 1989) because it will enhance the reliability and validity of the case research data (Yin 1994; Stuart et al., 2002). The general interview guide approach was chosen to be adopted over other type of interview approaches (informal conversational interview, standardized open-ended interview and closed fixed-response interview) to ensure that the same general areas of information are collected from each interviewee; this provides more focus than the conversational approach, but still allows a degree of freedom and adaptability in getting the information from the interviewee. A number of subject matter experts (SMEs) and stakeholders related to the problem situation of the case study were contacted for interviews including the sponsor of the case study and quality assurance department of the healthcare. Prior to the case study, a first meeting and discussions with sponsor will identified key contact persons at each case healthcare and suggested relevant and useful people for interviews. In addition, the researcher and key contact persons in the care delivery system agreed upon the possible means of data collection, and arranged an interview

timetable. Paper and pencil will be used to record the note from the minutes. Additionally, voice recorder will also be used as a supplement in case the researcher is not able to follow everything. In case where SMEs are unsure about the course of action and situations other member of team can be included to participate in the discussion session. Participate mode of data collection has both advantages and disadvantages. Participation with wider stakeholders allow for an open discussion and knowledge sharing between the participants. During the fieldwork with case healthcare, on-site observations were also conducted. Marshall and Rossman (1989) define observation as "the systematic description of events, behaviours, and artefacts in the social setting chosen for study". It is the approach of learning through exposure to or involvement in the day-to-day or routine activities of participants in the researcher setting (Schensul, Schensul, and LeCompte, 1999; Kawulich, 2005). Observations enable the researcher to describe existing situations using the five senses, providing a "written photograph" of the situation under study (Erlandson, Harris, Skipper and Allen, 1993). It involves "active looking, improving memory, informal interviewing, writing detailed field notes, and perhaps most importantly, patience" (DeWalt and DeWalt, 2002). The process enables the researcher to learn about the activities of the people under study in the natural setting through observing and participating in those activities. It is a simple form of data collection method where “seeing” and “listening” are key to observation (Trebble et al, 2010). Observation provides the opportunity to note activities, behaviour and physical aspects without having to depend upon people’s willingness and ability to respond to questions. It served as a check against bias, prejudice and selective perceptions and through reporting, ensured the authenticity and transparency of the implementation of the research process (Merriam, 1998; Cantrell, 2003; Henning, 2004). The observation approach is useful for this research due to the following conditions:

(i) Collection of direct information is required so that accurate representation of the delivery system can be depicted in order to pin point the issues being faced within the system;

(ii) Trying to understand an ongoing behaviour, process, unfolding situation or event in its natural phenomenon, that is in their day-to-day operation;

(iii) Physical evidence, products or outcomes can be readily seen from the daily operation within care delivery system, the services being provided to the patient and the to-and-for interaction between care providers and patients; and

(iv) Standardised observation provided a complimentary data tool to expand on the richness of data of the holistic study. It gave further meaning to the influence of each of the role players in the process and provided a wider picture description of the verbal and non-verbal reactions.

The observation will be conducted by following the journey of patient's treatment through the delivery system. The researcher will see and listen and notes will be collected using simple means of paper and pen. Voice recorder will also be used as a supplement in case the researcher is not able to follow everything.

The secondary data will also be collected which will serves as guidelines. These data can possibly enhance the richness of the context further. The secondary data for this research will be collected through:

(ii) Electronic medical and health record: this will help in understanding use of IT system within the existing care delivery workflow. Further other numerical data such as number of patient seen or no show on a particular day, can also be collected depending of the extent of the application usage.

(i) Quality report: such as internal and external satisfaction report, complaints and any form of benchmark.

(ii) Other Sources: such as the healthcare websites and internal documentation including archival records.

Once the method has been identified for data collection, the next step is to ensure the approach to validate the collected data. The following section presents the details.

3.9. Validation of collected information

It is important for research studies to emulate the scientific method in striving for empirical groundedness, generalizability, and minimization of bias (Hammersley, 1992). Validity can be defined as extent to which a measurement truly reflects the phenomenon under scrutiny while reliability can be defined as extent to which a measurement yields the same answer each time it is used (Pope and Mays, 1995). Questions concerning validity are associated with how reliable the researcher's data collection and analysis are (Thyer, 2009). Using research methods that ensure that the data recording is accurate and the interpretations of data are empirical and logical is important to increasing reliability and validity in qualitative studies (Golafshani, 2003).

Data validity is defined as ensuring that the data necessary for model building, model

evaluation and testing, and conducting the model experiments to solve the problem are adequate and correct (Sargent, 2005). Several versions of a model are usually developed in the modelling process prior to obtaining a satisfactory valid model. During each model's iteration, model verification and validation are performed (Sargent, 1984). Even though data validity is usually not considered to be part of model validation, it is important to bring to attention because it is usually difficult, time consuming, and costly to obtain sufficient, accurate, and appropriate data (Sargent, 2005). Data are needed for three purposes: for building the conceptual model, in this research for representing holistic healthcare delivery system, for validating the model, and for performing experiments, such as identifying issues or improvement area, with the validated model. To build a conceptual model, sufficient data must be available on the problem entity to develop theories that can be used in building the model, to develop the mathematical and logical relationships in the model that will allow it to adequately represent the problem identity for its intended purpose, and to test the model's underlying assumptions. However, the concern with data is that appropriate, accurate, and sufficient data is available, and if any simplifications or modifications to it are made then they are correctly performed. Unfortunately, there is not much that can be done to ensure that the data are correct. The best that can be done is to develop good procedures for collecting and maintaining it, test the collected data using internal consistency checks or even reviewing it with personnel or source of data being collected to determine if they are correct (Sargent, 2005). For this research, the validity of data is taken into consideration and good procedures are followed when collecting data. The primary data collected via interview, observation and participant discussion is recorded in the form of note taking (using paper and pen) and voice (using voice recorder) simultaneously. Simple means of note taking without using specialized tools minimizes time and effort required. Thus, allowing researcher to better focus on the situation being observed. Additionally, collecting via voice recorder ensures that conversations can be recorded and replayed to verify that the data is accurate. On several locations, researcher replayed the recorded data from the voice recorder to gain clarity and understand context being communicated. It is an addition to note-taking.

Also, data is represented via a conceptual model (in the form of process map) using a clear format after taking notes and replaying recorder, ensuring that the model captures the fundamentals of the delivery system. Conceptual model validity is determining that (i) the theories and assumptions underlying the conceptual model are correct, and (ii) the model presentation of the problem entity and the model's structure, logic, and mathematical and

causal relationships are “reasonable” for the intended purpose of the model (Sargent, 2005). Validation is performed by focusing experts on the problem entity to evaluate the conceptual model to determine if it is correct and reasonable for its purpose (Sargent, 2005). This usually requires examining the flowchart or graphical model, or the set of model equations. In this research, the representation of data was validated with subject matter expersts (SMEs) who were the original source of data. In case where SMEs are unsure other stakeholders were involved to discuss the validity and logic of data. This type of validation can be particularly valuable in action research projects, where researchers work with participants on an ongoing basis (Barbour, 2001).

After a conceptual model has been developed, to ensure if the logic is correct and if the necessary accuracy is maintained, entities can be tracked through each sub-model and the overall model. If errors are found in the conceptual model via validation by SMEs, it revised and the model validation is then performed again (Sargent, 2005). The same procedure can be adopted to track all the activities and logic of healthcare delivery workflow. This is done to ensure flow is accurate and depicts the current reality of the delivery system. For secondary data (including information from electronic medical and health record, quality report, website and archival documentation) collected, information are reviewed along with SMEs to ensure accurate interpretation and understanding. The validated conceptual model was used in the data analysis to understand the problem, identify the causes to the issue and their potential solutions. Both qualitative and quantitative analysis are conducted based on the problem at hand and stakeholders are engaged in the facilitated session to perform root-cause analysis and discuss symptoms, disconnects and problem area. The presences of multiple investigators in the brainstorming session allow corroboration of major findings and increase the validity of the final results (Giacomini and Cook, 2000).

3.10. Summary

This chapter presented the underlying research philosophy, research approaches, strategies, case study selection, time horizons, type and data collection, data collection methods and validation of collected information. The research design was based on a framework proposed by Creswell (2003) and complemented by a research onion of Saunders et al. (2007) The theoretical foundation and research philosophy of this research is based upon the pragmatism paradigm, which considers truth to be ‘what works’ and provides a solution to the problem. The pragmatism paradigm hence shapes and directs the research design and research processes.

The strategic framework to enhance problem understanding was developed through rigorous theory building and empirical theory testing (deduction). Action research was described as the appropriate research strategy with use of case studies to collect and evaluate the proposed framework. The 'Most Similar' method was chosen so as to develop and evaluate the framework using two case studies. The method employs a minimum of two cases which are similar across all dimensions relevant to the outcome of interest except one dimension. For time horizons, Cross Sectional time horizons, referring to a study in which data are gathered just once over a period of days or weeks or months, is selected. The type of data collection method adopted was triangulation, which utilizes a mix of both qualitative and quantitative approach. Interivew, participation, documentation and archival records were used as data collection methods. The chapter further discussed the methodology for validation and generalization of collected information. The outcome of the literature findings (in Chapter Two) and the design of research (in Chapter Three) will serve as an input to the development of a proposed framework which is discussed in detail in the next chapter.

4. A PROPOSED FRAMEWORK

4.1. Introduction

Chapter Two has established that there exist limitations in the major PSM approaches to understand problem in healthcare delivery system and identifies the need for a framework to enhance the understanding of problems in healthcare delivery system in an effective and rapid manner. The purpose of the extensive literature review on existing PSMs approaches in the Chapter Two was to gain a thorough understanding regarding the way PSM has been deployed in the past. Chapter Three presented the research philosophy, strategy, process and design of that will be undertaken in this study which helps will build the structure and pathway of the research. This chapter attempts to fill that gap by proposing a framework for problem understanding. In this chapter, the knowledge gained from the literature provides the basis for establishing requirements for the proposed framework. Further, the evaluation criteria for each requirement will also be defined in this chapter which will serves as a basis for assessing the proposed framework. By the end of this chapter it is hoped to provide a workable version of a framework which is capable of addressing those requirements. The next paragraph describes the structure of the rest of the chapter.

This chapter commences with Section 4.1 providing a brief introduction and an outline to the chapter. Section 4.2 presents the requirements of the framework along with detailed discussion on how each requirement is derived. Section 4.3 discusses the steps of the proposed framework in details along with the rationale for the tools and techniques involved. This is followed by Section 4.4 which summarises the structural framework. Section 4.5 provides an evaluation criteria which will be developed from the requirements and this criteria will be used to test the effectiveness of the framework. Finally, Chapter Four will end with Section 4.6 which provides the summary of the chapter.

4.2. Requirements for the proposed framework

This section lists the requirements that were gained from the theoretical review conducted in Chapter Two (as summarized in Table 2.5 and Table 2.8). Further each section will also graphically illustrate how each requirement is derived. As suggested by Robinson (2008), it is useful to establish requirements for generic conceptual frameworks. The descriptive nature of

the model at this stage poses a challenge to set measurable criteria for evaluation. These requirements provide the basis for evaluation of conceptual frameworks and will serve as a foundation of the proposed framework for problem understanding. Based upon the similarities, dissimilarities and limitations identified for SCA, SODA, and SSM, the requirements for the proposed framework are derived as:

1) **Need of collaboration amongst stakeholders:** Collaboration is helpful in gaining consensus (Eden and Ackermann, 2006) and is cited as a common theme in the literature (Eden and Radford, 1990; Van Bueren, Klijn, and Koppenjan, 2003; Kreuter et al., 2004; Ritchey, 2005; Westbrook et al., 2007; Camillus, 2008) and usage of PSM approaches (Table 2.5). Table 2.8 also provides two limitations of SCA, SODA and SSM that are directly related to the need of collaboration amongst stakeholders. The *lack of clear cut route to problem definition* and *the inability to handle stakeholder* diversity. The former can be addressed to an extent by leveraging stakeholder knowledge, as knowledge to deal with complex problems usually exist among the different stakeholders. The latter is directly related to the difference in stakeholder's backgrounds and expertise. The framework should encourage equal participation from all stakeholders at all stages. It is important to find an approach to function through group so that they are able to promote shared understanding by sharing their views and perceptions of the problem and allowing them to participate openly, assume ownership and brainstorm through different causes and possible solutions. High levels of participation between stakeholder can provide a richer and more detailed observation of strategic events and can create more opportunity for self-organizing and co-evolution (Ashmos, Duchon and McDaniel, 2000). Figure 4.1 highlights the linkage of these attributes extracted from the characteristics summarised in Table 2.5 and the limitations summarised in Table 2.8 of SCA, SODA and SSM to the proposed framework.

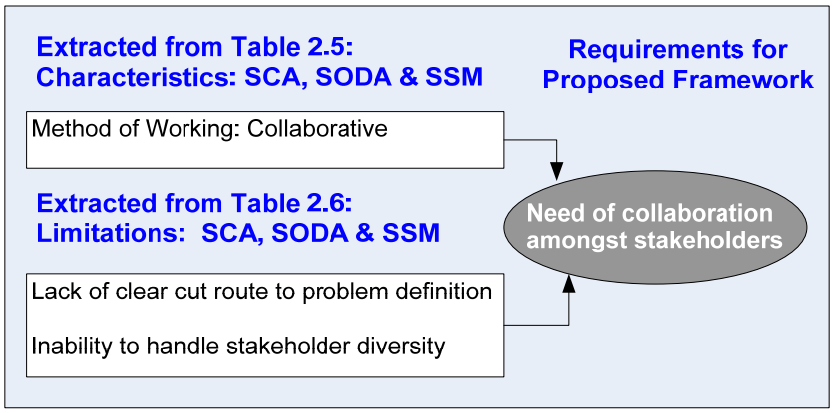

Figure 4.1: Mapping of requirement - Need of collaboration amongst stakeholders

2) **Amenable to use of facilitation skills:** A review of the characteristics of major PSM approaches cited the use of facilitation skills as an important aspect which contributes to problem understanding (Table 2.5). Facilitation skills are important in enabling effective model building and reaching consensus (Richardson and Andersen, 1995; Ackermann, 1996; Andersen and Richardson, 1997). Table 2.8 provides limitations of SCA, SODA and SSM that is directly related to the need for use of facilitation skills. This is *inability to handle stakeholder diversity*, which requires facilitation skills to ensure that stakeholders from different backgrounds and perceptions are able to openly express their views. The framework should pay attention to facilitation, with some accounting for the power and politics within organizational settings (Eden, Jones and Sims, 1983; Eden, 1989; Eden and Ackermann, 2004; 2006). Clear mechanisms should be provided for systemic decision making which can stimulate stakeholders to move toward decisions (Williams et al., 1995; Georgiou, 2007). This becomes more important in situations involving stakeholders with varied interests, backgrounds, motivations and personalities. It should further facilitate negotiation and gaining consensus in a transparent fashion while being amenable to model building and analysis. Based on the discussion presented above, Figure 4.2 illustrates how the requirement 'amenable to use of facilitation skills' has been derived from the characteristics and limitations of SCA, SODA and SSM.

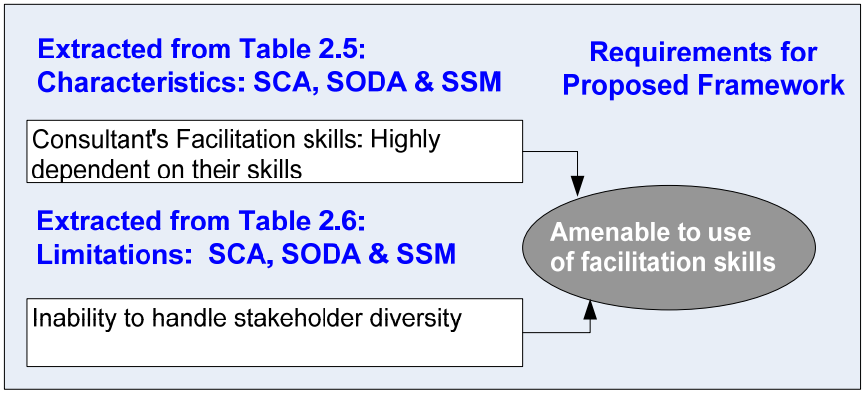

Figure 4.2: Mapping of requirement - Amenable use of facilitation skills

3) **Graphical and easy representation of current problem situation**: Some PSM approaches use visual approaches to foster discussion (Table 2.5). However, one of the limitations identified in literature for the major PSM approaches is that *representation of problem situation can be challenging and does not represent real world accurately* (Table 2.8). Other limitations derived from literature that are relevant to this requirement are *weakness in systemic understanding* of PSM methods and *complexity in implementation, explanation and usage*. Figure 4.3 graphically depicts the mapping of this requirement from the characteristics and limitations of SCA, SODA and SSM. Creating a graphical and visual modelling has been proposed as an effective transitional object to address this limitation while facilitating negotiation and agreement (Eden and Sims, 1979; Hyerle, 1996). It is helpful for thinking during the process of decision making which helps simulate and organize thought process and enables stakeholders to put down their thoughts, be creative and at the same time help identify any unforeseen uncertainties (Pidd, 1996). Previous authors have suggested that modellers should select a simple model that describes the healthcare intervention adequately (Elixhauser et al., 1998; Sculpher, Fenwick and Claxton, 2000; Edwards, Hall and Shaw, 2005). Models that are simple or transparent are more likely to be understood and accepted by non-specialists. Further, such a representation is likely to highlight multiple improvement opportunities as the relationships amongst components will be clearly depicted and understood.

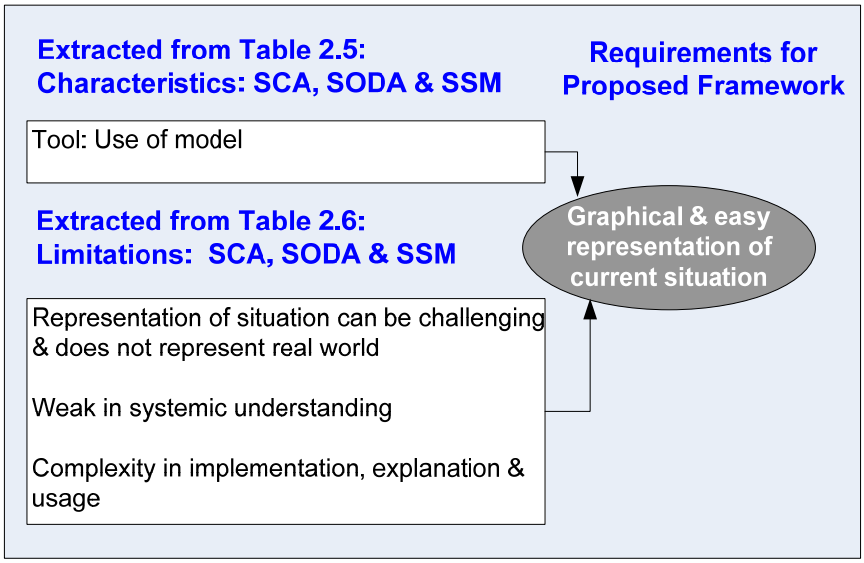

Figure 4.3: Mapping of requirement - Graphical representation of problem situation

4) **Minimize time and effort:** One of the major limitations identified with the use of current PSM approaches (Table 2.8) is the *significant investment required in time and effort* and Figure 4.4 graphically depicts the mapping of this requirement from the limitations mentioned for SCA, SODA and SSM. The framework would have the capability to be deployed with minimal time and cost requirements while ensuring minimum disruption to delivery system workflow. This can be achieved if firm guidelines are provided for implementation and the framework is easy to explain and use, leading to less training requirements. Some of the case studies raise concerns about the time and cost implications of using PSM methods (Lehaney, Clarke and Paul, 1999; Mingers and Taylor, 1992; Ledington and Donaldson, 1997; Winklhofer, 2002). Time-consuming attributes is a drawback when accessing problem in healthcare because of the dynamic nature of healthcare which can result in the exact nature of problem not being understood.

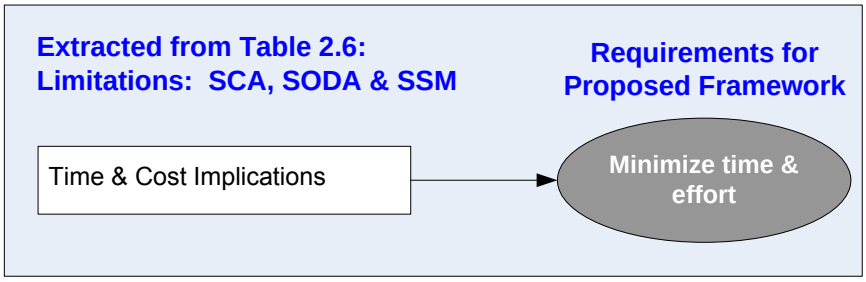

Figure 4.4: Mapping of requirement - Minimize time and effort

5) **Minimizes need for understanding tools by stakeholders:** *Complexity in*

implementation, explanation and usage has been identified as a major limitation to current PSM approaches (Table 2.8). Figure 4.5 graphically depicts the mapping of this requirement from the limitations mentioned for SCA, SODA and SSM. The framework should focus on avoiding usage of specialized tools and terminologies and focus on gathering the right detail of formal and informal knowledge of facts from the involved stakeholders along with concentrating on precise rather than abstract knowledge. This is necessary so as to strike a balance between collecting data which will remove confusion and aid in constructing and structuring thoughts and the time required to do so. Data collection efforts should explicitly focus on promoting a holistic understanding of the system and highlighting the interdependence between the components and sub-systems as the end result. The framework should provide clear structural assumptions for representation in a simple and effective table, graph, diagram and/or text, focusing on relationships of different attributes. These steps will enable the information to be presented and analysed in an intuitive fashion.

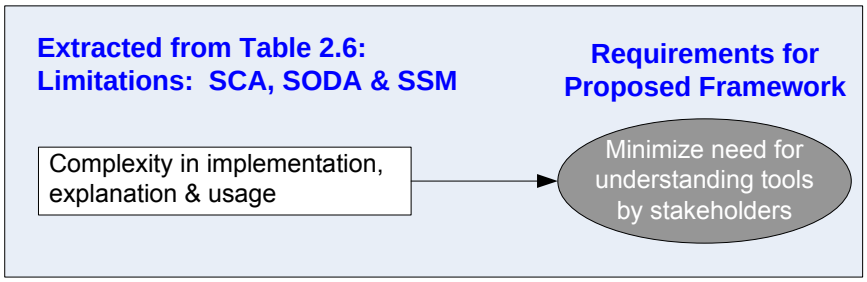

Figure 4.5: Mapping of requirement - Minimize need for understanding tools

4.3. Framework Design

This section describes the steps of the framework keeping in mind the aim and requirements of the framework. The aim is to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner. Using the generic steps proposed in literature for tackling problems (Polya, 1957; Jackson, 1975; Lyles, 1982; Garofalo and Lester, 1989; Francis, 1990; Mayer, 1992; Bransford and Stein, 1993), the steps for the proposed framework are derived as:

4.3.1. Step 1: Define Problem

The first step relates to ensuring a common definition for the problem at hand and the context in which it exists. This step is directly related to the first two requirements defined in Section 4.2. It is necessary to first establish the problem statement and understanding of stakeholder involvement along with past improvement initiatives, policy and workforce regulations. It is also important to agree on the problems that one is trying to solve amongst stakeholder before finding a mutually acceptable solution. Since, each stakeholder may have different perceptions of the problem, they can have differing understanding of the related causes and views about what can be done to solve it. The perceived causes may or may not be the root causes and actually may be the symptoms of the root causes. Not defining an agreed definition of the actual problem at the onset may lead to misdirected effort. Establishing the problem, generating a consensus between the stakeholders and drawing the scope will make the problem more manageable to tackle. Also, there can be a concern whether the stakeholders can be motivated sufficiently to participate, especially due to inherent power and hierarchies (Rose and Haynes, 1999). It is important to understand how the individual group members feel when they contribute or share their knowledge. To address this issue, the proposed framework aims to firstly meet the stakeholders individually and engage them to discuss their views about the problem. These meetings are conducted individually so that stakeholders can express their opinions openly. Information about current method of work, benchmark reports and past initiatives is also collected. This includes finding out about a problem situation and its causes, cultural and political perspectives without attempting to impose a preconceived structure or over-simplify processes. For each stakeholder, roles and responsibilities are identified; propose causes and solutions are noted in a tabular fashion along with a description of their perception of the problem. Table 4.1 provide a snapshot of table in which problem situation, proposed causes and proposed solutions are noted for each stakeholder. The “proposed causes” and “probable situations” are analysed to ensure uniqueness as different stakeholders could have provided same solutions or causes. “Problem situations” are then defined to express the view or perception of each stakeholder regarding the problem.

Stakeholders are then be engaged in facilitated session to review the collected data. Following that, responses provided for “proposed causes” and “probable solutions” by each stakeholder are presented to the group by the facilitator. The different problem situations are then debated and the problem statement is derived via discussion and agreed upon to by all stakeholders. As discussed in Section 2.6, facilitation techniques and their selection are often situation based, and rely heavily on the skills and expertise of the facilitator at hand

(Kolfschoten and Rouwette, 2006). Based upon the expertise level, facilitators have been shown to use anywhere between 6 and 23 techniques, with experts using more than novices (Kolfschoten et al., 2005). Thus, the framework does not propose a specific facilitation technique for generic application due to inherent variability in group settings, dependence on skills and expertise of the end user and other situational considerations that can be specific to an application. Such an approach is not apt for generic application due to inherent variability in group settings, dependence on skills and expertise of the end user and other situational considerations that are specific to an application. Rather, the framework encourages the healthcare practitioner to select facilitation techniques based upon the choice criteria described in Section 2.6.

Table 4.1: Problem Situations, Causes and Solutions

Stakeholders	Problem Situations	Proposed Causes	Proposed Solutions

Once a problem statement has been derived, the next step is to identify the basic descriptions of the proposed system. These are helpful in understanding the system composition and purpose (Lehaney and Paul, 1996; Pidd, 2007; Kotiadis, 2011). It is accomplished through by answering the following questions: (i) who is the beneficiary of the system?, (ii) what is the core activity of the system? (iii) who is the sponsor of the system?, (iv) what are the environmental constraints to the system?, and (v) who are the stakeholders of the system. This analysis helps to understand the purpose, beneficiary, owner and the stakeholders involved.

Since problems in healthcare can be well-structured or ill-structured, it is important to establish the nature of the problem in defining the scope for investigation. A simple problem may have a known implementation criteria or method and can be solved by involving the right expertise. A complex problem, on the other hand, would require a more comprehensive approach. These kinds of problems are highly non-programmed where it requires more human interpretation and solutions are not based on following a set of rules. Further, they typically involve large number of proposed solutions and possible causes. Possessing an understanding of the complexity of the problem is relevant in scoping the problem and for the facilitator to decide how to direct further efforts in terms of data collection, representation and analysis. An index is devised to clearly differentiate between simple and complex problems. Similar

approaches for categorizing problems or understanding problem complexities have been provided in the literature (Van Bueren, Klijn, and Koppenjan, 2003; Batie, 2008; Batie and Schweikhardt, 2010). The number of "proposed causes" and "proposed solutions" is mapped in a category index, as shown in Figure 4.6. A high number of either proposed causes and/or proposed solutions, as shows in Zones 2, 3 and 4, indicate that the problem is more likely to be wicked or ill-structured in nature as the stakeholders have numerous perspectives and views about the problem. A low number of proposed causes and proposed solutions likely indicate a tame or well-structured problem, as the stakeholders have a shared opinion on causes and solutions.

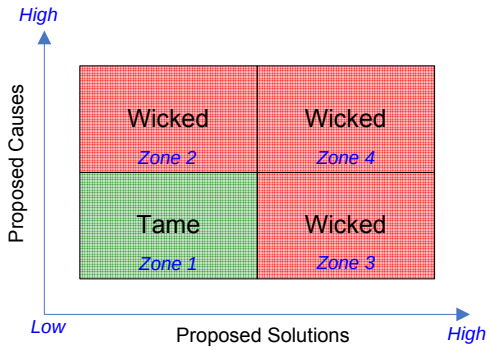

Figure 4.6: Problem Category Index

Further the problem statement that was derived is also compared to the characteristics of ill-structured problem described by Rittel and Weber (1973). The characteristic is listed in the table below which help to further confirm the nature of ill-structured problem.

Table 4.2: Characteristics of Ill-structured problem
(adapted from Rittel and Weber, 1973)

Characteristics of Ill-Structured Problem
There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem).
Wicked problems have no stopping rule
Solutions to wicked problems are not true-or-false, but better or worse.
There is no immediate and no ultimate test of a solution to a wicked problem.
Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly
Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan

Every wicked problem can be considered to be a symptom of another problem.
The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).

4.3.2. Step 2: Data Collection

The next step is to collect data for problem comprehending and relates to requirements 2, 3, 4 and 5 in Section 4.2. The approach should be accurate and include perspectives of all stakeholders that is, not only care providers but also the patients. This would also present a patient-centred view which is important, since the patients' perspective does not always match with those of the health care professionals, as a survey of 2000 patients in the U.S. revealed (Edwards, Hall and Shaw, 2005). It would be advantageous if the data collection approach is simple, have minimal disruption to daily hospital operations and requires minimal specialized skill. Facilitators' ability to draw out information by asking relevant question is also an important attribute when collecting information.

To collect stakeholder information, multidisciplinary meetings can be used where information is collected via single or short series of meetings of staff in a non-clinical environment (Trebble et al., 2010). This approach allows stakeholders to freely share their knowledge and information while ensuring their empowerment. Results can be obtained by the facilitator in a defined time and reflect the care-providers perspective. In cases where one stakeholder does not know a subject matter, other stakeholders can be involved. Apart from filling the knowledge gap, this would increase collaboration and buy-in from multiple stakeholders. The facilitator should employ effective techniques to gather the right detail of information, filter noise from the required data, channel conversations and discussions towards providing the right information and be objective in nature (Silverman, Kurtz and Draper, 1998; Ackermann 1996 and 2011; Paulsen, 2004; Bens, 2012). In fact facilitator can employ "profile tool" facilitation technique described by Kolfschoten and Rouwette (2006) in Table 2.6 since it is simple and can also help facilitator navigate through different possibilities and interdependencies that can exist.

To collect data from a patient's perspective, walking the journey approach can be used Walking the route involves collection of data physically by following the normal route of the patient's journey via seeing and listening (Womack, and Jones, 2003; Jacka and Keller, 2009; Trebble et al., 2010). This is a valuable method for collecting and evaluating information in a

time sensitive manner and provides an opportunity to document activities, behaviour and physical aspects without being time consuming or being influenced by day-to-day variations in clinical environments. Further, it provides an opportunity to perform investigation without having to depend upon people's willingness and ability to respond to questions. The facilitator should ensure that openness and a feeling of trust are maintained between the personnel and patients in each other's company. A combination of the multidisciplinary meetings and walking the journey approach depicts the actual operations of the care delivery systems and their interdependence in a neutral and objective fashion. Information can be collected via a simple paper and pencil format so as to eliminate training and effort requirements associated with using specialized software.

4.3.3. Step 3: Devise 'as-is' model

Step three relates to the mode of representing the data collected in the previous step and directly relates to the requirements 3, 4 and 5 specified in Section 4.2. Literature (Ritchey, 2005; Rosenhead, 1996; Eldabi, 2009; Kreuter et al., 2004; Goodman, 1974; Senge, 1990; Berjis et al., 2011), has suggested that to address the interdependence associated with understanding of complex problem, the following attributes should be considered: (i) focus on interdependencies, (ii) providing a graphical (visual) representation, and (iii) representing a "worldview" that is a holistic view of problem showing the parts and their interconnectedness.

A process map has been widely recognised to offer useful and relatively inexpensive descriptions which can help towards understanding, improving and re-designing processes (Biazzo, 2002). It shows the relationships between the activities, people, data and objects involved in the production of a specified output (Curry, McGregor and Tracy, 2006) and implementation of this approach to a healthcare delivery system, can be utilized to examine workflow using the care-provider's and patient's perspective to identify problem areas and suggest improvements in the patient care (Beuscart-Zephir et al., 2006; Bevan and Lendon, 2006). In healthcare, a type of process map, swim lane activity (SLA) diagrams have been widely used in understanding the interactions and responsibilities of personnel (NHS Modernisation Agency, 2002; Carstensen and Sandkuhl, 2005; Perjons at al., 2005; Jun, 2007; Wedgwood, 2007; Turkewitz and Colman, 2009; Hinman, Mann and Singh, 2009; Margaria, 2010). A swim-lane activity (SLA) diagram represents sequence of activities with a clear role defined by arranging activities according to responsibilities (Jun, 2007). The data collected is illustrated using cross-functional process maps and is useful for depicting activities of different

stakeholders collaborating in a workflow to highlight interfaces between different activities that make up the workflow (Colquhoun, Baines, and Crossley, 1996; Carstensen, and Sandkuhl, 2005; Jun, 2007). For analysing the delivery of care process, it is useful to be able to identify the roles of the various participants and understand how they interact with one another in the care process (Edwards, Hall and Shaw, 2005). While SLA diagrams were considered very helpful especially in understanding roles, they were less helpful in understanding the whole process in terms of task allocation to stakeholders because in reality, some tasks require the cooperation of a group of individuals or have several alternative individual in charge.

Project management techniques like the RACI matrix (Responsible, Accountable, Consulted and Informed) can be used to describe such participation (Middleton and Roberts, 2000; Houston and Bove, 2007; Rogers, 2011). The matrix clearly identifies the personnel to whom work is assigned (Responsible), who has ultimate ownership of a project (Accountable), who should be consulted before an action is taken (Consulted) and who is informed after an action has taken place (Informed). RACI can be used in healthcare to help understand and communicate roles and responsibilities of care providers and units (Middleton and Roberts, 2000). While SLA diagrams only represents the responsibility of a single person in a row or a column, RACI matrices can only be represented in a tabular fashion. To enable graphical representation of resource allocations, roles and responsibilities, the complete treatment workflow can be depicted via SLA diagram enhanced with RACI technique. The framework adopts this integrated modelling approach, referred to from hereon as RACI-SLA map (Figure 4.7).

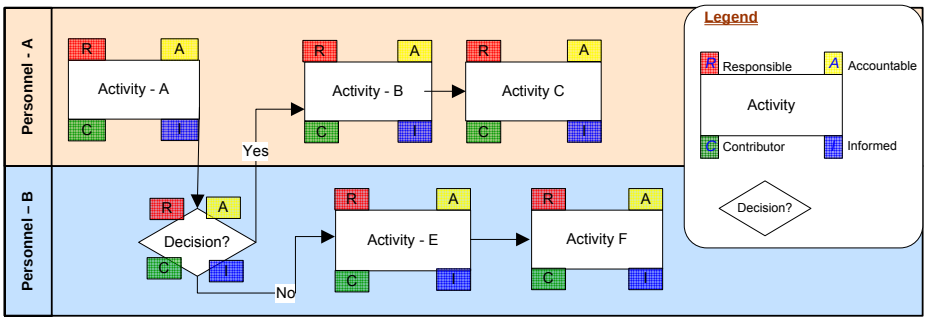

Figure 4.7: RACI-SLA Schematic

The schematic (Figure 4.7) shows the RACI tabs for each activity for a given personnel (represented in a swim-lane). The roles of stakeholders are included explicitly using colour codes where: 'R' in red implies Responsible; 'A' in yellow implies Accountable; 'C' in green

implies Consulted and 'I' in blue implies Informed.

4.3.4. Step 4: Verification and Validation

Step 4 relates to verification and validation of data collected and represented and relates to requirements 1, 2 and 4 specified in Section 4.2. It is important to represent the information collected accurately so that future efforts can be directed towards tackling the right problem. To ensure that time and effort is directed towards the right problem, it is important to verify and validate the information. The RACI-SLA map created during data collection and representation can be used to verify and validate the activities, flow of processes and resource allocation. Verification is concerned with the structure of the model and the overall workflow. For example, the set of treatments a patient is more likely to go through represents whether the patient is following the right pattern of care. In this sense verification is to make sure the structure is depicting the reality and whether it is acceptable by the stakeholders. Further, information regarding stakeholders' responsibilities for each process is also confirmed to ensure accuracy. Validation is required to ensure that the suggested changes to the collected information, if any, are in agreement with the stakeholder's knowledge and best represent the real workflow. Validation also provides a distinct feeling of ownership to the stakeholder. The best way to cross verify the information is with the source individually. This avoids any special facilitation skills that may be required when conducting in a group as the input is taken directly from the expert. However, in cases where the stakeholder does not have the necessary knowledge to provide the right input, other stakeholders can be involved to complete the input. The facilitator can adopt "summarise observations of effective behaviour" facilitation techniques to help confirm his/her understanding with the stakeholders (Kolfschoten and Rouwette, 2006). This tool is especially useful later in the project when the complete information that is, entire workflow is available. Verification and validation can be conducted during non-critical times of the operation so as to avoid disrupting the workflow and ensuring high attention from the stakeholder. Historical trend data may be needed for cross reference from the information system used in healthcare. Any variance found will be reflected on the 'as-is' model by making changes to the RACI-SLA map. This step is also helpful in gaining approval and ownership from the stakeholders, as a review of the visual representation is likely to spark enthusiasm and richer feedback on the content.

4.3.5. Step 5: Stakeholder analysis

The last step relates to a method to identify the causes to the issue and their potential solutions and directly relates to requirements 1, 2 and 5 in Section 4.2. Documents collected during the data collection phase are reviewed by the facilitator. Stakeholders are engaged in facilitated brainstorming sessions to where he/she can adopt "issue analysis" techniques described by Kolfschoten and Rouwette (2006) to perform root cause analysis and discuss symptoms, disconnects and problem areas in the RACI-SLA map. These sessions encourage stakeholders' involvement and broader thinking which can often results in enhanced problem understanding that no one person or one side would have been likely to develop on their own. Also, the approach motivates participants at the grass roots level to share their knowledge and experience and promote ownership. In cases where the analysis failed to yield the root-cause due to limited knowledge of the participants, other individuals with specialization in that area were involved. A gap analysis can then be performed with the group to define and identify the gaps between the intended functionality of the process versus the actual performance. Identified problems can be categorized as process flaws and process deficiencies where former is defined as an indication of gap between process steps and latter is identified as the lack of appropriate use of available tools and techniques. Process flaws are due to improper system design while process deficiencies are related to the inefficient use of resources.

4.4. CARE framework: Structure

Figure 4.8 shows the structure of the CARE framework, as described in Section 4.3 above. The figure shows the Steps 1, 2, 3, 4 and 5 in a sequential arrangement along with major components associated with each step. For example, Step 1 which is 'Define problem' is associated with Problem category matrix and derivation of the Problem statement as two important components. This gives the healthcare practitioner a visual guide for implementation in real life settings.

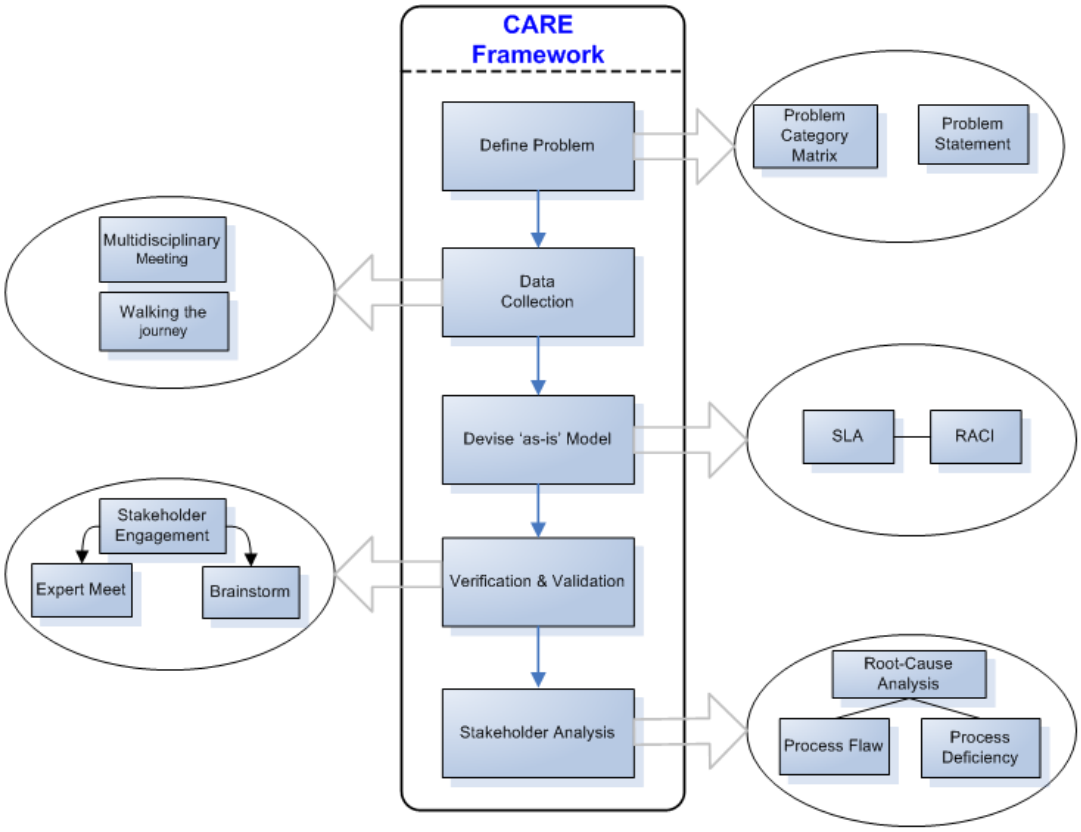

Figure 4.8: Structure of the CARE framework

For brevity, the proposed framework is defined as CARE which is a mnemonic for **C**are **A**ssessment via **R**apid **E**xecution. The term adequately reflects the objective and chief characteristics of the framework which are "to serve as a decision-aid to promote problem understanding within healthcare delivery system in a rapid and effective manner".

4.5. Framework Evaluation Criteria

As discussed in Section 2.7, there exists a dearth of evaluation criteria for applications of PSM methods (White, 2006). Also, evidence of whether these methods are useful or better than others is scarce (Mingers and Rosenhead, 2004). Also, no consensus exists in the OR community on the evaluation of PSMs and a few methods that have been applied are application specific. Due to the lack of universally applicable and accepted evaluation criteria, the theoretical framework developed in this research is evaluated against its ability to meet requirements set in the previous chapter. It is to be noted that these requirements have been derived from a comprehensive literature review of current methods and limitations and are noted in Section 4.2.

Due to the descriptive nature of the proposed framework, it is not possible to measure accuracy of theoretical frameworks until a full complete model is available (Robinson, 2008). However the modeller can assess it theoretically whether it can provide sufficient accuracy for the purpose to which it will be applied. The initial analysis of the proposed framework is based on its ability to fulfil requirements and provision of guidance for identification. The following subsections provide a discussion on the evaluation criteria and the how the framework performs against fulfilling these criteria.

4.5.1. Ability to promote collaboration amongst stakeholders

The framework is assessed with regards to its ability to promote collaboration in gaining consensus (Eden and Ackermann, 2006) which is cited as a common theme in the usage of PSM approaches (Table 2.5) in literature. The need for collaboration among stakeholders appears to be a common theme when recognizing the nature of the problems (Eden and Radford, 1990; Van Bueren, Klijn, and Koppenjan, 2003; Kreuter et al., 2004; Ritchey, 2005; Westbrook et al., 2007; Camillus, 2008). As healthcare problems consist of ill-structured problems, which can possess multiple solutions or solution methods or often no solutions at all (Kitchner, 1983), use of facilitation techniques is important so as to promote collaboration between the stakeholders. Such ill-structured problems present a challenge if approached by a single expert or viewpoint (Waddoc, 1991; Mitchell and Shortell, 2001). If only one discipline examines the issue, the solutions can be narrow in focus and can cause worsening of the problem (Buchbinder, 2009). To address such problems, the possible causes and solutions to the problem should be identified and discussed in a group involving multiple disciplines so as to understand the individual viewpoint of the stakeholders. As resources to deal with complex problems usually exist among the different stakeholders, it is important to find an approach to function through group so that they are able to promote shared understanding. Sharing views and perceptions of the problem and allowing them to participate openly helps assume ownership and brainstorm through different causes and possible solutions. The framework will be evaluated in its ability to promote collaboration of stakeholders in order to focus the problem solving process. The framework will be assessed for its ability to encourage sharing of knowledge from different perspectives and engage stakeholders for presenting their views to enable decision making.

4.5.2. Ability to effectively use facilitation skills

The framework is assessed with regards to its ability to use of facilitation skills as an important aspect which contributes to problem understanding (Table 2.5) and is important in enabling effective model building and reaching consensus as described in literature (Richardson and Andersen, 1995; Ackermann, 1996; Andersen and Richardson, 1997). The framework should pay attention to facilitation, with some accounting for the power and politics within organizational settings (Eden, Jones and Sims, 1983; Eden, 1989; Eden and Ackermann, 2004; 2006). The framework will be evaluated for providing clear mechanisms and a clear-cut route for systemic decision making which can stimulate stakeholders to move toward decisions (Williams et al., 1995; Georgiou, 2007). It should be able to gain consensus in a transparent fashion while being amenable to model building and analysis will also be assessed.

4.5.3. Ability to graphically represent problem situation

The framework is assessed with regards to its ability to provide visual approaches to foster discussion (Table 2.5) as representation of problem situation can be challenging and does not represent real world accurately (Table 2.8). Literature suggests that creating a graphical and visual modelling can be an effective transitional object to address this limitation while facilitating negotiation and agreement (Eden and Sims, 1979; Hyerle, 1996). Models that are simple or transparent are more likely to be understood and accepted by non-specialists. Further, such a representation is likely to highlight multiple improvement opportunities as the relationships amongst components will be clearly depicted and understood. The framework will be evaluated in its ability to create meaningful visual representations which can stimulate discussion.

4.5.4. Ability to minimize time and effort

The framework is assessed with regards to ensuring minimal time and cost requirements while ensuring minimum disruption to delivery system workflow. The framework will be evaluated in ability to provide firm guidelines for implementation along with ease of explanation and use, leading to less training requirements. This is especially important as literature points to some concerns about the time and cost implications of using PSM methods (Mingers and Taylor, 1992; Ledington and Donaldson, 1997; Lehaney, Clarke and Paul, 1999; Winklhofer, 2002).

4.5.5. Ability to minimize need for understanding tool by stakeholders

The framework is assessed with ability to understand tools and technologies which are identified as a major limitation to current PSM approaches (Table 2.8). This is directly assessed via framework's focus on gathering right detail of formal and informal knowledge of facts from the involved stakeholders along with concentrating on precise rather than abstract knowledge. This is necessary so as to strike a balance between collecting data which will remove confusion and aid in constructing and structuring thoughts and the time required to do so. The framework will also be assessed in providing clear structural assumptions for representation in a simple and effective table, graph, diagram and/or text, focusing on relationships between discrete alternatives rather than continuous variables.

4.6. Summary

The main objective of this chapter is to present a proposed framework to tackle the gaps identified in Chapter Two with regards to the limitations of major PSM approaches to enhance the understanding of problems in healthcare delivery system in an effective and rapid manner. The requirements of the framework are presented in this chapter which was derived from the comprehensive study of characteristics and limitations of SCA, SODA and SSM. These requirements included: need of collaboration amongst stakeholders, amenable to use of facilitation skills, graphical and easy representation of current problem situation, minimize time and effort and minimizes need for understanding tools by stakeholders. The attributes of these requirements were used to develop the steps that made up the framework. The chapter also outlined the rationale for undertaking each steps. The steps outlined were: (i) define problem, (ii) data collection, (iii) devise 'as-is' model, (iv) verification and validation, and, (v) stakeholder analysis. The section then concluded with terming the proposed framework as CARE which is a mnemonic for Care Assessment via Rapid Execution which clearly reflects the objective of the framework that is, to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner. Further, the chapter also provided the evaluation criteria derived from the requirement for which the framework will be assessed when deployed to the real world problem in healthcare delivery system. The next chapter will describe and evaluate the CARE framework adopted via case study at The Regional Cancer Center.

5. CASE STUDY I: THE REGIONAL CANCER CENTER

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5.1. Introduction

Chapter Four proposed the framework CARE to aid healthcare practitioners and decision maker to understand problem that occur in healthcare delivery system. The previous chapter also laid out the criteria for which the framework will be evaluated. The effectiveness of the CARE framework will be assessed by means of two case studies at different healthcare settings.

The case study presented in this chapter is conducted at The Regional Cancer Center (TRCC), affiliated with University of Pennsylvania Medical Center (UPMC). This chapter will provide a detail discussion of the implementation of CARE at TRCC based upon steps presented in the previous chapter. The framework adopted will also be assessed with the aim of identifying its effectiveness using the criteria listed in the previous chapter. Findings from this exercise will be analysed to examine whether there is a need for modifying the CARE in order to enhance the process of understanding the different types of problem that can exist in healthcare delivery systems. The following paragraph provides a description of the structure of the rest of the chapter.

This chapter commences with Section 5.1 providing a brief introduction and an outline to the chapter. Section 5.2 provides a detail discussion showing how the CARE framework was implemented at TRCC based upon the principles and structure of CARE presented in the previous chapter. The case presented here is a concern management has within the dietary services facilities that the TRCC offers. Section 5.3 provides the feedback obtained from TRCC management and Section 5.4 will provide the details of CARE assessment adopted at TRCC. The last Section 5.5 will conclude with a summary of the chapter.

5.2. CARE Implementation

Having attained high-level background information of the TRCC, this section provides a detail discussion of how the CARE framework provided an aid to TRCC management to understand the problem that exists within the TRCC. The steps discussed in chapter three are use as guidelines for the implementation of CARE.

5.2.1. Step 1: Define Problem

At TRCC, the management team, in particular the director of operations (also, the sponsor of the services), had concerns with the performance of dietary services. The concerns stem from the patient satisfaction score received via monthly Press Ganey reporting for each service. Press Ganey has a standardized approach for conducting patient surveys and calculating patient satisfaction scores. A snapshot of the summary of the January 2010 report is shown in Figure 5.1. (also a sample of the detailed report can be referred to in Appendix-A). For example, the score for the dietary services under 'Dietitian and nutritional educ srvc' (also highlighted in red) indicates a mean score of 77.6 out of 100 with 19 patients responded to that particular question. Comparing this score to a mean score of 84.5 for the dietary services for all the cancer centre facilities in the U.S., shows that the dietary services of TRCC are below the average satisfactory score.

UPMC Cancer Centers

OUTPATIENT ONCOLOGY REPORT

Question Analysis

	TRCC		All Respondents					
			All Facilities		Freestanding Fac		UPMC Custom	
Overall Section / Question	Mean	*n*	Mean	Rank	Mean	Rank	Mean	Rank
Inclusion in treatment decisions	90.6	61	90.6	47	91.1	39	89.8	70
Home care instructions	91.5	53	90.1	63	91.1	55	89.2	84
Concern for privacy	92.8	59	92.3	54	92.8	41	91.0	79
Availability of nutrition support †	80.6	18	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Overall Assessment	93.6	67	93.9	40	94.2	33	92.9	63
Overall Assessment	93.6	67						
Care coordinated among Drs/caregvrs	91.9	65	92.4	39	92.8	37	91.2	65
Care given at this facility	94.0	67	94.6	35	95.1	24	93.6	55
Likelihood of recommending services	95.1	66	94.9	44	95.2	35	94.3	60
Std Special Services	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Special Services	77.6	19						
Dietitian & nutritional educ srvc †	77.6	19	84.5	1	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Oncologist	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Oncologist	91.9	66						
Dr's discussion of trtmt options †	90.2	64	93.0	14	93.9	1	92.0	21
Courtesy of the Physician †	94.9	34	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Care Providers	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Care Providers	91.1	56						
Amount of time NP spent w/patient †	91.1	56	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A

Mean Score

No of Respondant to that question

Figure 5.1: Snapshot of Cancer Centre Press Ganey Report for Jan 2010

The underperforming patient satisfaction scores in the area of dietary has been a consistent dilemma for the past several years (as far back as early 2000s when the service was

introduced). There were several past initiatives conducted to improve the dietary service where focus was given on increasing the target number of patients seen by dietician from average of 28 per week in 2005 to 38 per week in 2009. In addition, four years ago the dietician had conducted an internal survey with the staff to gage the awareness of her availability and accessibility. The results indicated that the internal staff would prefer dietician to be available full-time (that is, 35 hours per week previously 28 hours per week), in order to be able to reach out to more patients. However implementing this recommendation did not adequately tackle the real issues and there was no improvement in the patient satisfaction scores. The issue stated earlier is not necessarily a problem but a symptom of the problem(s) that may exist within the dietary services care delivery system and are directly contributing to it. The management would like to understand the root cause(s) of this issue as when discussed with different personnel, multiple views emerge about the cause and the solution to the problems. In addition, the TRCC management wanted to keep away from any further implementation, especially increases in resources without understanding the real reason that contributing to the patient satisfaction score.

