HITEQI - A Framework to Implement Health Information Technology-Enabled Quality Improvement

By

Ines Jowitt RN, BScN (Hons.)

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Ines Jowitt

Abstract

This thesis proposes a framework known as the Health Information Technology-Enabled Quality Improvement (HITEQI) to provide a structured approach to quality improvement in healthcare where the intervention is through the use of information technology. HITEQI combines the core elements of Canada Health Infoway's Change Management Framework (CMF) with the formal process structure of the National Health Services' Clinician Deployment Guide, and addresses gaps noted by the researcher in the CMF. Specifically, these gaps are the lack of; patient-centred focus, intra/inter-organizational considerations, and data and information flows. The proposed HITEQI Framework provides a structured approach for implementing health information technology (HIT). The framework is demonstrated through a case study of a proposed remote Intensivist consultation service to provide critical care to patients at a rural hospital. The service requires the implementation of an advanced telemedicine technology. Careful consideration of change management (CM) can help mitigate the high failure rate associated with IT implementation and adoption. The HITEQI framework provides a structured CM approach while utilizing PaJMa to provide a patient centred approach that supports clinician information needs and workflows across intra/inter-organizational boundaries.

Keywords: change management, quality improvement, health information technology, IT adoption, technology acceptance, process modelling, PaJMa

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1 Chapter 1 – Introduction

1.1 Introduction

This thesis proposes a framework known as the Health Information Technology-Enabled Quality Improvement (HITEQI) to provide a structured approach to quality improvement in healthcare where the intervention is through the use of information technology. HITEQI combines the core elements of Canada Health Infoway's *Change Management Framework* (CMF) (Canada Health Infoway, 2011a) with the formal process structure of the National Health Services' *Clinician Deployment Guide* (NHS Connecting for Health, n.d.), and addresses gaps noted by the researcher in the CMF. Specifically, these gaps are the lack of; patient-centred focus, intra/inter-organizational considerations, and data and information flows. The proposed HITEQI Framework provides a structured approach for implementing health information technology (HIT).

1.2 Research Motivation

The research motivation underlying this thesis is based on a real world problem, a request for help to provide quality critical care medicine access to a small rural hospital. The proposed solution was to provide a remote Intensivist consultation service to be delivered via an advanced telemedicine technology. During the early stages of determining the project requirements, a literature review was performed that revealed a low rate of adoption of Health Information Technology (HIT) initiatives (B. Karsh, Weinger, Abbott, & Wears, 2010). This

was attributed to the underuse of change management (CM) strategies to promote successful change adoption (Grol, Baker, & Moss, 2002; Mitchell, 2013; PanCanadian Change Management Network - Communications Working Group, 2012). While exploring possible resources for CM, Canada Health Infoway's recently released *Change Management Framework* (CMF) was discovered. The CMF was created specifically to provide a best practice model for CM support for HIT adoption in Canada (Hodder & Frazer, 2012).

While attempting to use the CMF for planning the implementation of the proposed telemedicine technology, several gaps in the CMF became apparent. These gaps created challenges which reduced the effectiveness and usability of the tool. Recognizing that these same CMF gaps would impact other potential HIT implementations led to the development of the proposed research construct, the HITEQI Framework for implementing HIT-enabled quality improvement initiatives.

1.3 Background

There is a shortage of Intensivists, specially trained Critical Care physicians, in Ontario (Bell & Robinson, 2005). This has created an inequity in access to high quality Critical Care medicine as there not enough Intensivists to staff all Ontario ICUs. The rural hospital that motivated this research has an Intensive Care Unit (ICU) but it does not have an Intensivist on staff. When a patient's condition becomes unstable, they must be transferred to a tertiary hospital to receive Intensivist-led care. This restricts access to critical care for

patients in rural communities and is not patient-centred as it requires the transport away from their families and "local support networks" during a time of great stress (Singh & MacDonald, 2009, p.4). It also puts the critically ill patient at risk of adverse events associated with transfers such as equipment failure, inadequate monitoring and communication, and an increased risk of clinical deterioration or death (Bérubé et al., 2013). Although low, this risk increases with the length of duration of transport (Singh & MacDonald, 2009) so avoiding unnecessary transfers reduces overall risk for the patient. By providing a proposed remote Intensivist consultation service through the use of advanced telemedicine technology, increased access to quality critical care medicine could be potentially achieved (Bell & Robinson, 2005).

The proposed telemedicine technology would use existing Ontario Telemedicine Network (OTN) connections combined with an additional technology. In order to support the complex information requirements for clinical decision making by the Intensivist, the advanced telemedicine service would use the Artemis Cloud platform (McGregor, Catley, James, & Padbury, 2011). This technology would provide real time, visual physiological data streams from the patient's hemodynamic monitors. It would also allow access to the patient's electronic health record for clinical results including diagnostic imaging, laboratory results, and pathology findings (Blount et al., 2010; McGregor, Catley, James, & Padbury, 2011; McGregor, 2013) . Implementing this advanced technology would require careful change management to promote successful

adoption by the clinicians and support staff at both organizations involved in providing this remote care and its associated clinical practice changes.

Technology on its own should not drive quality improvement (QI) (Lorenzi & Riley, 2000). Instead, HIT should be used as an enabler to provide various opportunities to support QI initiatives in health care (Institute of Medicine, 2001; Lorenzi & Riley, 2000). However, the failure rate for HIT implementations is high and technology adoption is poor (Karsh, Weinger, Abbott, & Wears, 2010; Lorenzi & Riley, 2003). The Technology Acceptance Model (TAM) was developed to predict end-users acceptance and use of IT but has not been fully developed for use in healthcare at this time (Holden & Karsh, 2010). Kaplan & Harris-Salamone (2009) identify that problems with HIT tend to be more “managerial” (ie sociological, cultural, or financial) than “technical” in nature. To improve success, HIT must be carefully planned and implemented using thoughtful change processes that address human and organizational factors along with the typical technical considerations (Lorenzi & Riley, 2003). Infoway’s CMF was developed to be Canada’s best practice CM model for HIT implementation and the research contribution addresses the gaps that were noted by the researcher in the CMF.

1.4 Hypothesis

The primary hypothesis of this thesis is:

A framework to utilize health information technology for patient centred care within an inter and intra organizational context incorporating explicit representation of data and information flows can be quantified to enable measureable quality improvement in healthcare.

Within this research this framework will be demonstrated in the context of the remote Intensivist consultation service, known as the "Virtual Specialist Project". The case study will use the HITEQI framework to demonstrate each component of the structured approach.

1.5 Research Method

The research approach is based on the constructive research design (Kamaleswaran, McGregor, & Mb, 2012; Kasanen, Lukka, & Siitonen, 1993; Smith, 2011). The method focuses on a practical problem and develops a solution or "construct" using current theoretical knowledge to solve the problem (Kasanen et al., 1993). The constructive research approach is broken into six phases (Kasanen et al., 1993):

1. *Find a practically relevant problem which also has research potential.* The underlying problem was a lack of a structured approach to addressing the issue of remote ICU with technology.
2. *Obtain a general and comprehensive understanding of the topic.* The literature was explored to gain an understanding of quality improvement (QI) in health care, specifically Intensive Care (ICU), through technology

implementation of telemedicine and the associated considerations required to promote adoption of new HIT.

3. *Innovate, i.e., construct a solution idea.* This research proposes an adaptation of the Canada Health Infoway's Change Management Framework (CMF) to promote the implementation of HIT-enabled quality improvement in health care. The proposed research adds on to the existing CMF to develop a new construct that addresses issues of structure and missing components related to lack of patient-centred focus, intra/inter-organizational considerations, and data/information flows. The new framework provides a structured HIT implementation approach using change management techniques to promote adoption.
4. *Demonstrate that the solution works.* The proposed research will be demonstrated through a case study of a remote Intensivist ICU consultation service, ie. the "Virtual Specialist Project", provided via telemedicine technology.
5. *Show the theoretical connections and the research contribution of the solution concept.* The proposed research framework is based on a previous construct, the *Change Management Framework* from Canada Health Infoway, and has been influenced by the structure provided in the *Deployment Guide for Clinicians* from the National Health Services (NHS Connecting for Health, n.d.). These two tools have been combined and extended to include the research contribution; a patient-centred focus, intra/inter-organizational considerations, and data/information flows.

6. *Examine the scope of applicability of the solution (Kasanen et al., 1993).* The applicability of the solution will be discussed after the research contribution is demonstrated in the case study.

1.6 Thesis Overview

Chapter 2 presents a literature review based on the informatics themes in this thesis including Quality Improvement, Patient Journey Modelling, Health Information Technology and Change Management. Also included are Patient-Centred Care and intra/inter-organizational and data/information flow considerations for technology adoption. Chapter 3 provides a literature review for the background to the Case Study and describes ICU, Intensivist care, and telemedicine technology. Chapter 4 describes in detail the research contribution, HITEQI framework. Chapter 5 demonstrates the functionality of the HITEQI framework using a Case Study of the remote Intensivist consultation service, known as the “Virtual Specialist Project”. The final chapter, Chapter 5, will provide a discussion relating to the research completed, limitations of the research together with potential opportunities for future research and conclusion to this thesis.

2 Chapter 2 - Literature Review - Informatics Contribution

2.1 Introduction

This chapter is divided into several sections to underpin the research question - can a framework be defined for the implementation of health information technology-enabled quality improvement in health care? As the case study is about a quality improvement initiative in an ICU, the literature review will have a focus from the critical care domain. The chapter begins with a discussion of Quality Improvement (QI) in health care. It then describes process improvement using PaJMa – a patient focused process modelling approach. A brief overview of Health Information Technology and Technology Acceptance is provided. Change Management (CM) for eHealth initiatives is discussed as supported by Infoway's CMF and then gaps in the CMF are identified and addressed in the literature review. It concludes with a discussion of findings.

2.2 Quality Improvement

In 2010, Bill 46 was passed in Ontario. The *Excellent Care for All Act* "puts patients first by improving the quality and value of the patient experience through the application of evidence-based health care" (Government of Ontario, 2010b, pg.1). The act defines a high quality health care system as one that is "accessible, appropriate, effective, efficient, equitable, integrated, patient centred, population health focused, and safe" (Government of Ontario, 2010a, pg.2). The act requires health care organizations to develop yearly quality improvement

plans and holds their executive teams accountable for achieving those quality improvement goals.