As discussed in Section 4.3.1, it is important to examine how the problem is understood by different stakeholders with the ultimate objective being to devise a problem statement that is agreed by all the stakeholders involved. This will help identify and understand the scope of the problem at a high-level. In this case, it is important to understand how the dietary services is perceived by different personnel at TRCC and based on that, what are the different solutions proposed by them. A high-level multidisciplinary meeting was first conducted with director of operation to understand and attained key list of stakeholders that she perceived would be involved with the dietician. An analysis was conducted with the director of operation to determine the five main attributes, mainly, the beneficiary of the system, the main activity, the sponsor, the operating environment and the stakeholders of the dietary services. This form of analysis clarifies what the management is trying to achieve with the dietary services and help to consider the impact of any proposed changes on the people involved with the dietary service. The result of this analysis is presented in Table 5.1.

Table 5.1: High-level analysis for the Dietary Services

Parameters	Key Attributes
Beneficiary	Patient, Dietician
Activity	Efficient Vital Health and Nutrition Assessment
Sponsor	Director of Operations
Environment	Resource limitations, financial constraint, regulatory body
Stakeholder	Registration, Medical Assistant (MA), Physicians, Triage Nurse, Chemo MA, Front Office Nurse, Dietician, Chemo Nurse

Subsequently, additional high-level multidisciplinary meetings were conducted with those key stakeholders identified. General and objective information was collected about the cancer centre with regards to stakeholders and problem situations. The stakeholders were asked to describe what in their opinion were the real causes and solutions. This lead to a discussion on what the actual problem situation was which was leading to low patient satisfaction scores. Table 5.2 shows the different problem situations that were expressed by the stakeholders.

Table 5.2: Results from High-Level Multidisciplinary Meeting

Stakeholders	Problem Situations	Proposed Causes	Proposed Solutions
Registration	Patient are not fully aware of the dietary services provided and limited availability of dietician	Not many patients come in to see the patient directly or dietician not available	Increase dietician availability and make more patients aware of services
MA	No guideline for making decisions regarding dietary services	Was not aware of possibility or responsibility of her involving dietician	Better definition of roles and responsibilities
Physicians	Patients tend to rely more on physician advice than dietician	Patients may tend to prefer getting nutrition advice from the physician rather than the dietician; Only selective or special cases (for example throat or lung cancer) are being referred to dietician	Refer all patients to dietician
Triage Nurse	Dietician is overloaded	Sometimes dietician is overloaded so that immediate access to patients is not possible;	Incorporate ways to automatically notify dietician of patient availability
Chemo MA	Dietician is overloaded	Dietician may be overloaded	Involve dietician on a full-time basis or add another part-time position

Front Office Nurse	Dietician is unavailable	Is not able to reach dietician in some cases	Involve dietician on a full-time basis or add another part-time position
Dietician	Patient are not fully aware of the dietary services provided	Patients may not be aware of and/or able to physically locate the dietary services; Patients are not referred by doctors, she has to actively seek patients	Explain, refer and advertise dietary service actively to patients; Locate dietician's room to front to enable better access.
Chemo Nurse	Patient does not know where to find dietician	Pamphlet contains outdated dietician details	Update pamphlet or make more patients aware of services

As can be inferred, the exact problem is not very defined and several problem situations, causes and solutions were apparent. It is possible that only one or few root causes actually result in the other causes or it may be possible that the actual root cause is not even apparent and hence not even recognized by the stakeholders. The stakeholders may report the possible causes and solutions from their world view or perspectives based upon their knowledge, amount of exposure and extent of participation with the overall dietary services. Hence, implementing one or all of the solutions may not resolve the root cause of the problem and may lead to suboptimal use of efforts or in a worst case, lead to further problems.

From the above table, a list of possible causes and proposed solutions, seven unique causes and six unique solutions were identified and a problem category index of 42 was calculated. As the problem requires high level of human interpretation, does not have a set of exact causes and solutions, it was categorized as a complex problem. A hard OR approach may not help to understand and tackle the dietary service problem as the problem is perceived differently and not well-understood among the TRCC personnel themselves. These can result in tackling of the wrong problem. The keywords represented in Table 5.2 such as "overloaded", "unavailable" and "lack of guideline or awareness" are indications of possible larger issues such as flaws in process design or inherent inefficiencies. It is important to define the problem statement in a way which best captures the essence of the possible causes without being too specific or susceptible to misinterpretation.

Stakeholders are then engaged in facilitated session to review the collected data. Firstly, the facilitator utilizes a technique of "informal introductions" (Kolfschoten and Rouwette, 2006) so as to set all the stakeholders on an equal footing, which not only warms up the people but also removes or reduces the hierarchical boundaries. For example, at the start of the facilitation

session, the facilitator in this case the researcher introduces herself to the TRCC participants and gives a brief introduction about the session. That was then followed by the TRCC participants, each giving an informal personal introduction and things they like to do in their spare time while excluding information about their title, role and responsibilities at the hospital. This exercise helps the participants to understand the motivation of the session, get settled in and familiarize with one another. Once the introduction is complete, the facilitator then sets the goals and expectation about the session by describing what the outcome may look like. This visualization technique helps to create a mental picture for each of the stakeholder's. The mental picture is also kept aside on a flip chart throughout the session to help remind participants. The expectations also include setting the ground rules for the session, as required or expected by the facilitator. Following that, responses provided for "proposed causes" and "probable solutions" by each TRCC stakeholders are collected in tabular form (shown in Table 5.2) and presented to the group by the facilitator. This is similar to the methodology defined in the technique "write down the problem that brought you here" (Kolfschoten and Rouwette, 2006), except that instead of each of the stakeholders presenting the "proposed causes" and "probable situations" themselves, the facilitator presents it for them to all participants in the session. The name of the stakeholders is kept anonymous, so as to ensure that the discussion is not affected by negative group dynamics, while all views are adequately presented by the facilitator, irrespective of the hierarchy or the personality of the stakeholders. This also allows the stakeholders to openly share their view without the fear of being pin-pointed. The different problem situations are then debated, similar to the facilitation technique of "issue analysis" discussed by Kolfschoten and Rouwette, (2006). Issue analysis helps to keep the session in a problem solving mode while ensuring a strong focus on the scope of discussion.

If there was a discrepancy or conflict in the information provided by the stakeholders, issue analysis was used to surface it for broader discussion by the group. For areas of conflict, techniques were employed to accommodate a variety of viewpoints to get the best solution. For example, stakeholders, who had real-life experience or knowledge relevant to the issue, presented their view points in front of their peers and a peer based analysis was used to derive the optimal result. The problem statement is derived via discussion and agreed upon to by all stakeholders. The facilitator is responsible for ensuring that the problem statement is not too specific or vague in order to ensure the right direction of efforts. From the exercise conducted to derive the problem category index, proposed causes and solutions, a problem statement was formulated during discussion with TRCC stakeholders as:

"Possible dietary process gaps or inefficiencies leading to low patient satisfaction"

The problem statement was derived after discussion with stakeholders to best represent the possible causes listed in Table 5.2 and the information and knowledge available to-date. This problem statement was agreed amongst stakeholder as a potential area to further explore and resolve. The problem statement derived provides a starting point rather than a conclusion, for further investigation and provides the researcher a direction and also assists in defining the scope. **Table 5.3** shows a comparison of the characteristics of ill-structured problems described by Rittel and Webber (1973) and the problem of low patient satisfaction score at TRCC. As can be inferred, there are distinct similarities between the two sets of characteristics, which further points to the problem at TRCC as an ill-structured problem.

Table 5.3: Characteristics of ill-structured problem & problem at TRCC

Characteristics of Ill-Structured Problem (adapted from Rittel and Weber, 1973)	Characteristics of problem at TRCC
There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem).	Different stakeholders have different views about what the problem is
Wicked problems have no stopping rule	Previous methods of eliminating the problem have proved ineffective
Solutions to wicked problems are not true-or-false, but better or worse.	The problem of underperforming patient satisfaction scores will never be eliminated but can become better or worse and has to be continuously monitored
There is no immediate and no ultimate test of a solution to a wicked problem.	It is not possible to test one solution as a "cure-all" for the problem.
Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly	Testing solutions involve formulating a best possible solution and investment of significant time to test it. Multiple tests based on trial and error are not possible due to time and resource constraints
Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan	No pre-defined way of solving problems exist. For example, what is applied at another hospital cannot be used as a plug and play method due to operational differences.
Every wicked problem can be considered to be a symptom of another problem.	Underperforming patient satisfaction scores are a symptom of systemic problems in the operation
The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.	Coming to an agreement about the root causes is necessary to formulate solutions
The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).	Implementing a solution to tackle the problem of underperforming patient satisfaction scores may generate another

	problem in the operation, if not carefully planned and monitored

5.2.2. Step 2: Data collection

The objective of this step is to collect relevant information in regards to and aspects that affect or interact with the dietary services at TRCC. As mentioned in Section 4.3.2, data from all dimensions that is, from care providers and patients will help build accurate process model that depicts the 'as-is' hospital workflow. However, it is important to understand the high-level role that the dietician plays along with summary of their responsibilities.

A high-level multidisciplinary meeting was conducted with the dietician to gain an understanding of her responsibilities. The facilitator can employ "profile tool" facilitation technique described by Kolfschoten and Rouwette (2006) in Table 2.6 since it is simple and can also help facilitator navigate through different possibilities and interdependencies that can exist. At this time, detailed information was not collected as it could overwhelm the practitioner. Rather, the objective was on familiarizing with the process, terminology and interactions. The dietician is a part-time employee, currently working 35 hours a week serving both medical oncology as well as radiation therapy patient and is available on-site to assist with patients' dietary needs during and after cancer treatments. For cancer patients, maintaining good nutrition is critical to obtaining the full benefit of therapy. She is also responsible to enter all her patient's assessment into the MOSAIC, the electronic medical record system at TRCC. A sample screenshot of nutritional assessment screen is shown in Figure 5.2. Currently, it is not mandated for all patients to meet with the dietician. The dietician takes the initiatives to try and meet with as much patient as she can possibly reach out to. Further, the dietician locates patient details by printing a schedule of patients under treatment from MOSAIC system. This schedule includes the patient name, time of appointment, treatment and diagnosis. The area of treatment is noted on this schedule and carried over each week until the patient completes treatments. The dietician especially ensures to reach out to patient where chances of eating disorders are likely to been seen. Sometimes the dietician uses the priority system in MOSAIC as guidance. A priority system is set up to help screen patients by their treatment region and helps to determine which patients may require more care. Those patients generally under moderate or high risk include (but are not limited to) the following regions of treatment: (i) head and neck region (with highest risk), (ii) oesophagus region, (iii) upper abdomen region, (iv) thorax region, and (v) pelvic region. Also, the patient may be referred to the dietician by

other personnel at TRCC.

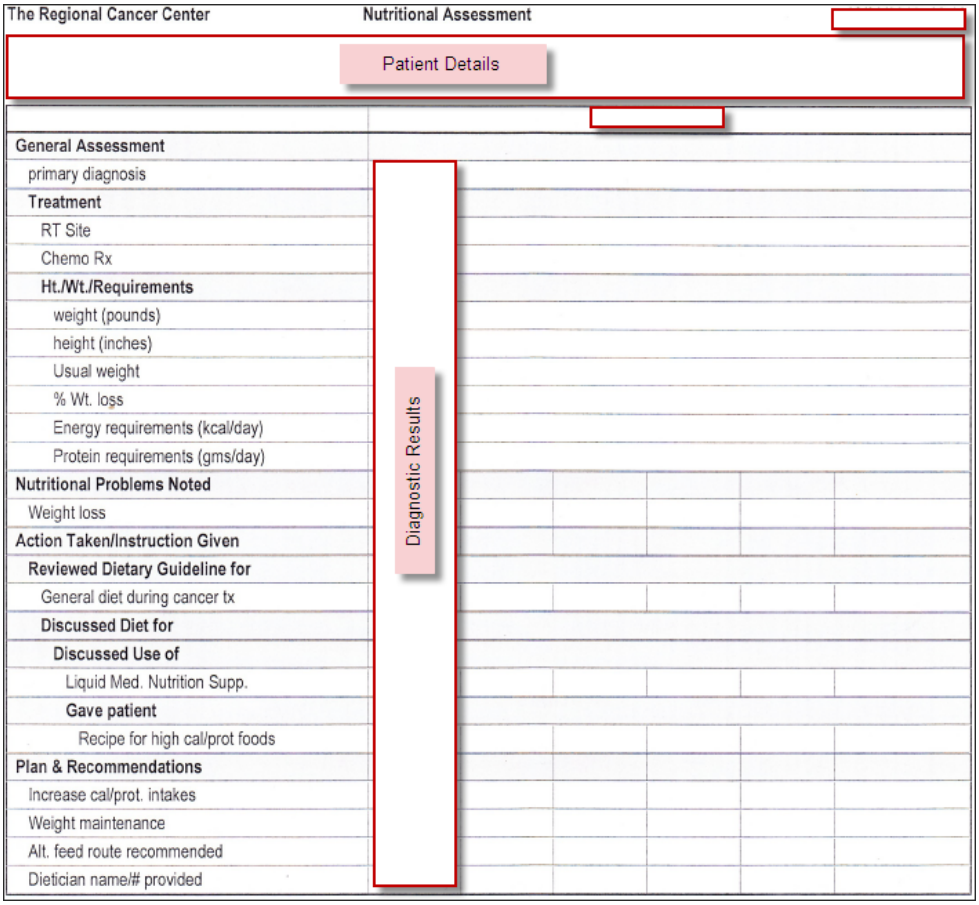


Figure 5.2: Screenshot of Nutritional Assessment Screen in MOSAIC

To gain comprehensive understanding of the dietary services provided by the TRCC including the interaction of patient with the dietician a detail data is collected via walking the daily patient's journey. This approach also allows patient's perspectives to be recorded. The journey of a patient within TRCC is initiated with the registration process at the front desk of the cancer centre. Upon patient's visit, the registrar requests for patient identification (id) card and verify patient identity with their date of birth. It can be possible that patient id is lost or patient is new to the centre in that case a new id card is created. Further, there may also be a case where patient forgot to carry an id card along with them at their appointment visit; in that case other official id is requested for verification. In addition the registrar also ensures that all patient details including insurance information are updated within last six months. Once registration is completed, patient is directed to the waiting room where they can be attended to, based upon the nature of their visit. For example, the patient may be scheduled for a blood test, in which case they will go directly to the lab waiting room. It may also be possible for the

patient to have appointment with the nurse, dietician or other non-clinical support personnel. In that case they will remain in the main waiting room for those personnel to attend to them. During the data collection via observation it was found that no patient asks to see the dietician. This observation was further queried with the personnel at the registration unit during the multidisciplinary meeting. They highlighted that the observation made was accurate and possibly problem was in line with what they mentioned earlier that is patient are not fully aware of the dietary services provided at the TRCC.

Additionally, it may also be possible that the patient comes for their scheduled visit with the Physicians or Extenders (P/E). The extenders are physician assistant who is not a physician but who performs medical activities typically performed by a physician. In which case, the patient is received by the MA who obtains the patient from the main waiting room, conducts historical medical query (including allergy) and vital assessment and updates the information into the electronic medical record - MOSAIC. The snapshot of the assessment conducted by MA is shown in Figure 5.3 where basic vital assessment is conducted. Once the assessment is completed, the MA sends alerts via MOSAIC to P/E to notify them that the patient is waiting to be attended to in the examination room.

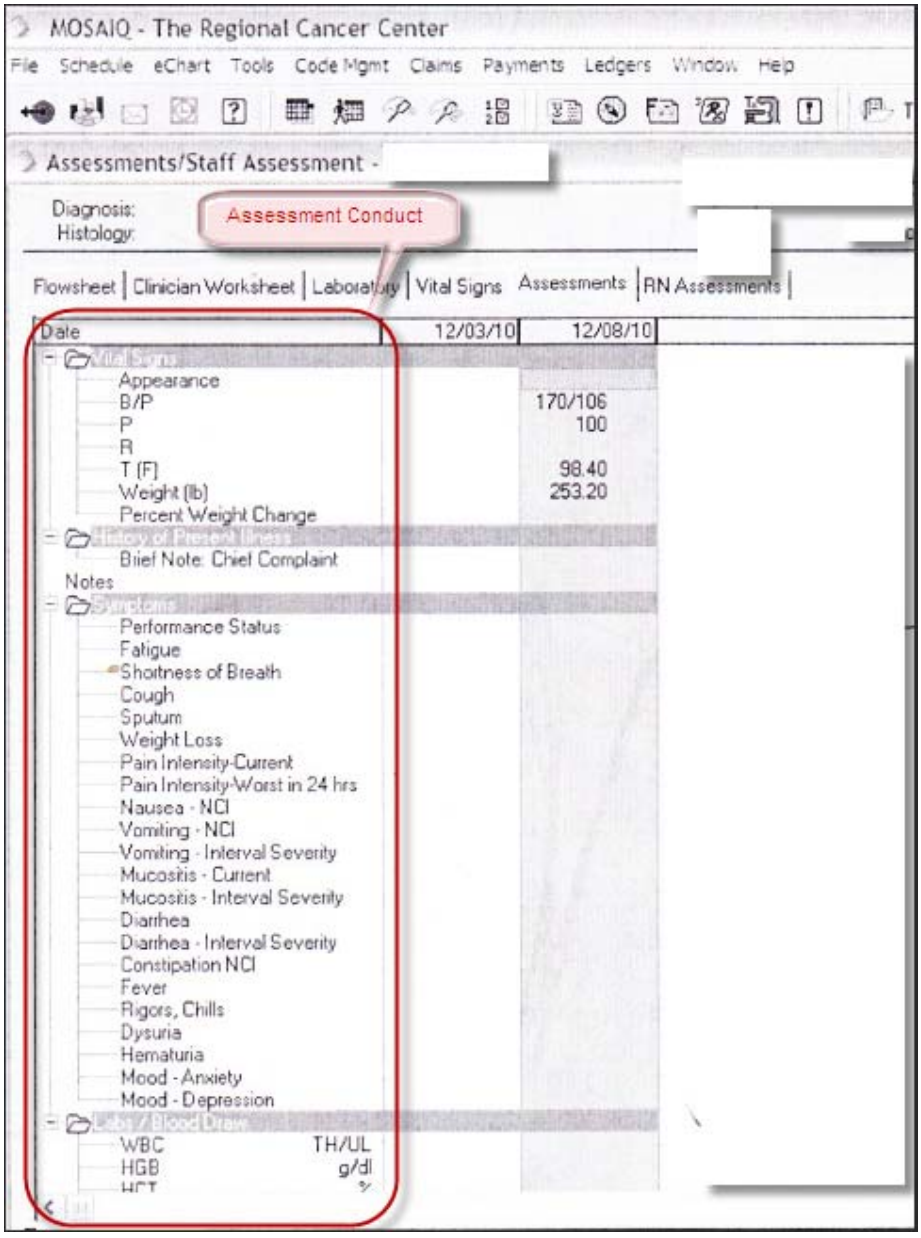


Figure 5.3: Snapshot of assessment conducted by MA

The P/E attends to patient and prescribes treatment plan and medication. If required, the P/E can refer the patient to visit the dietician or request the nurse to contact the dietician to notify them regarding the patient's condition. The dietician provides nutrition advice and dietary recommendation to the patient. Further, the referrals for nutritional consults or services can come through not only from P/E but also from the nurses, radiation therapists, support services staff, volunteer staff, or directly from the patient or their family members when they have nutrition concerns. The mode to contact the dietician for the internal TRCC personnel can

be done in-person at the dietician's office, via email or via telephone. The patient can reach out to the dietician by contacting registration unit or through other TRCC personnel directing them. They may also directly reach out to the dietician at her office or via telephone.

Prior to the chemo treatment, the triage nurse conducts pre-diagnosis of patient and is responsible for flushing port and drawing blood for patients with port. During chemotherapy, the chemo MA assists and assigns patient to chemo chair, conduct pre and post vital assessment, stock up medical and food cart and provide any other non-clinical help required by chemo nurse. The chemo nurses provide chemo treatment to the patient. They review the medication which was prepared by the centre pharmacist and also third-party vendor (in case medication or equipment is needed which is not available at the TRCC). They also ensure that the medication is reviewed by a second chemo nurse. This is done to ensure accuracy and to handle any reaction/issue patient may face during treatment.

For those patients who require a nutritional assessment, the dietician will review the patient's chart to find out information regarding the patient's diagnosis. The dietician will also review the patient's area of treatment, medical history, laboratory data and any other data that is available in the MOSAIC. Once the dietician has reviewed the patient details, they would check the MOSAIC to locate for patient. Interview will be held with the patient and family to determine the patient's height, weight, usual body weight, type of diet, appetite, symptoms experienced from the treatment and any other details required by the dietician. The dietician will diagnose the patient and also inform the patient and their family of the importance of adequate nutrition and weight maintenance during any form of radiation or chemo therapy. She will also discuss the possibility of nutritional problems associated with their individual treatment and explain appropriate dietary modifications needed to help relieve some of the side effects. As mentioned previously, all dietary intervention is charted in the MOSAIC. The nutritional assessment forms are located in the e-chart of the MOSAIC under the assessment tab. The dietician follows patients as often as needed. Those patients which are followed more closely include, but are not limited to: (i) those patients receiving tube feedings, (ii) those patients with five percent or more loss of usual body weight during the treatment course and (iii) those patient with severe complication from the treatments which can alter nutritional intake. The assessment from follow-up patient is also entered into the MOSAIC as a free form text with no character limits and a screenshot of follow-up screen in MOSAIC is shown in Figure 5.4.

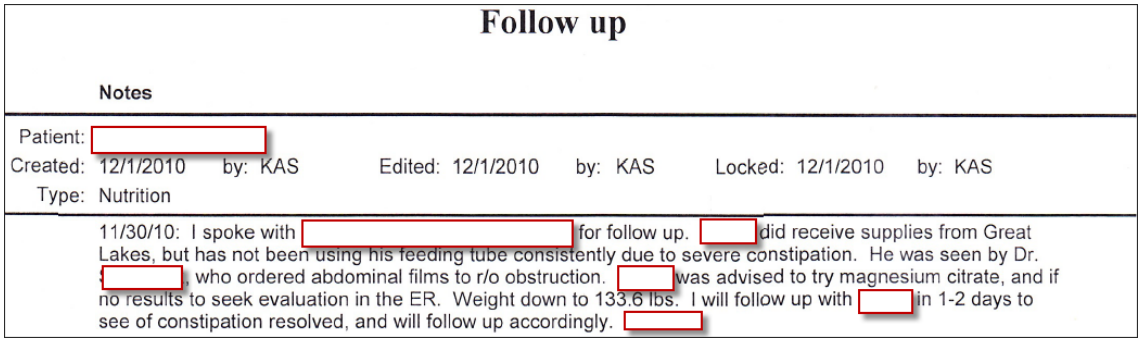


Figure 5.4: Screenshot of follow-up screen in MOSAIC

In addition, the dietician may also provide sample of nutritional supplements to the patients as samples for them to try. These samples are provided by the various companies which produce them. Also, a variety of patient educational materials are available from the dietician. The patients receive support guidelines that include dietary modifications necessary during the therapy. Sometime these materials are pre-available in the "nutrition resources" binder while sometimes the dietician would customise one for the patient. This depends on dietician's judgement.

Other clinical support personnel include the front office nurse who assists P/E with any request they require and can also contact dietician for attending to patient. The pharmacist reviews and prepares medication that the P/E prescribes and the diagnostic technicians conducts blood tests, x-ray, CT and PET scan tests, direct the patient to different departments and update MOSAIC. Non-clinical support personnel that the patient comes in contact with include palliative nurse, social worker, billing administrators and pharmacist. These personnel are not mandated to be seen by the patient during a treatment process. Palliative nurses provide emotional support and end-of-life guidance to patients undergoing treatment or terminally ill patients. The social worker personnel assist in securing any financial help that patient insurance does not cover. The billing administrators reach out to patient's insurance party to ensure patient's coverage. The pharmacist prepares medication for patient per the P/E prescription.

The data collected for this case study does not include an observation with all the personnel but only those in contact with the dietary services or those that affect the dietary services. Also, the data collected especially for the dietician's responsibilities is quite detailed though all the information may not be required. Paper and pencil were used to collect these data (sample of snapshot is provided in Figure 5.5) and recorder was used as a supplement in case the modeller was not able to follow through the information. The attributes discussed in Section 4.3.2 serves

as an aid with data collection and to ensure that all information required is collected. In addition, historical benchmark report including internal and external Press Ganey reports were also collected at this stage.

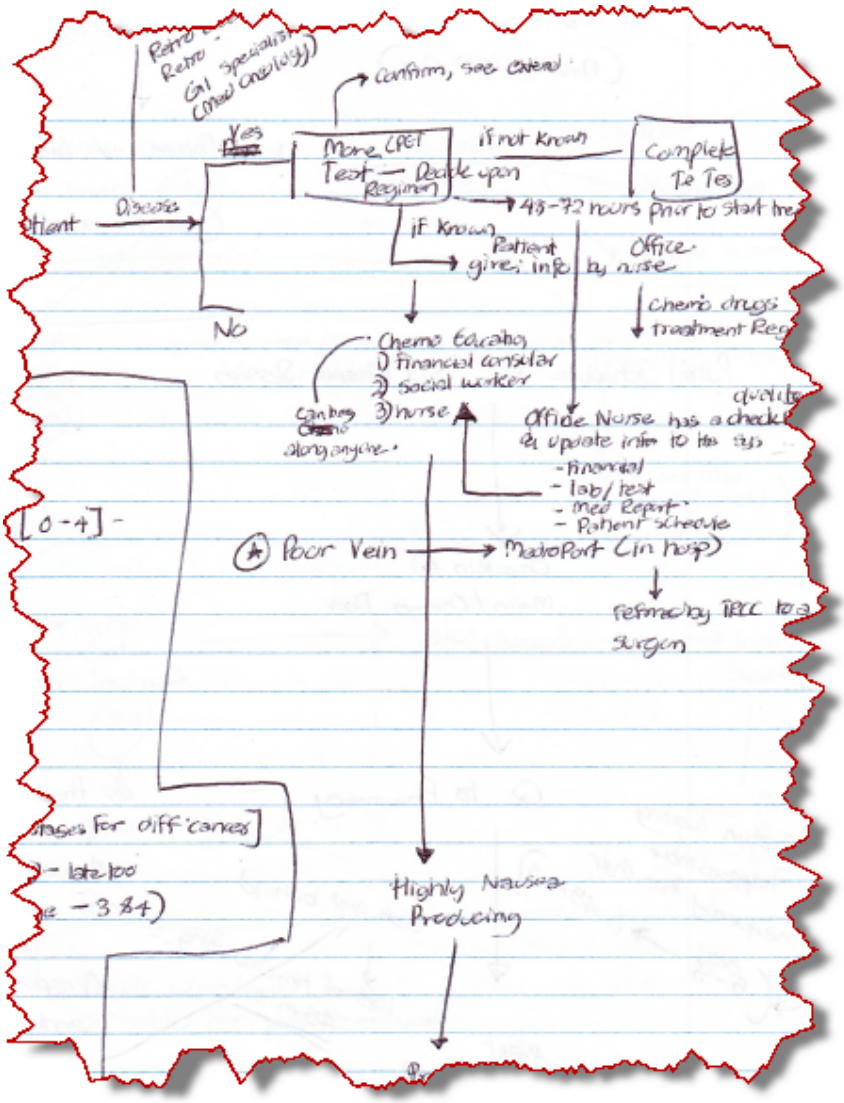


Figure 5.5: Snapshot of data collection approach

5.2.3. Step 3: Devise 'as-is' model

To represent the 'as-is' model as described in Section 4.3.3, the information from multi-disciplinary meetings and walking the journey approach were correlated and filtered to form a complete treatment workflow which was depicted using RACI-SLA diagram. Figure 5.6 shows a snapshot of RACI-SLA of those personnel who has interaction with the dietician or with the

dietary services.

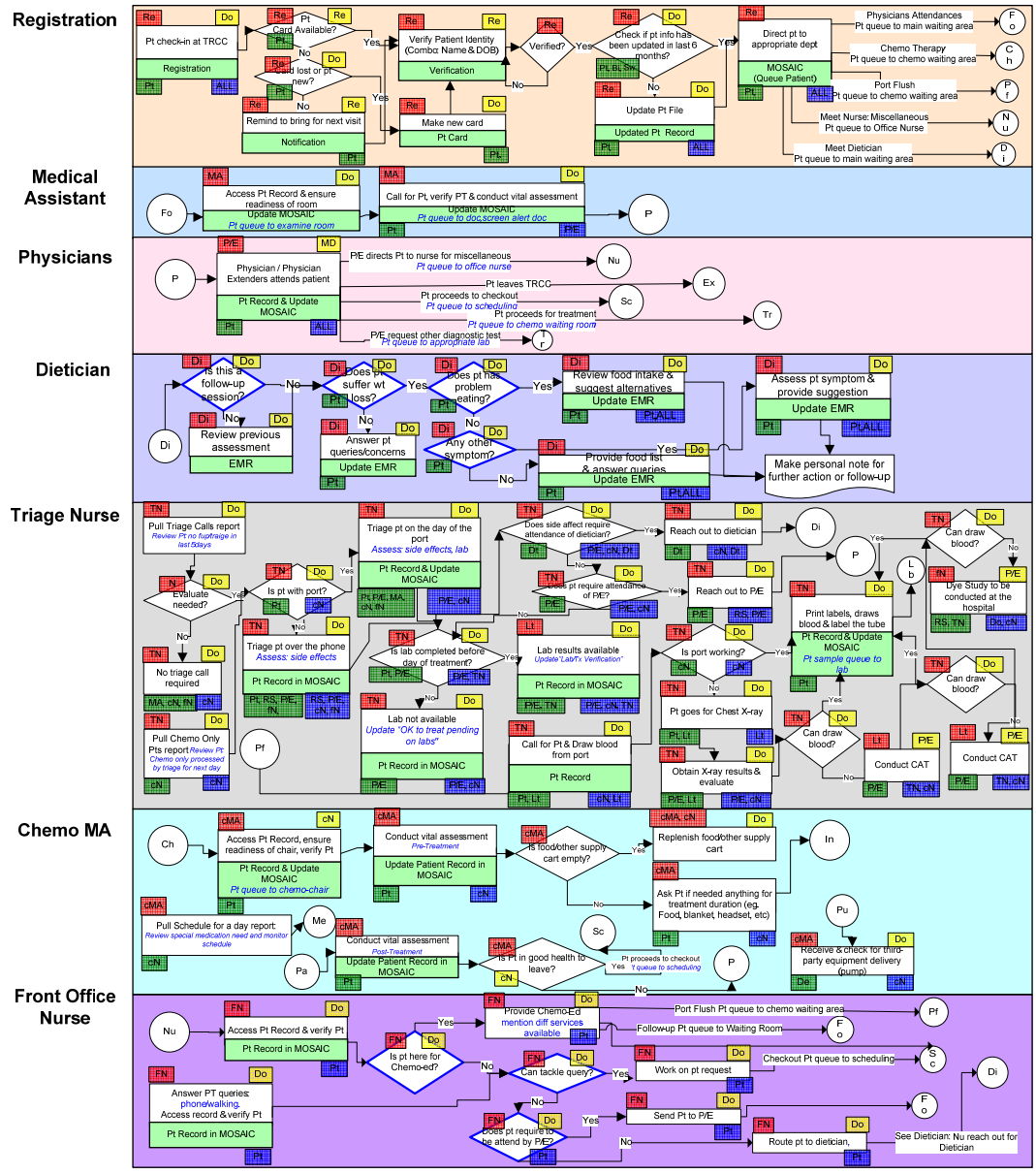


Figure 5.6: Snapshot of RAC-SLA for the dietary service

For the purpose of description, the RACI-SLA map for dietician in Figure 5.7 is extracted.

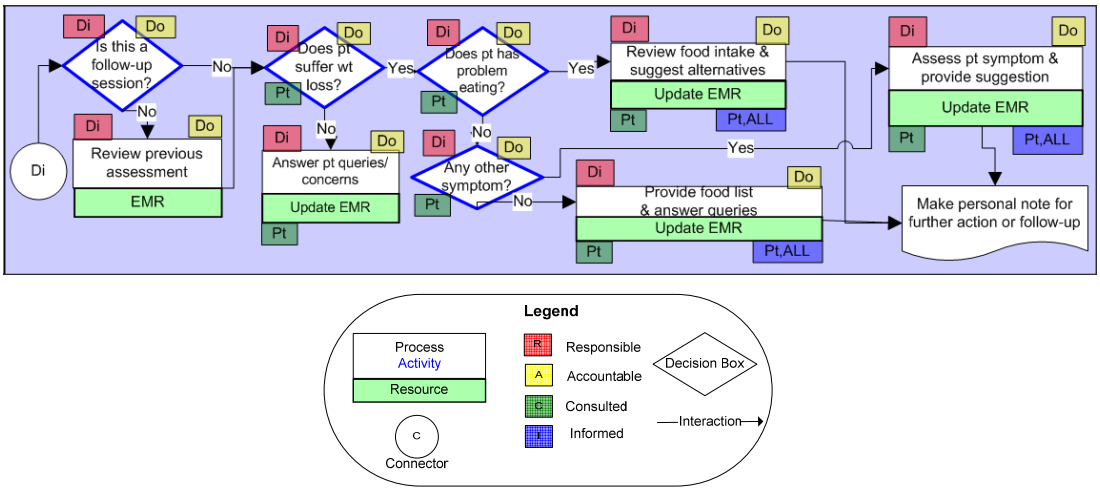


Figure 5.7: RACI-SLA for Dietician

It can be observed that multiple roles exist in the dietary service process which is represented using the RACI matrix. The primary personnel "responsible" for all the processes in the dietary service is the dietician (Di). Figure 5.7 also shows the "accountable" roles for each process where all of them trace the accountability to the middle or senior management of TRCC, in this case Do which stands for Director of Operation. The figure further shows that only single "consulted" role exists for most of the dietary service activity; in this case it is Pt or Patient and multiple "informed" roles for some activities. This shows the wide range of input, output and collaborative work that can be required to complete an activity and the extent of communication required between different personnel. The tool and techniques used as a mean to perform each process are also represented in the "resource" box. The RACI-SLA map depicts the current or 'as is' treatment flow of the dietary services in a comprehensive and easy to interpret model. Representing this information in a visual fashion aids understanding of responsibilities and resource allocation at the same time identifying impact of changes to the process. Though the RACI-SLA diagram could be drawn using the paper and pencil approach, the author have chosen to develop using Microsoft Visio. Apart from it being ease of representation and comprehension, it is also useful when any modifications have to be made.

5.2.4. Step 4: Verification and Validation

Verifying and validating information collected is as important as collecting data. The 'as-

is' RACI-SLA map for dietary services that was produced was used as a basis to verify if information is accurately and objectively collected and represented. It was also used to validate that the map depicting the current treatment flow at TRCC. The verification and validation is conducted with each subject matter expert personnel at TRCC. It was conducted via follow-up interviews and observations to validate and verify any discrepancy or information gaps. In cases where it appeared that conflicting information was reported by two stakeholders who had similar or shared responsibilities, a larger audience was invited in a facilitated group brainstorming session. At the session, the facilitator can adopt "Summarise observations of effective behaviour" (Kolfschoten and Rouwette, 2006) facilitation techniques to verify and attain accurate understanding of the workflow.

As previously discussed in Section 4.3.4, the verification and validation exercise was conducted toward the end of representation and not in between or at the time the data was collected. This help avoids any disruption that can affect the TRCC personnel's daily operation and their ability to provide accurate information. Also, conducting validation and verification in this way prevents from several reworks hence save up time since having some picture or a model in front of a personnel make it easier to communicate and also make information easier to verify and validate. Lastly, the discrepancies found were documented and the RACI-SLA map is modified.

5.2.5. Step 5: Stakeholder analysis

To analyse the data collected, historical records and Press Ganey reports were studied along with the RACI-SLA map. The Press Ganey report was reviewed to understand the composition and administration of the report and approach on how surveys were conducted at the cancer centre. The results of Press Ganey report including the patient satisfaction score for the dietary services and the feedback given were also analysed. In additions to the analysis of RACI-SLA map, the current tools (the IT application, medical recording device and reporting tool) used at the TRCC to assist care providers in their day-to-day operation were also analysed. This helps better understand the inclusion and interaction of the dietary services within the treatment process and how their attention is invoked. It also provides the knowledge of the entire treatment journey providing a big picture view of the treatment workflow. A print out of 'as-is' RACI-SLA map was discussed with care providers in facilitated brainstorming sessions where the facilitator adopted a facilitation technique "issue analysis" techniques (Kolfschoten and Rouwette, 2006) summarized in Table 2.6 to perform root cause analysis and

discuss symptoms, disconnects and problem areas in the RACI-SLA map. These sessions encourage stakeholders' involvement and broader thinking which can often results in enhanced problem understanding. As discussed in Section 4.3.5, root-cause analysis was used to explore the cause and effect relationships underlying a particular problem. In cases where the analysis failed to yield the root-cause due to limited knowledge of the participants, other individuals with specialization in that area were involved. A gap analysis was performed to differentiate between what was represented in the RACI-SLA map versus what should actually happen. This gap can help pin point any gap in the dietary services and also can help identify any improvement area in the process.

The identified gaps and area of improvement were categorized as process flaws and process deficiencies. For example, via brainstorming it was observed that although an established function within TRCC, dietary service is not a formally included function within the main stream process flow of a treatment lifecycle. Thus, there is no set way to introduce the dietary services to the patient. This is an example of a process flaw. On the other hand, an example of process deficiency points to the non availability of facility within MOSAIC for dietician to enter the details of findings from her patient's visit. Thus, the system does not currently have capability to schedule the patients to dietician for their visits. Table 5.4 illustrates the results from the facilitated brainstorming session conducted with the TRCC personnel based on the observation identified along with categorisation of problem as process flaws and deficiencies. A total of six observations were identified where three of each process flaws and process deficiencies were highlighted.

Table 5.4: Results from the facilitated sessions conducted with stakeholders

SN.	Observation	Flaw	Deficiency	Results of root-cause analysis
O1.	Although an established functions within the TRCC, culturally and procedurally, dietary service is not formally included function within the main stream process flow of a treatment lifecycle. That is, there is no set way to introduce the dietary services to the patient.	√		**Chemo MA and MA** Q. Why is nutrition assessment done by MA? A. **(Chemo MA)** Her responsibilities are to perform basic vital assessment which includes nutrition assessment. Q. Why is the information related to patient condition (eating or physical) not utilized in current treatment flow? A. **(MA)** Possible that this is reported or performed again by dietician or physician. Q. Why is change in patient condition change to the dietician? A. **(MA)** Currently MOSAIC does not have provision for reporting/alerting. Q. Why does MOSAIC not have this provision? A. **(MA)** Currently MA's responsibilities do not require reporting nutrition assessment to Physician or dietician.
O2.	The dietician has to work on an ad-hoc basis.		√	**Dietician** Q. Why do you not know which patient you will be seeing today? A. I do not have a set schedule that is set by other personnel. So, I have to monitor patient's arrival and have to interrupt other activities to perform assessment. Q. Why can't you use the MOSAIC scheduling? A. I am not responsible for scheduling and do not have access to scheduling calendar. I only record my assessment of patient. Q. Why do you not have authority or access? A. I do not know **Brainstorming with IT, FO nurse, dietician** - Discuss dietician manual scheduling effort and review the spreadsheet. - Review the scheduling capabilities in MOSAIC and trace back to the treatment workflow. - Understand how nurse handle patient that require dietician's attendance and understand their approach of contacting the dietician.
O3.	MOSAIC has the capability to capture patient condition and can be used as a trigger for alerting dietician's attendance. However, this aspect of the system is not being used.		√	**MA** Q. How and who completes the detail nutrition assessment section in MOSAIC? A. Usually left empty. May be dietician. **Dietician** Q. Why is nutrition assessment left blank? A. Did not even know it existed. Q. Where do you record your assessment? A. I normally record under the note session screen in the MOSAIC. Q. Why do not record them in nutrition assessment section?

				A. Previously the old dietician uses manual word processing application and I raised to director of operations to have them record in MOSAIC Q. Who review the information you recorded? A. Nobody I know apart from me.
O4.	Press Ganey surveys were administered without any pre-qualification and random in nature. For example, a patient first ever visit to cancer centre to consult with the physicians, where a treatment plan has not been prescribe, hence no chemotherapy education has been received, hence not met/been introduced to dietician services. The survey is not methodical and the score may not be accurate and random.	√		**Quality Control Officer** Q. Why is the patient satisfaction survey handed to every patient? A. That is how Press Ganey conducts their survey. Q. Why is Press Ganey selecting patients that have not received the treatment at TRCC to complete the survey? A. Press Ganey randomly gives out their survey. Q. Why does patient have to answer all questions in the survey? A. The form requires them to do so.
O5.	There is a general lack of understanding and awareness surrounding the role definition of a dietician and the overall function of dietary services within the TRCC as well as the patient community.	√		**Triage Nurse** Q. Why is the side effect happening to patient? A. Maybe due to food constraints. Q, Why does the dietician not know? A. I don't know when the dietician has to be involved & what the scope of her responsibilities. Q. Why does the patient not go directly to dietician? A. May be, they have not been recommended by physician or don't know about the dietary service. Q. Why should you have to contact the dietician? A. Because email/phone from me is the only way we know. Q. Why can't you use system to do notification? A. I don't know if that feature is available.
O6.	The dietary service availability is mentioned in the video and the promotional pamphlet but no contact information is provided during chemo education. This may cause the patient to put less emphasis on dietary service.		√	**Front Office Nurse** Q. Why is the dietary service visibility to patient limited? A. Possibly there was no introduction to dietary service or it was poorly introduced. Q. How is it poorly introduced when they are mentioned of them in the pamphlet & during chemo education? A. They are mentioned; however the contact information (or whereabouts) is not specified. Q. Why is the contact information not specified? A. From what I would guess, the pamphlet & video are outdated.

5.3. Feedback from post CARE implementation

The recommendations were presented to the TRCC management in January 2011. An action plan was developed and implemented for integrating the dietary services in the overall delivery system. To address the process flaws and deficiencies, changes were made to existing sub-processes by eliminating or restructuring activity steps. This was done internally by the TRCC personnel based on the brainstorming session conducted during the implementation of CARE framework. Feedback provided by the Director of Operation suggested that the dietician's visibility and availability to the patients was increased and more information was provided to the patients via active referrals from other care providers, clinical session and message boards. The pamphlets and chemotherapy education video provided to patients were also updated to included accurate dietician contact information.

Patient Satisfaction Scores were monitored monthly to evaluate the impact of these changes. The patient satisfaction scores (refer to Figure 5.8), administered by Press Ganey indicated an increased from an average of 83.17 (out of 100) for 2010 to 87.38 to-date after implementation of recommendations (Kaveney, personal communication, September 1, 2011). Changes were also made to MOSAIC to incorporate automatic report generation and alerts. The automation of report generation has saved time and effort for the dietician. However the exact savings are unknown. Automation of alerts has further reduced the effort of dietician as well as other personnel that need to contact the dietician. Queries from stakeholders were also concentrated on estimating the possible savings in time and effort due to steps taken to restructure the process flow. It was important to gage the impact of structural changes to the process which would ultimately result in different possible scenarios. This could feed into decision making by providing ability to gauge effective trade-offs between solutions which could be evaluated in terms of the time and effort required for different scenarios.

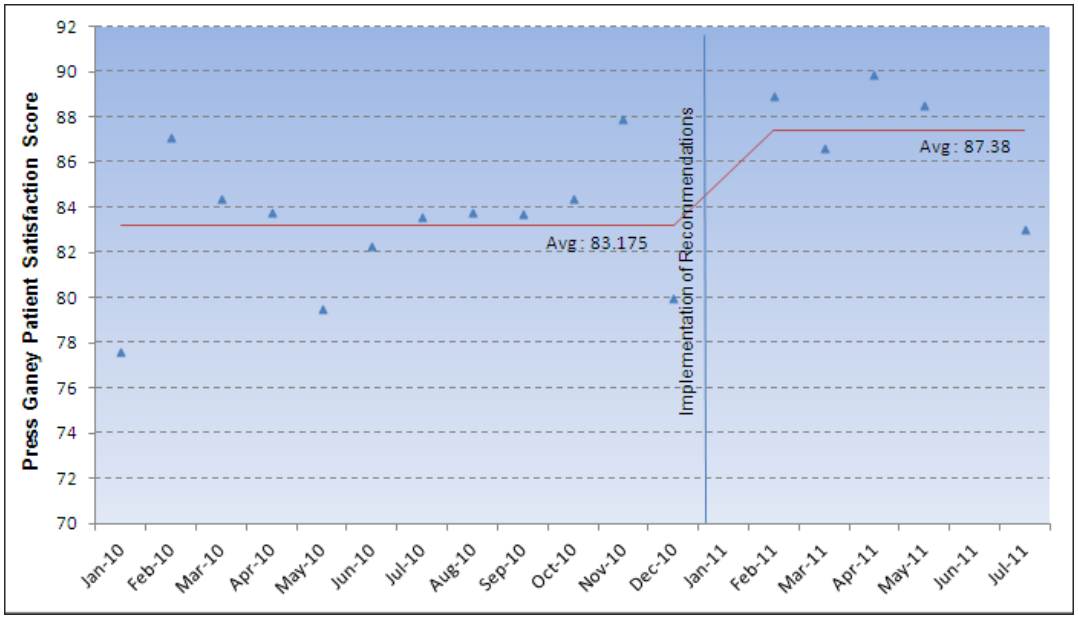


Figure 5.8: Patient Satisfaction Score reported by Press Ganey for Dietician Service

5.4. Evaluation of CARE at TRCC

This section presents the evaluation of the CARE adopted at TRCC and describes how the framework was used to achieve the requirements. As discussed in the previous sections, the aim of this research is to develop a framework which provided an accurate and holistic representation of the delivery workflow so as to promote problem understanding in a rapid manner. To achieve this, one of the defined objectives was to evaluate the framework so as to identify its effectiveness in bridging the gaps identified in current research methods. It is obvious that it may not be possible to identify all of the positive factors and the negative factors from a single case study conducted. However, this section aims to evaluate the CARE framework to identify the obvious missing attributes that are required to modify the framework. A set of evaluation criteria, described in detail in Section 4.5, were developed based on the requirements of the framework and will be used as basis of assessment which is described in the subsection below.

5.4.1. Ability to promote collaboration amongst stakeholders

At the onset, the CARE framework strived to examine the view of different stakeholders regarding the actual problem at hand. Rittel and Webber (1973); Grint (2005) and Raisio (2009), among others, states that one needs to recognize the nature of the problem before

proceeding to seek ways of resolving it in an acceptable manner. Different kinds of problems have different semantic structures, so successfully solving these problems requires that decision makers develop semantic models of the deep structure of the problem as well as a model of the processing operations (Riley and Greeno, 1988). As discussed in literature, it is necessary not only to have many disciplines involved, but also to have interaction with those whose resources and cooperation are indispensible for tackling the problem (Van Bueren, Klijn, and Koppenjan, 2003) as they bring different values and perceptions to the dialogue and debate. High levels of participation between stakeholder can provide a richer and more detailed observation of strategic events and can create creates more opportunity for self-organizing and co-evolution (Ashmos, Duchon and McDaniel, 2000). A high-level multidisciplinary meeting was conducted with management to attain list of stakeholders involved with the dietary process. The focus of the meeting was to gain high-level perspective of the delivery workflow. It was also to familiarize the practitioner with the process and the terms involved in the process of problem understanding. During the meeting, information was collected about the beneficiary of the system, the main activity, the sponsor, the operating environment and the stakeholders of the dietary services. This form of analysis clarified and formalized intention of the exercise and helped understand the impact of proposed changes on the people involved. Following that, individual meetings were conducted with key stakeholders involved or affected in the delivery workflow. These meetings allow individual to express their views and opinion freely thus encouraging all involved to share their thought without any fierce. As highlighted in literature, there can be a concern whether the stakeholders can be motivated sufficiently to participate, especially due to inherent power and hierarchies (Rose and Haynes, 1999), hence these meeting is important to understand how the individual group members feel when they contribute or share their knowledge. The intention of the meeting is also to collect the individual views on proposed causes, solutions and problem situations. The consolidated field notes highlighted the diverse views on proposed causes, solutions and problem situations at hand. The exact problem was not very defined and several problem situations, causes and solutions were apparent. This is because the stakeholders may have reported the possible causes and solutions from their world view based upon their knowledge, amount of exposure and extent of participation with the overall dietary services. A problem statement was derived by facilitation and agreed upon by all the TRCC stakeholders and thus had a clear ownership and buy-in from not only the management but also grass root employees.

In the data collection step, information was collected based upon walking the journey and

multidisciplinary meetings. During the latter initiative, stakeholder expertise was leveraged in understanding the process flow. If one stakeholder was unable to explain process steps or provides root causes for process flaws and deficiencies, other stakeholders were involved in the facilitated session. Similarly during the stakeholder analysis step, a print out of 'as-is' RACI-SLA map was discussed with care providers in informal facilitated sessions and a root cause analysis was performed to discuss any symptoms or disconnects found in the treatment workflow. As discussed in Section 4.3.5, root-cause analysis was used to explore the cause and effect relationships underlying a particular problem. In cases where the analysis failed to yield the root-cause due to limited knowledge of the participants, other individuals with specialization in that domain were involved. During these steps, the framework utilized a high level of collaboration amongst stakeholders.

5.4.2. Ability to effectively use facilitation skills

The CARE framework strived to use effective facilitation skills to carefully examine the view of different stakeholders regarding the actual problem at hand. As highlighted in the literature, facilitation supports groups in achieving their defined goals and several tools and techniques are available to apply facilitation in group settings (Zigurs and Buckland, 1998; Kolfschoten et al., 2004). A list of stakeholders involved with the dietary process was collected by meeting with the management and detailed information was collected about the operating domain of the dietary services. Direct face to face facilitation with the key stakeholder was used, with the aim of leveraging stakeholder knowledge, extracting relevant data and filtering unwanted information. This form of facilitation helped in clarification of the intention of the exercise while consolidating relevant information in a short time frame. These individual meetings highlighted the diverse views on proposed causes, solutions and problem situations at hand. Different set of facilitation skills were required in a meeting format, such as a brainstorming session, which involved all the stakeholders. Facilitation had to take into account multiple views, personalities, education, experience and also inherent hierarchy of the organization. This involved moderating the discussion, so as to allow all views to be expressed in a fair and open fashion and negotiation to gain buy-in. This resulted in a problem statement which had a clear ownership and buy-in from not only the management but also grass root employees.