A review of the literature reveals that Patient Centred Care (PCC) has multiple definitions depending on the organization involved. There is “no globally accepted definition” (International Alliance of Patients’ Organizations, 2007 p. 28). The International Alliance of Patients’ Organizations (IAPO) Declaration of Patient-Centred Healthcare states;

> “the essence of patient-centered healthcare is that the system is designed and delivered to address the healthcare needs and preferences of patients so that healthcare is appropriate and cost-effective” (International Alliance of Patients’ Organizations, 2007 p. 29).

Quality of care can be assessed using Donabedian’s framework based on structure-process-outcomes (Donabedian, 1997; Varkey, Reller, & Resar, 2007). Structure is defined as the setting that care is given in and includes things like staffing resources, technology and equipment, and organizational policies; process is how the care is actually given; and outcome is the effect of the care provided on the patient and/or population (Curtis et al., 2006; Donabedian, 1988; Varkey et al., 2007). These three domains are separate but interrelated (Bell & Robinson, 2005; Kahn et al., 2011).

The “closed unit” ICU management model is an example of a way to improve quality of care in the ICU through changing the organizational structure (Curtis et al., 2006). A “closed unit” is an ICU where all

admissions and patient care-decisions are managed by the Intensivist –a physician with specialty training in critical care medicine (Ontario Critical Care LHIN Leadership Table, 2006). An example of process improvement would be using the latest clinical guidelines for providing medical treatment (Curtis et al., 2006). Improved outcomes are the results seen when structure and process improvements are made. The relationships between structure, process, and outcomes must be understood in order for changes to result in expected improvements (Hebert, 2001).

Quality improvement (QI) in health care is a relatively recent field of research (Berwick, 2002; Donabedian, 1988). In the past, QI was not considered “real” research and was not usually formally published (Ellsbury & Ursprung, 2010; Varkey et al., 2007). The methodological quality of studies evaluating the effectiveness of QI interventions was frequently low and lacked scientific rigour (Fan, Laupacis, Pronovost, Guyatt, & Needham, 2010). What QI research there was generally involved the implementation of particular interventions, usually complex and iterative, that were very context specific and therefore not easily generalizable (Fan et al., 2010).

In 2000, the Institute of Medicine released the seminal publication *To Err is Human* that exposed the appalling statistics around preventable health care system errors (Kohn, Corrigan, & Donaldson, 2000). This report has become the impetus for change through safety and quality improvement initiatives and is driving the current interest in QI research

(Cohen, Eustis, & Gribbins, 2003; Varkey et al., 2007). In response to this increased interest in QI, the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines were created in 2005 to develop and "strengthen the scientific evidence base in healthcare improvement" (Davidoff, Batalden, Stevens, Ogrinc, & Mooney, 2009 pg.282).

The SQUIRE guidelines provide a standardized approach to reporting and publishing formal quality improvement studies in order to share findings that contribute to advances in improvement science in health care (Davidoff, Batalden, Stevens, Orgrinc, & Mooney, 2008). The explicit guidelines also encourage better study design (Stevens, 2005) so overall research rigour has been improved through the use of the SQUIRE guidelines. However, careful evaluation of a QI publication results still must be made prior to implementation of a proposed intervention (Fan et al., 2010).

There are numerous methodologies that can be used to implement QI initiatives in healthcare. The most common are Lean, Plan-Do-Study-Act (PDSA) cycles, and Six-Sigma (Varkey et al., 2007). Choosing which method to use depends on the nature of the improvement project (Varkey et al., 2007).

Lean Thinking's Value Stream Modelling comes from the Toyota Production System auto manufacturing industry (Radnor, 2009; Varkey et al., 2007). It is based on customer defined value and when utilized in healthcare, is used to illustrate "process of service or product delivery"

(Varkey et al., 2007 p. 738). Typically, an observer with Lean training would go and watch the current processes required to provide a health care service. Afterwards they would develop a graphical flowchart, or "value stream map" (VSM), representing the current processes, steps, and time involved in providing care (Institute for Health Improvement, 2005; Joosten, Bongers, & Janssen, 2009; Radnor, 2009; Varkey et al., 2007). The multidisciplinary team would then use these VSMs to identify waste and discuss opportunities for improvement (Kim, Spahlinger, Kin, & Billi, 2006).

Lean methodology takes time to learn and is a philosophy that requires a change in organizational culture to implement (Radnor, 2009). The Institute for Health Improvement (IHI), 2005, defines organizational culture as a set of values and beliefs that are reinforced by the results of behaviours of the people in the organization. If leaders in an organization want to change the culture, they must intervene and require new behaviours that create better results. The reiteration of these behaviours and results will create a new culture (Institute for Health Improvement, 2005). Creating a Lean culture of continuous improvement is challenging and requires strong management commitment to empower staff and provide resources to support process improvement (Poksinska, 2010). Ideally, once a clinician learns the Lean methodology they will teach others and spread this learning through the organization (Poksinska, 2010). As process changes create improvements, these results will help to

create and reinforce a new culture (Institute for Health Improvement, 2005; Radnor, Walley, Stephens, & Bucci, 2006).

The “customer” in health care should be the patient (Kollberg, Dahlgaard, & Brehmer, 2007) so when using a VSM, it should model the patient’s movement through specific journeys of care (Curry, McGregor, & Tracy, 2006; Curry, McGregor, & Tracy, 2007). A limitation of the VSM is it lacks the ability to relay important policies/guidelines, staff roles, Information System usage (Curry et al., 2006) and patient socio-cultural needs (McGregor et al., 2008a), that are integral to healthcare (Curry et al., 2006; McGregor et al., 2008a).

The Institute for Healthcare Improvement’s (IHI) Breakthrough Series Model for Improvement (MOI) is an interdisciplinary collaborative approach that uses the Model for Improvement (MOI) and small scale rapid improvement cycles called “Plan-Do-Study-Act (PDSA) cycles” to develop, implement and evaluate process improvements (Kilo, 1998; Langley, Nolan, Nolan, Norman, & Provost, 2009; Varkey et al., 2007).

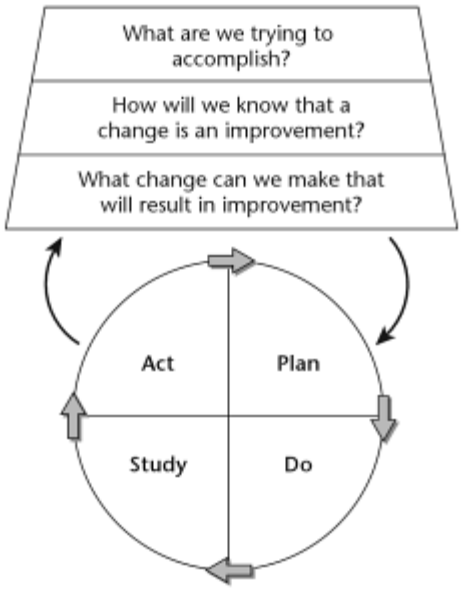


Figure 2.1 Model for Improvement (Langley et al., 2009, pg 24)

It is the most commonly used approach in health care (Varkey et al., 2007). A shortcoming of this methodology is that the MOI does not specify using a graphic modelling tool to promote communication for use during the interdisciplinary collaborative improvement sessions (Curry et al., 2006). This can lead to a lack of shared understanding of the health care processes which influences process improvement redesign (Jun, Ward, Morris, & Clarkson, 2009).

Six-Sigma was developed by Motorola Inc. and is a “rigorous statistical measurement methodology designed to reduce cost, decrease process variation, and eliminate defects … is achieved through a series of steps: define, measure, analyze, improve, and control” (Varkey et al., 2007, pg. 737). Six-Sigma involves defining project goals, measuring data

for analysis of findings, developing improvement initiatives in response to findings and then developing policies and guidelines to control processes from reverting to old versions (Kwak & Anbari, 2006; Varkey et al., 2007). This method requires extensive education (Aboelmaged, 2010; Kwak & Anbari, 2006; Proudlove, Moxham, & Boaden, 2008) and is perceived to be complex (de Koning, Verver, van den Heuvel, Bisgaard, & Does, 2006) and at times inefficient when simple problems appear not to require the full process of six sigma (de Koning et al., 2006; Proudlove et al., 2008).

2.3 Process Modelling

Improving the quality of care in a complex healthcare environment such as an ICU, requires a thorough understanding of processes and information flows and must include engagement of clinicians, with modelling of processes an important aid in developing this understanding (Jun et al., 2009; Malhotra, Jordan, Shortliffe, & Patel, 2007; Mathisen & Krogstie, 2012; Staccini, Joubert, Quaranta, Fieschi, & Fieschi, 2001). Process modelling in healthcare fulfils two aims in QI. First, to improve understanding in order to identify areas for improvement (Jun et al., 2009; Mathisen & Krogstie, 2012; Mendling, Strembeck, & Recker, 2012). Second, to document current and future planned processes in order to share this understanding (Jun et al., 2009; Mathisen & Krogstie, 2012; Recker, Safrudin, & Rosemann, 2012). There are numerous process models available to choose from in healthcare (Mathisen & Krogstie, 2012). As introduced in the previous section on QI, Lean VSM is one example of

a process modelling technique. Although it has been used in healthcare for process improvement (Gattnar, Ekinci, & Detschew, 2011), Lean was originally developed for the manufacturing industry. Its main weakness is its inability to fully capture the complexities of healthcare such as patient socio-cultural needs, clinical guidelines and policies (Percival, Catley, McGregor, & James, 2009).

Jun et al. (2009) performed a study that evaluated eight process model diagrams by clinicians for usability and utility. See Table 2.1.