During data collection, the CARE framework focused on collecting data via walking the patients' journey and via multidisciplinary meetings with stakeholders inquiring regarding the

process details. During data collection, if relevant information could not be received from one stakeholder, other stakeholders were also involved which required efficient facilitation and guidance of discussion. Since the setting for such discussions was informal rather than formal meetings, attention has to be given to ensure extraction of relevant data in a short time frame. Similarly, during stakeholder analysis, after presentation of the RACI-SLA map, process deficiencies and flaws, facilitation was required to inspire creative solutions from the stakeholders. Diverse view points, and personalities along with background and hierarchies of the organization had to be taken into account while moderating the discussion. This is important so as to allow views to be expressed in a fair and open fashion. This ultimately resulted in solutions which had a buy-in from all the stakeholders.

5.4.3. Ability to graphically represent problem situation

The framework is assessed with regards to its ability to provide visual approaches to foster discussion (as summarised in Table 2.5) as representation of problem situation can be challenging and does not represent real world accurately (as highlighted in Table 2.8). Literature suggests that creating a graphical and visual modelling can be an effective transitional object to address this limitation while facilitating negotiation and agreement (Eden and Sims, 1979; Hyerle, 1996). Further, it has also been proposed in the literature that the facilitating via a graphical visual representation provides for a systematic exploration of a solution space, focusing on relationships between discrete alternatives rather than continuous variables, and concentrating on possibility rather than probability (Ritchey, 2005). Further mapping processes has been suggested to help represent, analyse and evaluate complex problems at hand (Horn and Weber, 2007). To represent the ‘as-is’ model as described in Section 4.3.3, the data collected in the form of multi-disciplinary meetings and walking the journey approach was correlated to form a treatment workflow. This was depicted using RACI-SLA process map which in addition, depicted the multiple roles and responsibilities possible in the workflow. This represented the wide range of input, output and collaborative work that can be required to complete activities and the extent of communication required between different personnel. It serves as an effective visual aid for stakeholders to gain a holistic perspective of the treatment workflow and aids in decision making during the facilitated discussion session. For example, when discussing with the MA involvement of dietary services within the operation workflow, by referring to the RACI-SLA map, it became evident that the information with regards to food intake and changes in body weight do not trigger involvement

of the dietician automatically. In fact, this information is not utilized. The RACI-SLA map was able to show this gap in the process by providing a holistic view of the workflow and later aided in making decisions to the operation. As pointed out in literature, the visual diagram can be beneficial in putting forth information in an organized manner (Carlson and Bloom, 2005). The RACI-SLA diagram also proved useful for verification and validation, as having visual representation in front of the stakeholders make it easier to communicate and also make information easier to validate. For example, during the verification session with triage nurse, the RACI-SLA map aid in verifying the different possible routes the triage nurse can involve the dietician to discuss nutrition advice with the patient.

During facilitated brainstorming sessions, it was noted that multiple treatment methodology and routes could be adopted based upon the disease and symptoms of the patient. For example, referring to the extracted RACI-SLA map in Figure 5.6, there can be multiple treatment routes that the dietician can undertake based on the combination of patient's characteristics. This can be observed based on the presence of the 'decision box' such as if a patient suffer from a weight loss and also has a problem eating then the dietician would need to 'review food intakes & suggest alternatives'. However, if a patient suffer from a weight loss and but does not have a problem eating, then the dietician would further need to query for any other symptoms (via decision box 'any other symptoms') that could result in weight loss. Depending on patient's input, appropriate action will be taken. Due to the presence of multiple treatment possibilities, the facilitated discussion session with the stakeholders was affected by the lack of focus and effective visual representation of the same. This could be especially important when large variations in treatments were possible.

Also, during stakeholder analysis, queries also focused on the possible savings in time and effort due to steps taken to restructure the process flow. This was also one of the feedback TRCC management highlighted in Section 5.3 where the recommendation provided regarding automation of the report generation has been implemented and has saved the effort of the dietician; however the exact savings can not be easy calculated and would be useful. This is an important process data to be available when the stakeholders are deciding or considering on alternate strategies or structure of the process and the possible impacts on overall roles and responsibilities, and process times. These aspects will be considered when framework will be refined in the next chapter.

5.4.4. Ability to minimize time and effort

The framework is assessed regarding its ability to ensure minimal time and cost requirements while ensuring minimum disruption to delivery system workflow. The framework will be evaluated in ability to provide firm guidelines for implementation along with ease of explanation and use, leading to less training requirements. This is especially important as literature points to some concerns about the time and cost implications of using PSM methods (Lehaney, Clarke and Paul, 1999; Mingers and Taylor, 1992; Ledington and Donaldson, 1997; Winklhofer, 2002). In the facilitated discussion sessions conducted as part of stakeholder analysis, analyzing RACI-SLA map for process flaws and deficiencies led to easy and quick identification of systemic faults as well as areas for improvement in the care delivery system. For example, when discussing with the chemo MA involvement of dietary services within the vital assessment, by referring to the RACI-SLA map, it became evident that the information with regards to patient's health condition for the past week did not trigger involvement of the dietician automatically. In fact the information was not utilized. The RACI-SLA map was able to show this systematic fault in the process and later aided in making decisions to the operation.

Also, as pointed out in the literature, resources to deal with complex problems frequently exist among the different stakeholders, and these actors are interdependent on one another for problem resolution and it is important to find an approach so that they are able to share their perceptions of the problem (Van Bueren, Klijn, and Koppenjan, 2003; Kreuter et al., 2004; Westbrook et al., 2007). For this framework, this was achieved by leveraging stakeholder knowledge in identifying the root causes, conducting a gap analysis and formulating recommendations in the facilitated session. For example, a print out of 'as-is' RACI-SLA map was discussed with care providers in facilitated sessions where the facilitator adopted a facilitation technique "issue analysis" techniques (Kolfschoten and Rouwette, 2006) to perform root cause analysis and discuss symptoms, disconnects and problem areas in the RACI-SLA map. These sessions encouraged stakeholders' involvement allowing consensus building, ownership and buy-in about the possible causes for problems in dietary services. Providing an intuitive visual representation enabled the stakeholders to converge on a solution while minimizing time and effort in doing so.

Comparing to solutions proposed by the stakeholders via the high level meeting in problem definition (Table 5.1), only 3 of the 7 unique solutions fall under the umbrella of the

recommendations that were finally made via this study. It is important to note that the problem statement derived in Section 5.2.1, was used to provide a starting point and a focis for further investigation. If all solutions presented in Table 5.1 had been implemented they would not have had a comprehensive impact or would have led to a misdirection of effort, as they would not have adequately understood the problem areas and their root causes. Driving consensus amongst stakeholders at the onset enabled an acute focus on the direction of investigation and helped minimize the time and effort in investigation. In terms of the effort required for implementation, Table 5.5 shows a breakdown of tasks that were undertaken as part of the CARE framework and also presents the estimates time spent for each task in minutes (mins).

Table 5.5: Breakdown of Time Estimates for Implementation of CARE

S.N.	Project Task	Time (mins)
	Define Problem	
1	Assessment of Problem Situation, Causes & Solutions	110
	Past Initiatives and Supporting Doc	40
	Formalization of Problem Statement	30
	Sub-Total	**180**
	Data Collection	
2	High Level Multidisciplinary Meetings	
	2.1 Registration and Scheduling	30
	2.2 Medical Assistant	30
	2.3 Physicians	30
	2.4 Triage Nurse	30
	2.5 Chemo MA & Nurse	30
	2.6 Front Office Nurse	30
	2.7 Dietician	30
3	Detailed Multidisciplinary Focused Meetings	
	3.1 Registration and Scheduling	45
	3.2 Medical Assistant	30
	3.3 Physicians	30
	3.4 Triage Nurse	30
	3.5 Chemo MA & Nurse	30
	3.6 Front Office Nurse	30
	3.7 Dietician	180
4	Walking the journey	
	4.1 Registration and Scheduling	90
	4.2 Medical Assistant	90
	4.3 Physicians	60
	4.4 Triage Nurse	60
	4.5 Chemo MA & Nurse	45
	4.6 Front Office Nurse	60
	4.7 Dietician	360
5	Patient Satisfaction Score Analysis	60
	Sub-Total	**1410**
	Devise ‘as-is’ model	

6	Process Mapping using RACI-SLA map	**420**
Verification and Validation		
7	Validation and Verification with Personnel	**210**
Stakeholder Analysis		
8	Analysis: Gap and Brainstorming	480
9	Identification of process flaw & deficiency	180
	Sub-Total	**660**
	Total	**2880**
Other		
10	Recommendation & Presentation to Management	**90**

Figure 5.9 shows the effort breakdown for implementation of the CARE framework where majority of the effort of 1410 mins was spent on collecting data, followed by stakeholder analysis of 660 mins, devising the 'as-is' model of 420 mins, validating and verifying information collected of 210 mins, defining problem of 180 mins and presenting recommendation to management of 90 mins. In all, the CARE approach was able to analyse the dietary services process and provide recommendations in 2970 mins (about 6 business days considering an 8 hours work day).

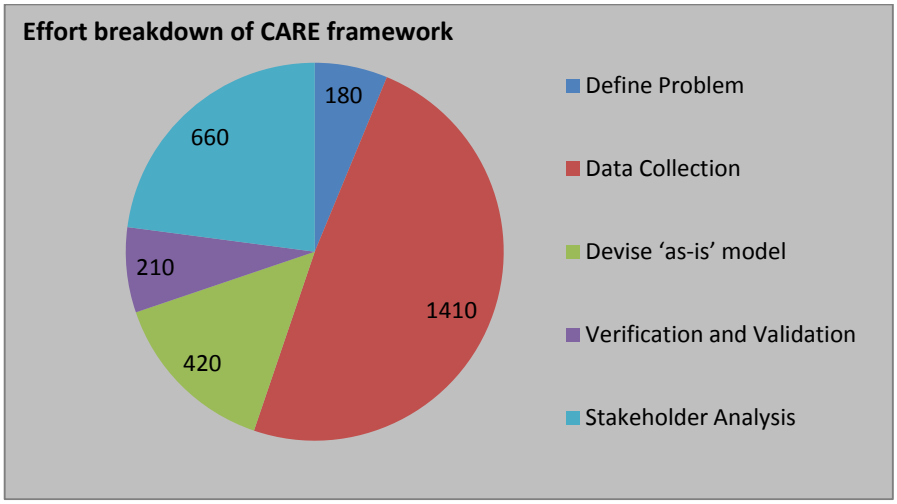


Figure 5.9: Effort Breakdown for CARE Framework at TRCC

Additionally, Table 5.6 provides a snapshot of number of stakeholders that were involved in each stages of CARE implementation at TRCC. During the first two stages, that is, "Define the problem" and "Data Collection", there were eight stakeholders involved, which include Registration and Scheduling, Medical Assistant, Physicians, Triage Nurse, Chemo MA, Chemo Nurse, Front Office Nurse and Dietician. These stakeholders were the key stakeholders that were involved in day-to-day operations of the center and possible interaction with dietician and

their workflow. In stage 3 (Devise 'as-is' model') no stakeholders were directly involved. The facilitator used the information collected to draft up the current process map. The same eight stakeholders were also involved in stage 4 where facilitator validate and verify the information collected with the subject matter experts. In the last stage, in addition to the eight stakeholders three more stakeholders were involved, including Director of Operations, Quality Control Officer and Information Technology Personnel. Information Technology Personnel was brought in during the facilitated brainstorming session to verify about the usage and scheduling capabilities within MOSAIC. The quality control officer was also bought in to help understand and verify information presented on Internal Quality and Press Ganey reports. The Director of Operations who is also the problem owner of this case study was involved to take the notice of the findings and help in with any other clarification that is required. In fact she was also valuable in resolving any conflict of information that arose since she was the one who was involved during the beginning of the center's operation to lay out the process.

Table 5.6: Number of stakeholders involved in each stages of CARE

Stages of CARE at TRCC	No. of stakeholders involved
(i) Define Problem	8
(ii) Data Collection: High Level Multidisciplinary Meetings	8
(ii) Data Collection: Detailed Multidisciplinary Focused Meetings	8
(ii) Data Collection: Walking the journey	8
(iii) Devise 'as-is' model	- (Only Facilitator)
(iv) Verification and Validation	8
(v) Stakeholder Analysis	11

5.4.5. Ability to minimize need for understanding tools by stakeholders

The framework is assessed with ability to understand tools and technologies which are identified as a major limitation to current PSM approaches (Table 2.8). The framework will be assessed in its ability to provide clear structural assumptions for representation in a simple and effective table, graph, diagram and/or text. This will directly affect the framework's focus on representing right detail of formal and informal knowledge of facts from the involved stakeholders along with concentrating on precise rather than abstract knowledge. This is necessary so as to strike a balance between collecting and representing data which will remove

confusion and aid in constructing and structuring thoughts and the time required to do so.

For data collection, in order to minimize understanding and training for tools by stakeholder, paper and pencil were used to collect the data (sample of snapshot is provided in Figure 5.5). A digital voice recorder was used as a supplement to capture discussions, in order to ensure capturing accurate information. Simplicity in data collection enabled minimal understanding of tools and technologies by stakeholder and did not disrupt operational workflow. For 'as-is' representation, SLA process map that has been widely used in understanding the interactions and responsibilities of personnel (NHS Modernisation Agency, 2002; Jun, 2007; Turkewitz and Colman, 2009; Carstensen and Sandkuhl, 2005; Perjons at al., 2005; Hinman, Mann and Singh, 2009; Margaria, 2010; Wedgwood, 2007) was combined with the RACI matrix (Middleton and Roberts, 2000; Houston and Bove, 2007; Rogers, 2011) to describe participation. As it is necessary to identify roles of the various participants and understand how they interact with one another in the care process, the combined RACI-SLA map proved useful in highlighting not only operation steps but also the roles and relationship between the personnel and the operation steps. The role of the RACI-SLA maps is similar to that suggested by Horn and Weber (2007) as process maps that can be used to represent, analyse, evaluate complex wicked problems and then to choose actions that ameliorate the complex problem at hand. Visual representation along with a holistic view of problem showing the parts, and their interconnectedness are attributes that help address complex interdependent problems (Goodman, 1974; Senge, 1990; Kreuter et al., 2004). The data collected is useful for depicting activities of stakeholders collaborating in a workflow to highlight interfaces between different activities that make up the workflow. Thus the diagram provides a holistic representation of the care delivery system.

Ritchey (2005) proposed that facilitating via a graphical visual representation for a systematic exploration of a solution space, focusing on relationships between discrete alternatives and concentrating on possibility can help surface the problem, making it easier to identify. The benefits of RACI-SLA diagram was evident during stakeholder analysis as, in the facilitated discussion session, a clear representation of the workflow proved useful in highlighting process gaps, deficiencies and improvement opportunities to the stakeholders. Discussions involving possible restructuring of the process were aided by the clarity of representation. During stakeholder analysis, a focus on simple and intuitive investigative techniques like gap analysis and root cause analysis resulted in the stakeholder focus on understanding and solving the issue rather than learning new terms and terminologies. To

summarize, utilization of simple and intuitive tools for data collection, 'as-is' model representation, verification, validation and stakeholder analysis resulted in an increased focus and efficiency from the stakeholders.

5.5. Summary

This chapter presented the results of a real life case study conducted using the CARE framework at the TRCC. The background of the case study and the generic process workflow were introduced. The concerns that the TRCC management had was with the consistently low patient satisfaction score in the dietary services function since it was first introduced.

The chapter provided a detailed implementation of CARE framework to aid management in understanding the problem and identifying the root causes that contributes to the low patient satisfaction score. The framework followed the five steps of the CARE framework described in the previous chapter. First, the problem was defined, data regarding the problem was then assembled and represented using a RACI-SLA model, which were verified and validated with subject matter experts and stakeholders to ensure accuracy and appropriateness. Finally, thorough root-cause analysis was conducted via facilitated and gap analysis to highlight the process flaws and deficiencies and recommendations were put forth to remove barriers or fill in any gaps that were observed from the RACI-SLA map. Feedback from implementation of recommendation were provided by TRCC and the results of implementation of these recommendation showed an increased in the patient satisfaction score within the dietary functions as well as the effort impact made on the effectiveness of TRCC personnel. Further evaluation of CARE framework was also conducted based upon the evaluation criteria outlined in Chapter Three and the findings indicated that the framework has met its intended objective that is to promote understanding in a rapid manner. However, there are possible areas that the framework could be enhanced to make it more effective. The shortcomings were encountered by absence of activity times which made the impact of recommended changes difficult to analyse. Further the variations of patient's characteristics could results in different care pathway consisting of combinations of sub-processes with several decision making junctures. These areas will be used to refine the CARE framework which will be discussed in the next chapter.

6. REFINEMENT OF CARE FRAMEWORK

6.1. Introduction

Chapter Four defined the proposed framework (CARE) to aid healthcare practitioner and decision maker in understanding problem that occur at the healthcare delivery systems. The chapter has also outlined the evaluation criteria based on the requirement of the framework for which the effectiveness of framework can be assessed. This framework was applied via case study to test its applicability and effectiveness and evaluate whether any modification or refinement is needed to make the framework more effective. Chapter Five provided the implementation details of the CARE framework undertaken at the TRCC which helped the healthcare practitioners and decision maker in understanding the root cause of the problem related to the consistently low patient satisfaction score in the dietary service. The previous chapter has also presented the results of evaluating the CARE framework and the outcome has shown that there are attributes that can be incorporated to make the framework more informative and useful. As previously highlighted, it is obvious that it may not be possible to identify all of the positive factors and the negative factors from a single case study conducted. However, the objective was to identify the obvious missing attributes that will enhance the usefulness and effectiveness of the CARE framework when it is modified. The objective of this chapter is to refine the framework based on the evaluation of TRCC case study conducted at the previous chapter. The shortcomings that were observed from the evaluation conducted at TRCC case study was the absence of activity times which made the impact of recommended changes difficult to analyse. Further the variations of patient's characteristics could results in different care pathway consisting of combinations of sub-processes with several decision making junctures. The outcome of this chapter is to provide a final modified CARE framework which will be further test via a second case study in Chapter Six. The following paragraph provides a description of the structure of the rest of the chapter.

This chapter commences with Section 6.1 providing the objective of the chapter and an outline to the chapter. Section 6.2 will provide the refinement of the CARE framework based on the findings from evaluation conducted at TRCC case study and Section 6.3 will then provide the refinement to the steps of the framework. Section 6.4 will presents the modified structure of the CARE framework. Section 6.5 will revisit the evaluation criteria of the framework and finally concludes with summary of the chapter in Section 6.6.

6.2. Refinement of steps for CARE framework

During implementation of the CARE framework at TRCC, it was noted that multiple treatment methodology and routes could be adopted based upon the disease and symptoms of the patient. The discussion with the stakeholders was affected by the lack of focus and effective visual representation of the multiple treatment possibilities. Due to the presence and likelihood of multiple variations in the process flow, the current methodology adopted for graphical representation in the CARE framework was unable to showcase all the possibilities effectively. Also, during stakeholder analysis, queries also focused on the possible savings in time and effort due to steps taken to restructure the process flow. It was important to gage the effect of structural changes in the process flow by eliminating or restructuring process steps. These would ultimately result in different scenarios that could be possible and were necessary to gauge effective trade-offs between solutions. The trade-offs could be evaluated in terms of the time and effort required for different scenarios. This could be especially important when large variations in treatments were possible. In light of the findings from implementation of CARE, a need for refinement is identified to the steps. Upon review, Steps 2, 3, 4 and 5 could be refined further to address the limitations discussed earlier, while Step 1 would have no impact. The following steps discuss the impact of the refinement in more detail.

6.2.1. Step 1: Define Problem

The first step relates to ensuring a common definition for the problem at hand, and the context in which it exists and is directly related to the first two requirements defined in Section 4.2. It is necessary to first establish the problem statement and understanding of stakeholder involvement along with past improvement initiatives and policy and workforce regulations. Since Step 1 is associated with categorization of the problem, defining the problem situation and analysis of probable causes and solutions and is not associated with time spent on activities during the operation workflow and possible treatment pathways, there is no impact on the methodology proposed earlier.

6.2.2. Step 2: Data collection

To address this limitation of the CARE framework, the collected workflow data from the multidisciplinary meeting and walking the journey approach needs to include data needed to

define patient pathways (PP). PP takes into account different attributes associated with treatment of patients such as nature of disease, treatment and type of insurance coverage (Ellis and Johnson, 1999; DoH, 2007; NHS, 2008). Data can be collected to identify PP within a workflow based on the nature of disease, applicable treatments and any other decision points that need to be considered. For example, the treatment workflow of a patient undergoing chemotherapy will be different to one undergoing a regular check up or triage.

Activity time is also collected for each activity that makes a PP. A best estimate time can be recorded from stakeholder input or by direct observation of workflow activities. While such estimates may be susceptible to stakeholder opinion, they can still serve as valuable estimates of effort required. As healthcare processes have inherent uncertainty and variability, the intention is not to capture the exact time because such an effort will be exhaustive and tenuous. Such an effort would require a large sample size to derive a statistically valid calculation.

If a certain PP is initiated in the process, it is certain that a given activity will be initiated. However, activities can differ between different PP's. For example, a registration process for a new patient will involve an activity for insurance verification and check and will have an activity time associated with it. However, registration process for an existing patient will not involve the activity for insurance verification that is if the same insurance is used. As set of activities differ between each PP and each activity has a unique time associated with it, the results for each PP will have a different total time associated to it and is calculated by summing the time of all activities that makes up a PP. Identifying these differences will enable focusing analysis efforts and stakeholder discussions on the right problem areas. The occurrence for each PP is also assessed using stakeholder's opinion or direct observation and using a scale where high, medium and low likelihood of occurrence are assigned a respective value of 0.9, 0.3 and 0.1. This can be especially useful while calculating a best estimate of the average time required completing a process given the various PP that can exist. The numerical values are relative rather than absolute in nature and similar techniques have been found in literature for comparing and analyzing features in terms of relative importance (Presley, Sarkis, and Liles, 2000; Presley, 2002; Chan and Wu, 2002). Several numerical scale have been applied, the framework has adopted a scale of 0.9, 0.3 and 0.1 so that the relative value can be easily distinguish from one another.

6.2.3. Step 3: Devise "as-is" model

Based upon the data collected, representation of PP and activity time can be included in the

RACI-SLA map. The schematic (Figure 6.1) shows the RACI tabs for each activity for a given personnel (represented in a swim-lane). The roles of stakeholders are included explicitly using colour codes where: 'R' in red implies Responsible; 'A' in yellow implies Accountable; 'C' in green implies Consulted and 'I' in blue implies Informed. The schematic (Figure 4.7) is modified to represent the activity time, above each activity, as shown in Figure 6.1.

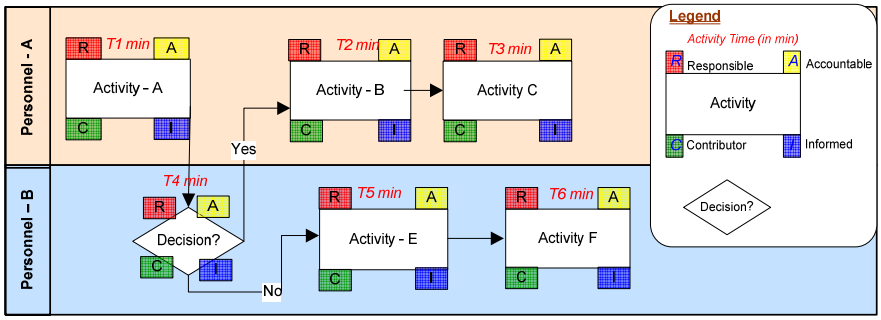


Figure 6.1: Modified RACI-SLA Map

The PP collected in the data collection stage can also be represented and inferred from the treatment workflow. PP's are identified by the presence of a "decision box" which most likely will point to two paths that can be undertaken following the decision point.

6.2.4. Step 4: Validation and verification

Step 4 relates to verification and validation of data collected and represented in the RACI-SLA map. To ensure that time and effort is directed towards the right problem, it is important to verify and validate the information. The modified RACI-SLA map is used to verify and validate the activity time in addition to the activities, flow of processes and resource allocation. The best way to cross verify the information is with the source individually. This avoids any special facilitation skills that may be required when conducting in a group as the input is taken directly from the expert. In cases where the stakeholder does not have the necessary knowledge to provide the right input, other stakeholders can be involved to complete the input. Verification and validation can be conducted during non-critical times of the operation so as to avoid disrupting the workflow and ensuring high attention from the stakeholder. Cross reference may require some historical trend data from the information system used within healthcare. Any variance found will be reflected on the 'as-is' model by making changes to the RACI-SLA map. This step is also helpful in gaining approval and ownership from the

stakeholders.

6.2.5. Step 5: Stakeholder Analysis

In this step, stakeholders are engaged in facilitated brainstorming sessions to perform root cause analysis and discuss symptoms, disconnects and problem areas in the RACI-SLA map. These sessions encourage stakeholders' involvement and broader thinking which can often results in enhanced problem understanding that no one person or one side would have been likely to develop on their own. In addition to the steps outline in Section 4.3.5 for stakeholder analysis, based upon the modification presented in this chapter, the analysis of PP's can be included. For example, Figure 6.1 shows two PP's, which are A-B-C and A-E-F. Both these PP require different allocation of resources and have different associated times. If the problem areas are identified within the PP(A-B-C), then the healthcare practitioner can emphasize his or her efforts and stakeholder discussions more on that treatment pathway rather than on other PP. Further, if one compares the activity time for PP(A-B-C) and PP(A-E-F), the activity time for the former (or $Time_{A\text{-}B\text{-}C}$) is given as the sum of T1+T4+T2+T3 min while the activity time for latter (or $Time_{A\text{-}E\text{-}F}$) is given as sum of T1+T4+T5+T6. This analysis can be presented to the stakeholders for comparison in addition to the RACI-SLA map. Facilitated brainstorming sessions that involve this information will provide stakeholders with information on the impact of restructuring or eliminating steps and associated trade-offs. The likelihood of a PP being undertaken by a patient is assigned a qualitative value taken and is taken through observation and actor opinion. The probability is defined as a low, medium or high and assigned respective value of 0.1, 0.3 and 0.9. For example, let's assume that PP(A-B-C) has a likelihood (or $Probability_{A\text{-}B\text{-}C}$) of occurrence as high (0.9) while PP(A-E-F) has a likelihood of occurrence (or $Probability_{A\text{-}E\text{-}F}$) as low (0.1). The time taken to complete the process comprising of PP(A-B-C) and PP(A-E-F) is a function of the activity times and the likelihood of occurrence of each PP. As an accurate estimation will require large samples of data, an average weighted time can be calculated for best estimate as:

$$\text{'X' Process Weighted Average Time} = \frac{(Time_{A\text{-}B\text{-}C} * Probability_{A\text{-}B\text{-}C}) + (Time_{A\text{-}E\text{-}F} * Probability_{A\text{-}E\text{-}F})}{Probability_{A\text{-}B\text{-}C} + Probability_{A\text{-}E\text{-}F}}$$

$$= \frac{((T1+T4+T2+T3) * 0.9) + ((T1+T4+T5+T6) * 0.1)}{0.9 + 0.1}$$

6.3. Modified CARE Framework

Figure 6.2 shows the structure of the CARE framework, as described in Section 4.3 above. The figure shows the Steps 1, 2, 3, 4 and 5 in a sequential arrangement along with major components associated with each step. For example, Step 1: Define problem is associated with Problem category matrix and derivation of the Problem statement as two important components. This gives the healthcare practitioner a visual guide for implementation in real life settings.

Taking into account the modifications discussed in Section 6.2, Step 1: Define problem is unchanged. Step 2: Data collection is changed to reflect the need to collect activity time and likelihood of occurrence. Step 3: Devise "as-is" model is changed to reflect PP and activity time. Step 4: Verification and validation is changed to include associated effort to validate and verify activity times. Step 5: Stakeholder analysis is changed to include the analysis associated with PP, likelihood of occurrence and activity times. Figure 6.2 shows the modified CARE framework where the amendment mentioned above is highlighted in deep blue box.

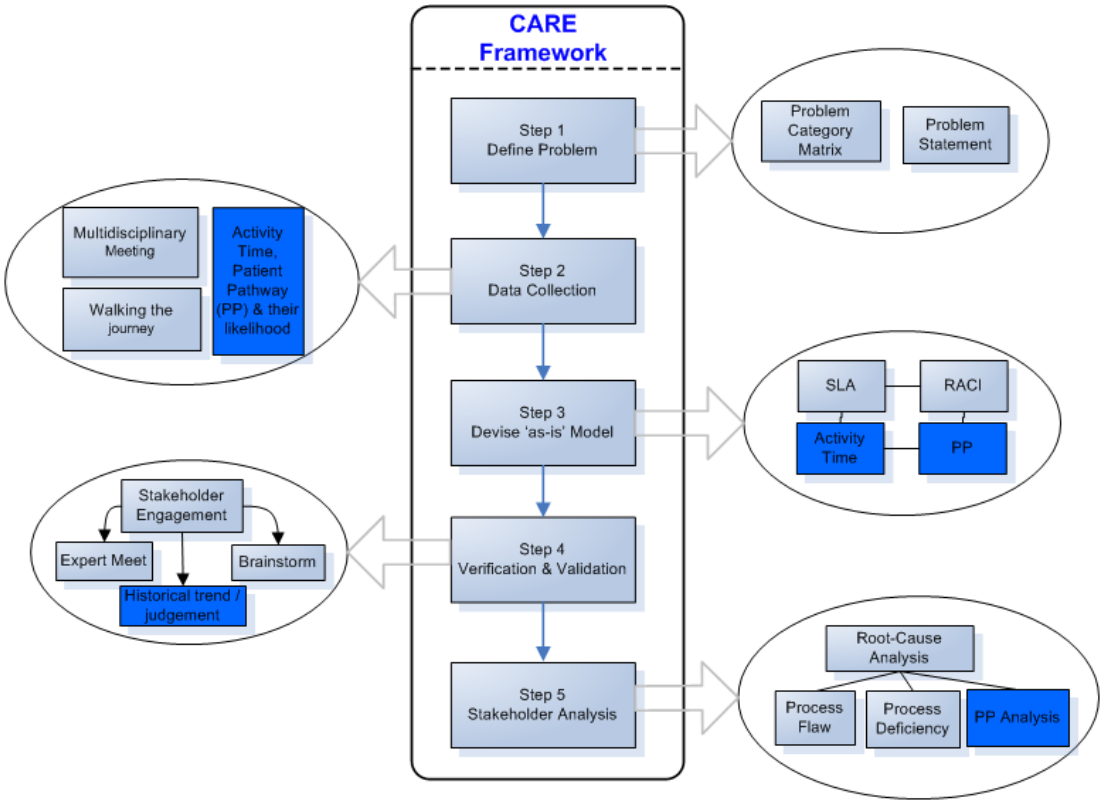


Figure 6.2: Modified Structure of the CARE framework

6.4. Framework Evaluation Criteria for Modified CARE framework

The modified CARE framework is evaluated against its ability to meet the original requirements set in Chapter Three. The set of requirements for the modified CARE framework remain the same as they have been derived from a comprehensive literature review and are not presented here to avoid repetition.

6.5. Summary

The main purpose of this chapter was to present the final CARE framework after the refinement to address the limitation encountered during a case study empirical evaluation at TRCC discussed in the previous chapter. This chapter provided a discussion on reflection from the empirical evaluation. As the purpose of the chapter was further refinement of the framework, the emphasis during discussion on reflections has been mainly on limitations encountered. The shortcomings were encountered by absence of activity times which made the impact of recommended changes difficult to analyse. Further the variations of patient's characteristics could results in different care pathway consisting of combinations of sub-processes with several decision making junctures. Thus resulting in confusion and causing difficult to comprehend the different possible treatment journeys that exist. Considering, these aspects, the steps of CARE framework were modified as followed: where Step 1 (Define problem) was unchanged. Step 2 (Data collection) was changed to reflect the need to collect activity time and likelihood of occurrence. Step 3 (Devise "as-is" model) was changed to reflect PP and activity time. Step 4 (Verification and validation) was changed to include associated effort to validate and verify activity times. Step 5 (Stakeholder analysis) was changed to include the analysis associated with patient pathways, likelihood of occurrence and activity times. As limitations provide the basis for improvement, the framework has been modified to eliminate the shortcomings. Further, the evaluation criteria have also been revisited to ensure that the criteria are still valid for the refined framework. The main output of this chapter was the final framework for enhancing the understanding of problems in healthcare delivery system in a simple and rapid manner, especially those problems that are complex and have inter-connected socio-technical aspects. The next chapter will describes the implementation of the final CARE framework in a case study conducted at gastroenterology clinic in the University of North Texas.

7. CASE STUDY II: THE GASTROENTEROLOGY CLINIC

7.1. Introduction

Chapter Six presented reflection of the CARE framework and refined area that was discovered as shortcomings from the evaluation conducted at the TRCC case study presented in Chapter Five. The main attributes that have been added to the framework is the time of each activity that make up a process as well as the encapsulation of patient pathways and its occurrences that can occur for each processes. The final structure and steps of the CARE framework were presented in the last chapter. The objective of this chapter is to evaluate the effectiveness of the final CARE framework via a case study. The case study adopted will be of a different nature of problem to the one described in Chapter Five. This will further auxiliary validate the guidelines and its usability. The case study selected is at a gastroenterology (GI) clinic in a patient care centre of a hospital in Fort Worth, Texas. The following paragraph presents the structure of the chapter.

This chapter commences with Section 7.1 providing a brief introduction and an outline to the chapter followed by Section 7.2 then provides a detail discussion on the implementation of the final CARE framework using the structure and steps of modified CARE presented in the Chapter Six. The case presented here is a concern the hospital management has regarding the increased wait time for patient to be attend to. The chapter also presents the evaluation of the CARE adopted at UNT in Section 7.3 and describes how the framework is used to achieve the stated objectives. The last section finally concludes with a summary of the chapter.

7.2. CARE Implementation

This section provides an in-depth discussion on the implementation approach of CARE framework at GI clinic within UNT's patient care centre. The approach adopted uses the structure and components of the modified CARE framework.

7.2.1. Step 1: Define Problem

Within the UNT hospital, the GI clinic has been receiving complaints and concerns on the length of office wait time from patient via survey conducted. For example, as shown in Figure 7.1 a total of 33 complaints were received from unique patients over a course of 6 months in

the GI clinic with regards to wait time. Further, the complaints have also been raised by care providers during the monthly GI clinic care provider meeting about wait time of patient with respect to their appointment and patient not being in the examination room on time. The causes to these concerns are unknown.

Gastroenterlogy Complaints for 2010-11

Date Received by Organ-ization	Approx. Date of Resolution	Reviewed/Closed	Resolved to Pt satisfaction	Pt dissatisfied	Pt retained	"Will not return to practice"	Unknown resolution	OTHER	Gastroenterology	Attitude	Business (Billing/Medical Records/Registration)	Check-In Process	Length of wait	Quality of Care Provided	Referral Process	Refills Controlled	Refills Non-Controlled	Return Call	Scheduling	Other	Front Office Staff	Non-Clinical Staff	Nursing(MA/LVN/RN)	Provider	Student/Resident	Other
			Outcome							Topic of Complaint											Person of Complaint					
9/13/2010	10/5/2010	y	1		1				1	1			2						1							
11/6/2010	12/15/2010	y	1		1				1				5					2	2							
1/24/2011	2/22/2011	y				1			1	1			5											1		
3/25/2011	4/28/2011	y			1				1				6					1	1		1					
5/12/2011	6/29/2011	y			1				1	1			8						1			1	1			
7/24/2011	8/28/2011	y	1		1				1				7	1				1		1		1		1		

Figure 7.1: Results from Patients' Complaint

Also, as part of the patient satisfaction benchmark conducted by AMGA shown in Figure 7.2, indicates that the length of patients' office wait for GI clinic to be consistently below the best practices as formulated by AMGA and also most of the time below the AMGA's norms.

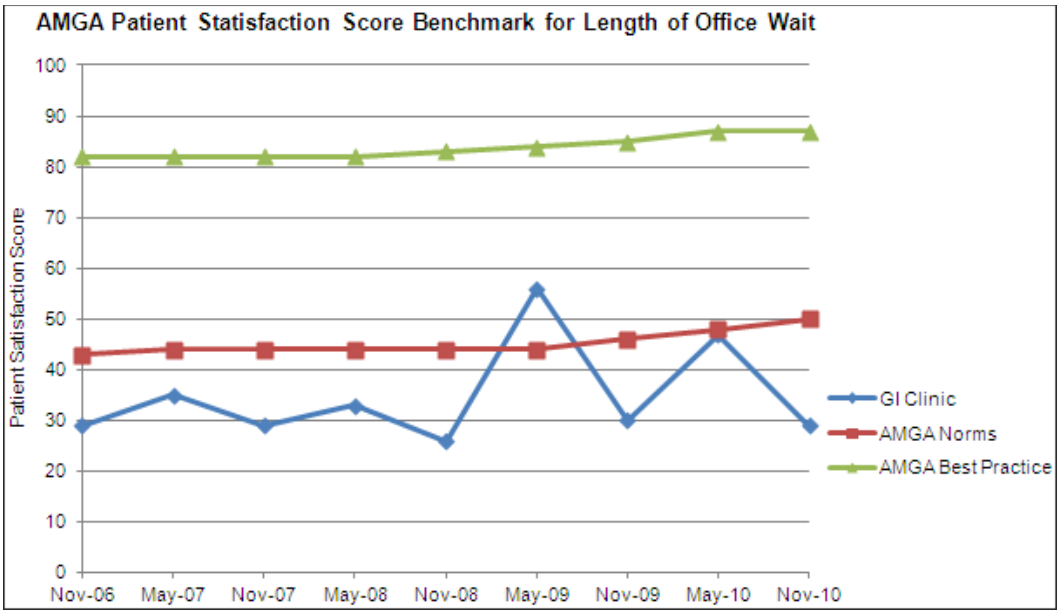


Figure 7.2: Length of Office Wait Benchmark by AMGA

In the past, several initiatives have taken place to optimize the length of patient's wait time. Some initiatives include suggesting the patients to arrive earlier than their actual appointment times in an effort to complete the registration formalities. In other instances resources for MA has been increased, medical records has been made electronic, ad-hoc assistance received by the front office staff from Geriatrics (other department) front office staff and when the observation rooms are not enough due to patient's demand then additional observations rooms are borrowed from other clinics on the same floor. With these initiatives, the clinic continues to experience the same issue where patients are still not in the exam rooms by their appointment time. However, the problem still continues and the cause is vague. To add to the problem complexity, the clinic has a cost constraint, hence not able to add more resources. In additions, the management also has an objective to identify and understand the real cause to this repeated issue.

As mentioned previously in the CARE components (Section 4.4.1), it is important to first analyse how different care providers at the UNT perceived the problem associated to wait time. This will help ensure that all stakeholders understand and working towards the same problem. As discussed in Section 4.3.1, before collecting information from the stakeholder it is important to understand who the stakeholders are. A high-level multidisciplinary meeting was conducted with director of clinical operation to identify key stakeholders that contributes to patient treatment flow at the GI clinic. Further analysis was conducted to understand the extent or the boundary of the patient treatment flow. This analysis helps modeller and management to understand the scope and boundary of this study and also the extent to which CARE framework should be applied. The analysis was conducted using query approach to the five main attributes includes: the beneficiary of the system, the main activity, the sponsor, the operating environment and the stakeholders of the dietary services. Table 7.1 presents the result of this analysis. For example, initially the management had noted nurse as one of the key stakeholders. However, when the analysis was conducted, it was noted that the tasks that nurse performed including request for referral documentation for new patient, pre-hospital operation readiness, arrangement for procedure and receiving results have minimum affect on daily patient's treatment workflow. Hence, the nurses were excluded from the list of the UNT stakeholders in the analysis and not included for further evaluation via CARE framework.

Table 7.1: High-level Analysis for the GI clinic

Parameters	Key Attributes
Beneficiary	Patient, Clinic Personnel
Activity	Diagnostic and Treatment to Patient
Sponsor	Director of Clinical Operation (or Operation Management)
Environment	Resource limitations, financial constraint, regulatory body
Stakeholder	CR, MA, Physicians

Once the analysis has been conducted and stakeholders have been identified, high-level multidisciplinary meetings were conducted with those personnel. A broad spectrum as well as objective information was collected about the GI clinic related to stakeholders' perception on problem situations, causes and solutions. Table 7.2 shows the different problem situations that were expressed by the UNT stakeholders. The information was interpreted to distinguish between facts and stakeholder opinions. As can be inferred, the exact problem is ill-defined and several causes are apparent. It is possible that only one or few root causes actually result in the other causes or it may be possible that the actual root cause is not even apparent and hence not even recognized by the stakeholders. The stakeholders are reporting the possible causes and solutions from their world view or perspectives which may only be based upon their knowledge, amount of exposure and extent of participation with the overall patient treatment workflow. Hence, implementing one or all of the solutions may not resolve the root cause of the problem and may lead to suboptimal use of efforts or in a worst case, lead to further problems.

From the Table 7.2, eight unique causes and five unique solutions were identified. The causes are not apparent and hence the solution is doubtful. UNT stakeholders have radically different world views and different frames for understanding the problem. Further, the problem needs to be better understood and known before a solution can be implemented. As the problem requires high level of human interpretation, does not have a set of exact causes and solutions, it was categorized as a complex problem. A traditional OR approach may not help to understand and tackle an ill-defined problem such as the one UNT is faced with the wait time since the problem is perceived differently and not well-understood among the UNT personnel themselves. These can result in tackling of the wrong problem.

Table 7.2: Results from High-Level Multidisciplinary Meeting

Stakeholder	Problem Situations	Proposed Causes	Proposed Solutions
Patient	Waiting too long to be seen by physician	- Too many patients - Physician is not always available	Increase physician availability
Physician	Patient are not always on-time; EMR is time-consuming	- Not enough room - Patient is not there on time - Hard to retrieve information from EMR	- Ensure that patient check-in is on-time - Patient arrives on-time - Paper chart is more efficient than EMR
CR	Too many patients all on the same time on certain days	- Fixed slot time for scheduling patients - Patient comes early due to transportation availability or late due to unpredictable causes - Physician is late - Some physicians are here only for half a session in a week - New patient do not always fill their welcome package prior to arriving for their appointment	- Increase physician availability - Increase slot time available
MA	Too many patients; Less rooms; Referrals are not received	- Not enough rooms available - Someday there is more than one doctor on the same session - Spare room is not always utilized even though room is not available due to physician's preference of desktop over laptop - Results or referrals can take too long to receive	- Increase rooms - Increase physician availability

The keywords represented in the problem situations column of Table 7.2 such as "wait time", "time-consuming", "too many" are indications of possible larger issues such as flaws in process design or inherent inefficiencies. It is important to define the problem statement in a way which best captures the essence of the possible causes without being too specific or susceptible to misinterpretation.

The stakeholders at UNT are then be engaged in facilitated brainstorming session to review the collected data. At the session, the facilitator utilized a technique of "informal introductions" (Kolfschoten and Rouwette, 2006) to open the session while ensuring all the

stakeholders are on an equal ground. This techniques help not only warms up the people but also removes or reduces the hierarchical boundaries. For example, this is conducted by letting each participant informally introduce themselves to other participants in the session providing information such as their name and what their hobbies are while excluding information about their title, role and responsibilities at the hospital. Once the introduction is completed, the facilitator then sets the goals and expectation from the session by describing what the outcome may look like. This visualization technique helps to create a mental picture for each of the stakeholder's. The expectations also include setting the ground rules for the session, as required or expected by the facilitator. Following that, responses provided for "proposed causes" and "probable solutions" by each stakeholder are presented to the group by the facilitator. This is similar to the methodology defined in the technique "write down the problem that brought you here" (Kolfschoten and Rouwette, 2006), except that instead of each of the stakeholders presenting their "proposed causes" and "probable situations", the facilitator presents it to the entire audience based on the field note conducted at the high-level multidisciplinary (shown in Table 7.2). The names of the stakeholders are kept anonymous, so as to ensure that the discussion is not affected by negative group dynamics, while all views are adequately presented, irrespective of the hierarchy or the personality of the stakeholders. The different problem situations are then debated, similar to the facilitation technique of "issue analysis" discussed by Kolfschoten and Rouwette (2006). Issue analysis helps to keep the session in a problem solving mode while ensuring a strong focus on the scope of discussion. If there was a discrepancy or conflict in the information provided by the stakeholders, issue analysis was used to surface it for broader discussion by the group. For areas of conflict, techniques were employed to accommodate a variety of viewpoints to get the best solution. For example, stakeholders, who had real-life experience or knowledge relevant to the issue, presented their view points in front of their peers and a peer based analysis was used to derive the optimal result. The problem statement is derived via discussion and agreed upon to by all stakeholders. The facilitator is responsible for ensuring that the problem statement is not too specific or vague in order to ensure the right direction of efforts.

From the exercise conducted to derive the problem category index, proposed causes and solutions, a problem statement was formulated and presented to UNT stakeholders as:

"Increased wait times for patients due to inherent process dependencies and inefficiencies"

The problem statement was derived after discussion with stakeholders to best represent the

possible causes listed in Table 7.2 and the information and knowledge available to-date. This problem statement was agreed amongst stakeholder as a potential area to further explore and resolve. Table 7.3 shows a comparison of the characteristics of ill-structured problem described by Rittel and Weber (1973) and the problem at TRCC. As can be inferred, there are distinct similarities between the two sets of characteristics, which further points to the problem at TRCC as an ill-structured problem.

Table 7.3 : Characteristics of ill-structured problem & problem at UNT

Characteristics of Ill-Structured Problem (Adapted from Rittel and Weber, 1973)	Characteristics of problem at UNT
There is no definitive formulation of a wicked problem (defining wicked problems is itself a wicked problem).	Different stakeholders have different views about what the problem is
Wicked problems have no stopping rule	Previous methods of eliminating the problem have proved ineffective. For example, increased resource (MA) and better planning (asking patient to arrive 15 minutes prior to scheduled appointment) have not led to satisfactory results
Solutions to wicked problems are not true-or-false, but better or worse.	The problem of patient and provider wait times will never be removed. It can become better or worse and has to be continuously monitored
There is no immediate and no ultimate test of a solution to a wicked problem.	It is not possible to test one solution as the ultimate solution for the problem. It may lead to further complications in the operation due to unforeseen dependencies between the steps in a process
Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial and error, every attempt counts significantly	Multiple tests based on trial and error are not possible due to time and resource constraints
Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan	No pre-defined way of solving problems exist. For example, what is applied for solving issues with wait times at another hospitals cannot be used due to differences in operation and stakeholder expectations.
Every wicked problem can be considered to be a symptom of another problem.	Increased wait times for the patient are a symptom of other problems in the operation
The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.	Coming to an agreement about the root causes is necessary to formulate solutions
The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).	Implementing a solution to tackle the problem of increased wait times may generate other problems in the operation, if not carefully planned and monitored

7.2.2. Step 2: Data collection

This step involves collecting relevant information from both patients and care providers perspectives that work collectively to form the patient treatment flow at the GI clinic. As mentioned in Section 4.3.2, data from all dimensions that is, from care providers and patients will help build accurate process model that depicts the 'as-is' hospital workflow. To begin collecting details information, high-level multidisciplinary meetings were conducted with the care providers' representatives, namely physicians, CR and MA to gain general understanding of their responsibilities. The facilitator can employ "profile tool" facilitation technique described by Kolfschoten and Rouwette (2006) in Table 2.6 since it is simple and can also help facilitator navigate through different possibilities and interdependencies that can exist. At this time, detailed information was not collected as it could overwhelm the practitioner. Rather, the objective was on familiarizing the modeller with the process, terminology and interactions. The following summarizes the responsibilities of the individual roles.

Clinical Staff Representative (CR)

CR is responsible for non-clinical administration activities within the clinic. They perform several tasks and are summarized in Table 7.4. These tasks can be broadly categorized into: fixed tasks per day (FT) and tasks per patient (TP). While FT has daily fixed efforts regardless of patient's demand, TP are carried out per patient.

Table 7.4: Description of Process responsible by CR

Process	FT/TP	Description
Check-in	TP	Include patient and their demographic verification, obtain consent and co-payment.
Check-out	TP	Check-out of patient and schedule for follow-up.
Schedule Appointment	TP	Schedule patient for appointment at the clinic.
Encounter label, Face-sheet Readiness	TP	Preparation of encounter label (patient information label) and face-sheet (summary of patient demographics and insurance detail).
Insurance Verification	TP	Patient's insurance verification for coverage details.
Appointment Reminder	TP	Manual reminder call to patient for their appointment.
New Patient (NP) Verification	TP	Include verification of all documentation required for treatment.
Answer Queries	TP	Address uncontrollable query raise over the counter or over the phone.

Cash Receive	FT	Includes cash received from finance which is used to provide change that may be required during collection of co-payment.
Print Schedule	FT	Print and distribution of schedule listing patient that have appointment at the clinic on that day.
Close Super-bill	FT	Reconciliation of superbill (summary of patient diagnosis and treatment order) with schedule of the day to ensure that superbill is completed for every patient by the provider and submitted by patient at the time of check-out. Details of cash received from patient for their co-payment is enter to the audit summary and are reconciled with super-bill to ensure accuracy.

Physician (PE)

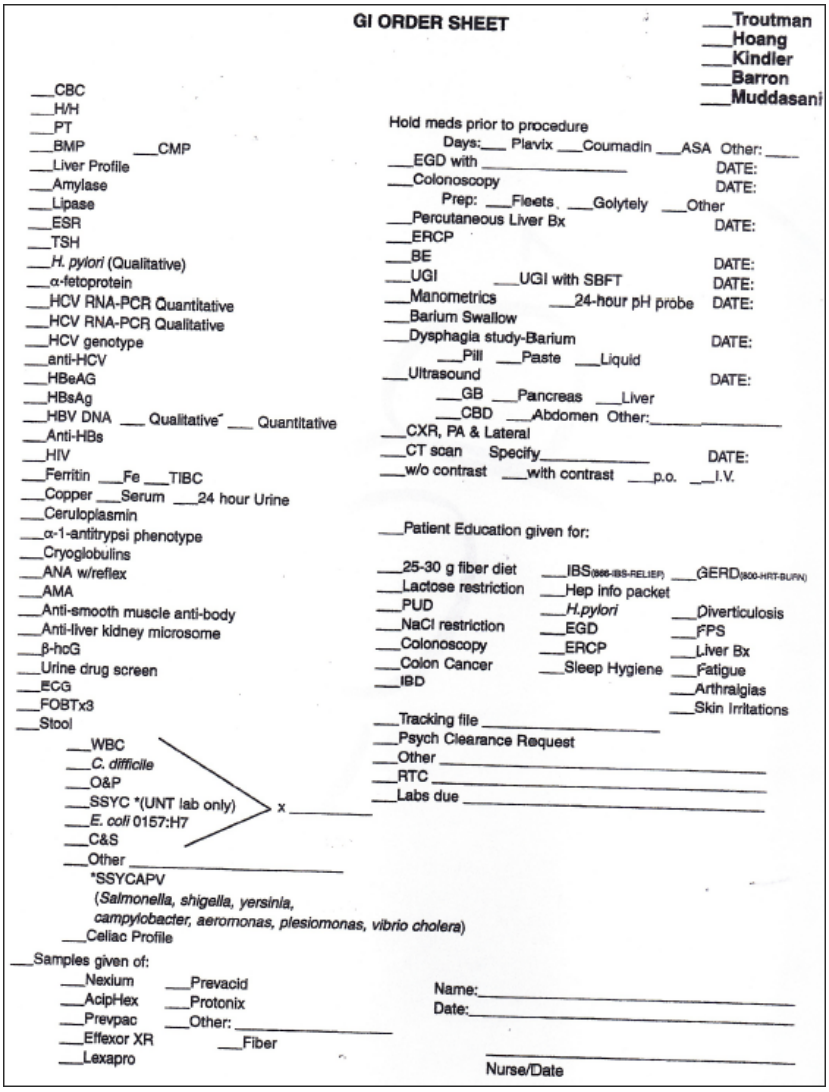
PE is responsible for diagnose, prescribe treatment plan and review results for all patients visiting the clinic. The patient could be new or established to the clinic. PE is also responsible for completing superbill once he or she has attended to the patient. Table 7.5 summarizes the processes responsible by PE.

Table 7.5: Description of Process responsible by PE

Process	Description
Patient Assessment	Includes review record (med History/results); diagnosis, treatment plan; update EMR; complete superbill

Medical Assistant (MA)

MA is responsible for conducting basic vital assessment for all patient visiting the GI clinic and waiting to be attended by PE. They are also responsible for processing the order prescribed by the physicians for patients that was seen by the GI clinic's physicians. Sample of GI order is shown in Figure 7.3 and the order ranges from sample and laboratory test, medical procedure and education session. Further, they may be required to request for medical history or other records from other referral or hospital that patient has visited.



GI ORDER SHEET

___Troutman
___Hoang
___Kindler
___Barron
___Muddasani

___CBC
___H/H
___PT
___BMP ___CMP
___Liver Profile
___Amylase
___Lipase
___ESR
___TSH
___*H. pylori* (Qualitative)
___α-fetoprotein
___HCV RNA-PCR Quantitative
___HCV RNA-PCR Qualitative
___HCV genotype
___anti-HCV
___HBeAG
___HBsAg
___HBV DNA ___ Qualitative ___ Quantitative
___Anti-HBs
___HIV
___Ferritin ___Fe ___TIBC
___Copper ___Serum ___24 hour Urine
___Ceruloplasmin
___α-1-antitrypsi phenotype
___Cryoglobulins
___ANA w/reflex
___AMA
___Anti-smooth muscle anti-body
___Anti-liver kidney microsome
___β-hcG
___Urine drug screen
___ECG
___FOBTx3
___Stool
___WBC
___*C. difficile*
___O&P
___SSYC *(UNT lab only)
___*E. coli* 0157:H7
___C&S
___Other _____
x _____
*SSYCAPV
(*Salmonella, shigella, yersinia, campylobacter, aeromonas, plesiomonas, vibrio cholera*)
___Celiac Profile

___Samples given of:
___Nexium ___Prevacid
___AcipHex ___Protonix
___Prevpac ___Other: _____
___Effexor XR ___Fiber
___Lexapro

Hold meds prior to procedure
Days:___ Plavix ___Coumadin ___ASA Other: ____
___EGD with _____ DATE:
___Colonoscopy DATE:
Prep: ___Fleets ___Golytely ___Other
___Percutaneous Liver Bx DATE:
___ERCP
___BE DATE:
___UGI ___UGI with SBFT DATE:
___Manometrics ___24-hour pH probe DATE:
___Barium Swallow
___Dysphagia study-Barium DATE:
___Pill ___Paste ___Liquid
___Ultrasound DATE:
___GB ___Pancreas ___Liver
___CBD ___Abdomen Other:_____
___CXR, PA & Lateral
___CT scan Specify_____ DATE:
___w/o contrast ___with contrast ___p.o. ___I.V.

___Patient Education given for:

___25-30 g fiber diet ___IBS(866-IBS-RELIEF) ___GERD(800-HRT-BURN)
___Lactose restriction ___Hep info packet
___PUD ___*H.pylori* ___Diverticulosis
___NaCl restriction ___EGD ___FPS
___Colonoscopy ___ERCP ___Liver Bx
___Colon Cancer ___Sleep Hygiene ___Fatigue
___IBD ___Arthralgias
___Skin Irritations

___Tracking file _____
___Psych Clearance Request
___Other _____
___RTC _____
___Labs due _____

Name:_____
Date:_____
_____
Nurse/Date

Figure 7.3: GI Order Sheet completed by Physicians

In addition they are also responsible to ensure that all established patient have their necessary documentation and results ready before their appointment with the physician. Table 7.6 summarizes the processes responsible by MA.

Table 7.6: Description of Process responsible by MA

Process	Description
Basic Vital Assessment	Includes room readiness, review patient chart, basic vital assessment and medical and allergy input and verification.
Complete Order Process	Includes review treatment order prescribed by providers and processing them accordingly.
Existing Patient Readiness for follow-up	Reviewing to ensure assessment plan per PE order and results are received prior to patient's visit.
Medical Record for Existing Referred Patients	Obtained medical records from patient's primary care physicians or other health care institution.

Once the high level responsibility of each personal is collected and comprehended, their roles and responsibilities are observed as part of the holistic treatment workflow via the walking the journey approach. To collect the method of work, walking the journey was conducted in real-time at the stakeholder workplace with minimal disruption to workflow. The data collection followed the route of a typical treatment workflow. The treatment flow is initiated, when patient arrives at the GI clinic where at the front desk the patient is attended to by CR and requested to sign-in on the label shown in Figure 7.4.

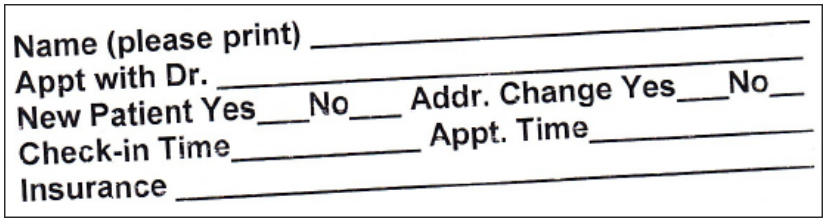


Figure 7.4: Patient Sign-in Label

CR reviews the patient completed label details and reconciles the information provided with the resource schedule (shown in Figure 7.5) of that day along with information sheet (Figure 7.6). The following information is used for verification: appointment time ('START'), patient identification ('PT ID'), patient name ('PATIENT NAME') and date of birth ('DOB'). Once the verification is completed, CR reviews the patient details in GOLD system (electronic medical record) to ensure that the consents are in place and updated within the last six months. Further, the patient is also required to review the patient information sheet, also shown in Figure 7.6, for accuracy.

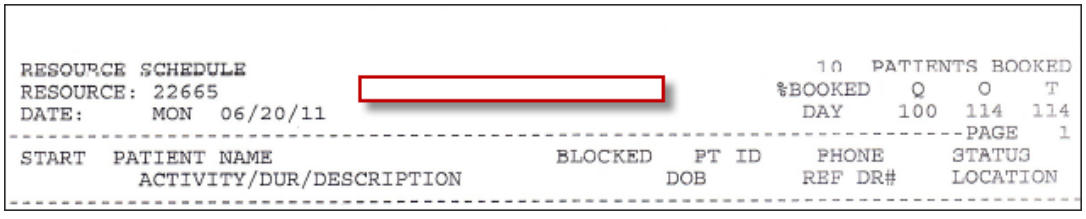
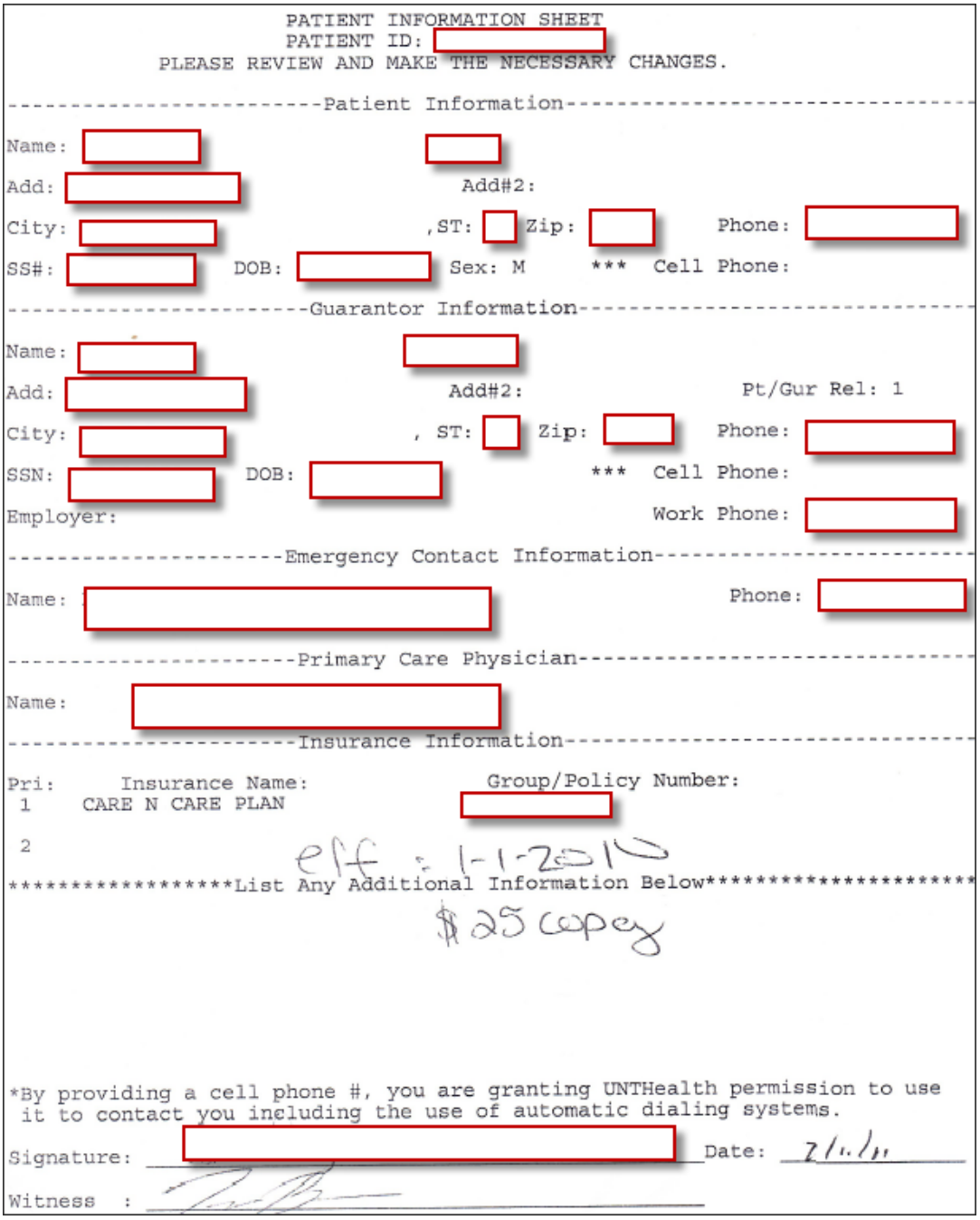


Figure 7.5: Details in Resource Schedule used for Patient Verification



PATIENT INFORMATION SHEET
PATIENT ID:
PLEASE REVIEW AND MAKE THE NECESSARY CHANGES.

----------Patient Information----------

Name:
Add: Add#2:
City: ,ST: Zip: Phone:
SS#: DOB: Sex: M *** Cell Phone:

----------Guarantor Information----------

Name:
Add: Add#2: Pt/Gur Rel: 1
City: , ST: Zip: Phone:
SSN: DOB: *** Cell Phone:
Employer: Work Phone:

----------Emergency Contact Information----------

Name: Phone:

----------Primary Care Physician----------

Name:

----------Insurance Information----------

Pri:	Insurance Name:	Group/Policy Number:
1	CARE N CARE PLAN	
2		

eff : 1-1-2010

**********List Any Additional Information Below**********

$25 copay

*By providing a cell phone #, you are granting UNTHealth permission to use it to contact you including the use of automatic dialing systems.

Signature: Date: 7/1/11

Witness :

Figure 7.6: Patient Information Sheet

Once the patient's details are verified, the CR collects co-payment from the patient based on the patient's insurance plan and provides them with receipt. Once completed, the CR checks the patient into the GOLD system. Check-in patient into the system allow other care providers at the GI clinic to track the patient activity and their pathway. The patient waits to be attended by MA who will direct them to an examination room and conduct the necessary vital

assessment including inquiry on the current medical and allergy history. All these information are entered into the NextGen as shown in Figure 7.7. When the assessment is completed, the MA notifies physician manually through the use of flag indicator in front of the examination room as well as through the use of tracker in GOLD. The tracker is not always used by all personnel hence the manual approach is also conducted.

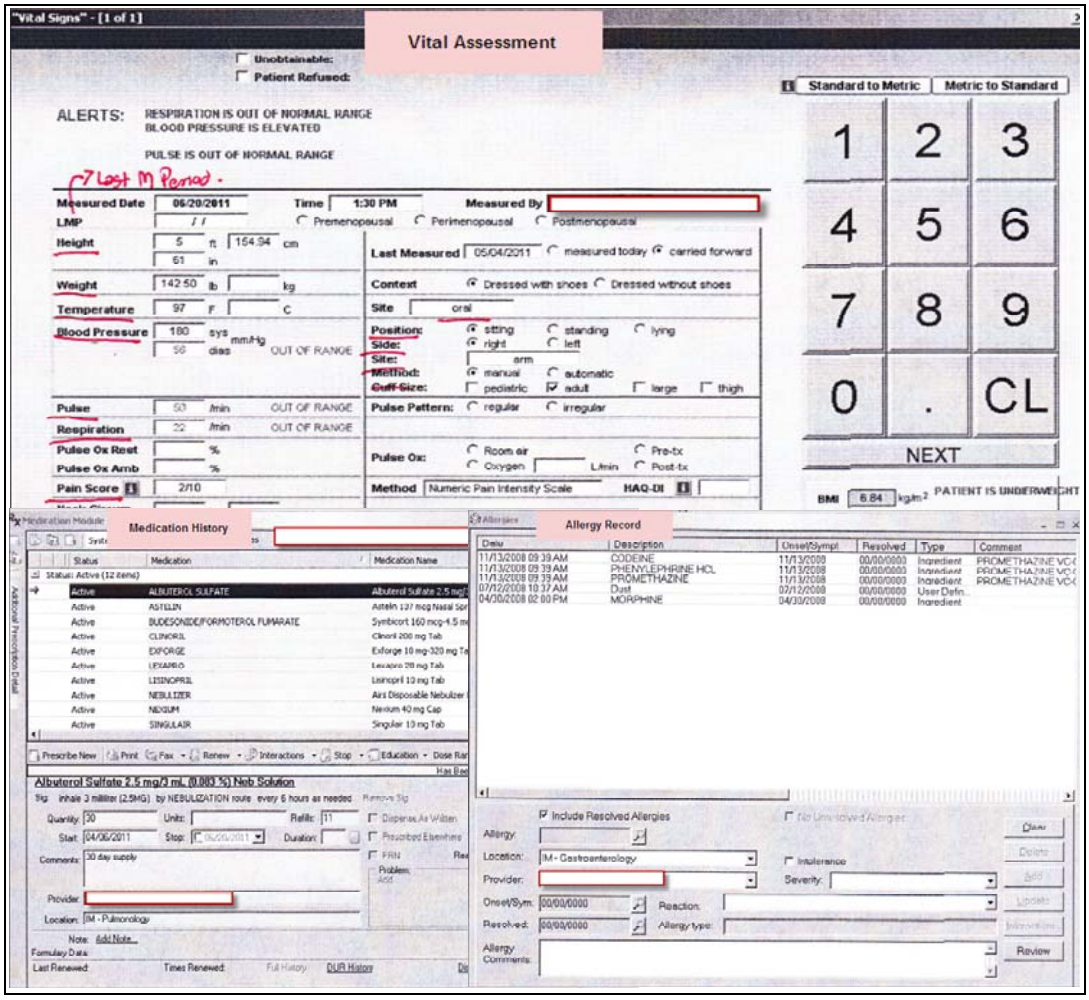


Figure 7.7: Snapshot of Vital Screen including Medical and Allergy Record

The physician reviews patient chart in the NextGen and enters the examination room to conduct further diagnosis and enters their findings into the system. From their findings a treatment plan would be prescribed by completing of the GI order sheet shown in Figure 7.3. All the information is also enter into NextGen as well as patient's superbill. The patient is then handed with the superbill and directed towards the front desk for checking out of the GI clinic. The CR requests for patient to signature on the superbill and then reviews the superbill to see if

any follow-up appointment is required. If required a follow-up appointment is completed and finally the patient is check-out from the GOLD system.

The data collected for this case study included observations with all the personnel that affect the normal patient's treatment workflow. The PP was also collected based on modified CARE framework (discussed in Section 6.2.2) which will help in the representation and in the analysis of the treatment workflow. Further, the time data for each activity (also discussed in Section 6.2.2) was also collected since the problem statement devise was concerned with the actual treatment time. The activity time for each activity was noted by collecting best estimate time from stakeholders or through direct observation and verification of a sample of patients. Best estimate time for a process is dependent upon stakeholders' opinions while direct observation can be time-consuming. Notes were collected about activities being performed using pencil and paper and recorder was also used as a supplement in case the modeller was not able to follow through the information.

7.2.3. Step 3: Devise 'as-is' model

To represent the 'as-is' model, the information collected via multi-disciplinary meetings and walking the journey approach were correlated and filtered to form a complete treatment workflow which was depicted using the modified RACI-SLA diagram (as illustrated in Section 6.2.3). For the purpose of illustrating the implementation of the CARE framework, the check-in process will be explained at length while results of other process maps will be included in the Appendix-B. Figure 7.8 shows an extracted RACI-SLA map for check-in process conducted by CR. The PP as well as the activity time is also represented in the RACI-SLA map.

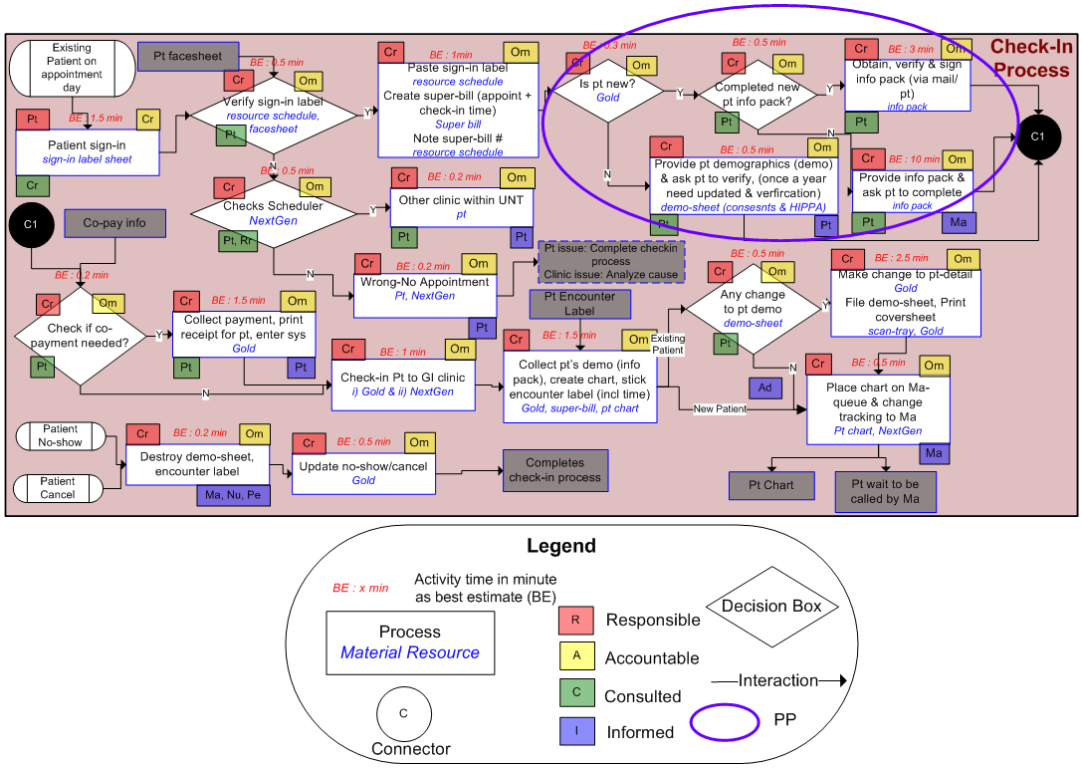


Figure 7.8: Snapshot of RACI-SLA map for Check-in Process

As it can be inferred from the RACI-SLA map multiple roles and responsibilities exist within the 'Check-in' process which is represented using the RACI matrix. The primary personnel "responsible" for majority of the check-in process is the Clinical Staff Representative (Cr). Further, the RACI-SLA map also shows the "accountable" roles for each process, where all is directed to the senior management of UNT (in this case Om which stands for Operation Management) who is liable for these processes. The figure further shows that single as well as multiple "consulted" role and "informed" roles exists for the check-in activity. This shows the wide range of input, output, and collaborative work that is needed to complete an activity and the extent of communication required between different personnel. The material resources are also indicated in the RACI-SLA map with mainly information systems such as the electronic medical record (GOLD) and electronic health record (NextGen) systems was utilised for the check-in process. PP is also represented with a means of a "decision box". The RACI-SLA map depicts the current or 'as is' treatment flow of the check-in process in a comprehensive and easy to interpret model. Though the RACI-SLA diagram could be drawn using the paper and pencil approach, for this case study the author have also chosen to develop using Microsoft Visio. Apart from it being ease of representation and comprehension, it is also

useful when any modifications have to be made.

7.2.4. Step 4: Verification and Validation

The 'as-is' RACI-SLA map for the patient treatment at the GI clinic that was produced was used as a basis to verify if information is accurately and objectively collected and represented. It was also used to validate that the map depicting the current treatment flow at the clinic. The verification and validation is conducted with each subject matter expert personnel at the clinic. Since the stakeholders could or had to perform multiple tasks simultaneously and so as to not disrupt daily operations, verification and validation was not conducted at the time of data collection. Instead, they were conducted at the end of the day during downtime and less process overload. This was also helpful in avoiding influence of stakeholder's opinion while conducting data collection. It was conducted via follow-up interviews and observations to validate and verify any discrepancy or information gaps. In cases where it appeared that conflicting information was reported by two stakeholders who had similar or shared responsibilities, a larger audience was invited in a facilitated group brainstorming session. At the session, the facilitator adopted "summarise observations of effective behaviour" (Kolfschoten and Rouwette, 2006) facilitation techniques to attain confirmation and accurate understanding of the workflow. For example, conflicting information received from CSR and MA on the existing patient appointment schedule slot. The two personnel were bought call into a facilitated session to clarify their understanding. The technique that the facilitator used to conduct the session was "profile tool" (Kolfschoten and Rouwette, 2006). This allow different perspectives to be discussed and understanding to be clarified. Lastly, the discrepancies found were documented and the RACI-SLA map is modified.

7.2.5. Step 5: Stakeholder analysis

To analyse the data collected, the UNT performance measures reports were studied along with the RACI-SLA map. The UNT performance measures reports were reviewed to understand the results and were also compared to the results of other clinic within UNT. Further, the results were also compared to the American Medical Group Association's (AMGA) results, a standard that the clinic follows. In additions to the analysis of RACI-SLA map, the current tools (the electronic medical and electronic health record systems) used at the GI clinic to assist care providers in their day-to-day operation were also analysed. This

provides a comprehensive holistic view of the treatment workflow.

A print out of 'as-is' RACI-SLA map was studied. Several PPs were observed from the existence of decision boxes. For example, in Figure 7.8 the highlighted portion shows that CR validates if a patient is new to the clinic via decision box "is patient (pt) new?". The following set of activities can differ significantly between each PP; in this case activities will differ if patient is new to the clinic from those that are established. For the new patient, the CR further checks (via decision box "completed new info pack?"), whether the patient has completed the new information package. In case the patient has completed the package, a different set of activity is performed which would comprise of a different PP from those who have not completed the package. As each activities has a unique activity time, thus the results for each PP will have a different time associated to it and is calculated by summing the time of all activities that makes up a PP. The occurrence for each PP is also assessed using stakeholder's opinion or direct observation and using a scale where high, medium and low likelihood of occurrence are assigned a respective value of 0.9, 0.3 and 0.1. Figure 7.9 shows different PP that can exist in check-in process along with the time each PP takes (shown above each bar). In addition each bar is coloured to represent the occurrences, where "red" indicates the chances of PP occurring is high, "yellow" indicates the chances of PP occurring to be medium and "green" for chances to be low. The check-in process can have a very high variability for activity time (0.7 min-18.5 min) based on 12-PPs that can exist. However, most likely activities range between 6.2 min-10.2 min.

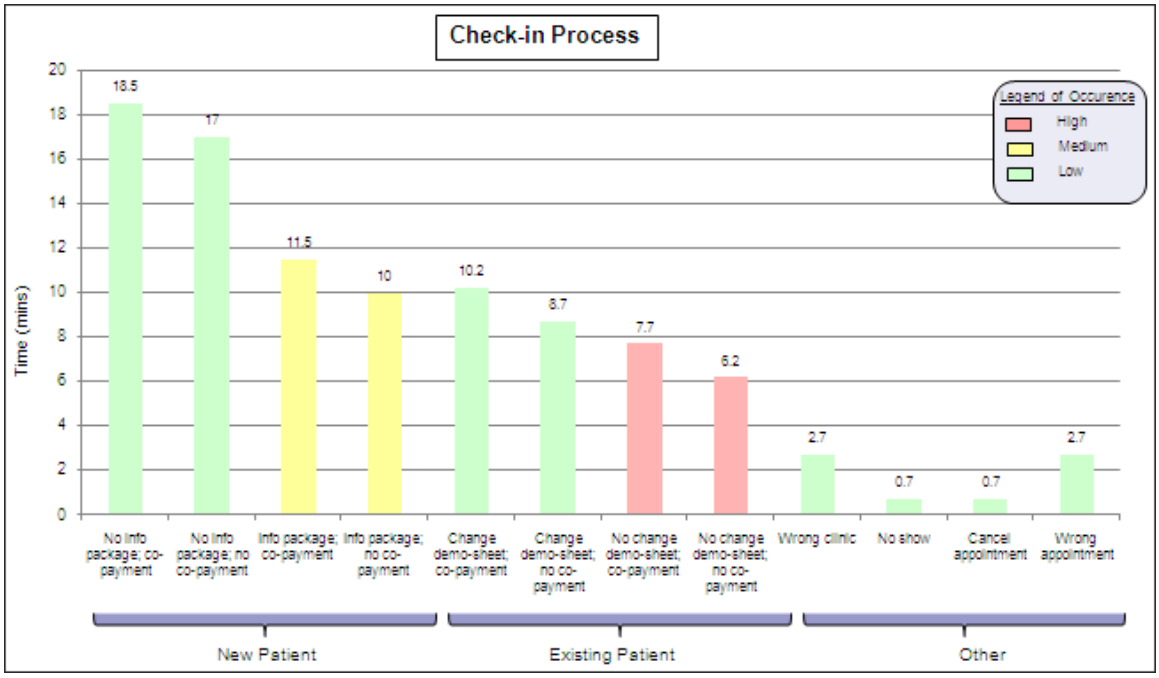


Figure 7.9: PP for Check-in along with time and probability

An average weighted time for the check-in process was calculated as:

$$\frac{(18.5*0.1+17*0.1+11.5*0.3+10*0.3+10.2*0.1+8.7*0.1+7.7*0.9+6.2*0.9+2.7*0.1+0.7*0.1+0.7*0.1+2.7*0.1)}{0.1+0.1+0.3+0.3+0.1+0.1+0.9+0.9+0.1+0.1+0.1+0.1} = \textbf{7. 84 minutes}$$

The above analysis was conducted for all the processes that occur within the treatment flow and all the PPs were formulated along with calculation of activity time, likelihoods of occurrence and weighted average time. Table 7.7 shows the weighted average time for tasks performed by the care providers and the details of calculations can be found in Appendix-C.

Table 7.7: Weighted Average Time for All Processes

Personnel	Process	Average Weighted Time (in minutes)
CSR	Check-in	7.84
	Check-out	3.64
	Daily Cash Receive and Print Schedule	8.5
	New Patient (NP) Verification	4.5
	Answer Queries	4.67
	Close Super-bill	11.64
	Encounter label and Face sheet Readiness	2.55
	Insurance Verification	7.25
	Appointment Reminder	4.82
	Appointment Schedule	8.42
MA	Basic Vital Assessment	22.5
	Complete Order Process	9.62
	Existing Patient Readiness for follow-up	7.67
	Medical Record for Existing Referred Patient	9.59
PE	Existing Patient (EP) Assessment	23
	New Patient (NP) Assessment	39

Each physician has different schedule with varying patient demands during the week. Thus, an analysis was conducted for each session (that is, morning and afternoon) in a day. Table 7.8 presents the analysis conducted for all stakeholders for the morning session in a week. The cell highlighted in 'red' shows a concern area where the resources are overload compare to the workload for the patient demand, while the cell highlighted in 'green' indicates that the resource are well staffed.

For Monday morning session, highlighted in Table 7.8 in red rectangle, there are total of 1 physician, 1 CSR and 2 MAs at the GI clinic with a total of 180 minutes physicians' office hour. Currently a 15 minutes slot is scheduled for all existing patient (EP) with a physician, which means that the provider can only see 12 patients. However, the total average demand currently is 15 patients which may be a combination of EP and new patients (NP). The actual average weighted time spent by physician on assessing existing patient is calculated via RACI-SLA map to be 23 minutes (can be referred to at Table 7.7). Thus, in reality the physician can actually see only 8 (7.83 patients) EP in the 180 minutes clinic session slot. Hence, the other 7 patients will either be waiting or rescheduling will be required. Also, this is assuming that there

is only EP at the GI clinic.

Table 7.8: Stakeholders' Analysis for Morning Session

Morning Session	Mon	Tues	Wed	Thurs	Fri
No. of Physician(s)	1	1	2	1	1
Provider Availability (min)	180	180	225	210	240
No. of patient demand	15	15	9	9	9
Time Slot per patient (min)	15	15	15	15	15
From current Method-of-Work					
No. of EP that can be seen	12	12	15	14	16
Difference (Actual vs. Calculated)	-3	-3	6	5	7
From RACI-SLA Map					
Provider Assessment Time with EP: Weighted Avg. Time (min)	23	23	23	23	23
No. of EP that can be seen	7.83	7.83	9.78	9.13	10.43
Difference (Actual vs. Calculated)	-7.2	-7.2	0.78	0.13	1.43
No. of CSR	1	1	1	1	1
CSR Availability (min)	180	180	225	210	240
From RACI-SLA Map: Mandatory Tasks					
Check-in: Weighted Avg. Time (min)	7.84	7.84	7.84	7.84	7.84
Check-out : Weighted Avg. Time (min)	3.64	3.64	3.64	3.64	3.64
Total time per patient (min)	11.48	11.48	11.48	11.48	11.48
Capacity per session	15.68	15.68	20.91	18.29	20.91
Difference (Actual vs. Calculated)	0.68	0.68	2.91	9.29	11.91
From RACI-SLA Map: Uncontrollable task: Answer Patient Queries					
Weighted Average Time (min)	18.94	18.94	18.94	18.94	18.94
Total Time required per session	191.1	191.1	225.58	122.26	122.3
Difference (Actual vs. Calculated)	-11.1	-11.1	-0.58	87.04	117.7
No. of MA	2	2	2	2	2
Time spent per patient for Vital Assessment (min)	22.50	22.50	22.50	22.50	22.50
Complete Order: Weighted Average Time (min)	9.62	9.62	9.62	9.62	9.62
Availability to conduct vital per provider session for 2 MAs	16	16	21.33	18.67	21.33
Availability to conduct order + vital per provider session for 2 MAs (min)	11.21	11.21	14.94	13.08	14.94

In case of CR, there are two tasks that are mandatory tasks and must be performed for each patient at their visit. That is, check-in and check-out are performed for each patient and the average weighted time are 7.84 and 3.64 minutes respectively, which total to 11.48 minutes, spent per patient. Thus the capacity CR that can handle based on 180 minutes office hours is 15.7 patients which leaves very little room to do any other task. In reality, CR is interrupted by queries received from patient or other personnel. Answering these queries is an ad-hoc uncontrollable task which takes an average of 18.94 minutes for each session. The average time was obtained from stakeholder. Hence, CR takes a total of 191.1 minutes to perform check-in, checkout and answer patient's queries. This shows an overload of 11.1 minutes for CR (highlighted in "red" in Table 7.8) only considering mandatory check-in and check-out

tasks and uncontrollable answering patient queries task.

On the other hand, there are two MAs and the mandatory task that needs to be performed during the session is conducting basic vital assessment. Based on RACI-SLA map, to conduct basic vital assessment per patient, a weighted average of 22.50 minutes is calculated. Based on a 180 minute session with two MAs, the capacity is calculated to be 16 patients meeting with the demand (15 patients). However, if other tasks have to be performed for example, executing order prescribed by provider, the capacity is reduced to 11 patients. Similar analysis was conducted for the afternoon sessions for the week and can be referred to in the Appendix-D. This analysis provides a detail of resource capacity and loading and gave an indication of possible problem areas. A facilitated session was conducted with the stakeholders to discussed these results and identify potential solutions.

In addition to the analysis above, RACI-SLA map was discussed with UNT care providers in facilitated brainstorming sessions where the facilitator applied "issue analysis" (Kolfschonten and Rouwette, 2006)techniques summarized in Table 2.6 to perform root cause analysis and discuss symptoms, disconnects and problem areas in the RACI-SLA map. In cases where root cause analysis failed to yield the root-cause due to limited knowledge of the participants, other individuals with specialization in that area were involved. A gap analysis was then performed with the group to define and identify the gaps between the intended functionality of the process versus the actual performance. Figure 7.10 shows the RACI-SLA map for check-in process with problems highlighted as process flaws and deficiencies using a white 'cloud' symbol. For the check-in process, a total of four process flaws and three process deficiencies were noted. A complete list of problems can be referred to in the Appendix-A.

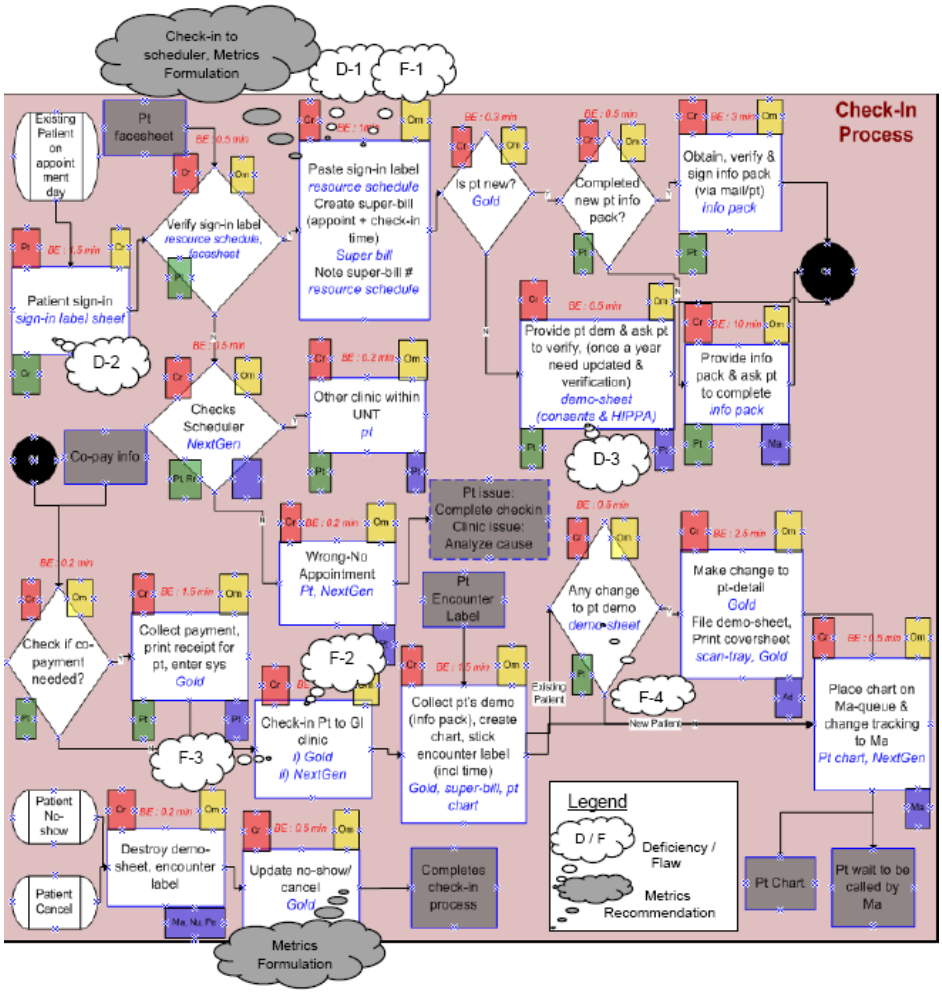


Figure 7.10: Illustration of Flaws and Deficiencies in the Check-in

Based on the data analysis conducted, Table 7.9 and Table 7.10 respectively present prioritized recommendations which were a result of quantitative analysis conducted for each clinic session (Table 7.8) and those achieved for Check-in process based upon brainstorming sessions conducted with stakeholders (Figure 7.10). For each recommendation, the impact on total process time, efficiency and stakeholders were identified which will assists the GI clinic management in prioritization for implementation.

Table 7.9: Recommendation from quantitative analysis of RACI-SLA map

Recommendations	Impact	Stakeholder
Increase schedule slot for NP to 45 min and EP to 25 min for Monday (Morning) and Tuesday (Morning and afternoon)	Increase in physician time/ availability (over same day/ different day)	Physician
For NP, MAs should have medical history and referral documentation in place. For EP they should ensure results of previous visit is in place	Save 8-12 min/patient or prevent possible reschedule	MA, Physician
Scan of referral or results of patient visit should be reviewed (for accuracy) in advance by MA	Save provider to locate these information (up to 6-8 min)/ patient	Physician
Welcome pack made available to NP prior to their visit else schedule their appointment 15 min prior to their actual appointment time to complete formalities	Could results in delay being room by MA up to 10-15 min	MA, Physician
Accurately automate schedule reminder	Save CR 4.82 min/ patient	CR
Automate calculation of charges per superbill	Save CR 11.64 min/ patient	CR

Table 7.10: Process Flaws and Deficiencies for Check-in

Findings	Flaw (F) / Deficiency (D)	Recommendations	Stakeholder Impacted
Manual work for noting superbill #, check-in and appointment time	D-1	i) Generate Superbill online ii) If check-in patient into EMR done correctly (at the time of arrival) - highlighted in R-1 Grey Cloud. Then check-in time should already be recorded online. iii) Effort should be removed since Appointment time is already online	CR
No reminder to CR if patient waiting for more than 15 min	D-2	Trigger in system for patient waiting for more than 15 min	CR
Manually check if HIPPA and Consents reached a year since last reviewed	D-3	Alert HIPPA and Consents when expiration is being reached	CR
Manual pasting sign-in label	F-1	Effort should be removed since this information is not used by anyone	CR
Wrong check-in	F-2	Check-in is done way after the patient arrives at the clinic which is inaccurate	CR
Wrong metrics	F-3	Since check-in is done incorrectly, the metrics currently being corrected is accurate. Also highlighted in R-1 Grey Cloud is where the metrics should retrieve the accurate check-in time	CR
Inconsistent use of electronic and manual patient chart	F-4	Some tasks are done electronically and some manually. Suggest complete everything online since the intention to use EMR	CR

Note that only two of the initially proposed causes and two of the solutions (Table 7.2)

were actually identified as recommendations after evaluation.

7.3. Feedback from post CARE implementation

The recommendations were presented to management in October 2011. Before developing an action plan, the management reviewed these recommendations and compared to issues that have been raised with other departments. For each recommendation the management conducted the cost analysis to evaluate and understand its benefit. From these exercises conducted, it was observed that the findings in Table 7.9 presented the management with a new insight which they never thought of would be an area of concern. Additionally, the outcome for check-in process presented in Table 7.10 indicated 7 findings, out of which 3 (D-1, D-2 and F-1) were common to other department, 2 (F-2 and F-3) were unique and the other 2 (D-3 and F-4) were not previously highlighted but should be common to all department since same EMR system is deployed throughout the patient centre clinic (Lyon, personal communication, December 9, 2011). The management highlighted in the note communicated to the author that they would like to adopt the CARE framework as a standardized process assessment tool in order to have an insight to their current workflow and help with the improvement initiatives.

7.4. Evaluation of CARE at UNT

This section presents the evaluation of the CARE adopted at UNT and how the framework was used to achieve stated objectives. As discussed in the Chapter Two, the aim of this research is to develop a framework which provided an accurate and holistic representation of the delivery workflow so as to promote problem understanding in a rapid manner. A set of evaluation criteria, described in detail in Section 4.5, were developed based on the requirements of the framework and will be used as basis of assessment which is described in the subsection below.

7.4.1. Ability to promote collaboration amongst stakeholders

At the patient care centre at the University of North Texas (UNT) Hospital, the management strived to implement CARE framework: (i) to optimize patient treatment process so as to reduce patient and provider wait time and evaluate resource requirements, and (ii) to have a simple and commonly understood visual representation that can be adopted by the healthcare personnel across all patient care centre for understanding the performance of their

services. The GI clinic had been receiving complaints and concerns on the length of office wait time from patient via survey conducted. Further, care providers have also raised concern about wait time of patient with respect to their appointment and patient not being in the examination room on time. The exact causes to these concerns were unknown.

A high-level multidisciplinary meeting was conducted with the management in a non-clinical setting to identify involved stakeholders and information was collected about the beneficiary of the system, main activity, the sponsor, the operating environment and stakeholders of the GI Clinic. This information provided a high-level constituent of the GI clinic delivery system. Individual meetings were then conducted with the UNT key stakeholders highlighting the diverse views on proposed causes, solutions and problem situations at hand. Individual allow stakeholders to freely share their views without the fear of others. As highlighted in the literature, the decision making in this complex system is heavily influenced by individuals or groups in healthcare who pursue self-interest via personal power and influence mobilizing economic strategies (Eldabi and Paul, 2001). Each healthcare professional will have their own view of the problem and provide assessment and solutions to the problems uniquely.

These stakeholders at UNT are then be engaged in facilitated brainstorming session to review the collected data. At the session, the facilitator utilized a technique of "informal introductions" (Kolfschoten and Rouwette, 2006) to not only warm up the people but also removes or reduces the hierarchical boundaries. Following that, responses provided for "proposed causes" and "probable solutions" by each stakeholder are presented to the group by the facilitator. This is similar to the methodology defined in the technique "write down the problem that brought you here" (Kolfschoten and Rouwette, 2006) where the facilitator presents it to the entire audience based on the field note conducted at the high-level multidisciplinary (shown in Table 7.2). As the exact problem was not very defined, the stakeholders identified 6 unique problem situations, 8 unique causes and 5 proposed solutions. Each stakeholder reported the possible causes and solutions from their world view based upon their knowledge, amount of exposure and extent of participation with the overall process. The different problem situations are then debated, similar to the facilitation technique of "issue analysis" discussed by Kolfschoten and Rouwette (2006). Issue analysis helps to keep the session in a problem solving mode while ensuring a strong focus on the scope of discussion. Ultimately, a problem statement was formulated via discussion as:

"*Increased wait times for patients due to inherent process dependencies and*

inefficiencies"

The problem statement was agreed upon by all the stakeholders at UNT allowing for clear ownership and buy-in. The framework utilized a high level of collaboration amongst stakeholders. In the data collection step, stakeholder expertise was leveraged in understanding the process flow and multiple stakeholders were involved in the facilitated discussion session, in case if one of the stakeholders was unable to provide the complete picture. Similarly during the stakeholder analysis step, a print out of 'as-is' RACI-SLA map was discussed with care providers in facilitated sessions where the facilitator applied "issue analysis" (Kolfschonten and Rouwette, 2006) techniques to perform root cause analysis and discuss symptoms, disconnects and problem areas in the RACI-SLA map. In cases where root cause analysis failed to yield the root-cause due to limited knowledge of the participants, other individuals with specialization in that area were involved. A gap analysis was then performed with the group to define and identify the gaps between the intended functionality of the process versus the actual performance. For example, within the check-in process conducted by CR, it was noted that the CR was manually pasting patient information on sign-in label. The CR did not know how and where that information was utilized. Other stakeholder such as the director of operation was involved in the facilitated discussion session and root-cause analysis was conducted to understand the purpose and usage of patient information on the sign-in label. In fact, it was found that the information was not utilized anywhere and the effort could be removed. As discussed in Section 4.3.5, root-cause analysis was used to explore the cause and effect relationships underlying a particular problem. As can be inferred, during implementation of these steps, the framework utilized a high level of collaboration amongst stakeholders.

7.4.2. Ability to effectively use facilitation skills

At the onset, the CARE framework strived to examine the view of different stakeholders regarding the actual problem at hand. A high-level multidisciplinary meeting was conducted with management to attain list of stakeholders involved in the GI treatment process. Information was collected about the beneficiary of the system, the main activity, the sponsor, the operating environment and the stakeholders of the dietary services. Face to face meetings with the key stakeholder were held to understand their perspectives, create social bonds, leverage knowledge and extract relevant data. This helped in clarification of the intention of the exercise while consolidating relevant information in a short time frame. The analysis also clarified and formalized intention of the exercise and helped understand the impact of proposed

changes on the people involved. Via effective facilitation, the meetings highlighted the diverse views on proposed causes, solutions and problem situations at hand. The problem statement was agreed upon by all the TRCC stakeholders and had a clear ownership and buy-in from not management and grass root employees. The framework utilized a high level of facilitation skills in decision making. During data collection, the usage of walking the patients' journey approach and multidisciplinary meetings with stakeholder, firstly, allowed for both the patients' and care providers' perspectives to be recorded and secondly, minimized the time spent in data collection while ensuring that adequate detail was being captured. Thus data collection was focused on using facilitation skills to extract relevant information and not dependent on large samples of data. The focus was on capturing the right detail of information to adequately represent the workflow and no special tools were required for data collection which minimized requirements for training and comprehension for both the facilitator and the stakeholders. By scheduling the multidisciplinary meetings during downtime or less process load, data collection was able to be completed with minimal disruption to daily hospital operations. Thus the framework utilized facilitation skills to meet the objectives in this step.

7.4.3. Ability to graphically represent problem situation

The framework is assessed with regards to its ability to provide visual approaches to foster discussion (Table 2.5) as representation of problem situation can be challenging and does not represent real world accurately (Table 2.8). To represent the 'as-is' model as described in Section 7.2.3, the data collected was correlated to form a treatment workflow which was depicted using RACI-SLA diagram. Similar to its implementation in Section 3.5.3, the RACI-SLA diagram represented the wide range of input, output and collaborative work required to complete activities. Information collected via multi-disciplinary meetings and walking the journey approach were consolidated along with estimates for time for each activity to form a complete treatment workflow. This depicted the multiple roles and responsibilities, PP possible in the workflow along with a best estimate of activity times.

Inclusion of PP and activity time provides further aids in gaining a holistic perspective of the treatment workflow and in decision making during the facilitated brainstorming session. The usage of PP and activity time is a significant improvement over implementation in case study at TRCC (Chapter 5). Collecting this data enables the representation of multiple patient and treatment flows that can occur based upon unique circumstances of each patient disease and treatment. As set of activities differ between each PP and each activity has a unique time

associated with it, the results for each PP will have a different total time associated to it and is calculated by summing the time of all activities that makes up a PP. Identifying these differences will enable focusing analysis efforts and stakeholder discussions on the right problem areas.

Visual representation of the process makes it easier to communicate and information easier to validate in front of the stakeholders. As each process could have multiple variations in PP and associated activity times based upon new or existing patients, the likelihood of occurrence for each PP was assessed using stakeholder's opinion or direct observation and using a scale where high, medium and low likelihood of occurrence are assigned a respective value of 0.9, 0.3 and 0.1. An average weighted time was then calculated for each process and consolidated in Table 7.7. As each physician had different schedule with varying patient demands during the week, an analysis was conducted for each session (that is, morning and afternoon) in a day. For each session, the available resources and process load (number of patients) were taken into account. This is important as each session had variable resource loading and demand (number of patients) and indicated if a particular provider was being overloaded. With the inclusion of PP and activity time in the RACI-SLA diagram and consolidation of average weighted time in an easy to understand tabular format (for example Table 7.8), large variations in treatment workflow are capable of being understood. The ability to estimate the time spent in each of the PP for comparison of different scenarios and further, the effect of structural changes to the process by changing or eliminating activities within PP is a significant improvement over the case study conducted described in Chapter 5. This was also part of the feedback received from stakeholders, described in Section 5.3.

Also, in facilitated brainstorming sessions, possible effects of restructuring the process on the overall activity time can be gauged by stakeholders. This is an important process data to be available when the stakeholders are deciding or considering on alternate strategies or structure of the process and the possible impacts on overall roles and responsibilities, and process times. The inclusion of PP, activity time and average weighted process times was able to address the limitation identified in Section 4.5.3.

7.4.4. Ability to minimize time and effort

The framework is assessed with regards to ensure minimal time and cost requirements while ensuring minimum disruption to delivery system workflow. In facilitated brainstorming sessions conducted as part of stakeholder analysis, analyzing RACI-SLA map for PP, process

flaws and deficiencies and average weighted times led to identifying systemic faults as well as areas for improvement in care delivery system. Stakeholder knowledge is leveraged in identifying the root causes, conducting a gap analysis and formulating recommendations. Compared to solutions proposed by the stakeholders initially (Table 7.2), only 2 of the 6 unique solutions were similar to the recommendations that were finally made via this study. It is important to note that the problem statement derived in Section 7.2.1, was used to provide a starting point and direction for further investigation. Similar to what was discovered in the case study conducted at TRCC, if all the initially proposed solutions had been implemented, not all the root causes would have been addressed and effort would have been misdirected due to inadequate understanding of the problem areas and their root causes.

In terms of the effort required for implementation at UNT, Table 7.11 shows a breakdown of tasks that were undertaken as part of the CARE framework and the time in minutes (mins) required for implementation.

Table 7.11: Effort Adopting CARE framework at GI Clinic

S.N.	Project Task	Time (mins)
	Define Problem	
1	Assessment of Problem Situation, Causes & Solutions	105
	Past Initiatives and Supporting Doc	60
	Formalization of Problem Statement	45
Sub-Total		**210**
	Data Collection	
2	High Level Multidisciplinary Meeting	
	Director of Operation	30
	Clinical Staff Representative	30
	Physicians	30
	Medical Assistant	30
3	Detailed Multidisciplinary focused interviews	
	Director of Operation	30
	Clinical Staff Representative	60
	Physicians	60
	Medical Assistant	60
4	Walking the journey	
	Clinical Staff Representative	150
	Physicians	60
	Medical Assistant	60
5	Patient Satisfaction Score Analysis (Quality Dept)	120
Sub-Total		**690**
	Data Representation	
6	Process Mapping using SLA Diagram	360

Verification and Validation		
7	Validation and Verification with Personnel	180
Sub-Total		**540**
Stakeholder Analysis		
8	Analysis: Gap, Brainstorming & Quantitative	600
9	Identification of process flaw & deficiency	240
	Sub-Total	**840**
	Total	**2280**
Other		
10	Recommendation & Presentation to Management	60

Figure 7.11 illustrates that the majority of the effort of 840 mins was spent on analysis, followed by collection data of 690 minutes, 360 minutes for devising the 'as-is' model, 180 mins for validating and verifying information collected, 210 minutes for defining problem and 90 minutes for presenting findings and recommendations to the management. In all, the CARE approach was able to analyse the patient wait time issues and provide recommendations in 2340 minutes (about 6 business days considering an 8 hours work day).