Table 2 Diagram evaluation results

Diagram type	Prior experience with diagram ($n = 29$) (%)	Usability: easily understandable ($n = 29$) (%)	Utility: helpful in better understanding how the system works ($n = 28$) (%)	Utility: helpful for specific purposes
① Stakeholder diagrams	48	86	57	Defining system boundaries Identifying key stakeholders
② Information diagrams	48	79	57	Understanding document standardization status, level of electronic document usage
③ Process content diagrams	48	90	64	Understanding a detailed task structure
④ Flowcharts	76	97	89	Understanding an overall process
⑤ Swim lane activity diagrams	76	79	61	Understanding roles and responsibilities
⑥ State transition diagrams	21	59	71	Understanding a process in a patient-centred way
⑦ Communication diagrams	14	38	39	Understanding communication and interactions between stakeholders
⑧ Data flow diagrams	21	62	50	Limited in describing overall care processes

Table 2-1- Process Diagram Evaluation Results (Jun et al., 2009 p. 217)

Although clinicians favour using flowcharts the most because they find them easy to use and effective for basic healthcare system understanding; (Jun

et al., 2009), flowcharts are limited in their ability to display complex system interactions (Jun et al., 2009; Mathisen & Krogstie, 2012). Findings from the study indicate that all of the models are really only an over-simplified “view of reality” and they are not able to capture all the complicated aspects involved in health care delivery (Jun et al., 2009). Therefore, the choice of modelling tool should be based on its purpose (Jun et al., 2009; Recker et al., 2012). Ultimately, the goal of the model is to encourage understanding when doing team-based modelling sessions so usability is crucial (Jun et al., 2009; Mendling et al., 2012; Recker et al., 2012).

2.4 Patient Journey

Ontario Bill 46 mandates that “care is organized around the person” (Government of Ontario, 2010b) thus any attempts at process modelling for the purposes of quality improvement must be patient focused and follow the patient’s journey. The patient journey is defined as the “end-to- end sequence of all the steps required to provide clinical care for a patient” (Ben-Tovim & Dougherty, 2008 p.14). Patient-centric process modelling illustrates the care processes that a patient undergoes throughout their patient journey and is known as Patient Journey Modelling (Curry, McGregor, & Tracy, 2007).

PaJMa is a patient-centric process modelling technique that was designed by business process researchers to specifically reflect the patient journey in healthcare (Curry et al., 2006) . The purpose of PaJMa is to identify patient care processes, staff roles, and information flows in order to illustrate problems ,

issues, and opportunities for improvement of quality of care (McGregor, Steadman, Percival, & James, 2012). PaJMa is user-intuitive, does not require special training, and promotes the participation and engagement of clinicians in the development of visual depictions of current and future care processes and information flows (McGregor et al., 2012). Clinician engagement increases support for the identified changes (Joshi, 2013; McGregor et al., 2008b).

What differentiates PaJMa from Lean's VSM is the ability of PaJMa to relay important policies/guidelines, Information System usage (Curry et al., 2006) and patient socio-cultural needs (McGregor et al., 2008a). This information is integral to healthcare (J. M. Curry et al., 2006; McGregor et al., 2008a).

2.5 Health Information Technology

In its 2001 report, *Crossing the Quality Chasm,* the Institute of Medicine (IOM) released six specific aims for healthcare improvement and identified the critical role that HIT has in supporting these aims and its "enormous potential for transforming the health care delivery system" (Institute of Medicine, 2001 p.5). The report warns that applying HIT is challenging because of the complexity of healthcare and that adoption of HIT will require "behavioral adaptations on the part of large numbers of clinicians, organizations, and patients" (Institute of Medicine, 2001 p.5).

Failure rates for IT implementations are high, "over half of IT projects do not deliver as they should, are over budget, or are late…Similar failure rates have been reported specifically for health IT"

(Kaplan & Harris-Salamone, 2009 p.292). However, the emerging consensus points to issues with HIT that are related more to sociological, cultural, and financial i.e. “managerial” factors, than technical (Kaplan & Harris-Salamone, 2009).

2.6 Technology Adoption

The Technology Acceptance Model (TAM) was developed to predict whether users would accept or reject the use of information technology. It posits that “perceived ease of use”, and “perceived usefulness” of the proposed technology are the key factors for technology adoption (Legris, Ingham, & Collerette, 2003). (see figure 2.2 below).

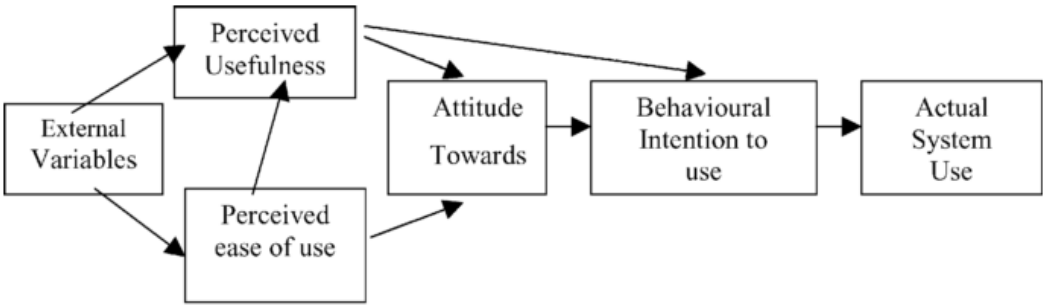


Figure 2.2 -Technology Acceptance Model (Legris, Ingham, & Collerette, 2003 p. 193)

The TAM has evolved over time to include more variables and is considered the “gold standard” theory for IT acceptance (Holden & Karsh, 2010). The TAM has only recently begun to be used with HIT thus future research is required to adapt the model to the healthcare context (Holden

& Karsh, 2010). Legris, Ingham, & Collerette (2003) explain that research in the fields of change management and innovation indicates that technology implementation is impacted by organizational dynamics which can strongly affect outcomes. Orlikowski and Hofman (as cited by Legris, Ingham, & Collerette, 2003, p. 202). assert that the “effectiveness of any change process relies on the interdependence between the technology, the organizational context, and the change model used to manage the change”. Legris, Ingham, & Collerette, (2003) conclude that the TAM would need to integrate organizational and social factors into a much broader model in order to retain its predictive capacity and this could prove to be quite difficult. The TAM can be used to predict technology acceptance but change management (CM) is required in order to promote technology adoption (Legris, Ingham, & Collerette, 2003).

Adoption of HIT initiatives in Canada is being encouraged through Canada Health Infoway (Infoway), an independent, non-profit, federal government sponsored corporation whose main goal is to “accelerate the development and adoption of health information technology projects in Canada” (Canada Health Infoway, 2013). Infoway identifies Change Management as “an essential driver of adoption” (Canada Health Infoway, 2011a, pg 35) and has developed numerous resources to support this goal. The Change Management Framework (CMF) is one such tool and will be discussed shortly.

2.7 Change Management

Change Management (CM) is the process of supporting people and organizations to move from a current state to a desired future state (Lorenzi & Riley, 2003; PanCanadian Change Management Network - Communications Working Group, 2012; Kerollos, 2012). CM for HIT implementation requires managing the “people” aspects of change and not just the “technology” aspects (PanCanadian Change Management Network - Communications Working Group, 2012). HIT enables the creation of options and opportunities for organizations to transform and improve the services they provide but HIT itself does not drive change (Lorenzi & Riley, 2000). Initiatives using effective CM strategies have been shown to be six times more successful at achieving project goals (PanCanadian Change Management Network - Communications Working Group, 2012). Successful change projects require a structured approach (J. Kerollos, 2012) and there are numerous models available for CM (By, 2005; Joseph Kerollos, 2012).

Kurt Lewin’s Three-Step Model for Change has “dominated the theory and practice of change management for over 40 years” (Burnes, 2004 p. 977). See Figure 2.3 below.

Figure 2.3 Lewin's 3 Step Model for Change (Portolese Dias, 2012)

Lewin posited that before an organization could change to a new behavior, the old behavior had to be discarded (By, 2005). His model has three steps; unfreezing the current state, moving to the new state, and then refreezing to a new stable state (Gareis, 2010). Critics claim that the model is only suitable for small-scale changes in stable organizations and ignores issues such as organizational politics and conflict (Burnes, 2004b) but recent reappraisals of the model find it is still relevant (Burnes, 2004a; By, 2005; Schein, 1996; Whelan-Berry & Somerville, 2010).

Kotter's Eight-Step Model is another "prominent" change model (Gareis, 2010) that is still considered relevant today (Fickenscher & Bakerman, 2011). See Figure 2.4 below. Its approach is practical and pragmatic for managers to implement (Appelbaum, Habashy, Malo, & Shafiq, 2012; By, 2005) but it lacks

research validation of the full eight steps (Appelbaum et al., 2012; Cronin, Baker, & Lee, 2011).

KOTTER'S EIGHT-STEP MODEL

1. **Establish a sense of urgency.** Discussing today's competitive realities, looking at potential future scenarios. Increasing the 'felt-need' for change.
2. **Form a powerful guiding coalition.** Assembling a powerful group of people who can work well together.
3. **Create a vision.** Building a vision to guide the change effort together with strategies for achieving this.
4. **Communicate the vision.** Kotter emphasizes the need to communicate at least 10 times the amount you expect to have to communicate. The vision and accompanying strategies and new behaviours needs to be communicated in a variety of different ways.
   The guiding coalition should be the first to role model new behaviours.
5. **Empower others to act on the vision.** This step includes getting rid of obstacles to change such as unhelpful structures or systems. Allow people to experiment.
6. **Plan for and create short-term wins.** Look for and advertise short-term visible improvements. Plan these in and reward people publicly for improvements.
7. **Consolidate improvements and produce still more change.** Promote and reward those able to promote and work towards the vision. Energize the process of change with new projects, resources, change agents.
8. **Institutionalize new approaches.** Ensure that everyone understands that the new behaviours lead to corporate success.

Source: Kotter (1995)

Figure 2.4 Kotter's Eight-Step Model (Cameron & Green, 2012 p.115)

By, 2005, provides a comparison of three models of emergent change to illustrate the "similarities and differences between these models" (By, 2005 p.375) see figure 2.5 below.

Table 4. A comparison of three models of emergent change

Kanter *et al.*'s Ten Commandments for Executing Change (1992)	Kotter's Eight-Stage Process for Successful Organisational Transformation (1996)	Luecke's Seven Steps (2003)
1) Analyse the organisation and its need for change		1) Mobilise energy and commitment through joint identification of business problems and their solutions
2) Create a vision and a common direction	3) Developing a vision and strategy	2) Develop a shared vision of how to organise and manage for competitiveness
3) Separate from the past		
4) Create a sense of urgency	1) Establishing a sense of urgency	
5) Support a strong leader role		3) Identify the leadership
6) Line up political sponsorship	2) Creating a guiding coalition	
7) Craft an implementation plan		
8) Develop enabling structures	5) Empowering broad-based action	
9) Communicate, involve people and be honest	4) Communicating the change vision	
10) Reinforce and institutionalise change	8) Anchoring new approaches in the culture	6) Institutionalise success through formal policies, systems, and structures
	6) Generating short-term wins	
	7) Consolidating gains and producing more change	
		4) Focus on results, not on activities
		5) Start change at the periphery, then let it spread to other units without pushing it from the top
		7) Monitor and adjust strategies in response to problems in the change process

Figure 2.5 Comparison of Three Models of Emergent Change (By, 2005 p. 376)

A Canadian-made CM model, Canada Health Infoway's "*Change Management Framework*" (CMF), will be described in further detail.

2.8 Change Management Framework

Quality Improvement (QI) involves change (Batalden & Davidoff, 2007). In 2009, a group of Canadian change management (CM) practitioners came together after attending a Clinical Adoption workshop to form the Pan-Canadian Change Management Network (PCCMN). Supported by Canada Health Infoway (Infoway), they shared their knowledge and identified change management issues common to e-Health across the country (Hodder & Frazer, 2012). The group defined "e-Health CM as the strategic, systematic approach that supports people and their organizations in the successful transition and adoption of electronic health solutions" (Pan-Canadian Change Management Network 2011 as cited by Hodder & Frazer, 2012 p.12). With help from Infoway, a CM working group (CMWG) was struck. In June 2011, The CMWG released a complete guide and toolkit; *A Framework and Toolkit for Managing e-Health Change: People and Processes* (Pan-Canadian Change Management Network 2011 as cited by Hodder & Frazer, 2012). The toolkit was based on a comprehensive literature review and a Canadian-wide current state analysis of e-Health CM methodologies (Hodder & Frazer, 2012). The Toolkit was intended to support a best practice model for CM in Canada with strategies to "accelerate the adoption and realization of benefits associated with the use of e-Health technologies in

Canada" (Hodder & Frazer, 2012 p.13). In conjunction with the toolkit, the CMWG also released multiple open-access tools, templates, and further CM resources on the Infoway website (Hodder & Frazer, 2012).

Central to the Toolkit is the "*Change Management Framework*" (CMF) which identifies six core CM elements that must be addressed during implementation planning and execution in order to promote successful change acceptance (Hodder & Frazer, 2012). These elements are; Governance & Leadership, Stakeholder Engagement, Communications, Workflow Analysis & Integration, Training & Education, and Monitoring & Evaluation.

See figure 2.6 below for the CMF.

Figure 2.6 -Change Management Framework (Canada Health Infoway, 2011a p. 14)

A brief description of each of the elements follows in table 2.2.

Change Element	Description
Governance & Leadership	The mechanisms used to guide, steer or regulate the course of a project, including how stakeholders can affect the priorities and progress of a project as well as the CM activities occurring within a project.
Stakeholder Engagement	The process by which the perceptions, issues and expectations of stakeholders are learned and managed. Stakeholder engagement includes focused attention on the individuals who are expected to change. Their behaviours and needs must be defined, understood and considered when implementing eHealth projects.
Communications	The process of providing stakeholders with what they need to know, in order to prompt appropriate responses and/or actions.
Workflow Analysis & Integration	The process of understanding current work processes and opportunities for improvement, so that new processes using eHealth solutions can be sustainably embedded into the culture, as evidenced through their presence within steady-state operations.
Training & Education	The act of imparting both knowledge and specific skills among key stakeholders to promote adoption.
Monitoring & Evaluation	The process of reviewing whether CM activities took place as planned; and the extent to which they were effective. As proposed in this framework, monitoring and evaluation take place throughout the lifecycle of the project.

Table 2-2 - Change Management Elements (Canada Health Infoway, 2011a p. 4)

Each of the CM elements describes “domains of activities” that need to be addressed and contains resources and tools that have been used with prior successful implementations of e-Health technologies throughout Canada

(Canada Health Infoway, 2011a). Although the resources have been grouped within the appropriate CM element, they are not organized in a structured manner. A structured approach is important as it provides guidance to support planning and implementation of a CM process while identifying gaps and preventing mistakes (Joseph Kerollos, 2012; Prosci, 2012). For an initiative to be successful, people need a detailed, methodical plan that outlines tasks and activities in an organized sequence that provides an explicit implementation guide (Curry et al., 2007). This structured approach is lacking in the CMF.

The CMF states that successful adoption of HIT will improve patient care (Canada Health Infoway, 2011a), but nowhere within the CMF elements is there any mention of patient involvement. Bill 46 mandates a patient centred focus and the Stakeholder Engagement element does not explicitly identify the patient as a stakeholder. This leaves out any opportunities for patients to be involved in identifying their concerns and issues for process improvement, or in planning of the HIT initiative. The IAPO Declaration outlines five principles that are necessary to achieve PCC;

1. Respect
2. Choice and empowerment
3. Patient involvement in health policy
4. Access and support
5. Information

Lorig (2012) identifies that the IAPO definition of Patient Centered Care (PCC) could possibly be the only one actually developed by patients

themselves. The importance of the definition for PCC is that it will determine how care is actually delivered (Lorig, 2012). Lorig (2012) states “patient-centred care will never be achieved if patients are not part of the solution” (Lorig, 2012, p. 524). In the CMF, Patients are not identified as stakeholders and thus they are excluded from sharing their input into any planning for improvement.

The Workflow Analysis & Integration element focuses on identifying workflow processes that can be improved through the implementation of HIT. The CMF states that “teams are often pressured to change their workflows solely to meet the requirements of the system” (Canada Health Infoway, 2011a p. 29). It cautions that clinical needs should drive workflow redesign and not just system requirements (Canada Health Infoway, 2011a). However, it lacks a patient centred approach as it does not use the patient journey as the focus for process modelling for improvement. The CMF recommends that workflow redesign should incorporate best practices from both clinical and technological requirements (Canada Health Infoway, 2011a). What is missing is that workflow redesign should also support data and information flows (Stead, 2009). Health care is information and knowledge intensive (Stead, 2009) and clinicians require and generate large volumes of information in the process of providing care (Locatelli et al., 2012). Technology implementation needs to support the information requirements of process change, not drive it (Stead, 2009). This underlies the importance of including data and information flows and using the appropriate tools to model these process workflows. The recommended tools in

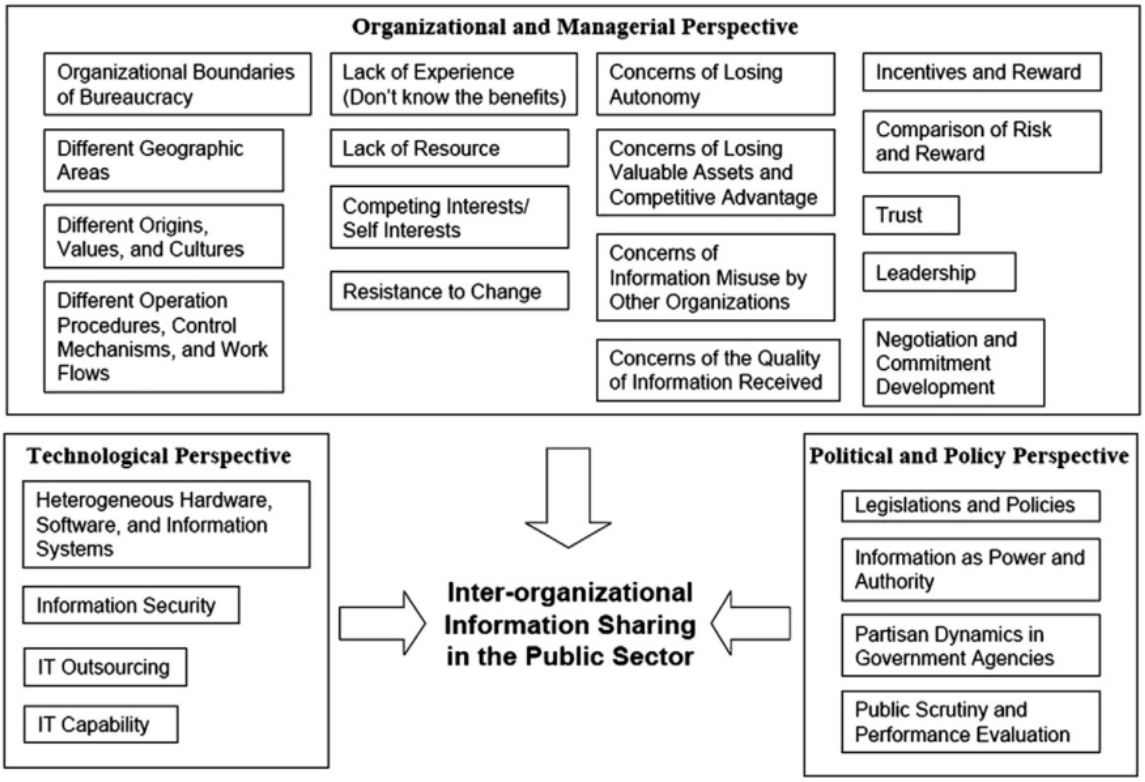
the CMF for the Workflow Analysis & Integration element are process modelling flow charts or system flow charts. These tools lack the ability to explicitly identify the information and data flows that are integral to healthcare (Curry et al., 2006; McGregor et al., 2008a). This type of functionality is important because of the complexity of information requirements necessary to support clinical decision making (Mathisen & Krogstie, 2012).