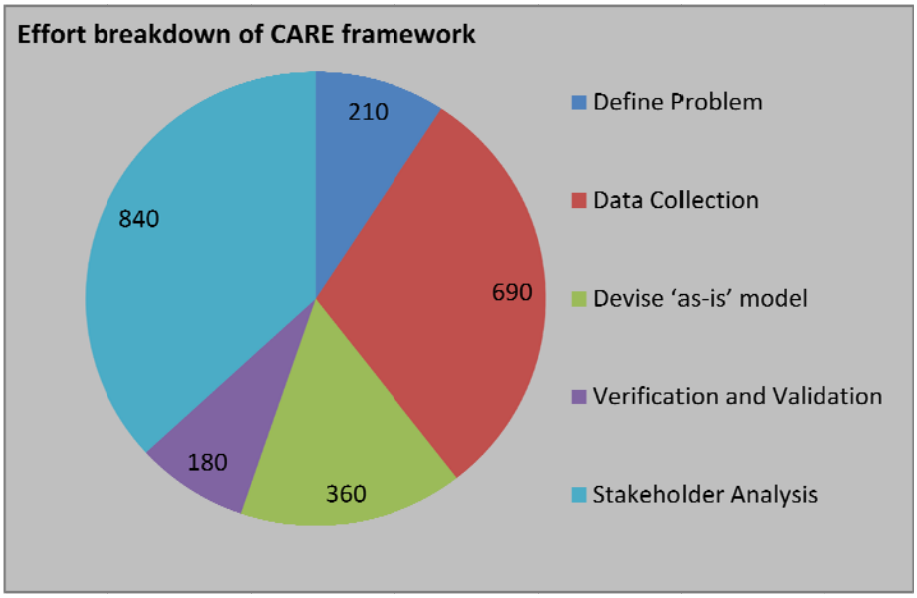


Figure 7.11: Effort Breakdown for CARE framework at GI Clinic

Additionally, Table 7.12 provides a snapshot of number of stakeholders that were involved in each stages of CARE implementation at UNT. During the first stage there were four stakeholders involved, which include Director of Operation, Clinical Staff Representative, Physicians and Medical Assistant. Initially in the second stage, all the stakeholders participated in stage 1 were involved. However, during walking the journey director of operation was not

included as she was not involved in day-to-day interaction with the patient and their workflow. In stage 3 (Devise 'as-is' model') no stakeholders were directly involved. The facilitator used the information collected to draft up the patient treatment workflow. The same four stakeholders were also involved in stage 4 where facilitator validate and verify the information collected with the subject matter experts. In the last stage, in addition to the four stakeholders three more stakeholders were involved, including Executive Director of Process Improvement, Director of Quality Compliance and Information Technology Personnel. Information Technology Personnel was brought in during the facilitated brainstorming session to clarify the workflow of NextGen and GOLD. The director of quality compliance was also bought in to help understand and verify information presented on quality metrics and benchmark reports. The Executive Director of process improvement who is also the problem owner of this case study was involved to take notice of the findings and help with any clarification that arose. She was valuable in providing what the norm should be in resolving any conflict that arose and was also capable to determine the effect of issues to other department within UNT.

Table 7.12: Number of stakeholders involved in each stages of CARE

Stages of CARE at UNT	No. of stakeholders involved
(i) Define Problem	4
(ii) Data Collection: High Level Multidisciplinary Meetings	4
(ii) Data Collection: Detailed Multidisciplinary Focused Meetings	4
(ii) Data Collection: Walking the journey	3
(iii) Devise 'as-is' model	- (Only Facilitator)
(iv) Verification and Validation	4
(v) Stakeholder Analysis	7

7.4.5. Ability to minimize need for understanding tools by stakeholders

The framework is assessed with ability to understand tools and technologies which are identified as a major limitation to current PSM approaches (Table 2.8). It is directly accessed via framework's focus on gathering right detail of formal and informal knowledge of facts from the involved stakeholders along with concentrating on precise rather than abstract knowledge. This is necessary so as to strike a balance between collecting data which will remove confusion and aid in constructing and structuring thoughts and the time required to do so.

Compared to the Case study presented in Chapter Five, the RACI-SLA diagram involved inclusion of the patient pathways and activity times. This increases the amount of information that the stakeholder has to comprehend in order to arrive at possible flaws and deficiencies in the process. However, as the stakeholders experience the different choices and decisions in treatment flows on a daily basis, the inclusion of PP is intuitive to them. The activity time is also a best estimate of the time required to complete an activity, provided by the stakeholders themselves. So while the additional information included in the RACI-SLA map does add to the effort required by the stakeholders to comprehend, it also provides additional value when comparing activity times, time spent on different PP, and effects of restructuring the process on total operation time. The presentation of average weighted time in a simple table aids in clarifying discussion.

In terms of the tools used, paper and pencil are still used to collect these data and recorder was used as a supplement in case the modeller was not able to follow through the information. The attributes discussed in Section 4.3.2 still serve as an aid with data collection and to ensure that all information required is collected.

7.5. Summary

This chapter presented the results of a real life case study conducted using the final CARE framework at a GI clinic. The CARE framework is implemented at the clinic to examine and identify the root-cause resulting in the increased of wait time for the patient at the clinic. The chapter provided a detailed implementation of the modified CARE framework to help understand that problems that contributes to the patient wait time. The framework followed the five steps of the CARE framework which was modified and described in the previous chapter. The five steps include: (i) Define Problem, (ii) Data Collection, (iii) Devise 'as-is' model, (iv) Validation and Verification and (v) Stakeholder analysis. Further evaluation of CARE framework was also conducted based upon the five evaluation criteria included and also outlined in Chapter Three as: (i) ability to promote collaboration amongst stakeholders, (ii) ability to effectively use facilitation skills, (iii) ability to graphically represent problem situation, (iv) ability to minimize time and effort, and (v) ability to minimize need for understanding tools by stakeholder. The framework was assessed and the findings indicated that the framework has met its intended objective that is to promote understanding in a rapid manner. The outcome of this chapter indicated a successful implementation of the CARE framework in gaining consensus amongst stakeholders regarding the problem of length of wait

time observed at the GI clinic. Further, the framework aided in highlighting both the qualitative and quantitative causes that contributed to the problem and recommendations were derived based upon stakeholders' input. In addition, a positive feedback about the CARE framework was received by the management at UNT. The main contributions, limitations and areas for future work for this research will be discussed in next chapter.

8. SUMMARY, CONCLUSIONS, LIMITATIONS AND FUTURE WORK

8.1. Introduction

This research proposed a framework for understanding problems in multiple healthcare settings in a rapid and easy to understand manner. This chapter summarizes the research, notes its contributions, lessons learnt, limitations and possible avenues for future research. The following paragraph presents the structure of the chapter. This chapter commences with Section 8.1 providing a brief introduction and an outline to the chapter followed by Section 8.2 provides a discussion on a brief summary of all the chapters presented in this research. Section 8.3 highlights the major conclusions of this research and notes the research contributions. Lessons learnt from application of the CARE framework are identified in Section 8.4 and the chapter then identifies the associated limitations in Section 8.4. Finally, possible avenues for future research are highlighted based upon the limitations of the framework in Section 8.5.

8.2. Summary of the Dissertation

The aim of this research was to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner. Chapter One started by manifesting the problem context of this thesis, relating to the challenges the healthcare practitioners and decision-maker face in understanding problems within the healthcare delivery systems. The major challenges were attributed to be caused by the complexity of healthcare delivery system, the involvement of multiple stakeholders in decision making and the silo structure between the different units. Major PSM approaches including SODA, SCA and SSM have been used to understand problem, however, their exist limitations with regards to addressing these complexities. The chapter provided a brief overview of the common limitations in the three approaches as: (i) challenging in representing situations of the real world, (ii) considerable time and cost implications, (iii) stakeholder must be experts in different tool, (iv) weakness in providing specific mechanisms for systemic understanding, and finally, (v) limitation in highlighting multiple improvement opportunities.
The chapter then briefly discussed multimethodology which can utilize a combination of several approaches for problem solving. Despite its advantages, limitations of multimethodology were noted as the strong dependence of implementation on practitioner

knowledge, experience and skills and difficulties in generalizing implementation approaches. The chapter highlighted the need of a proposed approach which can be developed to address the challenges in healthcare delivery systems and limitations of major PSM approaches. Hence the aim of this thesis was drawn upon which is, to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner. The method of achieving the aim was also presented.

Chapter Two expanded on Chapter One and concentrated on the research aim and literature survey and evaluation. It provides a comprehensive study of the domains of the research and established methods. The chapter started by giving a detailed discussion on the basic structure and components in healthcare delivery system. It further discusses the various models found in literature for describing the components of healthcare delivery systems and provided a detailed understanding of the major challenges within healthcare delivery systems and how they affect outcomes and efficiencies of decision making process. It then established the need to understand the nature of problems within healthcare and their characteristics. Major PSM approaches like SCA, SODA and SSM are then reviewed and analyzed along with a comparison, that is, similarities and dissimilarities and a review of their individual advantages and limitations. A review of multimethodology techniques and application in healthcare is undertaken while noting their limitations. The chapter then discusses facilitation techniques as it applies to the scope of this research. As facilitation techniques and their selection are often situation based, and rely heavily on the skills and expertise of the facilitator at hand, the research provides a background and a resource for the practitioner but does not propose a specific technique for generic application. A literature review is then undertaken for framework development and evaluation with a strong focus on principles that can be followed for developing a framework. Further, techniques for evaluation of PSM techniques are investigated which highlights that no consensus exists on the evaluation approach within literature. A research focus is then derived based upon the discussion of the components of healthcare delivery systems, nature of problem, problem structuring methods, multimethodology, facilitation techniques and framework development and evaluation. Based on this focus, an overarching question was then framed as: *"In a healthcare delivery system, could a framework be devised to enhance the understanding of complex problems that have inter-connected socio-technical aspects, in a simple and rapid manner?"*

Chapter Three presented the research design and methodology undertaken to fulfil the research aim and objectives. It discussed the underlying research philosophy, research

approaches, strategies, case study selection, time horizons, type and data collection, data collection methods and validation of collected information. The theoretical foundation and research philosophy of this research is based upon the pragmatism paradigm. The strategic framework to enhance problem understanding was developed through rigorous theory building and empirical theory testing (deduction). Action research was described as the appropriate research strategy with use of case studies to collect and evaluate the proposed framework. The 'Most Similar' method was chosen so as to develop and evaluate the framework using two case studies. Cross Sectional time horizons, referring to a study in which data are gathered just once over a period of days or weeks or months, is selected. The type of data collection method adopted was triangulation, which utilizes a mix of both qualitative and quantitative approach. Interview, participation, documentation and archival records were used as data collection methods. The chapter further discussed the methodology for validation and generalization of collected information.

Chapter Four presented the proposed framework to tackle the gaps identified in Chapter Two with regards to the limitations of major PSM approaches to enhance the understanding of problems in healthcare delivery system in an effective and rapid manner. It begins by presenting the requirements for the framework which needed to be considered which included: need of collaboration amongst stakeholders, amenable to use of facilitation skills, graphical and easy representation of current problem situation, minimize time and effort and minimizes need for understanding tools by stakeholders. The attributes of these requirements were outlined based on the findings in the literature and were used to develop the framework. The chapter then provides the detail of the steps that made up the framework as: (i) define problem, (ii) data collection, (iii) devise 'as-is' model, (iv) verification and validation, and, (v) stakeholder analysis. The chapter then provided a visual structure of the framework and defines the framework evaluation criteria with respect to the requirements as: (i) Ability to promote collaboration amongst stakeholders (ii) Ability to effectively use facilitation skills (iii) Ability to graphically represent facilitation skills (iv) Ability to minimize time and effort (v) Ability to minimize need for understanding tools by stakeholders. The discussion in the chapter recognized that there exists a dearth of evaluation of PSM applications and there is no consensus that is applicable across a wide variety of application. The section then concluded with terming the proposed framework as CARE which is a mnemonic for Care Assessment via Rapid Execution which clearly reflects the objective of the framework that is, to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as

to promote problem understanding in a rapid manner.

Chapter Five presented the results of a real life case study conducted using the CARE methodology at TRCC. The CARE framework is implemented at TRCC to aid management in understanding the problem and identifying the root causes that contributes to the low patient satisfaction score. The steps adopted within the framework and the outcomes achieved during each step are explained in detail. It proceeds by providing a discussion on the generic process workflow along with presenting the concerns of the management regarding consistent low patient satisfaction score in the dietary services function. A problem statement was formulated during discussion with TRCC stakeholders using multiple facilitation techniques and it was agreed upon by all the TRCC stakeholders and thus had a clear ownership and buy-in from not only the management but also grass root employees. During data collection, the focus was on collecting data via walking the patients' journey and via multidisciplinary meetings with stakeholders regarding details of the processes. These approaches firstly allowed for both the patients and care providers perspectives to be recorded and secondly minimized the time spent in data collection while ensuring that adequate detail was being captured. Data collected in the form of multi-disciplinary meetings and walking the journey approach was correlated to form a treatment workflow which was depicted using RACI-SLA diagram that aided understanding of the multiple roles and patient pathways possible in the workflow. Stakeholder analysis of the RACI-SLA map lead to identifying systemic faults for process flaws and deficiencies as well as areas for improvement in the care delivery system. Root cause and gap analysis was conducted to formulate recommendations. While the framework met its intended objective and results showed improvement in the patient satisfaction score within the dietary functions, some limitations and areas for improvement in the framework were identified. Due to the presence and likelihood of multiple variations in the process flow, the methodology adopted for graphical representation was unable to showcase all possibilities effectively. Further, it was not possible to gage the total activity times for the different treatment paths in the workflow. It was important to gage effect of structural changes in the process flow by eliminating or restructuring the process steps. These would ultimately result in different scenarios that could be possible and were necessary to gage effective trade-offs between solutions. The trade-offs could be evaluated in terms of the time and effort required for different scenarios. This could be especially important when large variations in treatments were possible. This functionality was not present in the framework during the evaluation of this case study.

Chapter Six presented a refinement to the CARE framework based on the results,

evaluation and identified limitations from the real life case study presented in Chapter Five. A refinement was made to the CARE framework which related to the inclusion of the effect of patient treatment pathways, activity times and probabilities of occurrence of each pathway. Step 2 (Data collection) was changed to reflect the need to collect activity time and likelihood of occurrence. Step 3 (Devise "as-is" model) was changed to reflect PP and activity time in the RACI-SLA diagrams. Step 4 (Verification and validation) was changed to include associated effort to validate and verify activity times with the stakeholders. Step 5 (Stakeholder analysis) was changed to include the analysis associated with patient pathways, likelihood of occurrence and activity times. The modified CARE framework could then be evaluated in Chapter Seven.

Chapter Seven presented the results of another real life case study conducted using the modified CARE methodology at a GI clinic to examine and identify the root-cause resulting in the increased wait time for the patient at the clinic. It began by providing the background to the GI clinic case study at the UNT hospital, used for evaluating the CARE framework. Based upon discussion with the UNT stakeholders, a problem statement which was agreed upon by all the stakeholders allowing for clear ownership and buy-in. Data was also collected using walking the journey approach which was conducted in real-time at the stakeholder workplace while following the route of a typical treatment workflow. The time data for each activity is also collected since the problem statement devised was concerned with the actual treatment time. Information collected via multi-disciplinary meetings and walking the journey approach were consolidated along with estimates for time for each activity to form a complete treatment workflow. This was represented in a RACI-SLA diagram which served as an effective visual aid for stakeholders to gain a holistic perspective of the treatment workflow, the likelihood of occurrence for each patient pathway was assessed using stakeholder's opinion or direct observation and using a scale where high, medium and low likelihood of occurrence are assigned a respective value of 0.9, 0.3 and 0.1. An analysis was conducted to evaluate resource loading in each medical session while comparing to the workload. In the facilitated sessions conducted, the results of the analysis were presented to the stakeholders. This along with the analysis of RACI-SLA maps for process flaws and deficiencies led to identifying systemic faults as well as areas for improvement in the care delivery system. Details of the implementation indicate a successful implementation of the CARE framework in gaining consensus amongst stakeholders regarding the problem of length of wait time observed at the GI clinic. Further, the framework aided in highlighting both the qualitative and quantitative causes that contributed to the problem and recommendations were derived based upon

stakeholders' input.

8.3. Conclusions and Research contribution

Figure 8.1 shows the overall approach taken in this research. At the onset of this research, a research aim was established as:

"*The aim of this research was to develop a framework which provides an accurate and holistic representation of the delivery workflow, so as to promote problem understanding in a rapid manner*."

To achieve this aim, five objectives for this research were derived as: (i) Investigate the current state of research, (ii) Formulate the research focus, (iii) Establish the foundations of the alternate framework, (iv) Deploy the framework and, (v) Evaluate the framework. A comprehensive literature review was then conducted in the core research areas which were: a) Nature of problems in healthcare b) PSM methods c) Multimethodology d) Facilitation e) Framework development and evaluation. Following the literature review, the research focus was then developed via establishment of three research questions as:

a) How can healthcare practitioners use a comprehensive methodology to address interconnected socio-technical aspects and limitations of current PSM techniques effectively?
b) What are the principles that can be followed to engage stakeholders, enhance problem understanding and promote a shared world view regarding problems and solutions?
a) What methods can be followed to ensure simple and rapid implementation to achieve desired goals?

These questions were then summarized into an overarching research focus question as:

"In a healthcare delivery system, could a framework be devised to enhance the understanding of complex problems that have inter-connected socio-technical aspects, in a simple and rapid manner?"

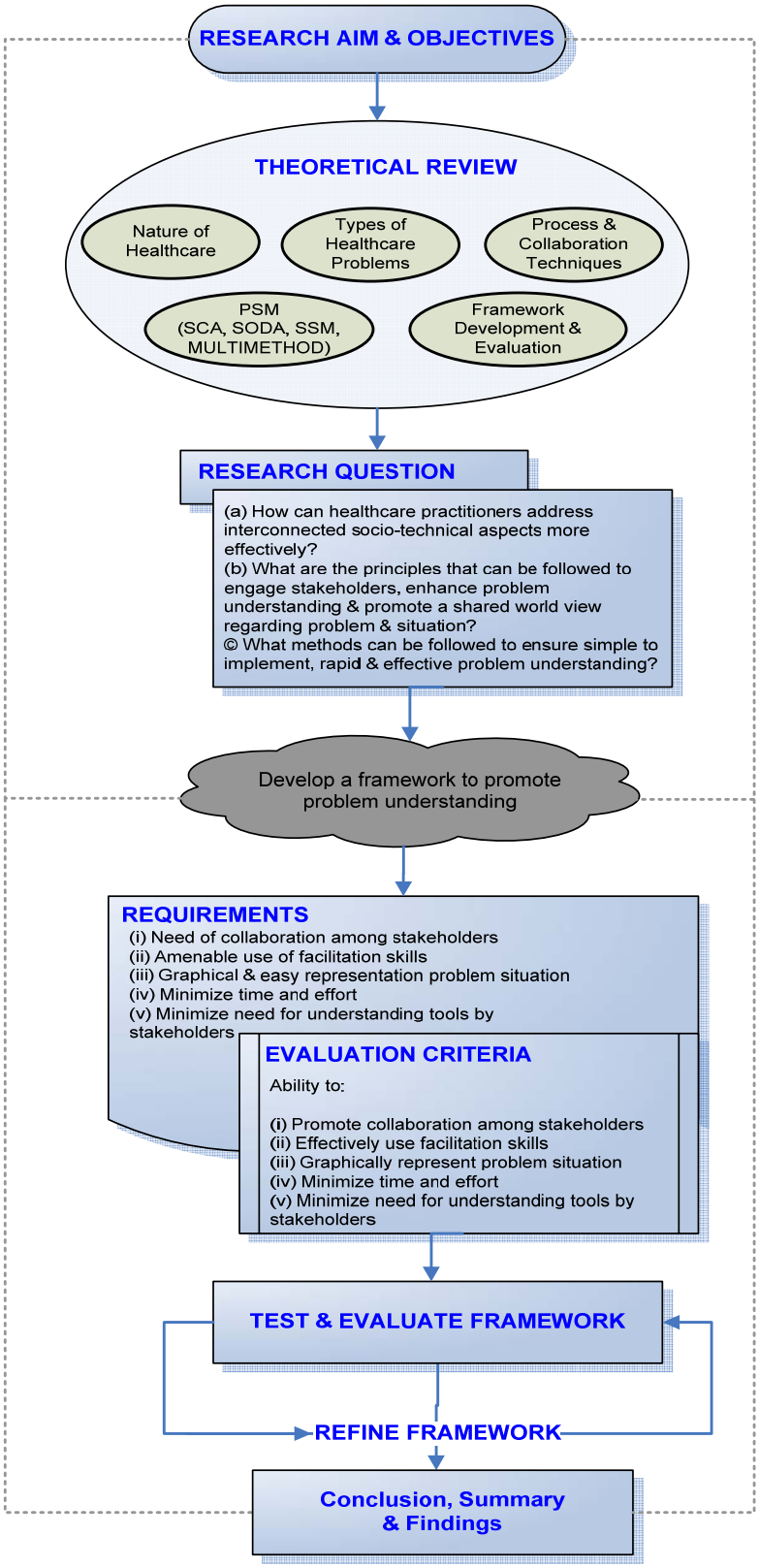


Figure 8.1: Summary of Research Pathway

To develop a framework to address the research question and fulfil the research aim and objectives, it was necessary to derive the requirements for development of such a framework. This was achieved based upon the similarities of current PSM methods which are advantageous for application and limitations identified for the current PSM methods. The five requirements that were derived based upon the similarities and limitations of current methods are:

a. Need of collaboration amongst stakeholders
b. Amenable to use of facilitation skills:
c. Graphical and easy representation of current problem situation:
d. Minimize time and effort
e. Minimizes need for understanding tools by stakeholders

Due to the lack of standardized, widely accepted or generic evaluation criteria for PSM methods in literature, the author utilized the ability to meet these requirements as the major criteria for success of the CARE framework. The evaluation criterion that was developed for testing the framework was:

a. Ability to promote collaboration amongst stakeholders
b. Amenable to effectively use facilitation skills
c. Ability to graphically represent problem situation
d. Ability to minimize time and effort
e. Ability to minimize need for understanding tools by stakeholders

As has been discussed in literature, the lack of availability of standardized evaluation criteria implies that it is impossible to gage the performance of the CARE framework against a given PSM method. The author chose to utilize internal validation of the criteria by evaluating success in meeting the requirements set for the framework to a satisfactory level. As has been outlined in literature, using an interpretivist approach, such evaluations and generalizations about effectiveness of methods that tackle issues with complex and multiple perspectives is possible (Mingers and Rosenhead, 2004). After evaluation of the framework, steps were refined based upon the feedback received from stakeholders and short coming identified during implementation in the first case study.

The outcomes of this research can be discussed in light of the five research objectives and the research focus question. The research objectives were derived as:

The first objective stated for the thesis was to “Investigate the current state of research” so as to develop a deep understanding of the structure and challenges in healthcare delivery

systems and problem understanding along with the major methods that have been applied to problems in healthcare. This was accomplished by a comprehensive literature review of components in healthcare delivery systems, the identification of major challenges, a study of nature of problems in healthcare, a review of current methods such as SCA, SODA, SSM and multimethodology, facilitation techniques and framework development and evaluation. The review was successful in firstly, establishing the background for the research by reviewing the structure of the healthcare delivery system and establishing the nature of problems in healthcare. Secondly, it was successful in completing a comprehensive review of application of PSM methods and multimethodology in healthcare and highlighting their advantages and limitations. Thirdly, the review provided a background for other core areas of research such as facilitation techniques and framework development and evaluation.

To achieve the second objective "Formulate the research focus", major findings from core areas of research used to achieve the first objective were analyzed. Limitations of existing PSM methods and multimethodology were tabulated to derive the constituent research questions. This lead to the development of the overall research question and focus, which enabled targeting efforts to develop the proposed framework for enhancing understanding of complex healthcare delivery system problems. To complement and complete the research focus, research methodology was derived in Chapter three. The discussion focussed on the underlying research philosophy, research approaches, strategies, case study selection, time horizons, type and data collection, data collection methods and validation of collected information.

To achieve the third objective "Establish the foundations of the proposed framework", firstly, a comprehensive review was conducted in Chapter Two regarding framework development, which provided the author with knowledge regarding the importance of framework development and past efforts related to it. Requirements for the framework were then derived in Chapter Four via a comprehensive review. A basic structure and components of the proposed framework was then proposed and the evaluation criteria for the framework were discussed in detail.

To achieve the fourth objective "Deploy the framework", the framework was implemented in two real world healthcare delivery systems to assess feasibility, limitations and estimate impact. The results of the deployment were presented in Chapter Five and Seven which showed that deployment in two independent healthcare delivery systems allowed its capability to be independently assessed and refined. The fifth objective "Evaluate and refine the

framework" was achieved by discussion of feedback received from real world implementation in Section 5.4 of Chapter Five. Discussion in Chapter Six focused on the refining steps of the framework to include details on patient pathway and activity times which led to a modification of the RACI-SLA diagram. The modified framework was then evaluated empirically using a case study, which was presented in Chapter Seven. The purpose of deployment, evaluation and refinement was to highlight the limitation of the framework which could not have been identified from theoretical evaluation alone.

The underlying research questions that were derived in Chapter Two can be addressed now in more detail, so as to highlight the contribution of this research.

a) How can healthcare practitioners use a comprehensive methodology to present interconnected socio-technical aspects effectively?

   This question is related to the possibility of developing a theoretical framework which can assist healthcare practitioners in representing and analysing complex interconnected workflow in a simple to understand manner. Testing and evaluation of the CARE framework in two similar healthcare settings has shown that a framework can be developed to analyze and represent interconnected information exchanges between multiple stakeholders. Multiple roles and responsibilities in each step of the healthcare delivery system can be represented to illustrate the resources involved, the nature and extent of their involvement along with providing insights into resource allocation. The framework has refrained from utilizing detailed process mapping techniques as the focus of the framework was not to accurately map the process steps. Rather, the focus was to understand the delivery system with more granularity than what can be achieved with traditional PSM methods. Also, an estimate of overall process time can be derived at in a short timeframe, which inspite of being approximate estimates, can lead to valuable insights. Representing this information to the stakeholders enables the healthcare practitioner to facilitate sessions with stakeholders and helps in leveraging their knowledge for problem solving.

   The framework relies on using simple models so as to promote ownership and comprehension by stakeholder in a reduced time. Also, building such a model does not require extensive modelling software and can be achieved using simple word processing applications like Microsoft Visio. Visual representation achieved via RACI-SLA diagrams ultimately lend themselves to be easily understood and accepted by non-specialists. This is in-line with literature (Pidd, 1999) which encourages the researcher

to "think complicated, model simple", as a complex model can be uneconomic to design and maintain. Thus inter-connected socio technical aspects of healthcare delivery systems can be captured, represented and analyzed effectively using, specifically Steps 2, 3 and 4 outlined in Section 4.3 and further refined and presented in Section 6.3.

b) What are the principles that can be followed to engage stakeholders, enhance problem understanding and promote a shared world view regarding problems and solutions?
This question is related to the possibility of developing a framework that enables effective engagement of stakeholders along with facilitating problem understanding and a comprehension of mutual views regarding problems and solutions. The framework relies on a multitude of facilitation techniques available in literature for the healthcare practitioner, but refrains from choosing or recommending a particular technique of a given application. As has been pointed in literature, the selection of a facilitation technique is dependent on situational considerations, such as the problem at hand, target audience, skill and expertise level of the facilitator. However, based upon the two case studies, it is likely that a real world implementation of the framework will utilize at least one facilitation technique. The choice and level of implementation, which is directly dependent on the skill of healthcare practitioner, can affect the desired outcome of the framework and the time required to achieve that. As has been shown in the implementation of the case studies (Section 5.4.1 and 7.4.1), utilization of effective facilitation techniques can promote useful discussion amongst stakeholders. Facilitation techniques can also be used to remove or reduce hierarchical boundaries, which can further promote a candid sharing of views between stakeholders. This is especially helpful while defining the problem in Step 1. Facilitation skills are also effective during Step 2 (data collection). Situations can exist where more than one stakeholders need to be engaged to extract relevant process information or one which requires resolution of discrepancies in data and methods. Step 4 (Validation and verification) can require facilitation skills to engage stakeholders so as to refine the conceptual model developed in Step 3 (Devise "as-is" model). To further aid in facilitation and to enhance problem understanding, RACI-SLA diagram can be adopted. The representation not only helps for representing the delivery system but acts as a tool for validation and verification from stakeholders as well. As it is developed by inputs provided by the stakeholders, it

also promotes a sense of ownership which encourages participation and initiative. Lastly, Step 5 (Stakeholder Analysis) requires practitioner to present relevant process specific data analysis to the stakeholders and engage them in brainstorming sessions to select solutions and implementation path. As can be inferred, most steps of the framework rely on facilitation skills to engage stakeholders combined with practitioners skills in collecting, representing and analyzing process data.

c) What methods can be followed to ensure simple and rapid implementation to achieve desired goals?

The question is related to the possibility of developing the framework in a manner which is easy and rapid to implement. In Step 2 (Data collection), The CARE framework utilized walking the journey and multidisciplinary meeting approach to collect data from both the care provider's and patient's perspectives while focusing on collecting relevant data rather than large volumes of data. To enable that, large samples of data were not collected. However, effort was placed on direct observation of a patients treatment journey and leveraging knowledge of the stakeholders to complete the treatment workflow. No specialized tools or software were used for data collection and process details were noted using a pen and notebook. In Step 3 (Devise "as-is" model), preparation of RACI-SLA diagram was achieved using simple word processing tools such as Microsoft Visio. The use of graphical representation allows for ease in collaboration and facilitation while collecting, verifying and validating data. High process variability in healthcare is taken into account by adoption of PP and associated likelihood of occurrence. This also enables the framework to be disease and treatment independent and ensure that recommendations are based upon methods of work, process bottlenecks and inefficiencies rather than nature of disease. This allows the framework to take into account the multiple delivery workflows which are possible while notifying the relative importance based upon frequency of occurrence. The CARE framework also relies on choosing effective facilitation techniques, while involving providers at all levels to reduce implementation time. It focuses on providing a platform for problem-solving to the stakeholders but is dependent on choice, quality and level of facilitation to achieve rapid implementation. Thus, following methods outlined in Step 2 (Data collection), Step 3 (Devise "as-s" model) and Step 4 (Validation and verification) can ensure a faster implementation.

With regards to the overarching research question, that is, **"**In a healthcare delivery system, could a framework be devised to enhance the understanding of complex problems that have inter-connected socio-technical aspects, in a simple and rapid manner?" , based upon the discussion outlined above, this research proves that such a framework can indeed be devised. That said, the framework does have limitations which will be discussed in more detail with respect to other PSM techniques and multimethodology in the next section.

8.4. Limitations and Lessons learnt

This research has contributed towards aiding problem understanding in a rapid manner in different healthcare environments by developing a framework which provides guidelines for implementation. Although it has attempted to address the characteristics of healthcare delivery systems along with major limitations of PSM methods to design and evaluate the framework, the author does not claim to have designed a panacea for such problems. While the framework has been tested with great success in two separate healthcare settings each possessing its unique set of problems, the framework has to be applied to a larger sample size of healthcare problems for further verification and refinement. While the two case studies presented in this dissertation show promise and its capability, the fact that the framework has not been tested in a large set of healthcare problems is one of its major limitations. Wider implementation will further validate the framework's ability in tackling complex problems in healthcare and also highlight nature of challenges met during implementation and areas for improvement. It is anticipated that with application of the framework in more healthcare settings, a rich database of best practices can be developed for future researchers.

The first case study identified the importance of highlighting PP and including activity times for graphical representation which aid brainstorming sessions. This was highlighted as an added requirement for the second case study for evaluation. While the inclusion of activity times and PP ultimately provided richer information and aided in decision making, it also increased the amount of information necessary to be understood and interpreted by the stakeholders. It is possible that while implementing in other healthcare settings, the effort versus the value obtained by collecting and interpreting this additional data (activity times and PP) will have to be evaluated. The framework currently does not possess means to provide this valuation to the facilitator. This is another limitation of the framework. Also, while RACI-SLA diagram represent the different activities sequentially, real time operations usually involve parallel processing of information and decision making. Since mapping of real time operations

will involve a large amount of time for observation, walking the journey approach and multi-disciplinary meetings have been used to capture sequential operations in a reduced time. However, the current data collection methodology is not conducive to capturing multiple parallel processes operating in real time. With reference to the collection of activity times, an accurate collection is not possible with the usage of CARE framework; as such a data collection will involve study involving a large number of samples and accurate time-motion studies. This can be classified as a minor limitation for the framework. That said, the objective of the framework was not to collect or calculate the most accurate data for activity times due to the large effort involved. Rather, the objective was to collect the best estimate time from the stakeholders or via observation which is capable of providing a good relative comparison between two different PP or activity times. One of the minor limitations of the CARE framework is the difficulty in building or editing RACI-SLA diagrams by the facilitator without computer support. While the creation of the RACI-SLA diagrams does not need any specialized software and can be accomplished by general purpose word processing tools such as Microsoft Visio, it does need basic skills in using personal computers. This is a minor limitation due to technological advantages which allow for easy capture and editing of information on mobile computing devices such as tablets and net-books. When limitations of CARE are compared to those of other PSM methods and multi-methodology, it is noted that CARE is unable to completely eliminate or satisfy the limitations identified at the onset of the research. However, it is able to satisfactorily overcome some major limitations. Table 8.1**Error! Reference source not found.** shows this comparison of the limitations of major PSM approaches and multimethodology with CARE along with some remarks on performance of CARE in addressing limitations that were originally identified in Table 2.9. Note that 3 of the limitations of existing methods are only partially overcome by CARE, while 2 limitations are not overcome.

One of the important lessons learnt while implementing CARE pointed to the need for support from senior management in order to get accessibility for resources and for employees to willingly share information. Further, it is important to ensure that employees understand that the intention is process improvement rather than scrutiny of their work. It is also important to portray the possible benefits and engage them throughout to ensure good accuracy of data collection. During data collection via multi-disciplinary meetings or brainstorming sessions, it is important to carefully distinguish between opinions and key facts. Stakeholder collaboration and facilitation is an important skill so as to derive the right detail of information. Facilitation

is most important in brainstorming sessions as it there can be multiple ideas discussed within a very short timeframe, which can be difficult to capture. Filtering relevant information from the pool of information collected can be laborious. It is important to keep an objective and open minded view on collected information. Past historical records or documents should be used as guidelines rather than absolute truth. Deciding the level of information collected and represented is important and can be challenging. Via walking the journey approach for data collection, the facilitator can quickly observe both the patient and care provider's perspectives and note similarities or dissimilarities. Some tasks are better understood by breaking down further while some can be kept high-level. Further it is important to focus on verification and validation after the entire information flow is collected and analysed. This gives the stakeholder opportunity to re-evaluate their initial inputs, especially when it is represented in a graphical fashion. Graphical visualization is an important aspect in verification, validation and analysis, especially in brainstorming sessions where the presence of a clear and concise representation of the workflow can stimulate discussion and drive decisions.

Table 8.1 : Comparison of CARE with respect to PSMs and multimethdology

		Major PSM Approaches			Other Approaches		
SN	Major limitations	SCA	SODA	SSM	Multi-methodology	CARE	Remarks
1	Representation of situation can be challenging and does not represent real world	√	√	√		This limitation is satisfactorily overcome	CARE uses simple data collection methods such as interviews, questionnaire, surveys and historical records. This is complemented by simple tools such as data recorder and pen and paper. CARE uses RACI-SLA diagram to represent patient pathways, activity time and roles and responsibilities of involved personnel in each step
2	Time and Cost Implications	√	√	√		This limitation is satisfactorily overcome	CARE minimizes time and associated costs involved in leveraging stakeholder knowledge. This is achieved via use of facilitation techniques, simple data collection tools and effective visual maps to promote understanding.
3	Stakeholder must be expert in different technologies / tool for maximizing value	√	√		√	This limitation is partially overcome	While CARE minimizes need for stakeholders to be expert in tools, it is unable to completely eradicate it. The stakeholders still have to understand RACI-SLA diagrams
4	Weak in providing specific mechanisms for systemic understanding & decision making	√	√	√		This limitation is satisfactorily overcome	CARE provides practitioner specific mechanisms for facilitation, data collection, representation and analysis. The effectiveness of implementation is however dependent on nature of problem, organizational context and practitioner's skill and expertise

5	Lack of clear cut route to problem definition	√	√			This limitation is satisfactorily overcome	CARE provides steps to enable derivation of problem and focus efforts. This is achieved by leveraging stakeholder knowledge to list problem situations, causes and solutions and then utilizing facilitation techniques to brainstorm and derive the problem statement. This promotes ownership of the problem in stakeholder and drives a common focus
6	Inability to handle stakeholder diversity	√				This limitation is satisfactorily overcome	CARE proposes use of facilitation techniques to remove or reduce hierarchical boundaries by setting stakeholders on equal footing via informal introductions. This is important as involved stakeholders come from different levels of the organization.
7	Possible complexity in implementation, explanation and usage	√		√	√	This limitation is partially overcome	While CARE minimizes complexity via simple data collection tools and intuitive visual representation, it adds to complexity of explanation and usage by introducing RACI-SLA diagrams, the concept of patient pathways and activity times to stakeholders.
8	Implementation strongly dependent on practitioners' knowledge and experience	√	√	√	√	This limitation is partially overcome	While CARE provides effective tools for practitioner to implement, the end result is still dependent on practitioners' knowledge and experience.
9	Difficulty in generalizing implementation approach				√	This limitation is satisfactorily overcome	CARE utilizes 'Most-Similar' method of case selection to ensure generalization of approach across two cases.
10	Dearth of testing in a wide variety of healthcare applications				√	This limitation of CARE is not overcome	While CARE has been tested in two healthcare delivery systems, it is yet to be subjected to a large sample evaluation. This could be part of future research.
11	Inability to map multiple processes occurring in real-time	√	√	√	√	This limitation of CARE is not overcome	While CARE can collect data to enable mapping of patient pathways in RACI-SLA maps, it is unable to provide a mechanism to do so for multiple process occurring in real time. These situations are possible in daily operations and it may be desirable to map two or more processes in real-time. This could be part of future development.

8.5. Future Research

Opportunities for future research can be based upon the limitations and lessons learnt from implementation at two care centres. These are consolidated as:

1. Further simplifying means for stakeholder understanding of tools and terminology

   As discussed in Section 8.3, while implementation of the CARE framework reduces the need for stakeholders to develop expertise in specialized tools by using intuitive graphical representation, it does add to additional terminologies that have to be understood. For example, underlying concepts of patient pathways, activity times, RACI, SLA have to be understood by stakeholders. Future research could look into further minimizing or simplifying these concepts for stakeholders. This will ultimately enable a faster and wider comprehension by stakeholders in a reduced time frame.

2. Further reduction in complexities in implementation, explanation and usage while reducing dependence on practitioner's knowledge and experience

   This relates to further reducing the load on practitioner for implementing the framework and reducing the dependence on practitioners' knowledge, skill and expertise. Firstly, the complexity in implementation is reduced via the use of simple data collection methods (interviews, questionnaires, surveys and historical records) and tools (data recorder, pen and paper) which reduces need for specialized software. Simple word processing tools then can be used for implementation. The concepts for patient pathways and activity times rely on simple algebra and arithmetic, which once understood are simple to implement. However, future research could investigate further simplifying the data collection, representation and analysis requirements for the framework. Secondly, while CARE provides specific guidelines for implementation in each of the steps of the framework, some aspects rely on practitioners' skill and expertise in bringing the stakeholders together for problem solving and decision making. The framework relies on generic facilitation techniques found in literature but stops short in recommending specific techniques. This is because of the large variability in healthcare problems and the inter-relation of the nature of the problem with the organizational context. Recent research in the area of Group decision support systems (GDSS) shows potential in further reducing the dependence of outcome of facilitation and brainstorming sessions on practitioners' skills. This could be an area for

future research for the CARE framework.

3. Promoting implementation in a wide variety of healthcare delivery system applications
   While CARE has been evaluated in two healthcare delivery systems using the 'Most Similar' case selection method (described in Section 3.4), its application should be expanded to other applications for further refinement. Future research can include implementation of the CARE framework in a wide variety of healthcare applications.
4. Exploring means for mapping multiple processes occurring in real-time
   While CARE can map multiple patient pathways in RACI-SLA maps, which allows the practitioner and stakeholders to see the possible treatment workflows based upon the nature of the patient disease, it is unable to provide a mechanism for collecting data to map these multiple process occurring in real time. These situations are possible in day-to-day healthcare operations and can further add to complexity due to variable and changing resource allocations. For example, a patient treatment pathway for a critically ill patient can require diversion of resources from the treatment of less critical patients. If such processes exist (for example, in an emergency care unit), taking into account the nature and severity of the problem, it may be desirable to collect data for two or more processes in real-time. This could be part of future development.

REFERENCES

- Ackermann, F. (1996) 'Participants' perceptions on the role of facilitators using group decision support systems', *Group Decision and Negotiation*, 5: 93–112.

- Ackermann, F. (2011) 'Advances in designing group decision and negotiation processes', *Group Decision and Negotiation,* 20(3): 271-272.

- Ackermann, F. (2011) 'Problem structuring methods in the dock: Arguing the case for soft OR', *European Journal of Operational Research*, 219 (3): 652–658.

- Ackermann, F. and Eden, C. (2010) 'The role of group decision support systems: negotiating safe energy', In Kilgour, D. M. and Eden, C. (eds), *Handbook for Group Decision and Negotiation.* Springer: London: 285-301.

- Ackermann, F., Cropper, S. and Eden, C. (1992) 'Getting Started with Cognitive Mapping', In *Seventh Young OR Conference Tutorial Papers*, Birmingham: O.R. society, [Online]. Available at: http://www.banxia.com/depaper.html.

- Ackermann, F., Eden, C. and Williams, T. (1997) 'Modeling for litigation: mixing qualitative and quantitative approaches', *Interfaces*, 27 (2): 48-65.

- Ackoff, R.L. (1999) 'Disciplines, the two Cultures, and scianities', *Systems Research and Behavioral Science*, 16(b): 533–537.

- Agrell, P.S. and Holmberg, S. (1998) 'Operational Research in Swedish Military Longterm and Complex Development Projects', *Systems Research and Behavioral Science,* 15: 61-65.

- Al-Karaghouli, W., Fitzgerald, G. and Alshawi, S. (2002) 'Knowledge requirement system (KRS): an approach to improving and understanding requirements', In Coakes, E., Willis, D. and Clarke, S. (eds) *Knowledge Management in the Sociotechnical World: The Graffiti Continues.* London: Springer-Verlag.

- Allam, O., Gray, A., McIntosh, S. and Morrey, D. (2004) 'A systems approach to a deeper understanding of a cancer care domain', *Health Informatics Journal*, 10: 205-220.

- American Hospital Association (AHA). (2004) *Hospital Statistics 2004*. Chicago, Illinois: AHA.

- Andersen, D. F. and Richardson, G.P. (1997) 'Scripts for group model-building', *System Dynamics Review*, 13(2): 107-129.

- Anderson, D. .R., Sweeney, D. J. and Williams, T. A. (2012) *An Introduction to Management Science: Quantitative Approaches to Decision Making*. New York: West Publishing.

- Argyris, C., Putnam, R. and Smith, D. (1985) *Action Science*. San Francisco, CA: Jossey-Bass.

- Ashmos, D.P., Duchon, D. and McDaniel, R. R. (2000) 'Physicians and decisions: a simple rule for increasing connections in hospitals', *Health Care Manage Rev*, 25(1): 109–15.

- Atkinson, C., Eldabi, T., Paul, R. and Pouloudi, A. (2001) 'Integrated Approaches to health informatics research and development', *Logistics Information Management*, 15: 138-152.

- Balbiani, P. and Cerro, L. F. D. (1999) eds Ohlbach, H. J. and Reyle, U. (1999) *Logic, Language and Reasoning*: Essays in honour of Dov Gabby Kluwer Academic Publishers.

- Barbour, R.S. (2001) Checklists for improving rigour in qualitative research: a case of the tail wagging the dog? *British Medical Journal*, 322: 1115-1117.

- Barach, P. and Johnson, J. K. (2006) 'Understanding the complexity of redesigning care around the clinical system', *Quality and Safety in Health Care*, 15: i10-i16.

- Batie, S. S. (2008) 'Wicked Problems and Applied Economics', *American Journal of*

Agricultural Economic, 90(5): 1176-1191.

- Batie, S. S. and Schweikhardt, D. B. (2010) 'Societal concerns as wicked problems: the case of trade liberalisation', Policy responses to societal concerns in food and agriculture: *Proceedings of an OECD Workshop*, Paris, France.

- Bennett, L. M. and Kerr, M. A. (1996) 'A systems approach to the implementation of total quality management', *Total Quality Management*, 7 (6): 631-665.

- Bennett, J. and Worthington, D. (1998) 'An example of a good but partially successful OR engagement: improving outpatient clinic operations', *Interfaces*, 28 (5): 56-69.

- Bens, I. (2012). *Facilitating with Ease!: Core skills for facilitators, team leaders and members, managers, consultants, and trainers*. CA: Jossey-Bass.

- Berg, M., Schellekens, W. and Bergen, C. (2005) 'Bridging the quality chasm: integrating professional and organizational approaches to quality', *International Journal for Quality in Health Care*, 17, (1): 75–82.

- Beuscart-Zephir, M.-C., Pelayo, S., Anceaux, F., Maxwell, D. and Guerlinger, S. (2006). 'Cognitive Analysis of Physicians and Nurses Cooperation in the Medication Ordering and Administration Process, *International Journal of Medical Informatics*, 15.

- Bevan, H. and Lendon, R. (2006). 'Improving performance by improving processes and systems', In: Walburg, J., Bevan, H., Wilderspin, J. and Lemmens, K. (eds) *Performance management in health care.* Abingdon: Routeledge.

- Biazzo, S. (2002) 'Process mapping techniques and organisational analysis: lessons from sociotechnical system theory', *Business Process Management Journal*, 8(1): 42-52.

- Boase, J.P. (1994) *Shifting sands: government-group relationships in the health care sector*. Montreal, Kingston: McGill-Queens University Press.

- Bodenheimer, T. (2007) *Building teams in primary care: Lessons learned*. Oakland, CA: California Health Care Foundation.

- Bolch, D., Johnston J.B., Giles, L.C., Whitehead, C., Phillips, P. and Crotty, M. (2005) 'Hospital to home: an integrated approach to discharge planning in a rural South Australian town', *Australian Journal of Rural Health*, 13: 91-6.

- Boon, H., Welsh, S., Kelner, M. and Wellman, B. (2003) 'Complementary/alternative practitioners and the professionalization process: A Canadian comparative case study', In: Tovey, P., Easthope, G. and Adams, J. (eds.) *Mainstreaming of complementary and alternative medicine in social context: An international perspective*. London: Routledge.

- Bransford, J. D. and Stein, B.S. (1993) *The Ideal Problem Solver*. Second Edition, New York: W. H. Freeman and Company.

- Braxster, G. (2010) 'White paper: Complexity in health care. Large Scale Complex IT System', London: The UK National Research and Training Initiative.

- Brink, H., van der Welt, C. and van Rensburg, G. (2006). *Fundamentals of research methodology for health care professionals.* 2nd ed. Capetown, South Africa: Juta and Co.

- Bryant, J. and Chin, C.K. (2000) 'Integrating approaches to revitalise a church's mission strategy', *Journal of Operational Research Society*, 51: 689–699.

- Brydon-Miller, M., Greenwood, D. and Maguire, P. (2003) 'Why action research?', *Action Research*, 1(1), 9-28.

- Bryman, A. and Bell, E. (2007) *Business Research Methods.* 2nd edition. New York: Oxford University Press Inc.

- Bryson, J., Ackermann, F., Eden, C. and Finn, C. (2004). *Visible Thinking: Unlocking Causal Mapping for Practical Business Results.* Chichester: Wiley.

- Buchbinder, Sharon B. (2009). **'**AJPM Special Supplement Explores: Interdisciplinary and the Science of Team Science', *Association of Integrative Studies Newsletter*, 31:(3) 5-8.

- Burrell, G. (1981) 'Systems thinking, systems practice; a review', *Journal of Applied System Analysis*, 10: 121-126.

- Camillus, J. C. (2008) 'Strategy as a Wicked Problem', *Harvard Business Review*, 86(5): 98-106.

- Carlson M., and Bloom, I. (2005) 'The cyclic nature of problem solving: An emergent multidimensional problem-solving framework', *Educational Studies in Mathematics*, 58: 45-75.

- Carstensen, A. and Sandkuhl, K. (2005) 'Coordination of Inter-Organisational Healthcare Processes: Experiences from Combining Process- and Document Centred Modeling', In: *International Workshop on Communication and Coordination in Business Processes*. Sweden: Kiruna.

- Cebul, R., Herschman, R., Rebitzer, J. B., Taylor, L. J. and Votruba, M. (2007) *Employer Based Insurance Markets and Investments in Health*. Department of Economics, Weatherhead School, Case Western Reserve University.

- Chalfin, D.B., Trzeciak, S., Likourezos, A., Baumann, B.M. and Dellinger, R.P. (2007) 'Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit', *Critical Care Medicine*, 35: 1477–83.

- Chan, L. and Wu, M. (2002) 'Quality function deployment: A literature review', *European Journal of Operational Research,* 143: 463–497.

- Checkland, P. B. (1972) 'Towards a systems-based methodology for real-worlds problem solving', *Journal of Systems Engineering*, 3: 87-116.

- Checkland, P. B. (1981) *Systems thinking, systems practice*. Chichester, UK: John Wiley

and Sons.

- Checkland, P. B. (2000) 'Soft Systems Methodology: A Thirty-Year Retrospective', *Systems Research and Behavioral Science,* 17: S11-S58.

- Checkland, P.B. and Haynes, M.G. (1994) 'Varieties of systems thinking. The case of Soft Systems Methodology', *System Dynamics Review*. 10(2-3): 189-197. Cambridge, MA: System Dynamics Society.

- Checkland, P. B. and Holwell, S. (1998) *Information, Systems and Information Systems: Making Sense of the Field*. Chichester: Wiley.

- Checkland, P. and Scholes, J. (1999) *Soft Systems Methodology in Action*. Chichester, UK: John Wiley and Sons.

- Cherryholmes, C. H. (1992) 'Notes on pragmatism and scientific realism', *Educational Researcher*, 21(6): 13-17.

- Chisholm, R. F. (1996) 'On the meaning of networks', *Group and Organisation Management*, 21(2): 216-235.

- Coffey, R.J. (2005) 'Engineering and the Health Care System', *In:* Reid PP, Compton WD, Grossman JH, Fanjiang G, (eds) *Building a Better Delivery System; A New Engineering/Health Care Partnership*. Washington, DC: The National Academy Press, pp. 107-111.

- Coffey, R.J., Fenner, K.M. and Stogis, S.L. (1997) *Virtually Integrated Health Systems: A Guide to Assessing Organizational Readiness and Strategic Partners*. San Francisco: Jossey-Bass.

- Coghlan, D. and Brannick, T. (2001) *Doing Action Research in Your Own Organization*. London: Sage.

- Cohen, T., Blatter, B., Almeida, C., Shortliffe, E. and Patel, V. L. (2006) 'Distributed cognition in the psychiatric emergency department: a cognitive blueprint of a collaboration in context', *Artificial Intelligence in Medicine*, 37:73–83.

- Colquhoun, G.J., Baines, R.W. and Crossley, R. (1996) 'A composite behavioral modeling approach for manufacturing enterprises', *International Journal of Computer Integrated Manufacturing,* 9(6): 463-75.

- Conklin, E. J. (2002) 'Dialog Mapping', *Working paper of the CogNexus Institute,* [Online]. Available at: http:// cognexus.org/index.htm.