The CMF provides some specific examples of successful provincial practices across Canada. In the CMF examples, the province of Alberta is the only one to discuss information flows. In Alberta, the process is to assess workflow and integrate it in a CM project; “Business requirements are documented early in the project and cover business and information flow” (Canada Health Infoway, 2011a p. 29). No other explicit mention of identifying information flows occurs in the CMF, instead, “Workflow” is used ubiquitously to identify process flow, and workflow analysis is done in order to “embed new processes using eHealth solutions into the operations of health service delivery organizations” (Canada Health Infoway, 2011a p.29). The importance of capturing the information flow with the workflow for healthcare needs to be emphasized and made explicit (Stead, 2009) .

In the Governance and Leadership element, the CMF states that governance structure is specific to an organization (Canada Health Infoway, 2011a). It identifies the importance of understanding the cultural and political environment within an organization in regards to how a proposed new initiative “fits” the perceived needs of the organization (Canada Health Infoway, 2011a) in

order to promote change acceptance. Matching the governance structure to the unique culture and objectives of an organization is critical for success (Canada Health Infoway, 2011a). Research by Leidner and Kayworth (2006) found that organizational culture influences the successful implementation of IT and that differences in culture effect use and outcomes of IT. In order for IT to be adopted, it must either fit the organizational culture or create cultural change to meet the “behavioural requirements” of the technology (Cabrera, Cabrera, & Barajas, 2001; Leidner & Kayworth, 2006). Ensuring the technology implementation fits with the organizational culture will increase the chance of successful adoption (J. Huang, 2011; Jackson, 2011).

The CMF does not address the situation of when there is more than one organization involved in a CM initiative. Consideration for multiple organizations is important as it increases the complexity of interactions between organizations because of the different values and cultures between the participating organizations (Leidner & Kayworth, 2006; Yang & Maxwell, 2011). It impedes information sharing and collaboration (Leidner & Kayworth, 2006). Yang & Maxwell, 2011, identify other factors that influence information sharing at the interpersonal, intra- organizational, and inter-organizational level. See Figure 2.7 below for factors influencing inter-organizational information sharing.



. . Factors influencing inter-organizational information sharing in the public sector.

Figure 2.7 Factors influencing inter-organizational information sharing in the public sector (Yang & Maxwell, 2011 pg. 169)

Patient journeys can cross numerous departments/divisions within an organization and between organizations (NHS Modernization Agency, 2005). A review of the literature revealed a paucity of information regarding intra/interorganizational patient journeys, especially in regards to patient information sharing across organizational boundaries (Eason, Dent, & Waterson, 2012). McGregor (2007), proposed a framework to define web services to support intra/interorganizational patient journey workflows which supports patient

centred process and workflow analysis (McGregor, 2007). This framework supports intra/interorganizational communication but does not address the other elements of the CMF, such as governance structure or stakeholder engagement.

2.9 Conclusion

Advanced Telemedicine technology shows promise in improving access to quality critical care medicine (Kahn et al., 2011a; Wilcox & Adhikari, 2012). However, findings from the literature review indicate the importance of using thoughtful change management techniques when attempting to implement HIT. Deliberations include ensuring that quality improvement initiatives are patient centred (Government of Ontario, 2010b) and that clinicians are involved in identifying workflow and information requirements (Jun et al., 2009; McGregor et al., 2012; Staccini et al., 2001) in order to guide the HIT implementation and promote adoption (Canada Health Infoway, 2011a; Kaplan & Harris-Salamone, 2009). Using a structured implementation approach is crucial for success (Kerollos, 2012; Prosci, 2012). The proposed implementation of an advanced telemedicine technology for provision of remote critical care requires careful consideration of all of these factors. An attempted use of the current CMF exposed limitations. This is the underlying motivation that drove the development of the proposed research construct, to provide a structured approach that met these considerations for implementing HIT while addressing gaps in Infoway's CMF.

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Quality improvement in health care can be supported through the thoughtful deployment of HIT. Taking into consideration clinician information requirements and workflows, and combining with a patient centred focus, while providing a structured CM approach; the proposed research construct can promote the implementation of health information technology-enabled quality improvement in health care and support the following hypothesis:

A framework to utilize health information technology for patient centred care within an inter and intra organizational context incorporating explicit representation of data and information flows can be quantified to enable measureable quality improvement in healthcare.

3 Chapter 3 – Literature Review – Case Study Context

3.1 Introduction

The case study in this thesis involves the provision of a remote Intensivist consultation service via advanced telemedicine technology. The purpose of this chapter is to provide the context for the case study. This will include a description of ICU and Intensivists, Telemedicine, and its use in ICU and in Canada.

3.2 Intensive Care

Intensive Care Units (ICU) are hospital areas that provide round the clock specialized care to acutely ill patients facing life-threatening disease or injuries (Bell & Robinson, 2005; Hopkins Medical Institution, 2011).

Figure 3.1 Intensive Care Unit (Unknown, 2010 retreived from: **http://roundlydismissed.blogspot.ca/2010/09/pumping-irony.html#comment-form**)

The complexity of care required by these patients creates high resource utilization and can account financially for up to 34% of hospital budgets (Bell & Robinson, 2005; Halpern, 2011). Moreover, the demand for ICU care is increasing as our population ages, new advances in life-support technology are developed, and expectations grow to “maintain life at all costs” (Bell & Robinson, 2005; Gajic & Afessa, 2009; Halpern, 2011; Hill, Fan, & Stewart, 2009). A large interprofessional team is required to meet the multifaceted needs of the critically ill (Bell & Robinson, 2005; Garland & Gershengorn, 2013). Shortages of nurses and Intensivists are well publicized, less well recognized are the scarcity of other members of the healthcare team, such as pharmacists and respiratory therapists (Bell & Robinson, 2005; CIHI, 2010; Halpern, 2011; Society of Critical Care Medicine Tele-ICU Committee, 2010a). Trends such as an aging workforce, an increase in early retirement, longer education programs related to the large knowledge base required to provide care to more complex health conditions, and fewer people choosing healthcare as a career (Bell & Robinson, 2005; Fifer, Everett, Adams, & Vincequere, 2010; Gajic & Afessa, 2009; Halpern, 2011) all contribute to the issue of shortages. The challenges of working in the ICU create stress and burnout, adding to staff turnover (Bell & Robinson, 2005; Garland & Gershengorn, 2013). Shortages of resources extend past the financial to include the human resource aspects as well (Bell & Robinson, 2005; Halpern, 2011).

3.3 Intensivists

Intensivists are physicians specially trained in providing medical care to critically ill patients (Ontario Critical Care LHIN Leadership Table, 2006). In the United States, the Leapfrog group and The Society of Critical Care Medicine have established staffing guideline recommendations allowing only Intensivists to admit to non-rural ICUs (Fine, Loheide, Swanson-Kazely, Clarke, & Simpson, 2010; Hopkins Medical Institution, 2011) as the scientific evidence shows a higher quality of care and lower mortality rates when care is provided by board certified Intensivists (Hopkins Medical Institution, 2011).

In Ontario, the Provincial Critical Care Advisory Group recommended that ICU's be managed using an Intensivist-led model known as a "closed" unit – that is, all admissions and patient care-decisions are managed by the Intensivist (Ontario Critical Care LHIN Leadership Table, 2006). In 2006, approximately 56 (74%) of 76 Level 3 critical care units with 8 or more beds were closed units (Hill et al., 2009; Ontario Critical Care LHIN Leadership Table, 2006). Level 3 units are defined by the Ontario Critical Care LHIN Leadership Table (2006) as:

> Capable of providing the highest level of service to meet the needs of patients who require advanced or prolonged respiratory support, or basic respiratory support together with the support of more than one organ system. This is generally considered a "full service" Critical Care unit despite the fact some specialized services may not be

> available (e.g. dialysis). All Level 3 units are capable of invasive ventilatory support. (p. 112)

Level 3 units provide care to the most critically ill patients, those that would benefit most from Intensivist management but because of shortages, not all units have access to these specialists (Burnham, Moss, & Geraci, 2010; Hopkins Medical Institution, 2011; Popovich, Esfandiari, & Boutros, 2011). Telemedicine has been proposed as an innovative way to extend current Intensivist resources (Bell & Robinson, 2005; Fifer, Everrett, & Adams, 2010; Hopkins Medical Institution, 2011; Romig, Latif, Gill, Pronovost, & Sapirstein, 2012; Society of Critical Care Medicine Tele-ICU Committee, 2010a) and to increase access to care for patients in remote and rural areas.

3.4 Telemedicine in Canada

"Telehealth is broadly defined as the application of telecommunications and information technology for delivery of health care and health related services and information over large and small distances"(McCarthy, Scott, & Coates, 2000 pg. 8) Telemedicine refers specifically to physician–patient interaction via telehealth technologies, usually video-conferencing (Canadian Society of Telehealth, 2007).

In Canada, telehealth was first used in the 1950's when a doctor at a Quebec hospital transmitted radiological images via closed-circuit television to his home (Canadian Society of Telehealth, 2007). Since then, communication

technology has evolved to include telephone, satellite, and now internet-based telehealth applications.(Canadian Society of Telehealth, 2007). Various funding initiatives through the federal government have encouraged the growth of telehealth in each of the provinces and territories in one form or another. Nunavut, Northwest Territories, and the Yukon, are mostly limited to satellite link because of the vastness of their geography (Canadian Society of Telehealth, 2007). The most common form is a telephone Nurse help-line, but 2-way video-conferencing is also available in most provinces. Video-conferencing is not only used to provide patient care, but to provide health-related educational sessions also (Canadian Society of Telehealth, 2007; Ontario Telemedicine Network, 2011b).

The Ontario Telemedicine Network (OTN) is one of the world's largest telemedicine networks (Ontario Telemedicine Network, 2011b) and is a not-for-profit corporation that provides services to support clinical, educational, and administrative needs that include video-conferencing, webcasting, store forward of scanned images and telehomecare (Ontario Telemedicine Network, 2011b). OTN is able to transmit from telediagnostic equipment such as digital stethoscopes and otoscopes, remote electrocardiograms (ECG), from high resolution cameras, and from endoscopes (Ontario Telemedicine Network, 2011b).

Some of the emergency services OTN lists includes telestroke, teletrauma, teleburns, emergency mental health, virtual Critical Care and also neonatal and paediatric intensive care (Ontario Telemedicine Network, 2011a).