- Conklin, E. J. (2006) *Dialogue Mapping: Building Shared Understanding of Wicked Problems.* London: Wiley.

- Connell, N. A. D. (2001) 'Evaluating Soft OR: Some Reflections on an Apparently Unsuccessful Implementation Using a Soft Systems Methodology (SSM) Based Approach', *The Journal of the Operational Research Society*, 52(2): 150-160.

- Coveney, P. and Highfield, R. (1995) Frontiers *of complexity: the search for order in a chaotic world*. New York (NY): Ballantine Publishing Group.

- Coyle, R. G. and Alexander, M. D. W. (1977) 'Two approaches to qualitative modeling of a nation's drugs trade', *Systems Dynamics Review*, 13 (3): 205-222.

- Creswell, J. W. (1998) *Qualitative Inquiry and Research Design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications.

- Creswell, J. W. (2003) *Research design: Qualitative, Quantitative, Mixed methods approaches*, 2nd ed. London: Sage Publications.

- Creswell, J. W. (2007) *Research design: Qualitative, Quantitative, Mixed methods approaches*, 4th ed. London: Sage Publications.

- Curry, J., McGregor, C. and Tracy, S. (2006) 'A Communication Tool to Improve the Patient Journey Modeling Process', *The 28th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC06)*. New York: IEEE, pp 4726-4730.

- Dade, M. A. (1973) *Modelling and evaluation of the health care delivery system*. Santa Monica: RAND Corporation.

- Dennis, A.R., Wixom, B.H., and Vandenberg, R.J. (2001) 'Understanding Fit and Appropriation Effects in Group Support Systems Via Meta-Analysis', *Management Information Systems Quarterly*, 25: 167-183.

- Department of Health (DoH) (2007) 'Patient Pathways', [Online]. Available at: http://www.dh.gov.uk/en/Healthcare/Primarycare/Treatmentcentres/DH_4097263.

- DeWalt, K. M. and DeWalt, B. R. (2002) *Participant observation: a guide for fieldworkers*. Walnut Creek, CA: AltaMira Press.

- Dick, B. (2002) 'Action Learning, Action Research Association', [Online]. Available at: http://www.aral.com.au/

- Dougherty, D. and Conway, P. H. (2008) 'The "3T's" Road Map to Transform US Health Care', *JAMA,* 299(19): 2319 - 2321.

- Easterby-smith, M., Thorpe, R. and Lowe, A. (2002) *Management Research*, 2nd Ed. London: Sage Publication.

- Eckstein, Harry. 1975. Case studies and theory in political science. In Handbook of political science. Vol. 7 of Political science: Scope and theory, ed. Fred I. Greenstein and Nelson W. Polsby, 79-138. Reading, MA: Addison-Wesley.

- Eden, C. (1988) 'Cognitive Mapping', *European Journal of Operational Research,* 36: 1-13.

- Eden, C. (1989) 'Operational research as negotiation', In: Jackson, M.C., Keys, P. and Cropper, S.A. (eds.) *Operational Research and the Social Sciences*. New York: Plenum Press.

- Eden, C. (1992) 'On the nature of cognitive maps', *Journal of Management Studies,* 29 (3): 261-265.

- Eden, C. (2004) 'Analysing cognitive maps to help structure issues or problems', *European Journal of Operational Research*, 159: 673-686.

- Eden, C. and Ackermann, F. (1998) *Making Strategy. The Journey of Strategic Management.* London: Sage.

- Eden, C. and Ackermann, F. (2001) 'Strategic Options Development and Analysis: the Principles', In: Rosenhead J and Mingers J (eds) *Rational Analysis for a Problematic World Revisited 2001*. Chichester: Wiley.

- Eden, C. and Ackermann, F. (2004) 'Use of 'soft-OR' models by clients—what do they want from them?', In: Pidd M (eds) *Systems Modelling: Theory and Practice*. Chichester: Wiley, pp. 146–163.

- Eden, C. and Ackermann, F. (2006) 'Where next for problem structuring methods', *Journal of the Operational Research Society*, 57: 766–768.

- Eden, C., Jones, S. and Sims, D. (1983) *Messing About in Problems.* Oxford, England: Pergamon Press,

- Eden, C. and Jones, S. (1984) 'Using repertory grid for problem construction', *The Journal of the Operational Research Society*, 35: 779-790.

- Eden, C. And Huxham, C. (1996) 'Action research for management research', *British Journal of Management*, 7: 75-86.

- Eden, C. and Radford, K. (eds) (1990) *Tackling Strategies Problems: The Role of Group Decision Support.* London: Sage.

- Eden, C. and Sims, D. (1979) 'On the nature of problems in consulting practice', *Omega*, 7: 119–127.

- Edwards, J. S., Hall, M. J. and Shaw, D. (2005) 'Proposing a systems vision of knowledge management in emergency care', *Journal of the Operational Research Society*, 56(2): 180-192.

- Eisenhardt, K. M. (1989) 'Building theory from case study research', *Academy of Management Review*, 14 (4):.532-550.

- Eldabi, T. (2000) *Simulation Modelling: Problem Understanding in Healthcare Management.* Thesis, (PhD). Brunel University.

- Eldabi, T. (2009) Implementation issues of modelling healthcare problems: misconceptions and lessons. In: Rossetti, M.D., Hill, R.R., Johansson, B., Dunkin, A. and Ingalls R.G. (eds) *Proceedings of the 2009 Winter Simulation Conference.* Piscataway, New Jersey: Institute of Electrical and Electronics Engineers, Inc, 1831-1839.

- Eldabi, T. and Paul, R, J. (2001) 'Evaluation of tools for modeling manufacturing systems design with multiple levels of detail', *International Journal of Flexible Manufacturing Systems,* 13(2) : 163- 176.

- Elixhauser, A., Halpern, M., Schmier, J. and Luce, B. R. (1998) 'Health care CBA and CEA from 1991 to 1996: an updated bibliography', *Medical Care,* 36: 1–147.

- Ellis, B. W. and Johnson, S. (1999) 'The care pathway: a tool to enhance clinical governance', *Clinical Performance in Quality Healthcare,* 7(3):134-144.

- Enthoven, A. (2009) 'Integrated delivery systems: The cure for fragmentation?', *American Journal of Managed Care,* 15(supp.): S284–290.

- Erlandson, D. A., Harris, E. L., Skipper, B. L. and Allen, S. D. (1993) *Doing naturalistic inquiry: a guide to methods*. Newbury Park, CA: Sage.
- Fennessy, G. (2001) 'Knowledge management in evidence-based healthcare: issues raised when specialist information services search for the evidence', *Health Informatics Journal*, 7(1): 4-7.

- Ferlie, E.B. and Shortell, S. M. (2001) 'Improving the quality of health care in the United Kingdom and the United States: a framework for change', *Milbank Quarterly,* 79(2): 281–315.

- Fisher, E. S., Staiger, D. O., Bynum, J. P. W. and Gottlieb. D. J. (2006) 'Creating Accountable Care Organizations: The Extended Hospital Medical Staff', *Health Affairs*, 26: 44-57.

- Flood, R. L. (1987) 'Complexity: A definition by construction of a conceptual framework', *System Research*, 4: 177–185.

- Flood, R. L. and Ulrich, W. (1990) 'Testament to conversations on Critical Systems Thinking between two system practitioners', *Systems Practice,* 3: 7-29.

- Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A. and Flynn, E. J. (1990) 'Empirical Research Methods in Operations Management', *Journal of Operations Management*, 9(2): 250-284.

- Forsberg, H.H., Aronsson, H., Keller, C. and Lindblad, S. (2011) 'Managing Health Care Decisions and Improvement Through Simulation Modelling: Modelling Versus Modelling', *Quality Management in Health Care,* 20(1): 15-29.

- Francis, D. (1990) *Effective Problem Solving*. London: Routledge.

- Franco, L. A. (2009) 'Problem Structuring Methods as Intervention Tools: reflections from their use with multi-organizational teams', *OMEGA: The International Journal of Management Science*, 37(1): 193-203.

- Franco, L. A. and Lord, E. (2011) 'Understanding multi-methodology: Evaluating the perceived impact of mixing methods for group budgetary decisions', *OMEGA: The International Journal of Management Science*, 39 (3): 362-372.

- Franco, L., Cushman, M. and Rosenhead, J. (2004) 'Project review and learning in the construction industry: Embedding a problem structuring method within a partnership context', *European Journal of Operational Research,* 152 (3): 586–601.

- Fraser, S. and Greenhalgh, T. (2001) 'Coping with complexity: educating for capability', *British Medical Journal,* 323:799.

- Friend, J. K. and Hickling, A. (1987) *Planning under pressure*. Chichester: John Wiley and Sons.

- Friend, J. and Hickling, A. (2005). *Planning under pressure. The strategic choice approach.* Third edition. Oxford: Elsevier Butterworth Heinemann.

- Gallagher, R. and Appenzeller, T. (1999) 'Beyond reductionism', *Science*, 248:79.

- Gardner, M. (1958) *Logic Machines and Diagrams*. 2nd edition. USA: The Harvest Press.

- Garofalo, J. and Lester, F. K. (1985) 'Metacognition, cognitive monitoring, and mathematical performance', *Journal for Research in Mathematics Education, 16:*163-176.

- Gaspoz C. and Wand, Y. (2012) 'Using Ontologies and Soft Systems Methodology to Provide Multi-user Support in Problem Structuring', In: *Proceedings of the 45th Annual*, Hawaii International Conference on System Sciences.

- Geiger, V. and Galbraith, P. (1998) 'Developing a diagnostic framework for evaluating

student approaches to applied mathematics', *International Journal of Mathematics, Education, Science, and Technology, 29*: 533-559.

- Gell-Mann, M. (1995) 'What is complexity?', *Complexity* 1 (1).

- Georgiou, I. (2007) *Thinking through systems thinking*. Routledge London.

- Georgiou, I. (2009) 'Mapping railway development prospects in Brazil', *Transport Reviews*, 29: 685-714.

- Georgiou, I. (2010) *Cognitive Mapping and Strategic Options Development and Analysis (SODA).* Wiley Encyclopedia of Operations Research and Management Science.

- Gerring, J. (2004) 'What Is a Case Study and What Is It Good for?', *The American Political Science Review*, 98(2): 341.

- Giacomini, M. K. and Cook, D. J. (2000) 'Users' guides to the medical literature: XXIII. Qualitative research in health care A. Are the result of the study valid?', *JAMA,* 284(3): 357-362.

- Gibb, J. (1993) 'Soft Methods in Shell', *Talk to London and South East Operational Research Society*, 22.

- Gill, J. and Johnson, P. (2002) *Research Methods for Managers*. London: Sage Publication

- Gilmour, J. M., Kelner, M. and Wellman, B. (2002) 'Opening the door to complementary and alternative medicine: Self regulation in Ontario', *Law and Policy*, 24(2): 150–174.

- Glouberman, S. and Zimmerman, B. (2002) 'Complicated and Complex Systems: What Would Successful Reform of Medicare Look Like?', [Online]. Available at: http://www.hc-sc.gc.ca/english/pdf/romanow/pdfs/8_Glouberman_E.pdf (Accessed: 9 November 2011).

- Golafshani, N. (2003) 'Understanding reliability and validity in qualitative research', *The Qualitative Report*, 8(4): 597-|607.

- Goldberger, A. L. (1996) 'Nonlinear dynamics for clinicians: chaos theory, fractals, and complexity at the bedside', *Lancet*, 347: 1312-4.

- Goodman, M. R. (1974) *Study Notes in Systems Dynamics*. Cambridge, MA: MIT Press.

- Green, L. A. (2010) 'The Implications of Measuring Complexity', *Annals of Family Medicine*, 8: 291-292.

- Greenwood, D. And Levin, M. (1998) Introduction to Action Research. Thouand Oaks, CA: Sage.

- Gregory, A. J. and Jackson, M. C. (1992) 'Evaluating organizations - a systems and contingency approach', *Systems Practice*, 5 (1): 37-60.

- Grint, K. (2005) 'Problems, problems, problems: The social construction of leadership', *Human Relations*, 58(11): 1467.

- Gummesson, E. (2000) Qualitative Methods in Management Research, 2nd edition. Thousand Oaks, CA: Sage.

- Hammersley, M. (1992) *What's wrong with ethnography? : methodological explorations*. London and New York : Routledge.

- Handfield, R. B and Melnyk, S. A. (1998) 'The scientific theory-building process: a primer using the case of TQM', *Journal of Operations Management*, 16: 321-339.

- Hart, E. and Bond, M. (1995) *Action Research for Health and Social Care*. Buckingham: Open University Press.

- Henning, E. (2004) *Finding your way in qualitative research*. Pretoria: Van Schaik.

- Heyer, R. (2004) 'Understanding Soft Operation Research: The Methods, Their Application and Its Future in the Defence Setting', DSTO Information Sciences Laboratory, [Online] Available at: http://www.dsto.defence.gov.au/publications/3451/DSTO-GD-0411.pdf. (Accessed: 21 January 2012)

- Hjortsø, C.N. (2004) 'Enhancing public participation in natural resource management using Soft OR and application of strategic option development and analysis in tactical forest planning', *European Journal of Operational Research*, 152: 667-683.

- Hinman, A.R., Mann, M.Y. and Singh, R.H. (2009) 'Newborn dried bloodspot screening: mapping the clinical and public health components and activities', *Genet Med,* 11: 418-424.

- Holland, J. H. (1995) *Hidden order: how adaptation builds complexity*. Reading, MA: Addison-Wesley.

- Holter, I. M. and Schwartz-Barcott, D. (1993) 'Action research: what is it? How has it been used and how can it be used in nursing', *Journal of Advanced Nursing*, 18:298-304.

- Holyoak, K. J. (1990) 'Problem solving', *The MIT Press*, 3: 117-118.

- Horn, R. E. and Weber. R. P. (2007) *New Tools for Resolving Wicked Problems: Mess Mapping and Resolution Mapping Processes*. Watertown, MA: Strategy Kinetics L.L.C.

- Houston, M.S. and Bove, A.L. (2007). *Project Management for Healthcare Informatics*. Health Informatics Series, New York: Springer Media, LLC.

- Hsiao, C. J., Beatty, P. C., Hing, E. S., Woodwell, D. A., Rechtsteiner, E. A. and Sisk, J. E. (2009) *Electronic Medical Record/Electronic Health Record Use by Office-Based Physicians: United States, 2008 and Preliminary 2009.* Atlanta, GA: National Center for Health Statistics.

- Hurst, D. and Zimmerman, B. J. (1994) 'From life cycle to ecocycle: a new perspective on the growth, maturity, destruction, and renewal of complex systems', *Journal of Management Inquiry*, 3: 339-54.

- Huxham, C. and Vangen, S. (1996) Working together, key themes in the management of relationships between public and non-profit organizations. *International Journal of Public Sector Management*, 9 (7): 5-17.

- Hyerle, D. (1996) *Visual tools for constructing knowledge*. Alexandria, VA: Association for Supervision and Curriculum Development.

- Institute of Medicine (IOM) (2001). *Crossing the quality chasm: A new health system for the 21st century. Committee on Quality Health Care in America, Institute of Medicine.* Washington, DC: National Academies Press.

- Ivanov, K. (1991) 'Critical Systems Thinking and Information Technology: Some Summary Reflections, Doubts, and Hopes through Critical Thinking Critically Considered, and through Hypersystems', *Journal of Applied Systems Analysis*, 19: 39-55.

- Jacka, J.M. and Keller, J.P. (2009) *Business Process Mapping: Improving Customer Satisfaction*. 2nd edition. New York: John Wiley and Sons, Inc.

- Jackson, K.F. (1975) *The Art of Solving Problems*. London: William Heinmann.

- Jackson, M. A. (1975) *Principles of Program Design.* London: Academic Press.

- Jackson, M. A. (1982) 'The nature of 'soft' systems thinking: the work of Churchman, Ackoff and Checkland', *Journal of Applied System Analysis*, 9: 17-29.

- Jackson, M. A. (1991) *Systems Methodology for the Management Sciences.* New York: Plenum Press.

- Jackson, M. A. (1992) 'With friends like this a comment on Mingers' recent developments in Critical Management Science', *Journal of the Operational Research Society,* 43: 729-735.

- Johnson, S. (2001) *Emergence: the connected lives of ants, brain, cities, and software.* New York (NY): Simon and Shuster.

- Jonassen, D.H. (1997) 'Instructional design model for well-structured and ill-structured problem-solving learning outcomes', *Educational Technology: Research and Development, 45* (1): 65-95.

- Jonassen, D.H. (2004). *Learning to solve problem: An instructional design guide*. San Francisco, CA: Jossey-Bass.

- Jun, G. T. (2007). *Design for patient safety: A systematic evaluation of process modelling approaches for healthcare system safety improvement*. Ph.D. University of Cambridge.

- Jun, G. T., Morris, Z., Eldabi, T., Harper, P., Naseer, A., Patel, B. and Clarkson, J. P. (2011) 'Development of modelling method selection tool for health services management: From problem structuring methods to modelling and simulation methods', *BMC health services research*, 11 (1): 108.

- Kannampallil, T.G., Schauer, G.F., Cohen, T. and Patel, V.L. (2011) 'Considering complexity in healthcare systems', *Journal of Biomedical Informatics*, 44: 943–947.

- Kawulich, B. B. (2005). Participant Observation as a Data Collection Method. Forum: Qualitative Social Research, 6(2), Art. 43, [Online]. Available at: <http://nbn-resolving.de/urn:nbn:de:0114-fqs0502430> [Accessed 25 August 2012].

- Kaveney, S. (2011) 'Discussion on recommendations provided by implementation of CARE framework at TRCC', [email]. (Personal communication, September 1, 2011)

- Keast, R. (2001) 'Government Service Delivery Project: A New Governance Approach for

Queensland', *Journal of Contemporary Issues in Business and Government*, 7(1): 51–58.

- Keast, R., Mandell, M. P., Brown, K. and Woolcock, G. (2004) 'Network Structures: Working Differently and Changing Expectations', *Public Administration Review*, 64(3): 363-371.

- Keating, C. B. (2000) 'A systems-based methodology for structural analysis of health care operations', *Journal of Management in Medicine*, 14 (4): 179-198.

- Kelly, R. (2009) *Where can $700 billion in waste be cut annually from the U.S. Healthcare System?* Ann Arbor, MI: Thomson Reuters.

- Kelner, M, Wellman, B., Boon, H. and Welsh, S. (2002) 'Complementary and alternative groups contemplate the need for effectiveness, safety and cost-effectiveness research', *Complementary Therapies in Medicine*, 10: 235—9.

- Kelner, M, Wellman, B., Boon, H. and Welsh, S. (2004) 'Responses of established healthcare to the professionalization of complementary and alternative medicine in Ontario', *Social Sciences and Medicine*, 59(5):915—30.

- Kernick, D. (2004) Complexity and Healthcare Organization: a view from the street. Oxford: Radcliffe.

- Kitchner, K.S. (1983) 'Cognition, metacognition, and epistemic cognition: A three-level model of cognitive processing', *Human Development*, 26: 222-232.

- Koh, C. S., Clegg, B. and Deighan, D. (2011) 'Tackling wicked NHS problems - developing a novel methodology', In: *KTP Associates Conference.* Brighton, pp. 32-43.

- Kolfschoten, G. L., Briggs, R. O., Appelman, J. H., and Vreede G .J., de, (2004) 'ThinkLets as Building Blocks for Collaboration Processes: A Further Conceptualization', Presented at *CRIWG*, San Carlos, Costa Rica.

- Kolfschoten G. L. And Rouwette, E. (2006) 'Choice Criteria for Facilitation Techniques', In: *First HICSS Symposium on Case and Field Studies of Collaboration*. Kauai.

- Kolfschoten, G. L. and Veen, W. (2005) 'Tool Support for GSS Session Design', Presented at *Hawaii International Conference on System Sciences*. Los Alamitos.

- Kotiadis, K. (2011) 'Using Soft Systems Methodology in Conceptual Modeling**:** A Case Study in Intermediate Health Care', In: *Conceptual Modeling for Discrete Event Simulation*. London: 29-35.

- Kotiadis, K. and Mingers, J. (2006) 'Combining PSMs with hard OR methods: the philosophical and practical challenges', *Journal of the Operational Research Society*, 57 (7): 856-867.

- Kreuter, M. W., De Rosa, C., Howze, H. H. and Baldwin, G. T. (2004) 'Understanding Wicked Problems: A Key to Advancing Environmental Health Promotion', *Health Education and Behaviour*, 31: 441-454.

- Lane, D. C. (1998) Rerum cognoscere causas; Social theory, determinism and the agency/structure debate. *LSEOR working paper*: OR.98.26. London: London School of Economics.

- Lane, D.C. and, Oliva, R. (1998) 'The greater whole: towards a synthesis of system dynamics and soft systems methodology'. *European Journal of Operational Research* 107(1): 214-235.

- LaPorte, T. R. ed. (1975) *Organized Social Complexity.* Princeton: Princeton University Press.

- Lasker, R. D. and Weiss, E. S. (2003) 'Creating partnership synergy: the critical role of community stakeholders', *Journal of Health and Human Services Administration,* 26: 119-39.

- Lawrence, D. (2005) 'Bridging the Quality Chasm', In: *Building a Better Delivery System: A New Engineering/Health Care Partnership*, Part II. Washington, D.C.: National Academies Press.

- Lebcir, R. (2006) 'A Framework for Project Complexity in New Product Development (NPD) Projects', *University of Hertfordshire Business School Working Paper*, 2006-1.

- Ledington, P. and Donaldson, J. (1997) 'Soft OR and management practice: a study of the adoption and use of Soft Systems Methodology', *Journal of Operational Research Society*, 48(3): 229-240.

- Lehaney, B. and Hlupic, V. (1995) 'Simulation modeling for resource allocation and planning in the health sector', Journal of the Royal Society of Health, 115 (6): 382-385.

- Lehaney, B. and Paul, R. J. (1996) 'The Use of Soft Systems Methodology in the Development of a Simulation of Out-Patient Services at Watford General Hospital', *The Journal of the Operational Research Society*, 47(7): 864-870.

- Lehaney, B., Clarke, S.A. and Paul, R.J. (1999) 'A case of intervention in an outpatients department', *The Journal of the Operational Research Society,* 50: 877-891.

- Leichsenring, K. and Alaszewski, A.M. (2004) 'Providing integrated health and social care for older persons: a European overview of issues at stake', In *Providing integrated health and social care for older persons: a European overview of issues at stake*. Farnham: Ashgate.

- Lijphart, A. (1971) 'Comparative politics and the comparative method', *American Political Science Review*, 65(3): 682-93.

- Lijphart, A. (1975) 'The comparable cases strategy in comparative research', *Comparative Political Studies*, 8:158-77.

- Little, J. D. C. (1970) 'Managers and models: The concept of a decision calculus',

Management Science, 16(8): B466–485.

- Lyles, R. I. (1982) *Practical Management Problem Solving and Decision Making.* New York: Van Nostrand Reinhold Company, Inc.

- Lyon, J. (2012) 'Discussion on recommendations provided by implementation of CARE framework at UNT', [phone call] (Personal communication, March 9, 2012).

- Magidson, J. (1992) 'Systems practice in several communities in Philadelphia', Systems *Practice*, 5(5): 493-508.

- Mainzer, K. (1997) *Thinking in Complexity: The Complex Dynamics of Matter, Mind, and Mankind*. Third revision ed. Berlin: Springer-Verlag.

- Malhotra, S., Jordan, D., Shortliffe, E. and Patel, V.L. (2007) 'Workflow modeling in critical care: piecing together your own puzzle', *Journal of Biomedical Informatics*, 40: 81–92.

- Manser, T. (2009) 'Teamwork and patient safety in dynamic domains of healthcare: A review of the literature', *Acta Anaesthesiologica Scandinavica*, 53: 143–151.

- Margaria, T. (2010) 'Leveraging Applications of Formal Methods, Verification, and Validation', In: *4th International Symposium on Leveraging Applications*, Proceedings, Part 1. Greece: Springer, pp. 492.

- Marshall, C. and Rossman, G. B. (1989) *Designing qualitative research*. Newbury Park, CA: Sage.

- Mathison, S. (1988) 'Why Triangulate?', *Educational Researcher*, 17(2): 13-17

- Mayer, R. E. (1992) *Thinking, problem solving, cognition*. Second edition. New York: W. H. Freeman and Company.

- Maylor, H. and Blackmon, K. (2005) *Researching Business and Management: A Roadmap for Success.* London: Palgrave Macmillan.

- McDaniel, R. R., Jordon, M. E. and Fleeman, B. F. (2003) 'Surprise, surprise, surprise! A complexity science view of the unexpected', *Health Care Management Review*, 28(3): 266-278.

- Mechanic, D. (2006) *The Truth About Health Care: Why Reform Is Not Working in America.* New Brunswick, NJ: Rutgers University Press.

- Meckstroth, T. (1975) '"Most different systems" and "most similar systems": A study in the logic of comparative inquiry', *Comparative Political Studies*, 8(2): 133-77.

- Mick, S. M. and Wyttenbah, M. E. (2003) *Advances in Health Care Organization and Theory.* San Franscisco, CA.: Jossey-Bass.

- Middleton, S. and Roberts, A. (2000). *Integrated Care Pathways: A Practical Approach to Implementation.* Butterworth-Heinemann.

- Midgley, G. (1992) 'Pluralism and the legitimation of systems science', *Systems Practice,* 5: 147-172.

- Midgley, G. (1990) 'Creative methodology design', *Systemist*, 12: 108-113.

- Midgley, G. (1997) 'Mixing methods: developing systemic intervention', In: Mingers, J. and Gill, A. (eds). *Multimethodology: The Theory and Practice of Combining Management Science Methodologies*. Chichester: Wiley.

- Midgley, G. (2000) *Systemic Intervention: Philosophy, Methodology, and Practice*. New York: Kluwer.Plenum.

- Midgley, G. (2006) 'Systemic intervention for public health', *American Journal of Public Health,* 96 (3), 466-472.

- Miles, M. B. and Huberman, A. M. (1994) *Qualitative data analysis: an expanded sourcebook*, 2nd ed. London: Sage Publications.
- Mill, J. S. (1872) *System of logic*. 8th ed. London: Longmans, Green.
- Mingers, J. (1984) 'Subjectivism and soft systems methodology - a critique', *Journal of Applied Systems Analysis*, 11, 85-103.
- Mingers, J. (1997) 'Combining research methods in IS: multi-paradigm methodology', In: Galliers, B., Murphy, C. and Carlsson, S. (eds.), *Proceedings of 5th European Conference on Information Systems II*. Cork: Cork Publishing.
- Mingers, J. (2000) 'Variety is the spice of life: combining soft and hard OR/MS methods', *International Transaction in Operational Research*, 7: 673-691.
- Mingers, J. (2004) 'Can social systems be autopoietic? Bhaskar's and Giddens' social theories', *Journal for the Theory of Social Behaviour*, 34 (4), 403-425.
- Mingers, J. (2011) 'Soft OR comes of age—but not everywhere!', *Omega*, 39(6): 729–741.
- Mingers, J. and Brocklesby, J (1997) 'Multimethodology: Towards a framework for critical pluralism', *Systemist*, 18 (3): 101-132.
- Mingers, J. and Gill, A. (1997) Multimethodology: Theory and Practice of Combining Management Science Methodologies. Chichester: Wiley.
- Mingers, J. and Rosenhead, J. (2004) 'Problem structuring methods in action', *European Journal of Operational Research*, 152 (3): 530-554.
- Mingers, J. and Taylor, S. (1992) 'The use of soft systems methodology in practice', *Journal of Operational Research Society*, 43: 321-332.
- Mingers, J. and White, L. (2010) 'A review of the recent contribution of systems thinking

to operational research and management science', *European Journal of Operational Research,* 207(3): 1147-1161.

- Mitchell, S. and Shortell, S. (2000) 'The Governance and Management of Effective Community Health Partnerships: A Typology for Research', *Milbank Quarterly* 78(2): 241–89.

- Murphy, J. (1990) *Pragmatism: From Peirce to Davidson*. Boulder: Westview Press.

- Munro, I. and Mingers, J. (2002) 'The Use of Multimethodology in Practice-Results of a Survey of Practitioners', *The Journal of the Operational Research Society*, 53 (4): 369-378

- National Association of Community Health Centers (NACHC) (2006) *A sketch of community health centers: Chart book, 2006*. Washington, DC: NACHC.

- National Center of Health Statistics. (2006) H*ealth, United States, 2006: With chartbook on trends in the health of Americans.* Hyattsvills, Maryland: Department of Health and Human Services.

- National Health Services (NHS) Modernisation Agency. (2002) *Improvement leaders' Guide to Process Mapping, Analysis and Redesign*. Ipswich: Ancient House Printing Group.

- NHS Institute for Innovation and Improvement. (2008) 'Quality and Service Improvement Tools. A Focus on the Whole Patient Journey', [Online] Available at: http://www.institute.nhs.uk/quality_and_service_improvement_tools/quality_and_service_improvement_tools/a_focus_on_the_whole_patient_journey.html

- Nelson, E.C., Batalden, P.B., Mohr, J.J. and Plume, S.K. (1998) 'Building a quality future', *Frontiers of Health Services Management*, 15(1): 3-32.

- Notcutt, W. (2002) 'Complexity science. New approaches to evaluation of treatment are needed', *British Medical Journal,* 324(7330): 171-2.

- O'Reilly, P. (2000) *Healthcare practitioners: An Ontario case study in policy making*. Toronto: University of Toronto Press.

- Ormerod, R. (1998) 'Putting soft OR methods to work: information systems strategy development at Palabora', *Omega*, 26 (1): 75-98.

- Orr, M. and Sankaran, S. (2007) 'Mutual empathy, ambiguity, and the implementation of electronic knowledge management', *E:CO*, 9(1-2): 44-55.

- Pala, O., Vennix, J. and van Mullekon, T. (2003) 'Validity in SSM: neglected areas', *Journal of the Operational Research Society*, 54: 706-12.

- Paley, J. (2007) 'Complex adaptive systems and nursing', *Nurse Inquiry*, 14: 233–42.

- Pasko, T. and Smart, D.R. (2004) *Physician Characteristics and Distributions in the US*. Chicago, Illinois: American Medical Association.

- Paucar-Caceres, A. (2010) 'Mapping the changes in management science: A review of 'soft' Operation Research or Management Science', *Omega 38*: 46–56.

- Pauley, G. and Ormerod, R. (1998) 'The evolution of a performance measurement project at RTZ', *Interfaces*, 28: 94-118.

- Paulsen, D. (2004) 'Leadership essentials: facilitation skills for improving group effectiveness', In: *Proceedings of the 32nd annual ACM SIGUCCS conference on User services.* New York: ACM Press, pp. 153–160.

- Pearson, N. (1999) 'Positive and Negative Welfare and Australia's Indigenous Communities', *Family Matters* 54(Spring/Summer): 30–35.

- Perjons, E., Wangler, B., Wäyrynen, J. and Åhlfeldt, R. (2005) 'Introducing a process manager in healthcare: an experience report', *Health Informatics Journal*, 11: 45-61.

- Phillips, L. and Phillips, M. (1993) 'Facilitated work groups: theory and practice', *Journal of the Operational Research Society*, 44: 533–49.

- Picker Institute. (2000) *Eye on Patients. A report by the Picker Institute for the American Hospital Association.* Boston, Massachusetts: Picker Institute.

- Pidd, M. (1996) *Tools for Thinking: Modelling in Management Science.* Chichester, UK: Wiley.

- Pidd, M. (1999) 'Just Modeling Through: A Rough Guide to Modeling', *Interfaces*, 29(2): 118-132.

- Pidd, M. (2007) 'Making sure you tackle the right problem: linking hard and soft methods in simulation practice', In *Proceedings of the 2007 Winter Simulation Conference*, (eds). S.G.

- Plsek, P. E. and Greenhalgh, T. (2001) 'Complexity science: the challenge of complexity in health care', *British Medical Journal*, 628.

- Plsek, P. E. and Wilson, T. (2001) 'Complexity, leadership, and management in healthcare organisations', *British Medical Journal*, 749.

- Platts, K. W. (1993) 'A Process Approach to Researching Manufacturing Strategy', *International Journal of Operations and Production Management*, 13(8): 4-17.

- Polya, G. (1957) *How to solve it.* Princeton, NJ: Princeton University Press.

- Pope, C. and Mays, N. (1995) 'Qualitative Research: Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research', *British Medical Journal*, 311: 42-45

- Presley, A. (2002) 'Evaluating ERP Impact Through Soft Systems Methodology', In:

Annual IIE Conference Proceedings. Dallas, TX: IIE.

- Presley, A., Sarkis, J. and Liles, D. H. (2000) 'A Soft-Systems Methodology Approach for Product and Process Innovation', *IEEE Transactions On Engineering Management*, 47(3): 379

- Press Ganey Associates, Inc. (2011) *Press Ganey Report*, [Online]. Available at: <http://www.pressganey.com/index.aspx> [Accessed 22 February 2011].

- Przeworski, A. and Teune, H. (1970) *The logic of comparative social inquiry*. New York: John Wiley.

- Raisio, H. (2009) 'Health care reform planners and wicked problems - Is the wickedness of the problems taken seriously or is it even noticed at all?', *Journal of Health Organization and Management*, 23(5): 477-493

- Reason, P. And Bradbury, H. (2001) Handbook of Action Research. Thousand Oaks, CA: Sage.

- Reid, I. (2002) 'Complexity science. Let them eat complexity: the emperor's new toolkit', *British Medical Journal*, 324(7330): 171.

- Reid, P.P., Compton, W.D., Grossman, J.H. and Fanjiang, G. (2005) *Building a Better Delivery System: A New Engineering/Health Care Partnership.* Washington, DC: The National Academies Press.

- Reynolds, M. and Holwell, S. (eds.) (2010). *Systems Approaches to Managing Change: A Practical Guide.* London: Springer.

- Rhodes, A.W. (1998) 'Different Roads to Unfamiliar Places: U.K. Experience in Comparative Perspective', *Australian Journal of Public Administration,* 57(4): 19–31.

- Richardson, G. P. and Andersen, D. F. (1995) 'Teamwork in Group Model Building',

System Dynamics Review, 11(2): 113–137.

- Riley, M.S. and Greeno, J. G. (1998) 'Developmental analysis of understanding language about quantities and of solving problems', *Cognition and Instruction*, 5: 49-101.

- Ritchey, T. (2005) *Wicked Problems: Structuring Social Messes with Morphological Analysis*, [Online] Available at <www.swemorph.com> [Accessed April 26, 2011].

- Ritchey, T. (2006) 'Problem Structuring using Computer-Aided Morphological Analysis', *Journal of the Operational Research Society*, Special Issue on Problem Structuring Methods, 57: 792–801.

- Ritchey, T. (2011) *Wicked Problems – Social Messes.* Dordrecht: Springer

- Rittel, H. W. J. and Webber, M. M. (1973) 'Dilemmas in a general theory of planning', *Policy sciences*, 4(2): 155-169.

- Robinson, S. (2008) 'Conceptual modeling for simulation Part 1: definition and requirements', *Journal of the Operational Research Society*, 59(3): 278- 290.

- Rodgers, N. (2000) *Learning to reason: An introduction to logic, sets, and relations*. USA: John Wiley and Sons.

- Rodríguez-Ulloa, R. A. (2004) 'Soft System Dynamics Methodology – SSDM: A Tool for Social Systems Analysis and Design', *System Research and Behavioral Science*, 21 (6): 445.

- Rodríguez-Ulloa, R. A., Montbrun, A. and Martínez-Vicente, S. (2011) 'Soft System Dynamics Methodology in Action: A study of the Problem of Citizen Insecurity in an Argentinean Province', *Systemic Practice and Action Research*, 24(4): 275-323.

- Rogers, R. (2011) 'RACI Matrix leading to consistent quality improvement', [Online]. Available at: < http://www.omniway.ca/news_details.php?id=9705> [Accessed April 20

2011]

- Roginski, C. (1995) Applying SODA in the NHS - A facilitator's story. OR Insight, Vol 8 Issue 2.

- Rose, J. and Haynes, M. (1999) *A soft systems approach to the evaluation of complex interventions in the public sector*. *Journal of Applied Management Studies*, 8(2): pp. 199-216.

- Rosenhead, J (ed). (1989) *Rational Analysis for a Problematic World: problem structuring methods for complexity, uncertainty and conflict*. Chichester: John Wiley.

- Rosenhead, J. (1996) 'What's the problem? An introduction to problem structuring methods', *Interfaces*, 26: 117-131.

- Rosenhead, J. and Mingers, J. (eds.) (2001) *Rational Analysis for a Problematic World Revisited*. Chichester: John Wiley.

- Rosenhead, J. (2006) 'Past, present and future of problem structuring methods', *Journal of the Operational Research Society*, 57 (7): 759-765.

- Rowley, T. J. (1997) 'Moving beyond dyadic ties: A network theory of stakeholder influences', *Academy of Management Review*, 22: 887-910.

- Rowley, T. J. (2002) 'Using Case Studies in Research', *Management Research News*, 25(1): 16-27.

- Ryan, J. K. (2005) *Systems Engineering: Opportunities for Health Care*. In: *Building a Better Delivery System: A New Engineering/Health Care Partnership*. Reid, P.P., Compton, W.D., Grossman, J.H. and Fanjiang, G. (eds). Washington D.C.: National Academies Press.

- Sachdeva, R., Williams, T. and Quigley, J. (2007) 'Mixing Methodologies to Enhance the

Implementation of Healthcare Operational Research', *The Journal of the Operational Research Society*, 58 (2): 159-167.

- Sardiwal, S. (2010) 'Coping Policies within Social Services in the UK', *System Dynamics UK Chapter Conference*, 11th-12th February, London South Bank University.

- Sargent, R. G. (1984) *Simulation Model validation, Simulation and Model-Based Methodologies: An Intergrative View*, ed. Oren, et al. Springer-Verlag.

- Sargent, R. G. (2005) 'Verification and Validation of Simulation Models', In: *Proceeding of 2005 Winter Simulation Conference* (eds), S.G.

- Saunders, M., Lewis, P. and Thornhill, A. (2007) *Research methods for business students.* 4th ed. London: Prentice Hall.

- Schensul, S. L., Schensul, J. J. and LeCompte, M. D. (1999) *Essential ethnographic methods: observations, interviews, and questionnaires*. Walnut Creek, CA: AltaMirna Press.

- Schoenfeld, A. (1989) 'Explorations of students' mathematics beliefs and behaviour', *Journal for Research in Mathematics Education, 20: 338-355.*

- Sculpher, M., Fenwick, E. and Claxton, K. (2000) 'Assessing quality in decision analytic cost-effectiveness models: a suggested framework and example of application', *Pharmacoeconomics*, 17:461-77.

- Seawright, J. and Gerring, J. (2008) 'Case Selection Techniques in Case Study Research: A Menu of Qualitative and Quantitative Options', *Political Research Quarterly*, 61(2):294-308.

- Senge, P. M. (1990) *The Fifth Discipline*. New York: Doubleday.

- Shaw, J. S., Edwards, P. M. and Collier, D. (2006) 'Quid Pro Quo: Reflections on the

Value of Problem Structuring Group', *The Journal of the Operational Research Society*, 57 (8): 939-949.

- Shehabuddeen, N. Probert, D., Phaal, R. and Platts, K. (1999) *Centre for Technology Management Working Paper Series: Working Paper Series.* London: University of Cambridge Institute for Manufacturing.

- Shi, L. and Singh, D. A. (2008). *Delivering Health Care in America*. Gaithersburg, MD: Aspen.

- Shih, A., Davis, K., Schoenbaum, S.C., Gauthier, R., Nuzum, R. and McCarthy, D. (2008) *Organizing the U.S. Health Care Delivery System for High Performance*. New York, NY: The Commonwealth Fund.

- Shortell, S. M., Gillies, R. R., Anderson, D. A., Erickson, K.M. and Mitchell. J.B. (1996) *Remaking Organized Delivery Systems: Building Organized Delivery Systems*. San Francisco: Jossey-Bass Publishers.

- Siddiqui, M. H. and Tripathi, S. N. (2011) 'Application of Soft Operations Research for Enhancing The Servicescape as a Facilitator', *Vikaipa*, 36 (1): 33-49

- Silverman, J., Kurtz, S. and Draper, J. (1998) *Skills for communicating with patients.* Oxford: Radcliffe Medical Press.

- Simon, H. A. (1962) 'The architecture of complexity', *Proceedings of the American Philosophical Society*, 106: 467–82.

- Simon, H. A. (1965) 'The architecture of complexity', *General System*, 10: 63-73

- Simon, H. A. (1973) 'Structure of ill-structured problems', *Artificial Intelligence*, 4: 181–201.

- Simon, H. A. (1996) *The sciences of the artificial.* Cambridge (MA): MIT Press.

- Skocpol, T. and Somers, M. (1980) 'The uses of comparative history in macrosocial inquiry', *Comparative Studies in Society and History,* 22(2): 147-97.

- Smith, M. and Feied, C. (2006) *The emergency department as a complex system*. New England Complex System Institute.

- Snowden, D. J. and Boone, M. E. (2007) 'A leader's framework for decision making', *Harvard Business Review*, 85(11): 68.

- Sørensen, L. and Vidal, R. V. (2008) 'Evaluating six soft approaches', *Economic analysis working papers*, 9.

- Starr, P. (1982) *The Social Transformation of American Medicine: The Rise of a Sovereign Profession and the Making of a Vast Industry.* New York, NY: Perseus Books Group.

- Stevens, R. (1972) *American Medicine and the Public Interest.* New Haven, CT: Yale University Press.

- Stuart, F.I., McCutcheon, D.M., Handfield, R.B., McLachlin, R. and Samson, D. (2002) 'Effective case research in operations management: a process perspective', *Journal of Operations Management*, 20 (5), 419–433.

- Susman, G. And Evered, R. (1978) 'An assessment of the scientific merits of action research', *Administrative Science Quarterly*, 23: 582-603.

- Tashakkori, A. and Teddlie, C. (1998) *Mixed Methodology: combining qualitative and quantitative approaches*. London: Sage publications..

- The Regional Cancer Centre. (2009) The Regional Cancer Centre, [Online]. Available at: <http://www.trcc.org> [Accessed 20 February 2011].

- Thompson, D. N., Wolf, G. A., and Spear, S. J. (2003) 'Driving Improvement in Patient Care: Lessons from Toyota', *Journal of Nursing Administration*, 33 (11): 585-595.

- Thunhurst, C., Cronin, M. and Curtin, M. (2006) 'The ORCHID project—using operational research to build partnerships for community health development', In: Brailsford S (ed). *Proceedings of the 31st Annual Meeting of the European Working Group on Operational Research Applied to Health Services*. University of Southampton.

- Travis, J. and Venable, J. R. (2002). *An Introduction to Soft Systems Methodology*, [Online]. Available at: http://cispom.boisestate.edu/cis310emaxson/ssm_intro.htm [Accessed May 17 2011]

- Trebble, T.M., Hansi, N., Hydes, T., Smith, M. and Baker, M. (2010) 'Process mapping the patient journey: an introduction', *British Medical Journal*, 341:1-8.

- Tucker, A. L. (2004) 'The impact of operational failures on hospital nurses and their patients', *Journal of Operations Management,* 22: 151-169.

- Tucker, A. L. and Edmondson, A. C. (2003) 'Why hospitals don't learn from failures: Organizational and psychological dynamics that inhibit system change', *California Management Review,* 45 (2): 55-71.

- Turkewitz, A. and Colman, G. (2009). Out-and–out Care, [Online] Available at: < http://www.hospitalmanagement.net/features/feature66404> [Accessed January 29 2011]

- Van Bueren, E. M., Klijn, E. H. and Koppenjan J. M. (2003) 'Dealing with wicked problems in networks: Analyzing an environmental debate from a network perspective', *Journal of Public Administration Research and Theory*, 13(2): 193–212.

- Vennix, J. A. M. (1999) 'Group Model-Building: Tackling Messy Problems', *System Dynamics Review*, 15: 379 – 401.

- Vidal, R. V. V. (2005) 'Soft OR Approaches', *ENGEVISTA*, 7 (1): 4-20.

- Wacker, J. G. (1998) 'A definition of theory: research guidelines for different theory building research methods in operations management', *Journal or Operations Management*, 16: 361-385.

- Waddock, S. (1991) 'A Typology of Social Partnership Organizations', *Administration and Society,* 22(4): 480-515.

- Wedgwood, D.I. (2007) *Lean Sigma: A Practitioner's Guide*. 1st edition. Prentice Hall.

- Weick, K.E. (1984) Theoretical assumptions and research methodology selection. (*McFarlan, F.W. ed.), The Information Systems Research Challenge: Proceeding.* Boston: Harvard Business School Press, pp. 111-132.

- Westcombe, M. (2002) 'Problem Structuring: The Process of SODA Modelling', *Working Paper as ACM Hypertext 2002 Conference: Workshop on Facilitating Hypertext-Augmented Collaborative Modeling*. MD: University of Maryland.

- Westbrook, J. I., Braithwaite, J., Georgiou, A., Ampt, A., Creswick, N., Coiera, E. and Iedema, R. (2007) 'Multimethod Evaluation of Information and Communication Technologies in Health in the Context of Wicked Problems and Sociotechnical Theory', *Journal of the American Medical Informatics Association*, 14 (6): 746-755.

- Wilensky, G. R., Wolter, N. and Fischer. M. M. (2006) 'Gain Sharing: A Good Concept Getting a Bad Name?', *Health Affairs*, 26: 58-67.

- Williams, T., Eden, C., Ackermann, F. and Tait, A. (1995) 'The effects of design changes and delays on project costs', *Journal of the Operational Research Society,* 47(7): 809-818.

- Wilson, J. (2010) *Essentials of Business Research A Guide to Doing Your Research Project.* London, UK: SAGE Publications Ltd.

- Wilson, T., Holt, T. and Greenhalgh, T. (2001) 'Complexity science: complexity and clinical care', *British Medical Journal,* 323: 685–8.

- Winklhofer, H. (2002) *A Case for Soft Systems Methodology Information Analysis and Information Systems Evaluation During Organizational Change*. Gdansk, Poland: ECIS.

- Womack, J.P. and Jones, D.T. (2003) '*Introduction: Lean thinking versus Muda',* In: *Lean thinking*. 2nd ed. London: Simon & Schuster, pp.15-28.

- Wood, P.K. (1983) 'Inquiring systems and problem structures: Implications for cognitive development', *Human Development*, 26: 249-265.

- Woolley, R. and Pidd, M. (1981) 'A pilot-study of problem structuring', *Journal of the Operational Research Society*, 31: 1063–8.

- World Health Organization (WHO). (2000) *The world health report 2000 - Health systems :improving performance.* Geneva: World Health Organization.

- WHO. (2007) Everybody's business to strengthen health systems to improve health outcomes – WHO's framework for action. Geneva: World Health Organization.

- WHO. (2009) Better knowledge for Safer Care. Human Factors in Patient Safety - Review of Topics and Tools Report for Methods and Measures Working Group of WHO Patient Safety. Geneva: World Health Organization.

- Yin, R. K. (1994) *Case Study Research: Design and Methods, Applied Social Research Methods Series*, USA: Sage Publications, 5.

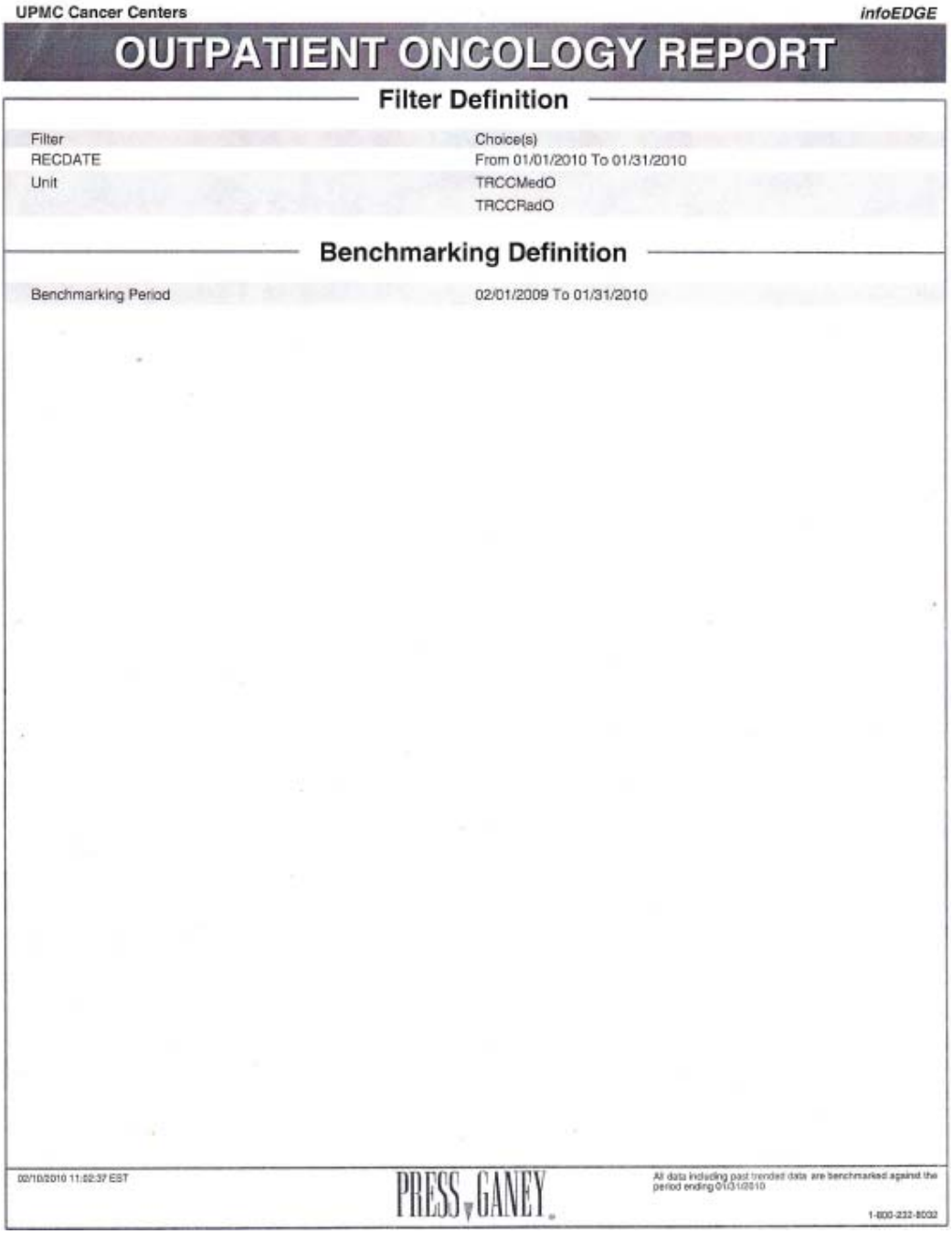
- Young, T., Eatock, J., Jahangirian, M., Naseer, A. and Lilford, R. (2009) 'Three critical challenges for modeling and simulation in healthcare', *In Proceedings of the 2009 Winter Simulation Conference, October,* pp. 1823–1830.

- Zigurs, I. and Buckland, B. (1998) 'A Theory of Task/Technology Fit and Group Support

Systems Effectiveness', *Management Information Systems Quarterly*, 22: 313-334.