These emergency consults can be activated by accessing the Criticall system which is an Ontario-wide, 24-hour emergency referral system that links hospitals and medical resources for physicians ("CritiCall," n.d.).

Canada Health Infoway (Infoway) is an independent non-profit federal government sponsored corporation whose main vision is to "accelerate the development and adoption of health information technology projects in Canada" (Canada Health Infoway, 2013). In 2011, Infoway commissioned the Telehealth Adoption and Benefits Study to evaluate the quality, access, and productivity benefits of telehealth activities in Canada (Canada Health Infoway, 2011b). Infoway found an increasing utilization of telehealth across the country; in 2010, 187,385 clinical, 44,600 educational, and 27,538 administrative telehealth events occurred (Canada Health Infoway, 2011b). Of the 187,385 clinical events, the top three clinical service activities were in Mental Health and Addictions (54%), Internal Medicine (15%), and Oncology (13%) (Canada Health Infoway, 2011b). Ontario has the largest telehealth program (OTN) but the Territories (Northwest, Yukon, and Nunavut) have the highest number of events per population (Canada Health Infoway, 2011b). 50% of all telehealth events were to rural, remote, or northern residents (Canada Health Infoway, 2011b).

3.5 Telemedicine in ICU

Telemedicine use in ICU can present as various models (Marcin, Marcin, Sadorra, & Dharmar, 2012). The simplest and most common use is the basic

“POTS” system - “plain old telephone service” for a direct telephone consultation between two clinicians (Canadian Society of Telehealth, 2007).

The “consultative model” uses videoconferencing for on-demand, “real-time” (synchronous) consultations that occur between the remote Intensivist and the on-site physician (Marcin et al., 2012). Physical assessments of the patient can be done through the use of specialty telediagnostic equipment and can be augmented through the use of asynchronous “store and forward” technology (e.g. Radiology images forwarded by computer) (Boots, Singh, Terblanche, Widdicombe, & Lipman, 2011).

The “continuous oversight model” (Marcin et al., 2012) uses virtual “command centres” or “Tele-ICU” that are staffed by Intensivists and nurses around the clock who can monitor and provide care up to 100 patients at various remote sites via the use of directly wired technological infrastructures that access real-time physiological data streaming from the patient’s bedside monitors and equipment, the patient’s electronic health record (EHR) including diagnostic images, and web cameras that can visualize the patient (Cummings, Krsek, Vermoch, & Matuszewski, 2007). The financial cost investment in setting up the equipment and staffing the Tele-ICU is very significant (Sapirstein, Lone, Latif, & Fackler, 2009).

Wilcox and Adhikari (2012) did a systematic literature review with meta-analysis of telemedicine in the critically ill in 2012. They found that telemedicine use in the ICU was associated with lower ICU and hospital mortality rates and reduced length of hospital stay. They also found mortality rates were similar

between the two models – between the continuous Tele-ICU model and the remote Intensivist consultation model but acknowledged that the remote Intensivist model analysis was “under powered”(Wilcox & Adhikari, 2012). They conclude that “telemedicine is a promising technology to reduce mortality in the critically ill” (Wilcox & Adhikari, 2012).

3.6 ICU Telemedicine in Canada

The use of telemedicine in Canada for critical care has been very limited (Shahpori, Hebert, Kushniruk, & Zuerge, 2010; Shahpori, Kushniruk, Hebert, & Zuege, 2011). In the fall of 2009 during the H1N1 influenza outbreak, Alberta used telemedicine (videoconferencing) to link Intensivists in regional ICUs with physicians in rural units to provide “real-time” consultations and decision making support (Canada Health Infoway, 2011b). This prevented unnecessary transfers and enabled patients to be cared for closer to home (Alberta Health Services, 2009).

In January 2011, the North East Local Integrated Health Network (NE LHIN) of Ontario presented the findings from a 15 month telemedicine pilot called the Virtual Critical Care Project to the Ontario Critical Care Secretariat and OTN (Boyle & Kostiw, 2011). Sudbury Regional Hospital (HRSRH) provided Temiskaming Hospital, Kirkland Lake District Hospital (KLDH), and Cochrane Hospital with Intensivist consultations via OTN videoconferencing and supplemented with direct access to an inter-hospital interface for the electronic medical record (EMR) and the radiology PACs (Picture Archiving and Collection)

system (Boyle, Kostiw, Nickoloff, & Beaton-Mills, 2011). The technology was not available at the time to provide the Intensivists with direct access to the physiological data from the bedside monitoring equipment. The Intensivists utilized the limited information that was manually transcribed into the EMR to support their clinical decision making. However, over the 15 month pilot, in total, there were 25 consults and in 9 cases (Boyle & Kostiw, 2011) they were able to prevent unnecessary transfers to the regional centre providing the consult (Boyle & Kostiw, 2011). Providers at the remote and lead sites believed the consults improved care and were valuable while patients "felt they received good care and their privacy issues addressed" (Boyle & Kostiw, 2011).

Canada does not currently have any instances of a Tele-ICU (Shahpori et al., 2011). Shahpori et al (2011), explain this is because Tele-ICU "financial benefits are uncertain and setup and operational costs are significant" (Shahpori et al., 2011 p. 424) and that study results from the United States may not generalize to Canada as funding and models of care are different (Shahpori et al., 2011). Given that Canadian health care is publicly funded there are limited funds available and minimal evidence to support its implementation (Shahpori et al., 2011).

3.7 Online Health Analytics

Online health analytics are a new form of clinical Big Data based clinical decision support system (McGregor, 2013a, 2013b). " "Big data" refers to datasets whose size is beyond the ability of typical database software tools to capture, store,

manage, and analyze " (Manyika, Chui, Brown, & Bughin, 2011 p.1). Online health analytics have significant relevance in the critical care domain. The enormous quantities of complex physiological data continuously produced by critical care monitors and equipment exceeds the clinician's capacity for processing (McGregor et al., 2011; McGregor, 2013b). The use of online health analytics and their adoption have great potential to enable quality improvement. They enable the real-time processing of early prognosticators of impending clinical deterioration (McGregor et al., 2011; McGregor, 2013b) and perform as an "early warning system". This promotes timely intervention and improved outcomes for patients (McGregor et al., 2011; McGregor, 2013b).

Artemis is an "online health analytics platform that enables concurrent diagnoses of multiple patients through real-time analysis of multiple data streams" (McGregor, 2013b). The sources of data come from various bedside physiological monitoring devices, medical equipment such as ventilators and infusion pumps, and clinical information management systems (CIMS) which house the patient's electronic medical record and includes laboratory results (Blount et al., 2010; McGregor et al., 2011; McGregor, 2013b). The analytic results provides clinicians with "integrated temporal summaries of events" (McGregor et al., 2011) which delivers advanced clinical decision support. Artemis is promising new technology that can be deployed in any critical care environment, and through its cloud-based functionality, is available to provide the

service of critical care to remote sites where information technology resources may be limited (McGregor et al., 2011; McGregor, 2011).

The Artemis Cloud platform's "early warning" functionality could be used in the proposed "consultative" ICU telemedicine model to initiate the remote Intensivist consultation prior to the development of clinical deterioration in the patient. Additionally, the Artemis Cloud platform would provide more robust information support for clinical decision making by the Intensivist to support higher quality of care for the remote patient (McGregor, 2011, 2013a).

3.8 Discussion

Critical care medicine is complex but patient outcomes have been shown to be improved if care is provided by Intensivists (Bell & Robinson, 2005). The shortage of Intensivists has created an inequity in access to care which could be mitigated through the application of telemedicine (Bell & Robinson, 2005; Hopkins Medical Institution, 2011; M. C. Romig, Latif, Gill, Pronovost, & Sapirstein, 2012; Society of Critical Care Medicine Tele-ICU Committee, 2010a). However, while there is evidence in Canada of "significant and growing utilization" in general telemedicine (Canada Health Infoway, 2011b p. 1) , adoption of critical care telemedicine initiatives, while slow in the United States (Zapka et al., 2013), has been almost non-existent in Canada (Shahpori et al., 2011). A paucity of research exists to provide knowledge around the implications, financial costs, and outcomes of its use in ICU (Kahn et al., 2011b).

Research is required to determine the ideal configuration for ICU telemedicine (Kahn et al., 2011b; Wilcox & Adhikari, 2012).

3.9 Conclusion

Advanced telemedicine could mitigate inequity in access to Intensivist care (Bell & Robinson, 2005; Society of Critical Care Medicine Tele-ICU Committee, 2010; Hopkins Medical Institution, 2011; Romig et al., 2012), however, there is a deficiency of information surrounding ICU telemedicine and its implementation (Kahn et al., 2011b). This chapter's overview of Intensive Care and Telemedicine has provided the context for the case study demonstration in Chapter 5 of the thesis.

4 Chapter 4 – The HITEQI Framework

4.1 Introduction

This chapter introduces the proposed Framework for Implementing Health Information Technology-Enabled Quality Improvement in Health Care (HITEQI). A review of the literature revealed that there is limited information about ICU Telemedicine and its implementation. Due to the high rate of failure with IT implementations, careful consideration of change management (CM) is required for the successful implementation of information technology in health care. The development of the HITEQI Framework was driven by the need for a structured, simplified approach to implement the proposed Intensivist Consultation Telemedicine initiative.

Canada Health Infoway (Infoway) recently published the *Framework and Toolkit for Managing eHealth Change: People and Processes* (CMF) to provide a best practice model for CM support of HIT implementation in Canada (Hodder & Frazer, 2012). As explained in Chapter 2, within the CMF are a large number of resources and tools for CM, however, the framework is not organized to support project planning from conception to completion and the toolkit presents as a large library with no structured approach for use. The CMF also does not have a patient-centered focus, does not address intra/inter-organizational considerations, and does not make explicit the requirements for data and

information flows, a key consideration when implementing new information communication technology (ICT) (McGregor et al., 2008b). The HITEQI framework grew from the need to address these limitations.

4.2 Framework Description

The HITEQI Framework is a modification and extension of Infoway's CMF. The HITEQI Framework modifies the six CMF elements by arranging the CM element's key tasks into a sequence to provide a structured order for project planning and implementation. HITEQI then extends the CMF by using PaJMa process modelling technique (PaJMa) to provide a patient centred focus, identify intra/inter-organizational considerations, and make data and information flows more explicit.