APPENDICES

APPENDIX-A: SAMPLE OF PRESS GANEY REPORT



UPMC Cancer Centers *infoEDGE*

OUTPATIENT ONCOLOGY REPORT

Filter Definition

Filter	Choice(s)
RECDATE	From 01/01/2010 To 01/31/2010
Unit	TRCCMedO
	TRCCRadO

Benchmarking Definition

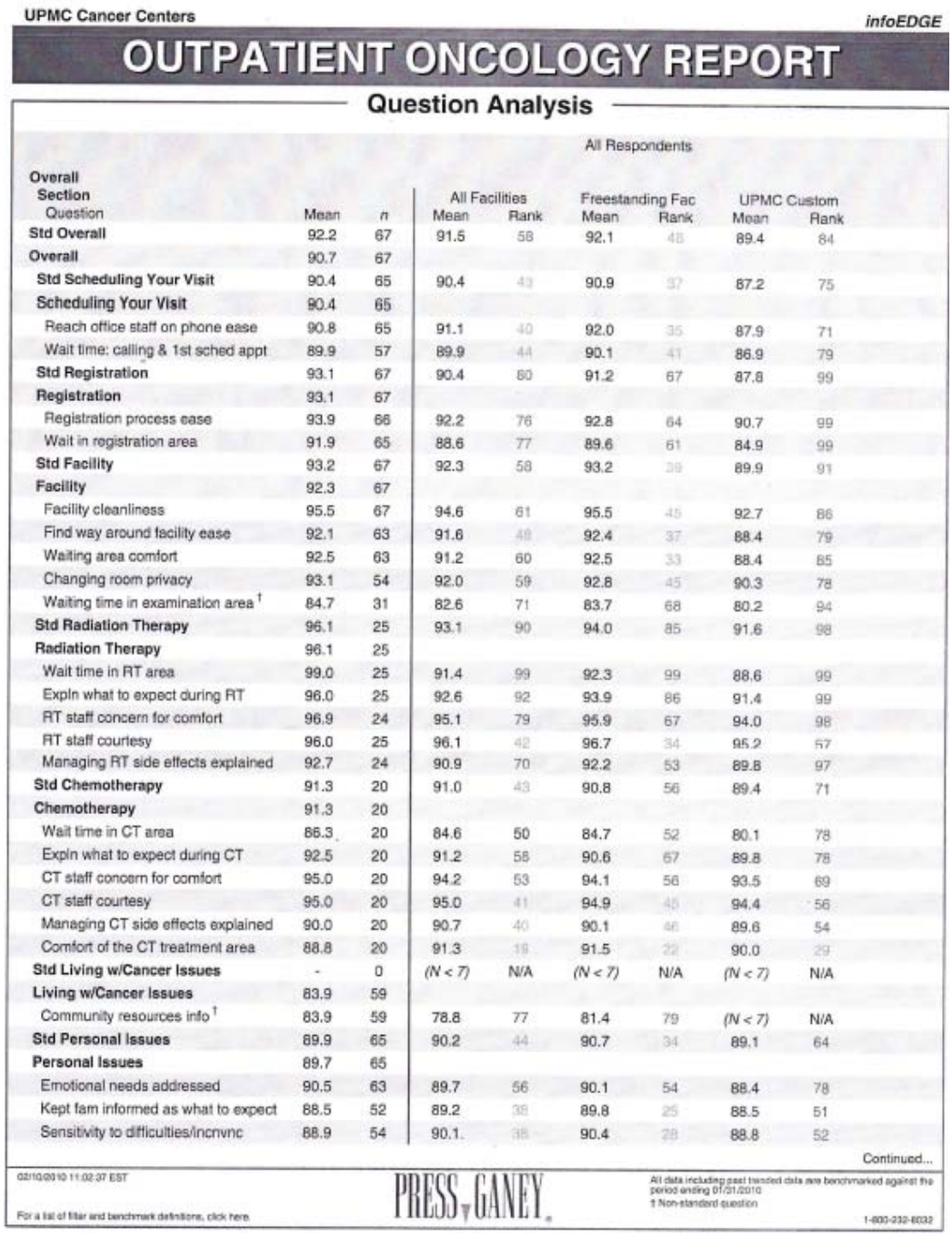
Benchmarking Period	02/01/2009 To 01/31/2010

02/10/2010 11:02:37 EST

PRESS GANEY

All data including past trended data are benchmarked against the period ending 01/31/2010

1-800-232-8032



UPMC Cancer Centers

infoEDGE

OUTPATIENT ONCOLOGY REPORT

Question Analysis

All Respondents

Overall / Section / Question	Mean	n	All Facilities Mean	All Facilities Rank	Freestanding Fac Mean	Freestanding Fac Rank	UPMC Custom Mean	UPMC Custom Rank
Std Overall	92.2	67	91.5	58	92.1	48	89.4	84
Overall	90.7	67						
Std Scheduling Your Visit	90.4	65	90.4	43	90.9	37	87.2	75
Scheduling Your Visit	90.4	65						
Reach office staff on phone ease	90.8	65	91.1	40	92.0	35	87.9	71
Wait time: calling & 1st sched appt	89.9	57	89.9	44	90.1	41	86.9	79
Std Registration	93.1	67	90.4	80	91.2	67	87.8	99
Registration	93.1	67						
Registration process ease	93.9	66	92.2	76	92.8	64	90.7	99
Wait in registration area	91.9	65	88.6	77	89.6	61	84.9	99
Std Facility	93.2	67	92.3	58	93.2	39	89.9	91
Facility	92.3	67						
Facility cleanliness	95.5	67	94.6	61	95.5	45	92.7	86
Find way around facility ease	92.1	63	91.6	48	92.4	37	88.4	79
Waiting area comfort	92.5	63	91.2	60	92.5	33	88.4	85
Changing room privacy	93.1	54	92.0	59	92.8	45	90.3	78
Waiting time in examination area †	84.7	31	82.6	71	83.7	68	80.2	94
Std Radiation Therapy	96.1	25	93.1	90	94.0	85	91.6	98
Radiation Therapy	96.1	25						
Wait time in RT area	99.0	25	91.4	99	92.3	99	88.6	99
Explin what to expect during RT	96.0	25	92.6	92	93.9	86	91.4	99
RT staff concern for comfort	96.9	24	95.1	79	95.9	67	94.0	98
RT staff courtesy	96.0	25	96.1	42	96.7	34	95.2	57
Managing RT side effects explained	92.7	24	90.9	70	92.2	53	89.8	97
Std Chemotherapy	91.3	20	91.0	43	90.8	56	89.4	71
Chemotherapy	91.3	20						
Wait time in CT area	86.3	20	84.6	50	84.7	52	80.1	78
Explin what to expect during CT	92.5	20	91.2	58	90.6	67	89.8	78
CT staff concern for comfort	95.0	20	94.2	53	94.1	56	93.5	69
CT staff courtesy	95.0	20	95.0	41	94.9	45	94.4	56
Managing CT side effects explained	90.0	20	90.7	40	90.1	46	89.6	54
Comfort of the CT treatment area	88.8	20	91.3	18	91.5	22	90.0	29
Std Living w/Cancer Issues	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Living w/Cancer Issues	83.9	59						
Community resources info †	83.9	59	78.8	77	81.4	79	*(N < 7)*	N/A
Std Personal Issues	89.9	65	90.2	44	90.7	34	89.1	64
Personal Issues	89.7	65						
Emotional needs addressed	90.5	63	89.7	56	90.1	54	88.4	78
Kept fam informed as what to expect	88.5	52	89.2	38	89.8	25	88.5	51
Sensitivity to difficulties/incnvnc	88.9	54	90.1	38	90.4	28	88.8	52

Continued...

02/10/2010 11:02:37 EST

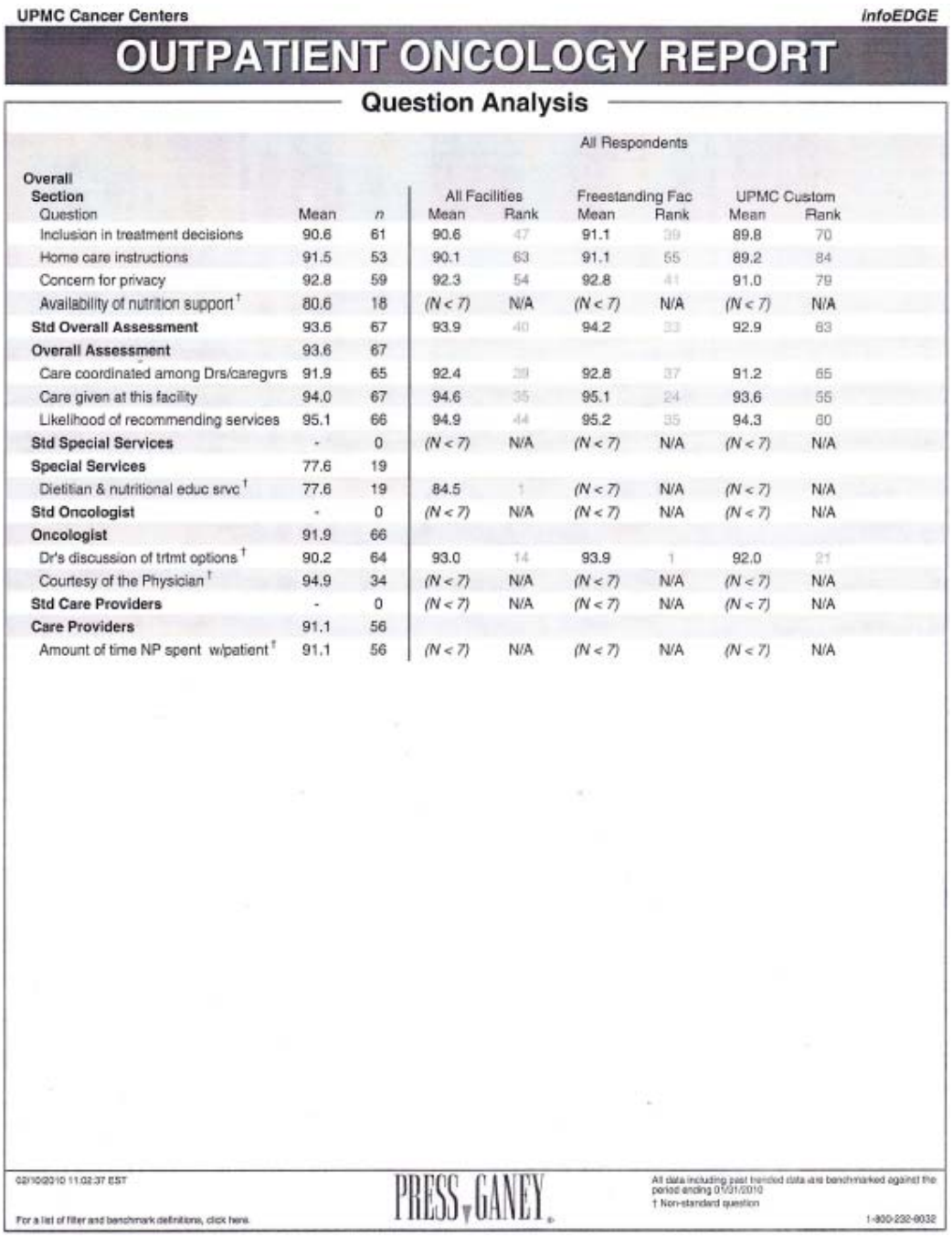
For a list of filter and benchmark definitions, click here.

PRESS GANEY

All data including past trended data are benchmarked against the period ending 01/31/2010

† Non-standard question

1-800-232-8032



UPMC Cancer Centers — infoEDGE

OUTPATIENT ONCOLOGY REPORT

Question Analysis

All Respondents

Overall Section / Question	Mean	n	All Facilities Mean	All Facilities Rank	Freestanding Fac Mean	Freestanding Fac Rank	UPMC Custom Mean	UPMC Custom Rank
Inclusion in treatment decisions	90.6	61	90.6	47	91.1	39	89.8	70
Home care instructions	91.5	53	90.1	63	91.1	55	89.2	84
Concern for privacy	92.8	59	92.3	54	92.8	41	91.0	79
Availability of nutrition support †	80.6	18	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Overall Assessment	93.6	67	93.9	40	94.2	33	92.9	63
Overall Assessment	93.6	67						
Care coordinated among Drs/caregvrs	91.9	65	92.4	39	92.8	37	91.2	65
Care given at this facility	94.0	67	94.6	35	95.1	24	93.6	55
Likelihood of recommending services	95.1	66	94.9	44	95.2	35	94.3	60
Std Special Services	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Special Services	77.6	19						
Dietitian & nutritional educ srvc †	77.6	19	84.5	1	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Oncologist	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Oncologist	91.9	66						
Dr's discussion of trtmt options †	90.2	64	93.0	14	93.9	1	92.0	21
Courtesy of the Physician †	94.9	34	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Std Care Providers	-	0	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A
Care Providers	91.1	56						
Amount of time NP spent w/patient †	91.1	56	*(N < 7)*	N/A	*(N < 7)*	N/A	*(N < 7)*	N/A

02/10/2010 11:02:37 EST

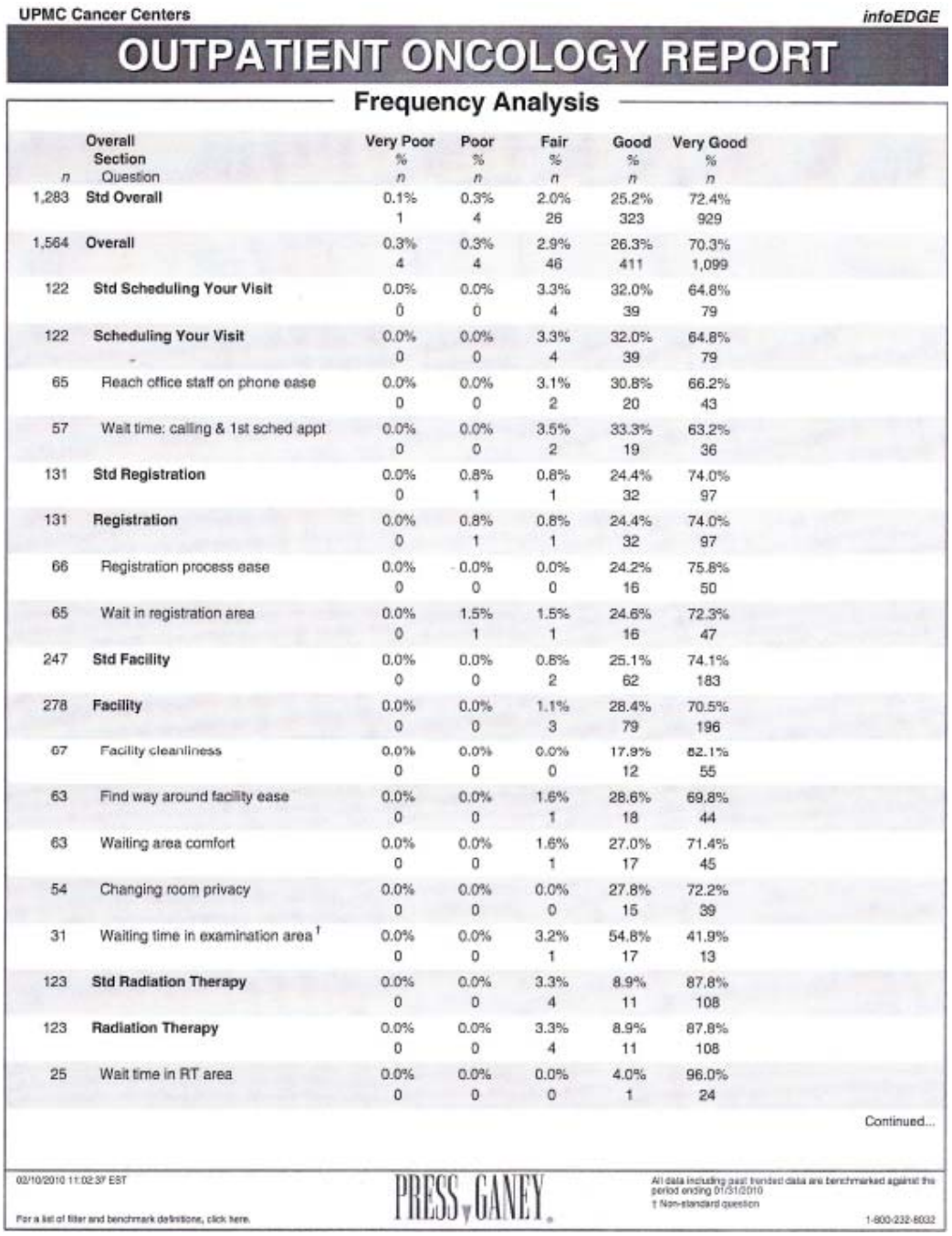
For a list of filter and benchmark definitions, click here.

PRESS GANEY

All data including past trended data are benchmarked against the period ending 01/31/2010

† Non-standard question

1-800-232-8032



UPMC Cancer Centers — infoEDGE

OUTPATIENT ONCOLOGY REPORT

Frequency Analysis

n	Overall Section / Question	Very Poor % n	Poor % n	Fair % n	Good % n	Very Good % n
1,283	**Std Overall**	0.1% 1	0.3% 4	2.0% 26	25.2% 323	72.4% 929
1,564	**Overall**	0.3% 4	0.3% 4	2.9% 46	26.3% 411	70.3% 1,099
122	**Std Scheduling Your Visit**	0.0% 0	0.0% 0	3.3% 4	32.0% 39	64.8% 79
122	**Scheduling Your Visit**	0.0% 0	0.0% 0	3.3% 4	32.0% 39	64.8% 79
65	Reach office staff on phone ease	0.0% 0	0.0% 0	3.1% 2	30.8% 20	66.2% 43
57	Wait time: calling & 1st sched appt	0.0% 0	0.0% 0	3.5% 2	33.3% 19	63.2% 36
131	**Std Registration**	0.0% 0	0.8% 1	0.8% 1	24.4% 32	74.0% 97
131	**Registration**	0.0% 0	0.8% 1	0.8% 1	24.4% 32	74.0% 97
66	Registration process ease	0.0% 0	0.0% 0	0.0% 0	24.2% 16	75.8% 50
65	Wait in registration area	0.0% 0	1.5% 1	1.5% 1	24.6% 16	72.3% 47
247	**Std Facility**	0.0% 0	0.0% 0	0.8% 2	25.1% 62	74.1% 183
278	**Facility**	0.0% 0	0.0% 0	1.1% 3	28.4% 79	70.5% 196
67	Facility cleanliness	0.0% 0	0.0% 0	0.0% 0	17.9% 12	82.1% 55
63	Find way around facility ease	0.0% 0	0.0% 0	1.6% 1	28.6% 18	69.8% 44
63	Waiting area comfort	0.0% 0	0.0% 0	1.6% 1	27.0% 17	71.4% 45
54	Changing room privacy	0.0% 0	0.0% 0	0.0% 0	27.8% 15	72.2% 39
31	Waiting time in examination area [1]	0.0% 0	0.0% 0	3.2% 1	54.8% 17	41.9% 13
123	**Std Radiation Therapy**	0.0% 0	0.0% 0	3.3% 4	8.9% 11	87.8% 108
123	**Radiation Therapy**	0.0% 0	0.0% 0	3.3% 4	8.9% 11	87.8% 108
25	Wait time in RT area	0.0% 0	0.0% 0	0.0% 0	4.0% 1	96.0% 24

Continued...

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For a list of filter and benchmark definitions, click here.

PRESS GANEY

All data including past trended data are benchmarked against the period ending 01/31/2010

1 Non-standard question

1-800-232-8032

UPMC Cancer Centers — InfoEDGE

OUTPATIENT ONCOLOGY REPORT

Frequency Analysis

n	Overall Section / Question	Very Poor % n	Poor % n	Fair % n	Good % n	Very Good % n
25	Expln what to expect during RT	0.0% 0	0.0% 0	4.0% 1	8.0% 2	88.0% 22
24	RT staff concern for comfort	0.0% 0	0.0% 0	4.2% 1	4.2% 1	91.7% 22
25	RT staff courtesy	0.0% 0	0.0% 0	4.0% 1	8.0% 2	88.0% 22
24	Managing RT side effects explained	0.0% 0	0.0% 0	4.2% 1	20.8% 5	75.0% 18
120	**Std Chemotherapy**	0.0% 0	0.0% 0	1.7% 2	31.7% 38	66.7% 80
120	**Chemotherapy**	0.0% 0	0.0% 0	1.7% 2	31.7% 38	66.7% 80
20	Wait time in CT area	0.0% 0	0.0% 0	5.0% 1	45.0% 9	50.0% 10
20	Expln what to expect during CT	0.0% 0	0.0% 0	0.0% 0	30.0% 6	70.0% 14
20	CT staff concern for comfort	0.0% 0	0.0% 0	0.0% 0	20.0% 4	80.0% 16
20	CT staff courtesy	0.0% 0	0.0% 0	0.0% 0	20.0% 4	80.0% 16
20	Managing CT side effects explained	0.0% 0	0.0% 0	0.0% 0	40.0% 8	60.0% 12
20	Comfort of the CT treatment area	0.0% 0	0.0% 0	5.0% 1	35.0% 7	60.0% 12
0	**Std Living w/Cancer Issues**	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
59	**Living w/Cancer Issues**	1.7% 1	0.0% 0	10.2% 6	37.3% 22	50.8% 30
59	Community resources info †	1.7% 1	0.0% 0	10.2% 6	37.3% 22	50.8% 30
342	**Std Personal Issues**	0.3% 1	0.6% 2	3.8% 13	27.5% 94	67.8% 232
360	**Personal Issues**	0.6% 2	0.6% 2	4.2% 15	27.8% 100	66.9% 241
63	Emotional needs addressed	0.0% 0	0.0% 0	4.8% 3	28.6% 18	66.7% 42
52	Kept fam informed as what to expect	1.9% 1	0.0% 0	3.8% 2	30.8% 16	63.5% 33
54	Sensitivity to difficulties/incnvnc	0.0% 0	0.0% 0	11.1% 6	22.2% 12	66.7% 36

Continued...

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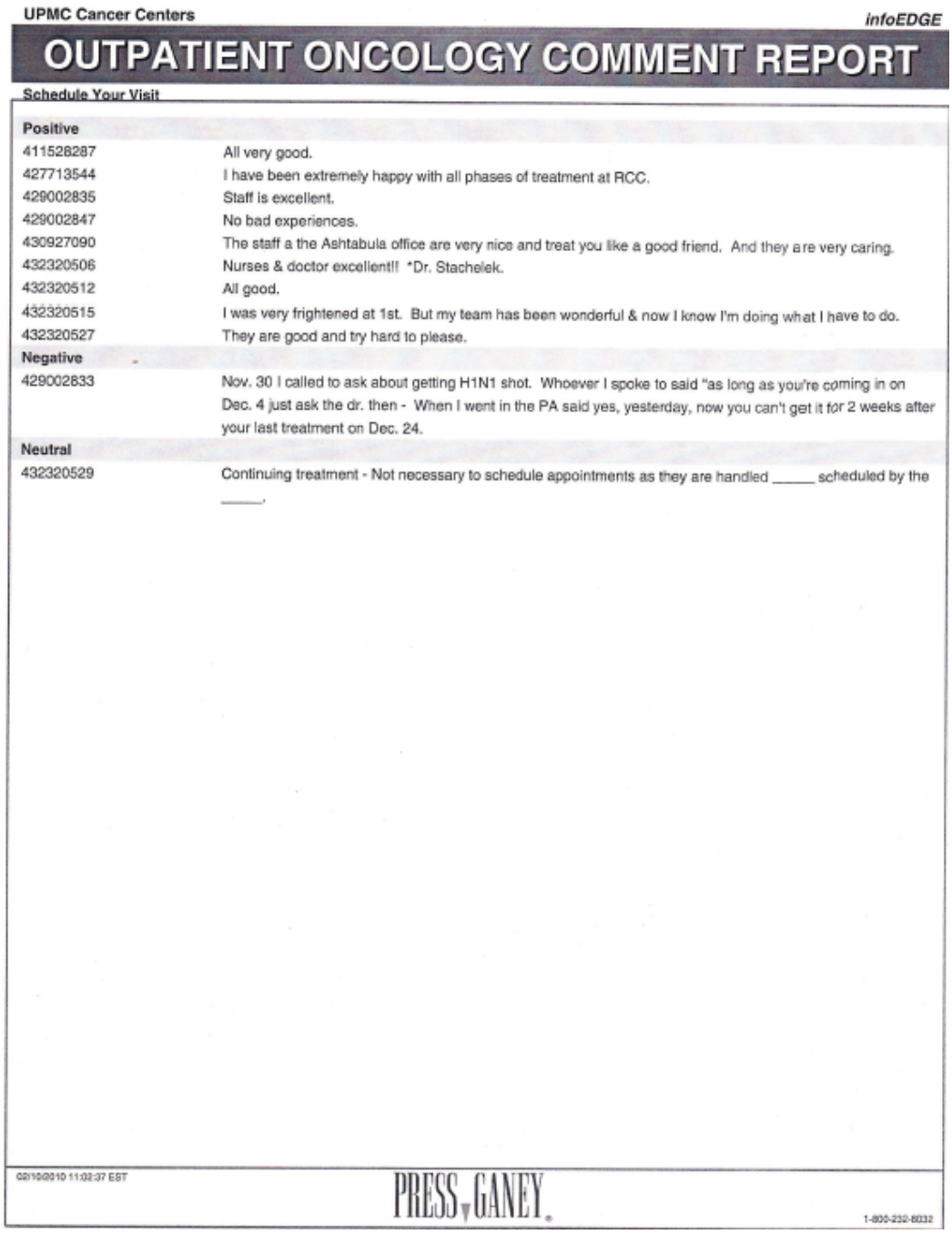
For a list of filter and benchmark definitions, click here.

PRESS GANEY

All data including past trended data are benchmarked against the period ending 01/31/2010

† Non-standard question

1-800-232-8032



UPMC Cancer Centers

infoEDGE

OUTPATIENT ONCOLOGY COMMENT REPORT

Schedule Your Visit

Positive	
411528287	All very good.
427713544	I have been extremely happy with all phases of treatment at RCC.
429002835	Staff is excellent.
429002847	No bad experiences.
430927090	The staff a the Ashtabula office are very nice and treat you like a good friend. And they are very caring.
432320506	Nurses & doctor excellent!! *Dr. Stachelek.
432320512	All good.
432320515	I was very frightened at 1st. But my team has been wonderful & now I know I'm doing what I have to do.
432320527	They are good and try hard to please.
Negative	
429002833	Nov. 30 I called to ask about getting H1N1 shot. Whoever I spoke to said "as long as you're coming in on Dec. 4 just ask the dr. then - When I went in the PA said yes, yesterday, now you can't get it for 2 weeks after your last treatment on Dec. 24.
Neutral	
432320529	Continuing treatment - Not necessary to schedule appointments as they are handled _____ scheduled by the _____.

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PRESS GANEY

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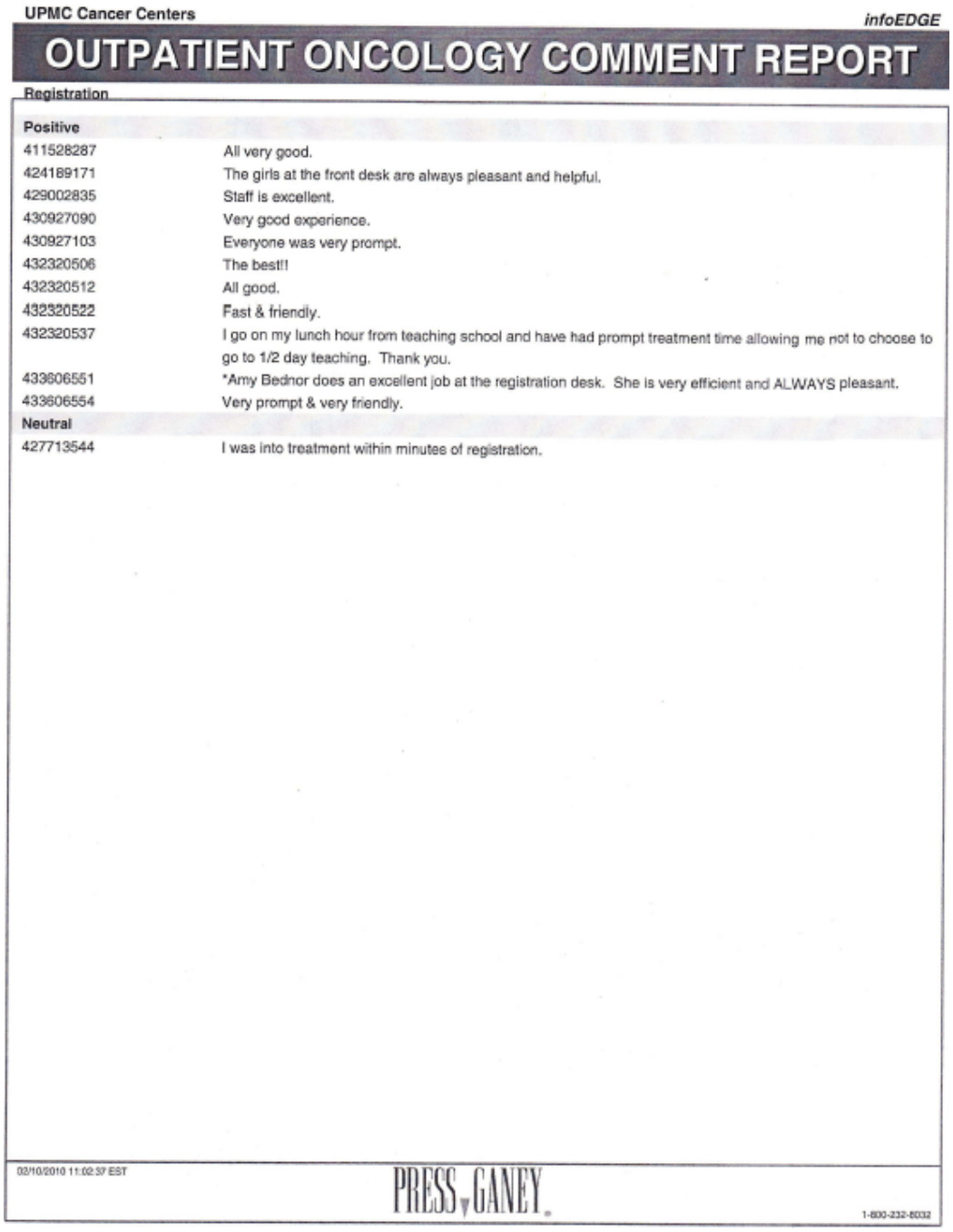

UPMC Cancer Centers

infoEDGE

OUTPATIENT ONCOLOGY COMMENT REPORT

Registration

Positive	
411528287	All very good.
424189171	The girls at the front desk are always pleasant and helpful.
429002835	Staff is excellent.
430927090	Very good experience.
430927103	Everyone was very prompt.
432320506	The best!!
432320512	All good.
432320522	Fast & friendly.
432320537	I go on my lunch hour from teaching school and have had prompt treatment time allowing me not to choose to go to 1/2 day teaching. Thank you.
433606551	*Amy Bednor does an excellent job at the registration desk. She is very efficient and ALWAYS pleasant.
433606554	Very prompt & very friendly.
Neutral	
427713544	I was into treatment within minutes of registration.

02/10/2010 11:02:37 EST

PRESS GANEY

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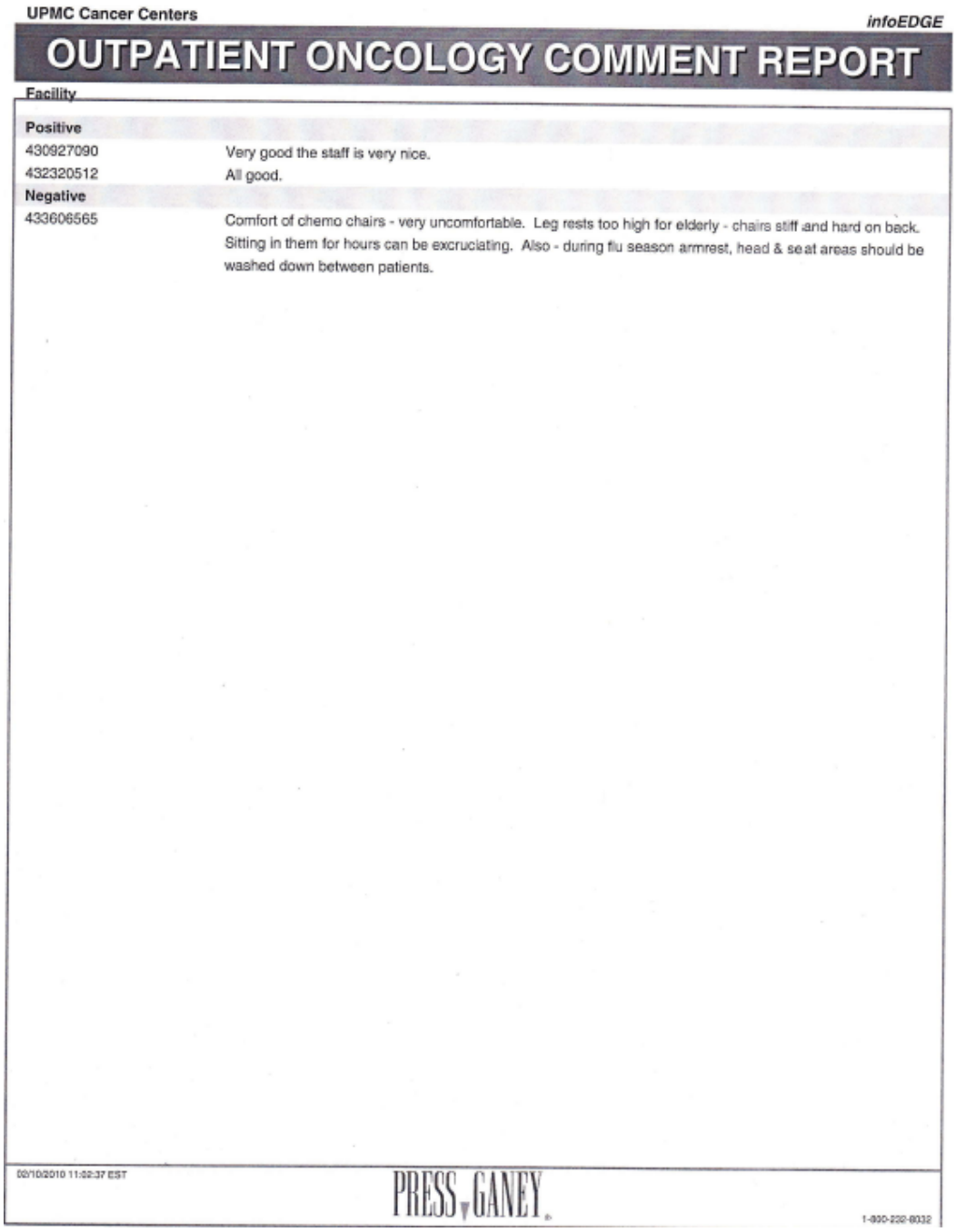

UPMC Cancer Centers

infoEDGE

OUTPATIENT ONCOLOGY COMMENT REPORT

Facility	
Positive	
430927090	Very good the staff is very nice.
432320512	All good.
Negative	
433606565	Comfort of chemo chairs - very uncomfortable. Leg rests too high for elderly - chairs stiff and hard on back. Sitting in them for hours can be excruciating. Also - during flu season armrest, head & seat areas should be washed down between patients.

02/10/2010 11:02:37 EST

PRESS GANEY

1-800-232-8032

UPMC Cancer Centers

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OUTPATIENT ONCOLOGY COMMENT REPORT

Radiation Therapy

Positive	
421639456	Very caring & helpful - supportive.
429002835	Staff is excellent.
429002848	All good - Very polite - Very-caring - me nice folks.
430927090	Very good experience the girls always ask how I am going they really care.
433606551	Radiation staff was very good - efficient and friendly.
Negative	
433606565	The warming blankets in chemo might be a good idea on the table and over the patient - it's cold in there.
Mixed	
432320515	Only one day - on a bad day - did I feel uncomfortable with the tone of voice one of the girls used. But I think it was because I just took it wrong because I was ill.
433606577	When I go for my daily treatments, I really like that I can scan my card & check in myself. One thing that really bothers me is that the RT technicians announce both my first & last name over the waiting room speaker when they say I can come back to the treatment area. What about HIPPA requirements?

02/10/2010 11:02:37 EST

PRESS GANEY

1-800-232-6032

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OUTPATIENT ONCOLOGY COMMENT REPORT

Radiation Therapy

Positive	
421639456	Very caring & helpful - supportive.
429002835	Staff is excellent.
429002848	All good - Very polite - Very-caring - me nice folks.
430927090	Very good experience the girls always ask how I am going they really care.
433606551	Radiation staff was very good - efficient and friendly.
Negative	
433606565	The warming blankets in chemo might be a good idea on the table and over the patient - it's cold in there.
Mixed	
432320515	Only one day - on a bad day - did I feel uncomfortable with the tone of voice one of the girls used. But I think it was because I just took it wrong because I was ill.
433606577	When I go for my daily treatments, I really like that I can scan my card & check in myself. One thing that really bothers me is that the RT technicians announce both my first & last name over the waiting room speaker when they say I can come back to the treatment area. What about HIPPA requirements?

02/10/2010 11:02:37 EST

PRESS GANEY

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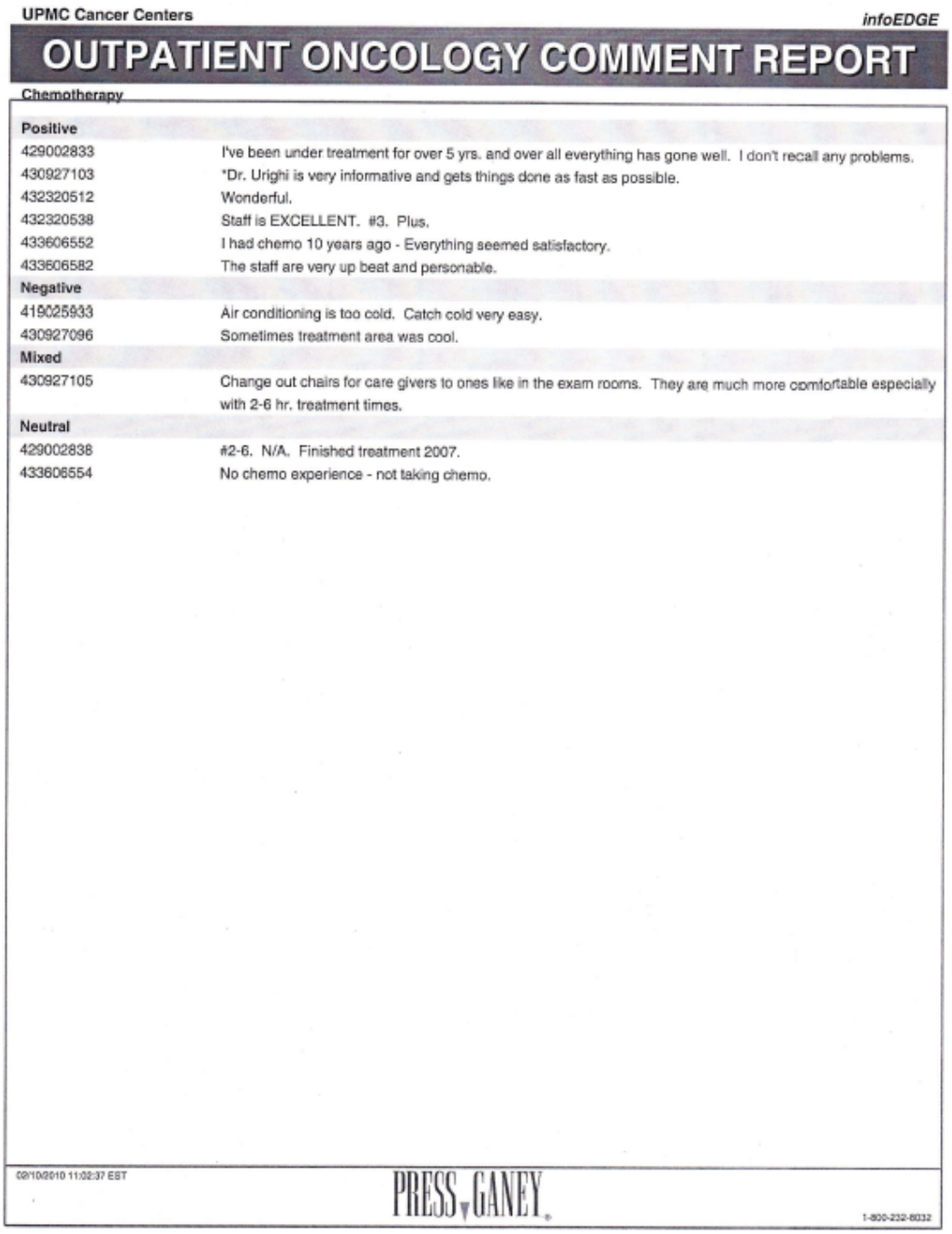

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OUTPATIENT ONCOLOGY COMMENT REPORT

Chemotherapy

Positive	
429002833	I've been under treatment for over 5 yrs. and over all everything has gone well. I don't recall any problems.
430927103	*Dr. Urighi is very informative and gets things done as fast as possible.
432320512	Wonderful.
432320538	Staff is EXCELLENT. #3. Plus.
433606552	I had chemo 10 years ago - Everything seemed satisfactory.
433606582	The staff are very up beat and personable.
Negative	
419025933	Air conditioning is too cold. Catch cold very easy.
430927096	Sometimes treatment area was cool.
Mixed	
430927105	Change out chairs for care givers to ones like in the exam rooms. They are much more comfortable especially with 2-6 hr. treatment times.
Neutral	
429002838	#2-6. N/A. Finished treatment 2007.
433606554	No chemo experience - not taking chemo.

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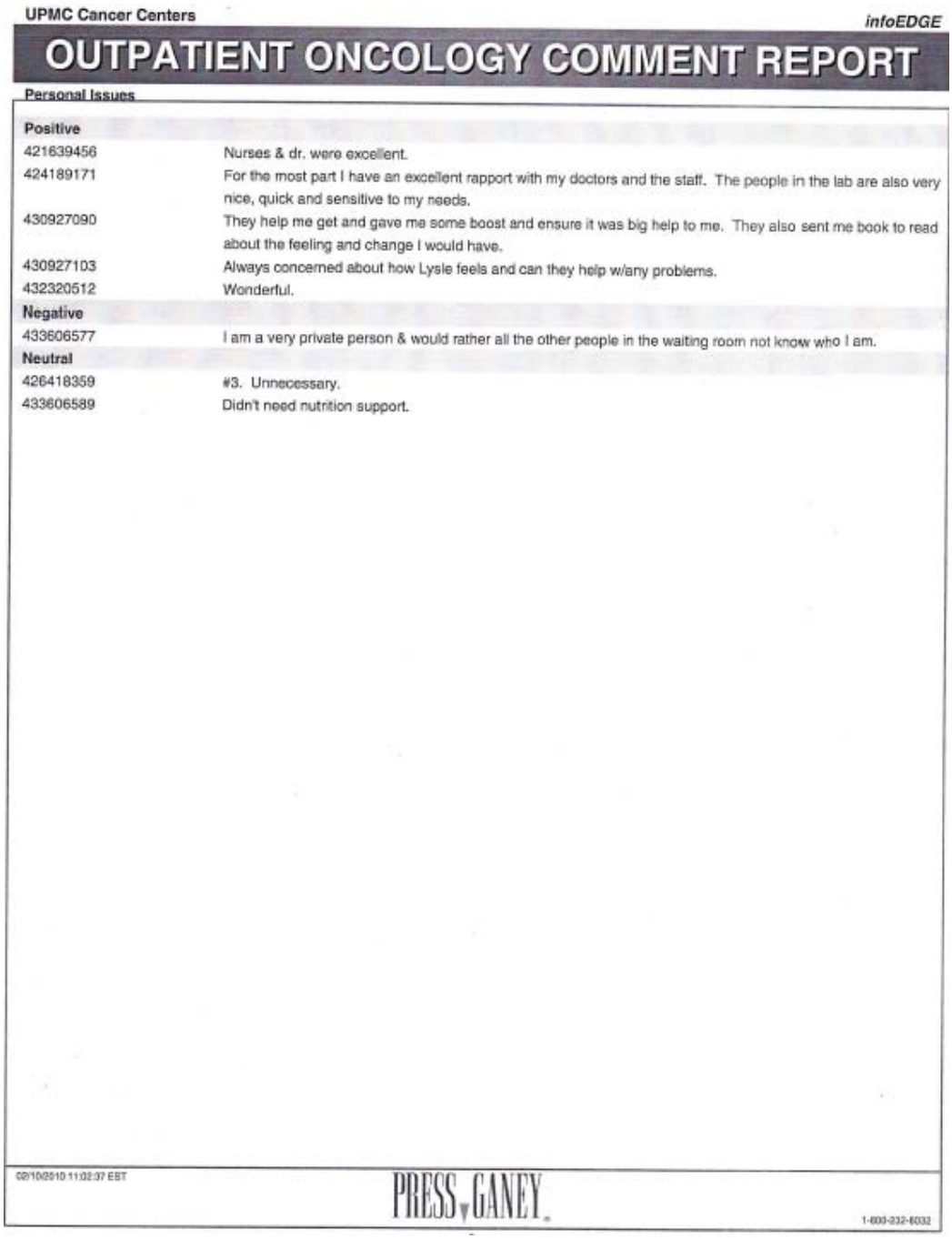

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OUTPATIENT ONCOLOGY COMMENT REPORT

Personal Issues

Positive	
421639456	Nurses & dr. were excellent.
424189171	For the most part I have an excellent rapport with my doctors and the staff. The people in the lab are also very nice, quick and sensitive to my needs.
430927090	They help me get and gave me some boost and ensure it was big help to me. They also sent me book to read about the feeling and change I would have.
430927103	Always concerned about how Lysle feels and can they help w/any problems.
432320512	Wonderful.
Negative	
433606577	I am a very private person & would rather all the other people in the waiting room not know who I am.
Neutral	
426418359	#3. Unnecessary.
433606589	Didn't need nutrition support.

02/10/2010 11:02:37 EST

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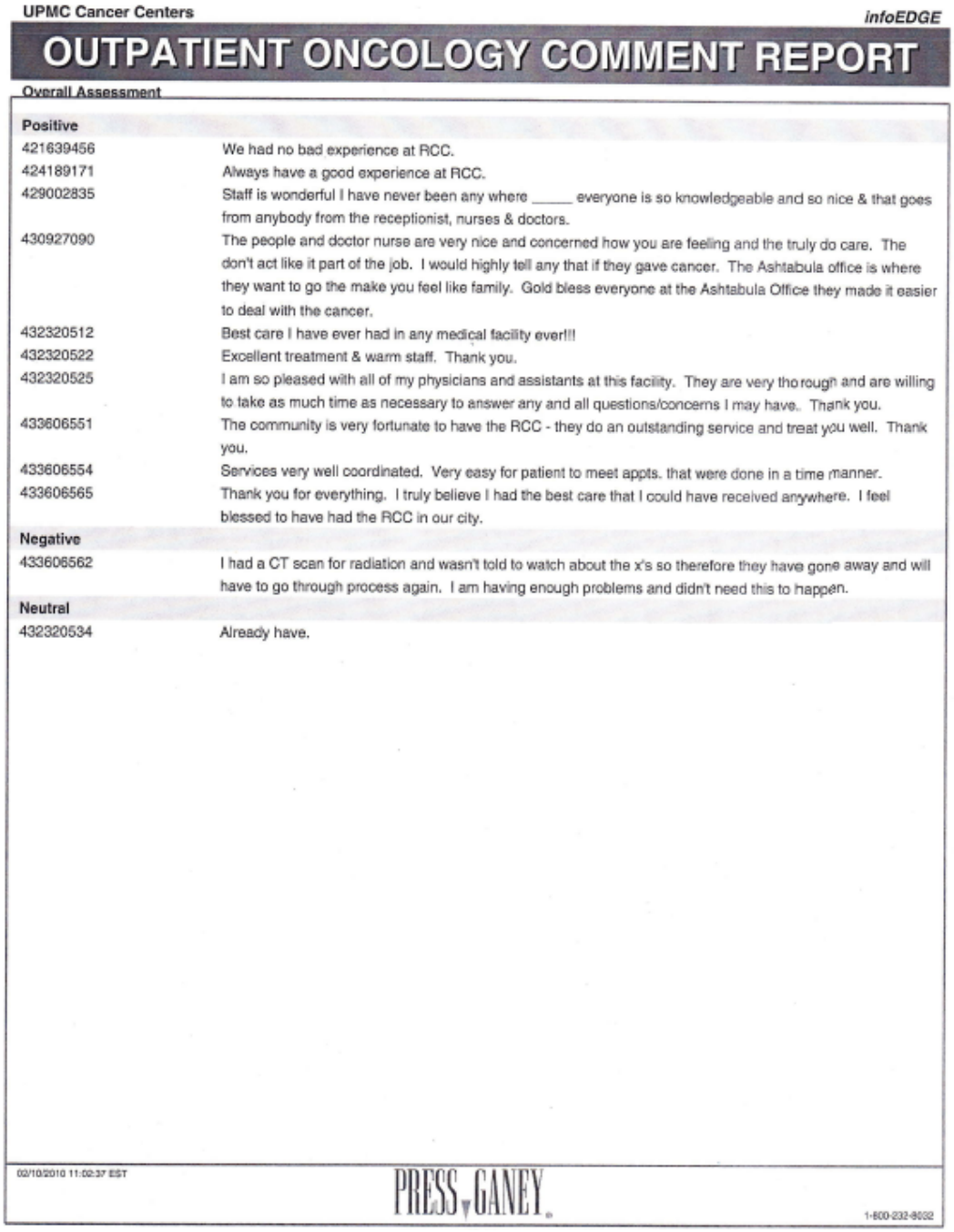

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OUTPATIENT ONCOLOGY COMMENT REPORT

Overall Assessment

Positive	
421639456	We had no bad experience at RCC.
424189171	Always have a good experience at RCC.
429002835	Staff is wonderful I have never been any where _____ everyone is so knowledgeable and so nice & that goes from anybody from the receptionist, nurses & doctors.
430927090	The people and doctor nurse are very nice and concerned how you are feeling and the truly do care. The don't act like it part of the job. I would highly tell any that if they gave cancer. The Ashtabula office is where they want to go the make you feel like family. Gold bless everyone at the Ashtabula Office they made it easier to deal with the cancer.
432320512	Best care I have ever had in any medical facility ever!!!
432320522	Excellent treatment & warm staff. Thank you.
432320525	I am so pleased with all of my physicians and assistants at this facility. They are very thorough and are willing to take as much time as necessary to answer any and all questions/concerns I may have. Thank you.
433606551	The community is very fortunate to have the RCC - they do an outstanding service and treat you well. Thank you.
433606554	Services very well coordinated. Very easy for patient to meet appts. that were done in a time manner.
433606565	Thank you for everything. I truly believe I had the best care that I could have received anywhere. I feel blessed to have had the RCC in our city.
Negative	
433606562	I had a CT scan for radiation and wasn't told to watch about the x's so therefore they have gone away and will have to go through process again. I am having enough problems and didn't need this to happen.
Neutral	
432320534	Already have.

02/10/2010 11:02:37 EST

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OUTPATIENT ONCOLOGY COMMENT REPORT

Your Oncologist

Positive	
430927105	*Dr. Varghai is an outstanding doctor.
432320512	Excellent.
433606554	Dr. was wonderful. Took much time to answer any & all questions.
Negative	
424189171	My blood issues continue, the issues are the same from one visit to another.