PaJMa is used to capture clinical information requirements such as clinical guidelines, policies, and patient-specific needs as opposed to using the CMF system flowcharts or LEAN VSM which do not portray these information flows (Steadman et al., 2012). As the patient journey can cross intra/inter-organizational boundaries (McGregor, 2007) PaJMa can be used to highlight intra/inter-organizational factors for consideration. A common example of this is that different technologies between organizations do not allow for the sharing of the patient's electronic health record (Eason et al., 2012), requiring the printing/ photocopying/faxing of copious patient records. Developing the PaJMa models engages clinicians in identifying current processes that can be improved through the proposed technology initiative (McGregor et al., 2008b). Moreover, visualizing

the current and future states also supports clinician acceptance of the proposed change (McGregor et al., 2008b). PaJMa is used in HITEQI to address the limitations noted by the researcher in the CMF.

The CM elements are: Governance & Leadership, Stakeholder Engagement, Communications, Workflow Analysis & Integration, Training & Education, and Monitoring & Evaluation. (see Figure 4.1 below)

Figure 4.1 Change Management Framework (Canada Health Infoway, 2011a p. 14)

In HITEQI, these elements have been coloured to match those in the CMF and have been arranged down the left side of the framework for clarity and organization. Main tasks for each element are organized horizontally across the framework, navigating from left to right using a vertical waterfall structure that was inspired by the *National Health Service's Deployment Guide for Clinicians* -

a recommended resource from the CMF(NHS Connecting for Health, n.d.). (See Figure 4.2 below – the red dashed lines indicate the components of the *Deployment Guide* that were used for HITEQI)

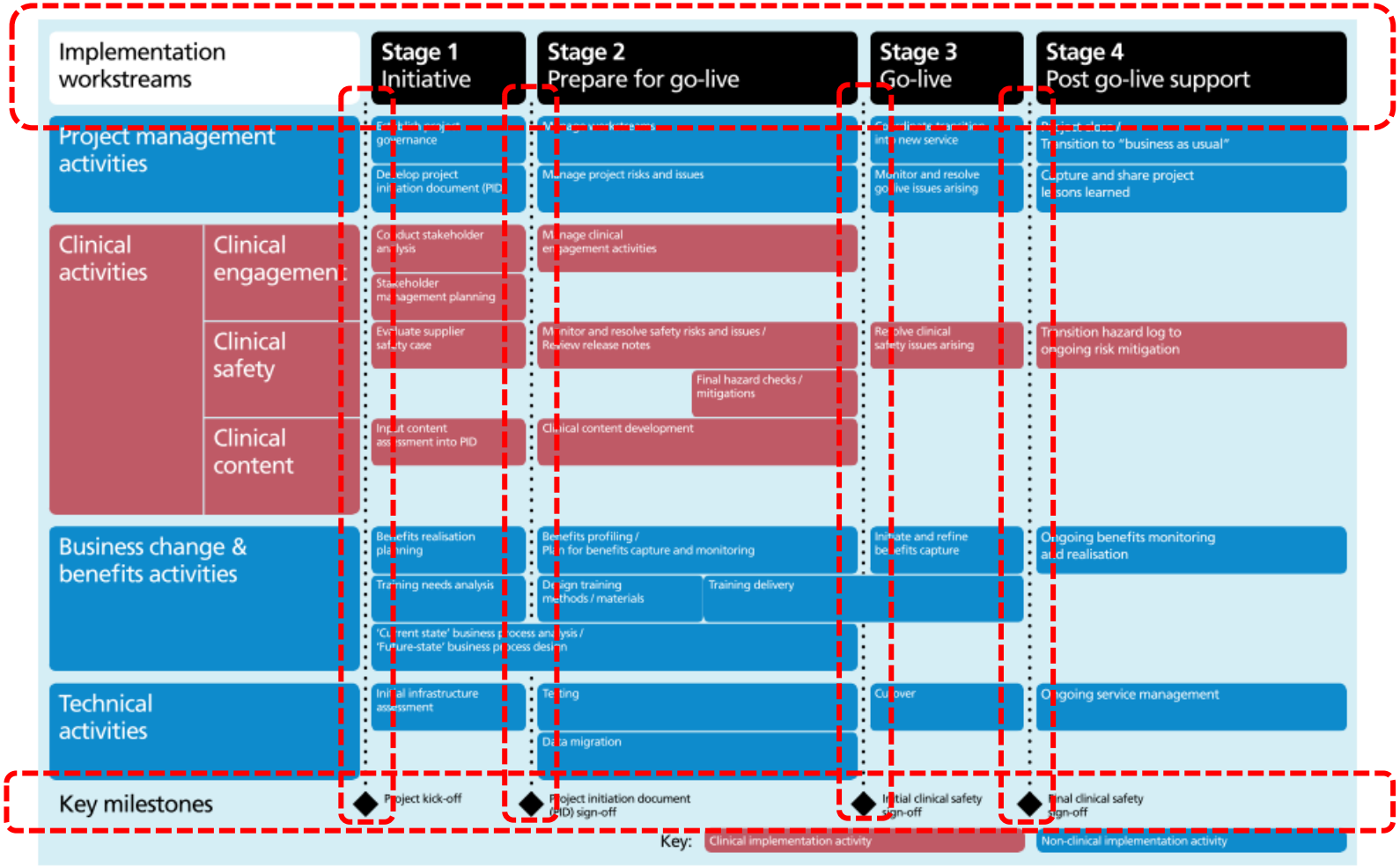

Figure 4.2 NHS Deployment Guide (NHS Connecting for Health, n.d. p. 39)

Project stages from the *Deployment Guide* are identified across the top row and are separated by a dashed line with key project milestones identified at the bottom. The main tasks for each CM element have been sorted under the appropriate project stage using a combination of the CMF and the *Deployment Guide* as a guide. Each element displays a visual reminder to incorporate a patient centred focus and intra/inter-organizational considerations. Within the "Workflow Analysis and Integration" element, the workflow analysis tasks have been modified to use PaJMa to visualize the data and information flow requirements that were not explicit in the CMF.

The HITEQI Framework utilizes Infoway's CMF tools for the six element's required tasks. Figure 4.3 below is a listing of the various tools available for each CM element.

Contents

TOOLKIT A Framework and Toolkit for Managing eHealth Change

Figure 4.3 - List of Tools and Resources from Framework and Toolkit for Managing eHealth Change: People and Processes(Canada Health Infoway, 2011a p. 37)

Table 4.1shows the expected outputs/deliverables for each stage of the HITEQI Framework. Figure 4.4 shows the HITEQI framework itself.

	Stage 1 Initiative	Stage 2 Prepare for Go-Live	Stage 3 Go-Live	Stage 4 Post Go-Live Support
Governance & Leadership	-Governance Advisory Committee (GAC) Terms of Reference -Readiness Assessment -Risk Assessment -Project Plan -Project Initiation document (PID) or Project Charter	-Sign off by GAC on PID/charter and on Project Plan -Policy development	-GAC approval to Go-Live	-Benefits Approach to Evaluation
Stakeholder Engagement	-Stakeholder Analysis -Roles & Responsibilities Chart -Resistance Management Framework - stakeholder recommendations for Project Plan			-Stakeholder feedback for Benefits Approach to Evaluation
Workflow Analysis & Integration	-Current State Analysis using PaJMa	-Future Desired State using PaJMa		-Assess outcome of Benefits Approach to Evaluation
Training & Education	-Training Needs Assessment -Training Roles & Responsibilities	-Training & Course Outlines -Training Materials -Training Schedule (Trainers and Trainees)		-Trainee Evaluation of training -Training Evaluation
Communications	-Communication Plan -Audience Assessment -Communication Templates	-Ongoing Communication Outputs		-Benefits Approach to Evaluation
Monitoring & Evaluation	-Defined evaluation indicators and metrics -Initiate Benefits Approach to Evaluation			Finalize Benefits Approach to Evaluation