03/10/2010 11:02:37 EST

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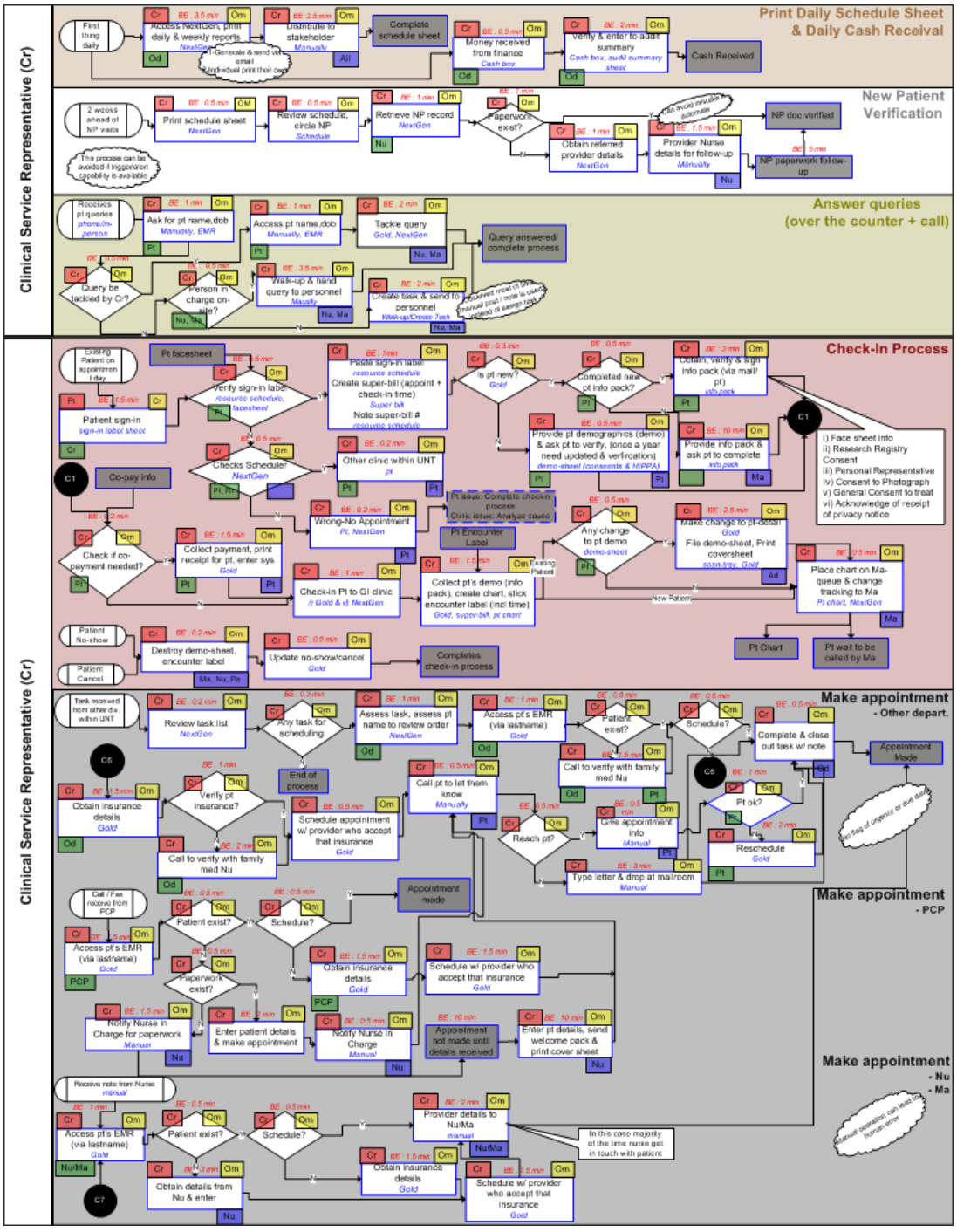
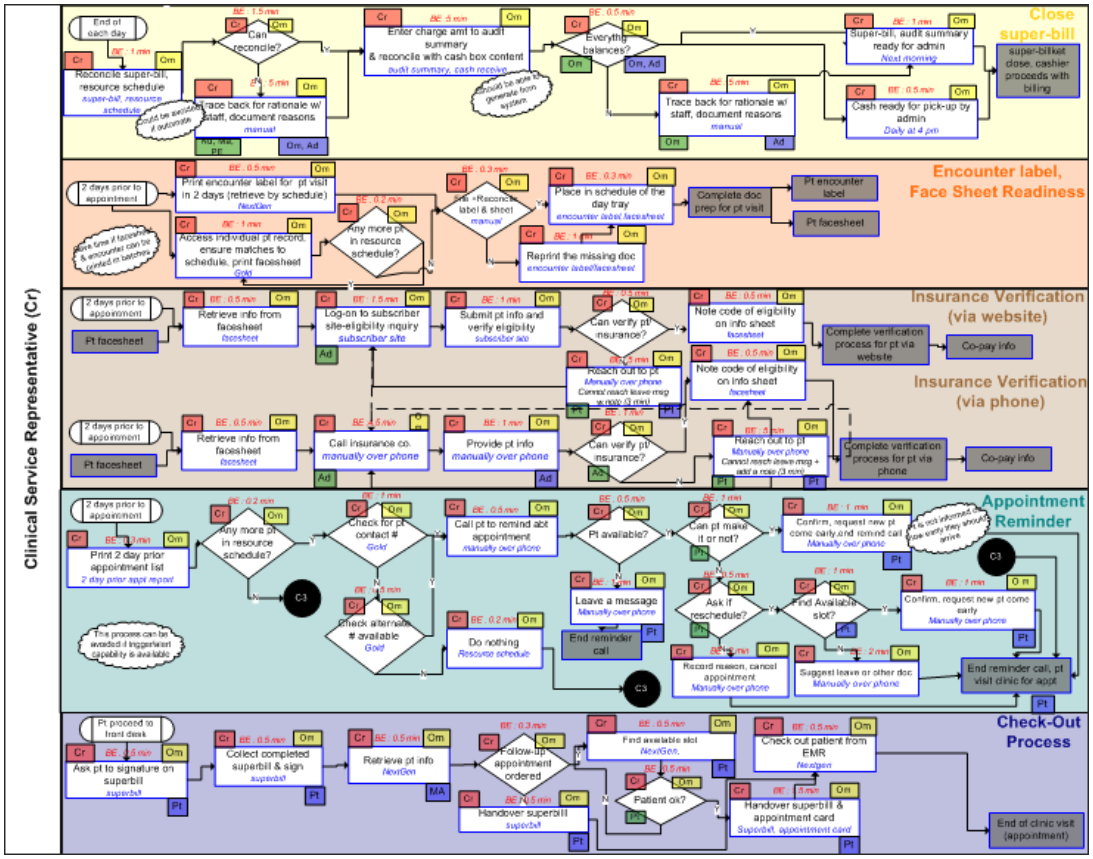
APPENDIX-B: COMPLETE RACI-SLA DIAGRAM FOR GI CLINIC

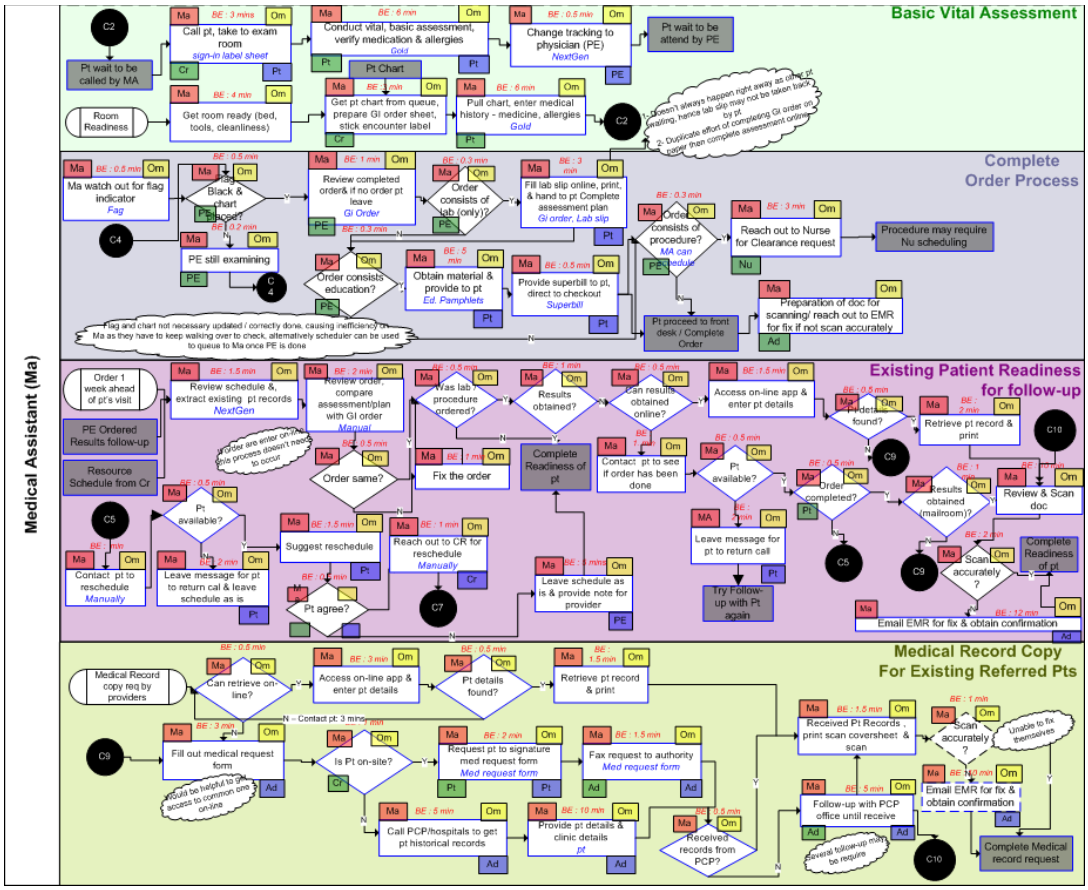
(also highlighted in the diagram are process flaws and deficiencies)

i) RACI-SLA diagram for Clinical Staff Representative

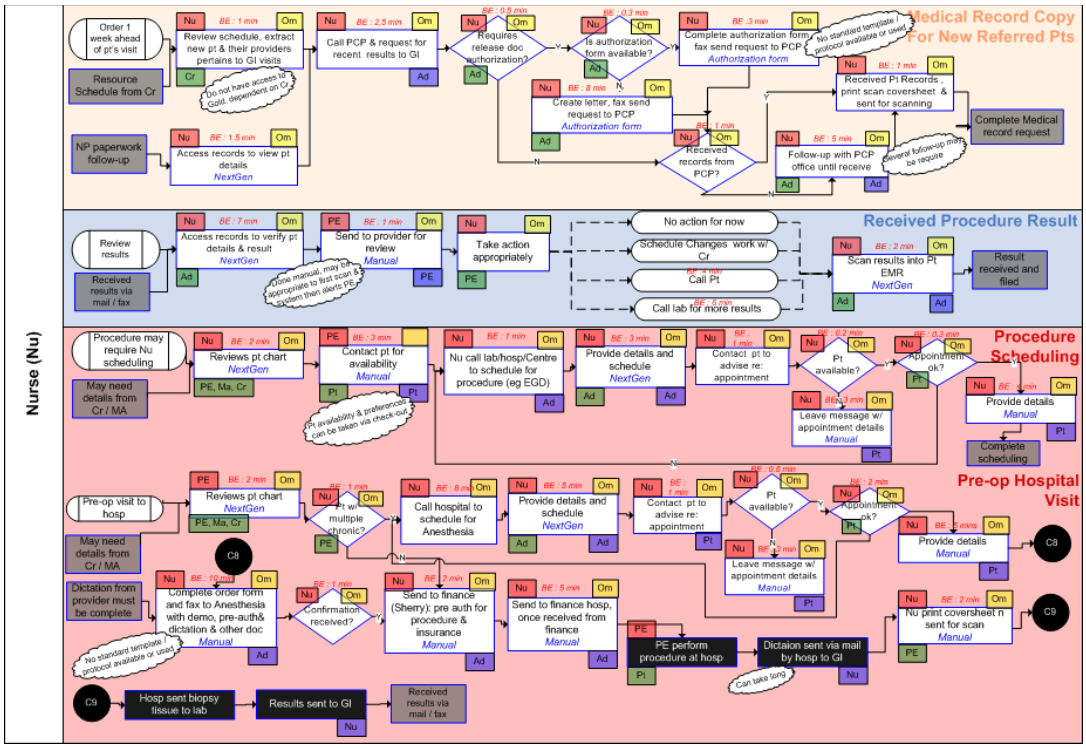



Clinical Service Representative (Cr)
Close super-bill
Encounter label, Face Sheet Readiness
Insurance Verification (via website)
Insurance Verification (via phone)
Appointment Reminder
Check-Out Process

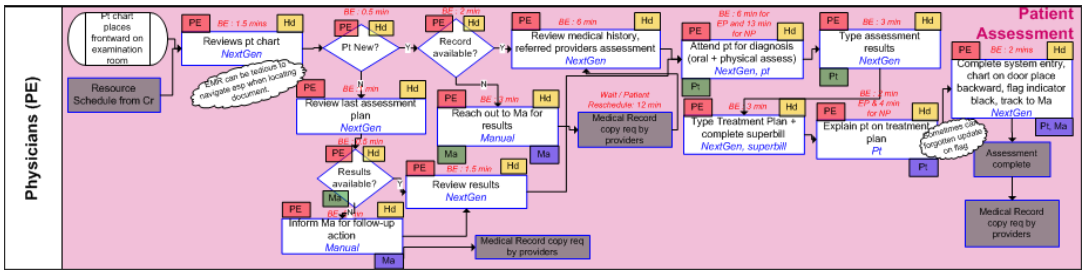
ii) RACI-SLA diagram for Medical Assistant



iii) RACI-SLA diagram for Nurse

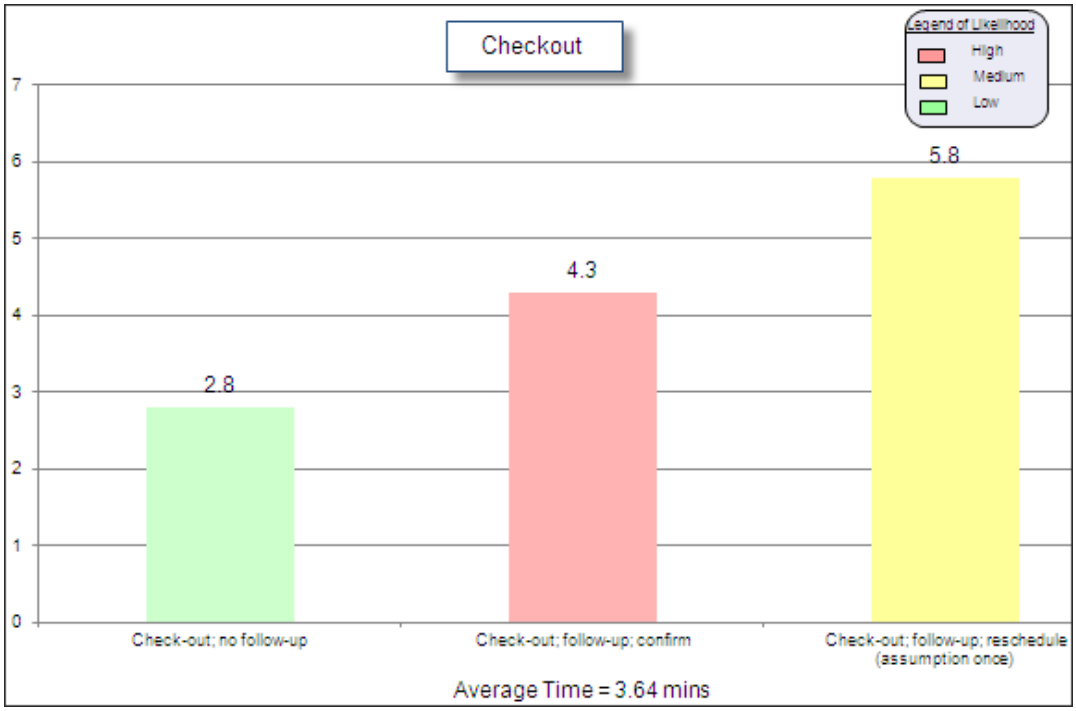


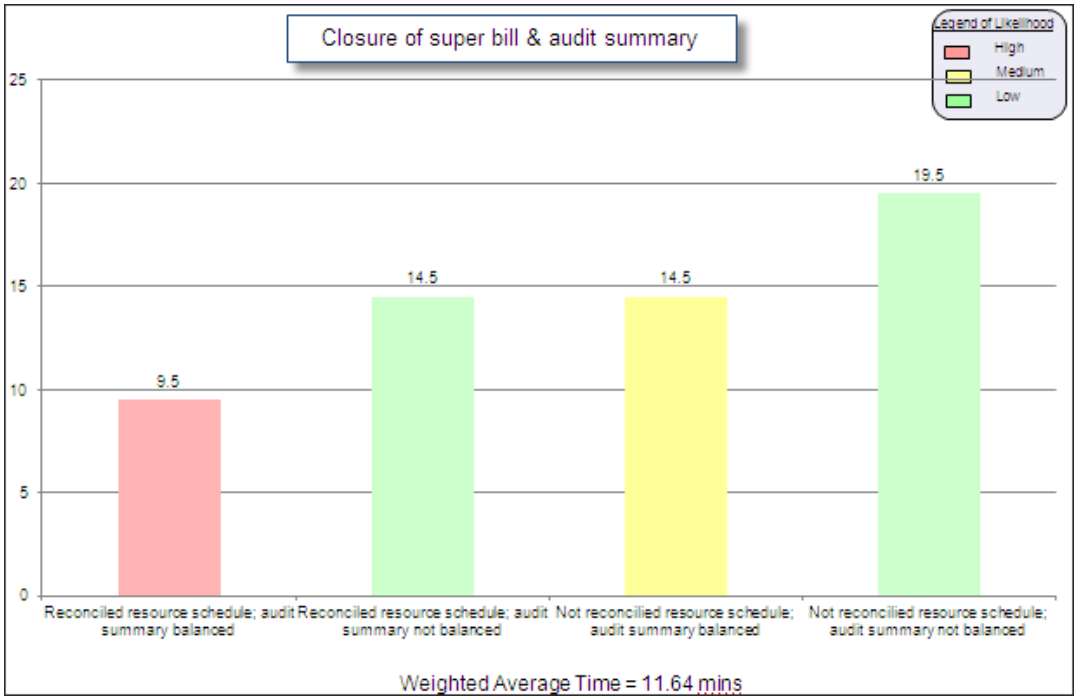
iv) RACI-SLA diagram for Physicians

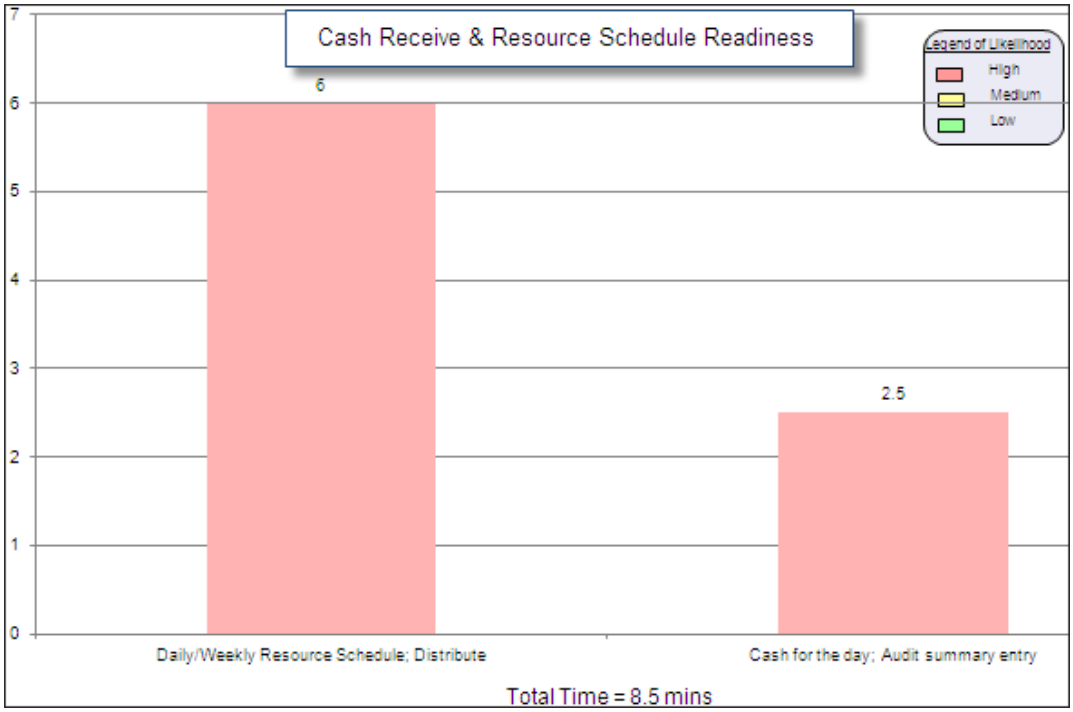


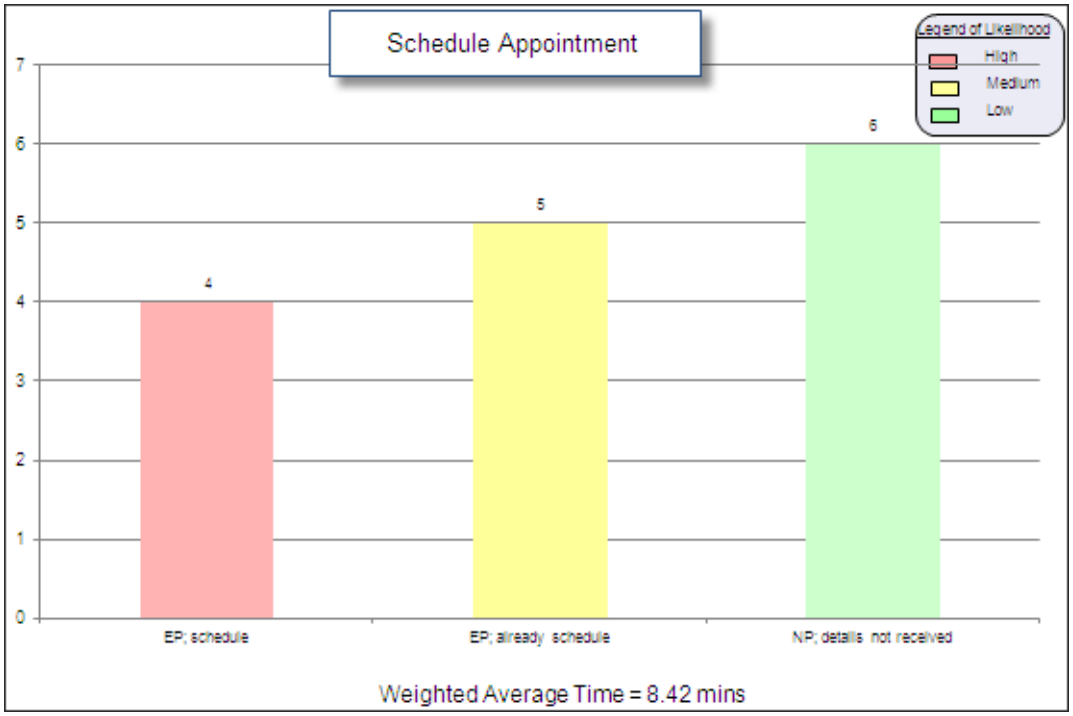
APPENDIX-C: WEIGHTED AVERAGE TIME FOR ALL PROCESSES

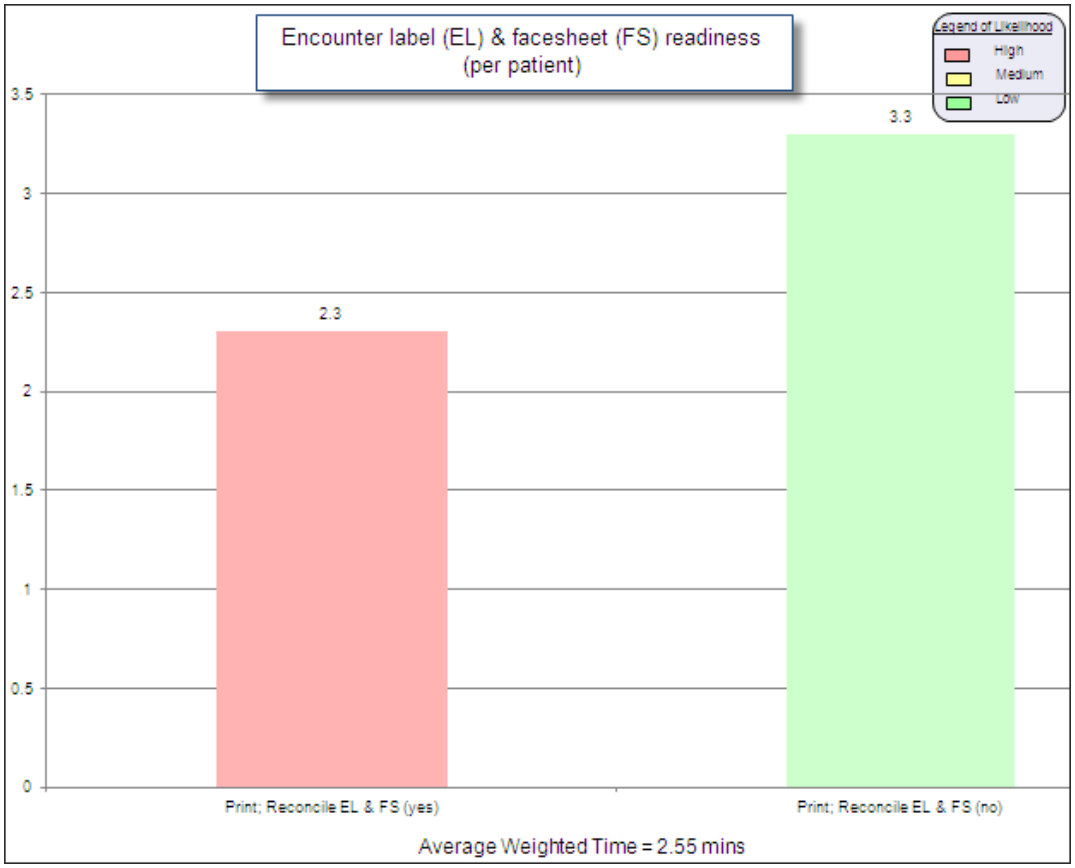
i) Process for CSR (all process time in minutes)

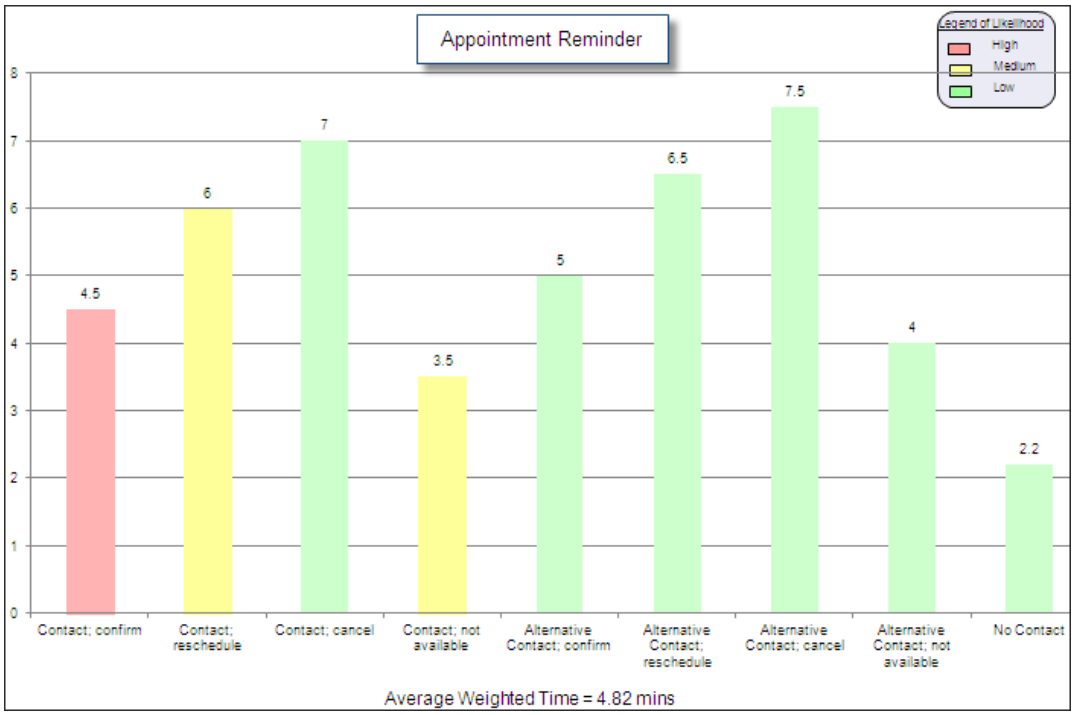


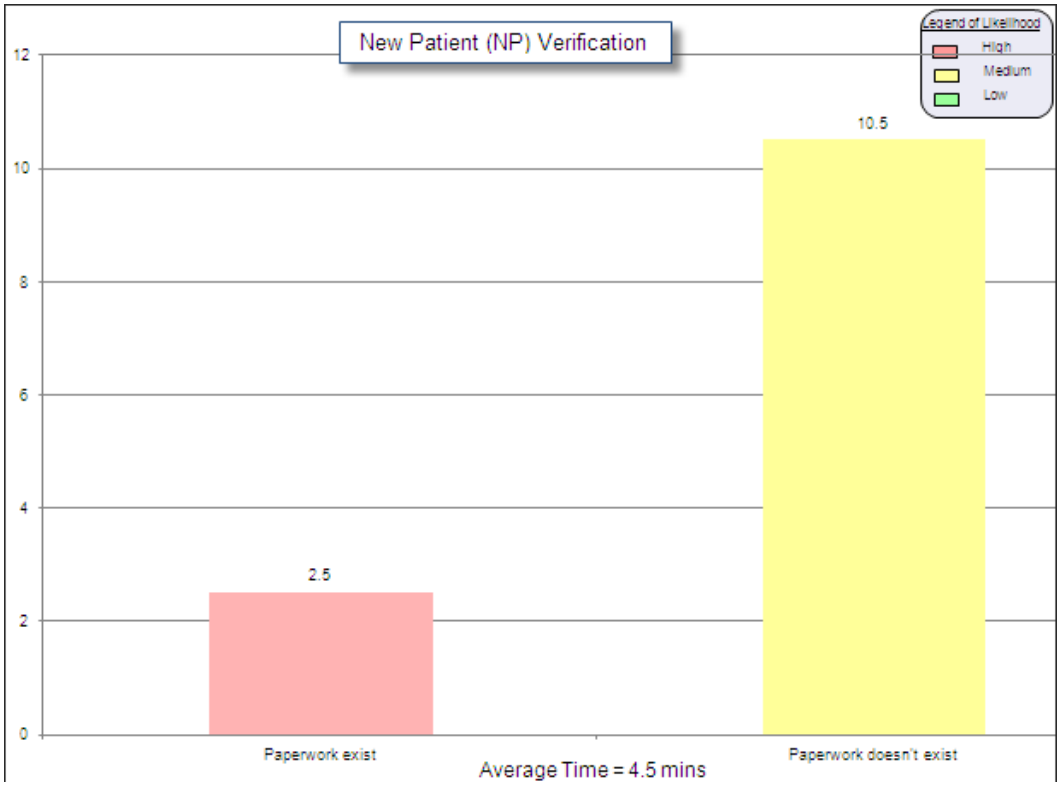


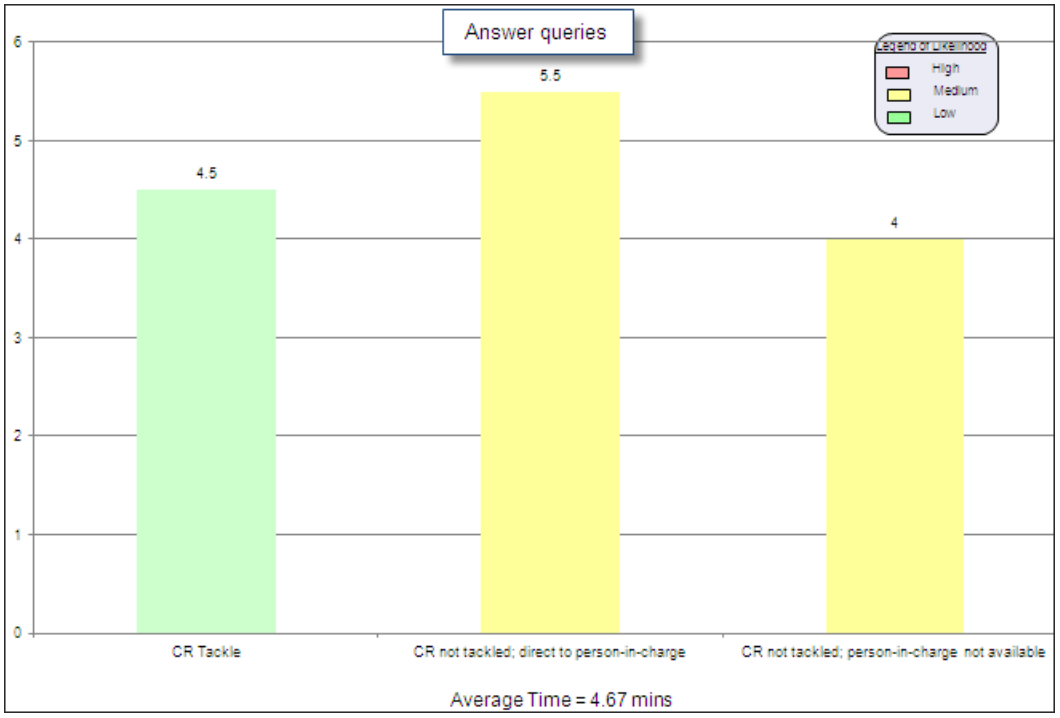

Cash Receive & Resource Schedule Readiness
Legend of Likelihood
High
Medium
Low
7
6
5
4
3
2
1
0
6
2.5
Daily/Weekly Resource Schedule; Distribute
Cash for the day; Audit summary entry
Total Time = 8.5 mins

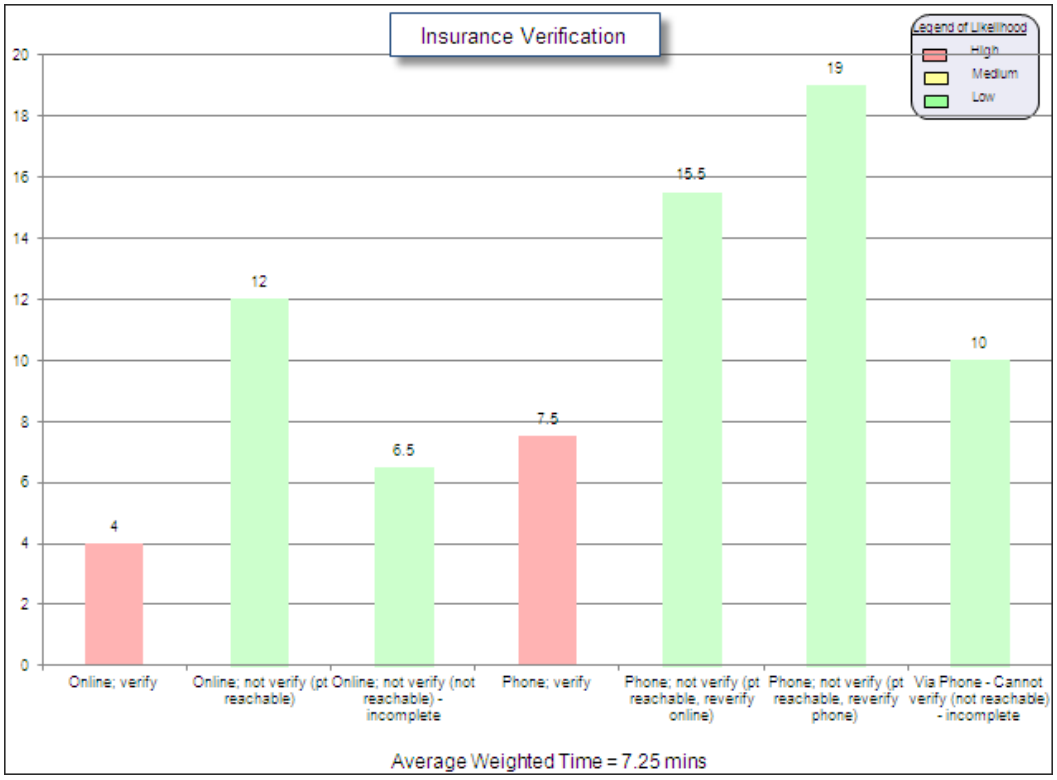

Schedule Appointment
Legend of Likelihood
High
Medium
Low
7
6
5
4
3
2
1
0
4
5
6
EP; schedule
EP; already schedule
N/P; details not received
Weighted Average Time = 8.42 mins


Encounter label (EL) & facesheet (FS) readiness (per patient)
Legend of Likelihood
High
Medium
Low
3.5
3
2.5
2
1.5
1
0.5
0
2.3
3.3
Print; Reconcile EL & FS (yes)
Print; Reconcile EL & FS (no)
Average Weighted Time = 2.55 mins

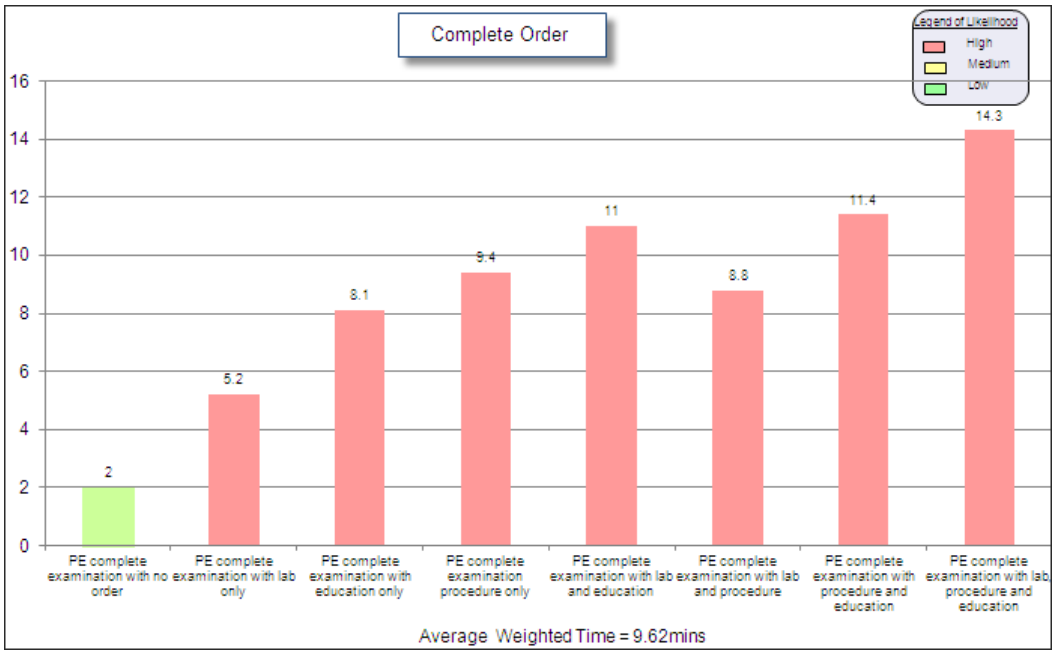

Appointment Reminder
Legend of Likelihood
High
Medium
Low
8
7
6
5
4
3
2
1
0
4.5
6
7
3.5
5
6.5
7.5
4
2.2
Contact; confirm
Contact; reschedule
Contact; cancel
Contact; not available
Alternative Contact; confirm
Alternative Contact; reschedule
Alternative Contact; cancel
Alternative Contact; not available
No Contact
Average Weighted Time = 4.82 mins

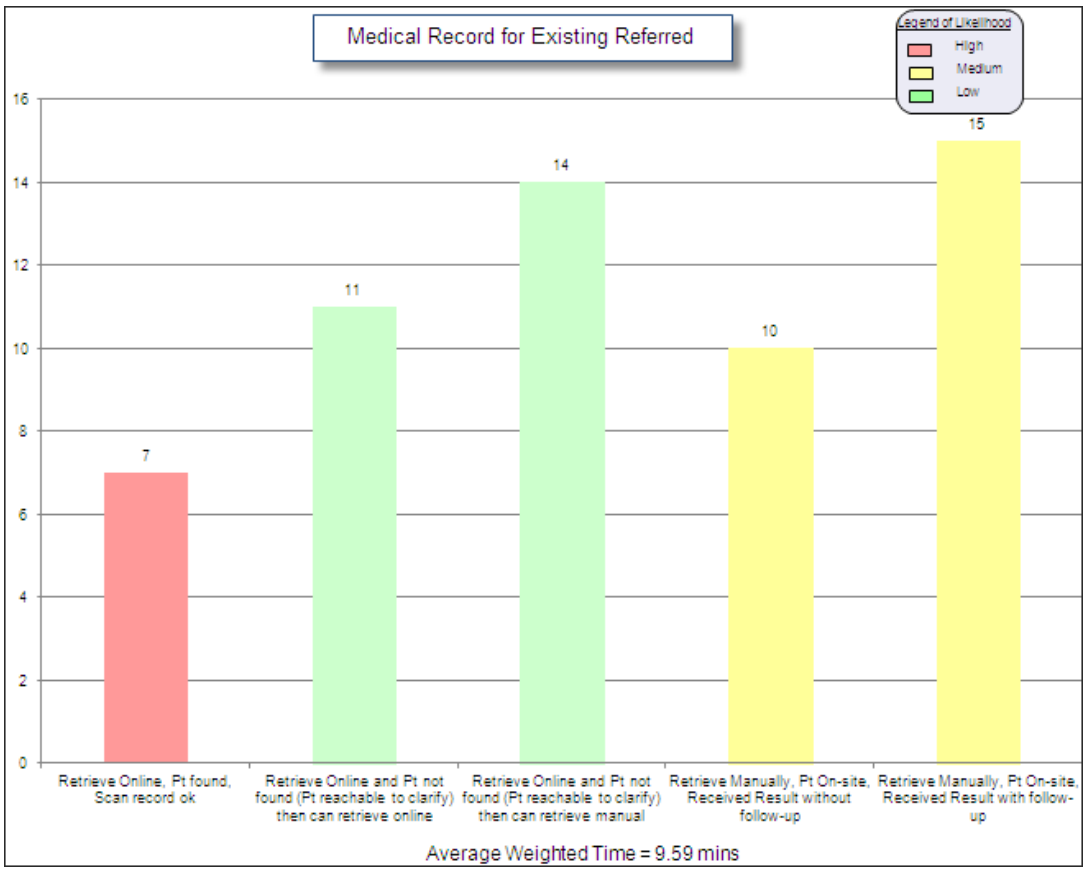

New Patient (NP) Verification
Legend of Likelihood
High
Medium
Low
12
10
8
6
4
2
0
2.5
10.5
Paperwork exist
Paperwork doesn't exist
Average Time = 4.5 mins

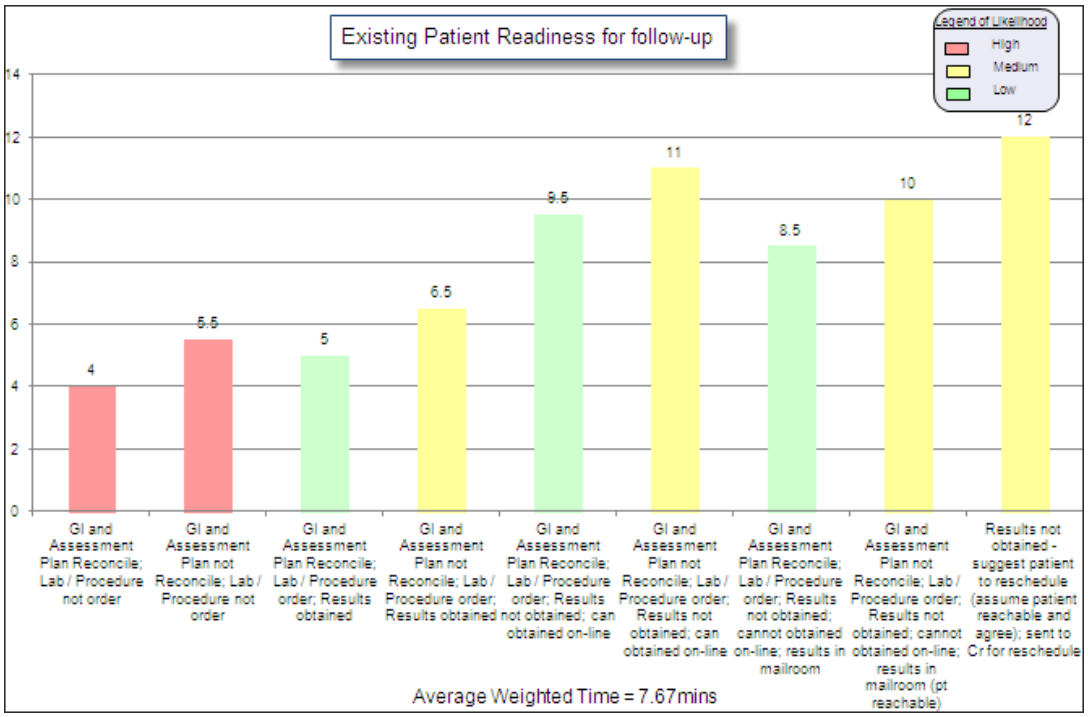

Answer queries
Legend of Likelihood
High
Medium
Low
6
5
4
3
2
1
0
4.5
5.5
4
CR Tackle
CR not tackled; direct to person-in-charge
CR not tackled; person-in-charge not available
Average Time = 4.67 mins



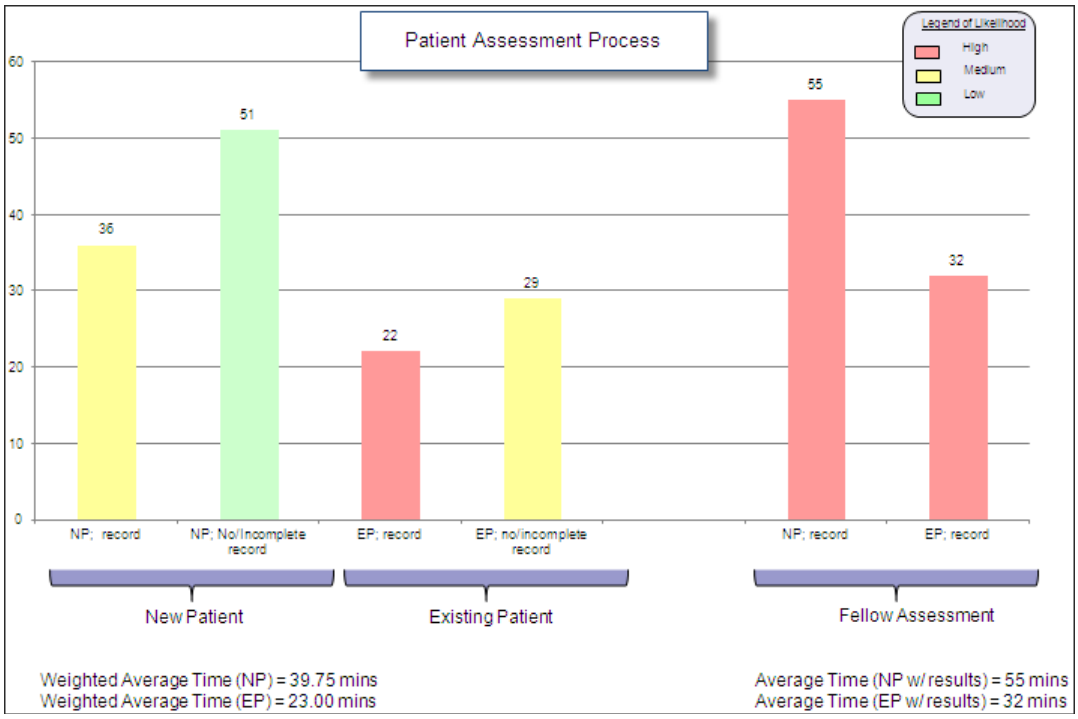
ii) Process for MA (all process time in minutes)




Medical Record for Existing Referred
Legend of Likelihood
High
Medium
Low
16
14
12
10
8
6
4
2
0
7
11
14
10
15
Retrieve Online, Pt found, Scan record ok
Retrieve Online and Pt not found (Pt reachable to clarify) then can retrieve online
Retrieve Online and Pt not found (Pt reachable to clarify) then can retrieve manual
Retrieve Manually, Pt On-site, Received Result without follow-up
Retrieve Manually, Pt On-site, Received Result with follow-up
Average Weighted Time = 9.59 mins


Existing Patient Readiness for follow-up
Legend of Likelihood
High
Medium
Low
14
12
10
8
6
4
2
0
4
5.5
5
6.5
9.5
11
8.5
10
12
GI and Assessment Plan Reconcile; Lab / Procedure not order
GI and Assessment Plan not Reconcile; Lab / Procedure not order
GI and Assessment Plan Reconcile; Lab / Procedure order; Results obtained
GI and Assessment Plan not Reconcile; Lab / Procedure order; Results obtained
GI and Assessment Plan Reconcile; Lab / Procedure order; Results not obtained; can obtained on-line
GI and Assessment Plan not Reconcile; Lab / Procedure order; Results not obtained; can obtained on-line
GI and Assessment Plan Reconcile; Lab / Procedure order; Results not obtained; cannot obtained on-line; results in mailroom
GI and Assessment Plan not Reconcile; Lab / Procedure order; Results not obtained; cannot obtained on-line; results in mailroom (pt reachable)
Results not obtained - suggest patient to reschedule (assume patient reachable and agree); sent to Cr for reschedule
Average Weighted Time = 7.67mins

iii) Process for Physicians (all process time in minutes)



APPENDIX-D STAKEHOLDER ANALYSIS FOR AFTERNOON SESSION

Afternoon Session		Mon	Tues	Wed	Thurs	Fri
Provider Analysis	No. of Providers	1	1	No Physician	1	No Physician
	Availability (mins)	240	195		240	
	Average Pt Demand	9	14		9	
	Schedule Slot for EP (mins)	15	15		15	
	Current Demand of Patient	16	13		16	
	Differences	7	1		7	
	Average Time Provider sent with EP without fellow (per patient in mins)	23	23		23	
	No. of EP (alone) that can be seen	10.43	8.48		10.43	
	Differences	1.43	5.5		1.43	
CSR Analysis	No. of CSR	1	1		1	
	Check-in Weighted Average Time	7.84	7.84		7.84	
	Check-out Weighted Average Time	3.64	3.64		3.64	
	Total time per patient	11.48	11.48		11.48	
	No. of patient per capacity	20.9	17.0		18.3	
	Differences	12	3		9	
	Ad-hoc Uncontrollable task: Answer Patient Queries Weighted Average Time (mins)	18.94	18.94		18.94	
	Task to be done by 4 pm: Closure of Superbill Weighted Average Time (mins)	11.64	11.64		11.64	
	Hence, Total Time will be	**133.9**	**191.3**		**133.9**	
Medical Assistant Analysis	No. of MA	2				
	Basic Vital Assessment - Fixed Effort	22.50				
	Complete Order Weighted Average Time	9.62				
	EP Referral Weighted Average Time	9.59				
	EP Readiness Weighted Average Time	7.74				
	Availability to conduct vital per provider session (mins) for 2 MAs	21.33	17.33		21.33	
	Differences	12	3		12	
	Availability to conduct order + vital per provider session (mins) for 2 MAs	14.94	12.14		14.94	
	If order has to complete during that session then	6	2		6	