Table 4-1 - Expected Outputs/Deliverables for Each Stage

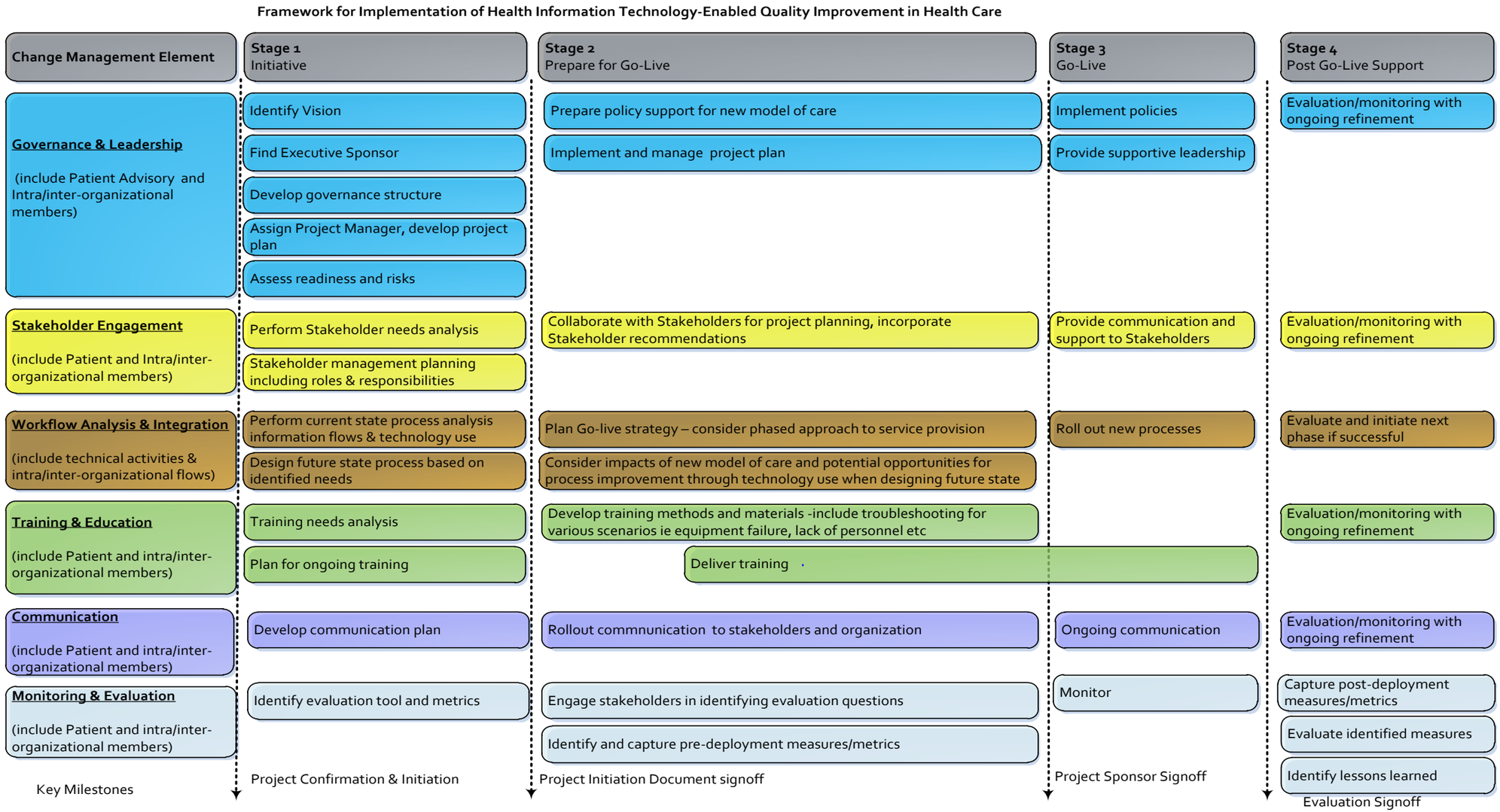

Figure 4.4 - HITEQI Framework

Each component of the HITEQI framework will be described in further detail below. The tasks for each of the CM elements have been structured into stages with the specific resources and tools (page numbers included) from Infoway's CMF identified for each stage. Please note; incorporated on each CM element is a visual reminder to include a patient focus and intra/inter-organizational considerations.

4.3 Governance & Leadership

4.3.1 Stage 1 –Initiative

Identify Vision – The clinical champion who identifies the need for the specified initiative must develop and articulate the vision and goals in order to encourage others in the organization to join efforts to lead the desired initiative and project.

Find Executive Sponsor – The executive sponsor is responsible for formally approving and assigning resources to the initiative, solving problems, and ensuring project success.

Develop governance structure – A formal governance structure is important to provide project steering, guidance, and formal decision making. The appropriate governance structure is often unique to an organization's culture and objectives and considerations must be made to include intra/inter-organizational members and have some form of patient representation. Patient representation is fundamental throughout, including the sign off process.

CMF Resources:

Determining Project Governance Structure in eHealth Projects p 47

Sample Terms of Reference for Governance Advisory Committee p 49

Assign Project Manager, develop Project Plan -The Project Manager (PM) is responsible for detailed planning required to implement the initiative and bring about the desired change. During this stage, consideration is given to engaging an Informatician if the PM does not have the suitable informatics skills or time.

Assess readiness and risks –An Organizational Change Readiness Assessment and Risk Assessment should be done for each organization to help identify possible issues and any areas requiring increased resources in order to better inform the project plan.

CMF Resources:

Organizational Change Readiness Assessment p 39

Risk Assessment Form p 45

4.3.2 Stage 2 – Prepare for Go-Live

Prepare policy support for new model of care – Intra/inter-Organizational policies must be developed and approved that support the changes in practice and processes brought about by the new initiative

Implement and manage project plan – The PM is responsible for ensuring that the project plan "progress as expected" (Canada Health Infoway, 2011a).

4.3.3 Stage 3 – Go-Live

Implement policies – Ensure all required policies identified in stage 2 are implemented to support the initiative go-live.

Provide supportive leadership- Senior leadership support has been shown to increase implementation success.

4.3.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement - Once the project has deployed successfully, the PM will transition out of the project and handover to the new owner for ongoing support.

CMF Resource:

Benefits Approach to Evaluation p 97

4.4 Stakeholder Engagement

4.4.1 Stage 1 –Initiative

Perform Stakeholder needs analysis – Identify all stakeholders potentially affected by the specified initiative including leadership, frontline staff, support staff, patients/family, and intra/inter-organizational members, and perform a needs analysis.

Stakeholder management planning including roles & responsibilities – From the needs analysis, identify key concerns/issues for each stakeholder group and develop management plans for engagement and risk mitigation.

CMF Resources:

Roles and Responsibility Charting (RACI) p 51

Stakeholder Analysis and Segmentation tool p 64

Model for Prioritizing Stakeholders p 66

Communicating with Stakeholders Model p 67

Resistance Management Framework "CLARA" p 69

4.4.2 Stage 2 – Prepare for Go-Live

Collaborate with Stakeholders for project planning, incorporate Stakeholder recommendations – Stakeholder involvement increases "the likelihood of an initiative's success and minimize the risk of failure" (Canada Health Infoway, 2011a).

4.4.3 Stage 3 – Go-Live

Provide communication and support to Stakeholders – Target communication to stakeholders and provide support as required for a successful implementation.

4.4.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement –Stakeholder feedback is one indicator for implementation evaluation and can be important for identifying opportunities for improvement.

CMF Resource:

Benefits Approach to Evaluation p 97

4.5 Workflow Analysis & Integration

4.5.1 Stage 1 –Initiative

Perform current state process analysis to include information flows and technology use – Work with stakeholders to identify the current patient journey and include processes, information/work flows and current technology in use. Use PaJMa process maps to visualize these flows.

Design future state process based on identified needs –Using the current state analysis, identify requirements and opportunities for process improvement including those potentially provided by the implementation of health information technology (HIT) –process requirements should drive technology (Canada Health Infoway, 2011a) and not vice versa. Use PaJMa process maps to visualize the desired future state.

CMF Resources:

Analyzing Workflow – Questions to Consider p 85

Mapping Current Workflow and Processes p 86

Flow Process Chart Template p 88

Systems Flow Chart p 89

4.5.2 Stage 2 – Prepare for Go-Live

Plan Go-live strategy – consider phased approach to service provision – If the HIT project is complex and large scale, it may be easier to implement if the project is broken out into incremental phases.

Consider impacts of new model of care and potential opportunities for process improvement through technology use when designing future state – As planning progresses from conceptual to concrete; more opportunities for improvement may become apparent.

4.5.3 Stage 3 – Go-Live

Roll out new processes –Provide support to stakeholders as new processes and technologies are rolled out.

4.5.4 Stage 4 – Post Go-Live Support

Evaluate/refine and initiate next phase if successful – Once implementation is successful and stable, initiate the next phase to build on previous experience.

4.6 Training & Education

4.6.1 Stage 1 –Initiative

Training needs analysis –Identify recipients, their education/training needs, and the required resources.

Plan for ongoing training –Consider ongoing training requirements for future sustainability.

4.6.2 Stage 2 – Prepare for Go-Live

Develop training methods and materials – include troubleshooting for various scenarios eg equipment failure, downtime, lack of personnel etc – Consider learning styles and unique requirements of various stakeholders when developing training materials.

Deliver training –Deliver training as close to the Go-live date as possible as this will support better retention of learning.

CMF Resources:

Training Roles and Responsibilities p 91

Training Session Evaluation Template p 92

Training and Course Planning Matrix p 95

4.6.3 Stage 3 – Go-Live

Deliver training –Continue providing/reinforcing training and support during Go-live.

4.6.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement –update and refine training materials to provide for ongoing sustainability

CMF Resource:

Benefits Approach to Evaluation p 97

4.7 Communication

4.7.1 Stage 1 –Initiative

Develop communication plan –-based on stakeholder analysis, develop targeted communication plan in order to inform and "prompt appropriate responses and/or actions" (Canada Health Infoway, 2011a)

CMF Resources:

Key Questions Associated with Communications Planning p 72

Communications Planning – Audience Assessment Template p 73

Communications Plan Template p 74

Preferred Media – Project Communications p 75

Communication Diagnostic p 78

Simple Communications Tools p 80

Sample FAQ Template p 81

4.7.2 Stage 2 – Prepare for Go-Live

Rollout communication to stakeholders and organizations –the magnitude of change implementation required will drive the scale of communication effort to promote success

4.7.3 Stage 3 – Go-Live

Ongoing communication –continued communication is important to project success as it promotes project involvement and motivation

4.7.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement – Evaluate communication effectiveness and address gaps if necessary.

CMF Resource:

Benefits Approach to Evaluation p 97

4.8 Monitoring & Evaluation

4.8.1 Stage 1 – Initiative

Identify evaluation tool and metrics –Use Infoway's Benefits Evaluation tool to help identify process and outcome evaluation components to establish results of goals and objectives of project and whether they have been met or not.

4.8.2 Stage 2 – Prepare for Go-Live

Engage stakeholders in identifying evaluation questions/metrics – Stakeholders have first-hand knowledge and the experience to identify key measures involved in the proposed initiative.

Identify and capture pre-deployment measures/metrics – Once measures are identified, capture pre-deployment results to generate a baseline for future comparison

4.8.3 Stage 3 – Go-Live

Monitor –Evaluate measures at frequent intervals to gauge effect of initiative.

4.8.4 Stage 4 – Post Go-Live Support

Capture post-deployment measures/metrics – Ensure that measures/metrics are being captured and tracked after the deployment of the initiative.

Evaluate identified measures/metrics –Use the post-deployment measures for comparison to original baseline to show effectiveness and/or make recommendations based on findings.

Identify lessons learned-Share findings so future initiatives can gain by lessons learned.

CMF Resource:

Benefits Approach to Evaluation p 97

5 Chapter 5 – The Case Study

5.1 Introduction

This chapter presents a case study based on a real-world project that was motivated by a shortage of critical care physicians at a rural hospital. The case study became the impetus behind the development of the HITEQI Framework when the attempt to use Infoway's CMF revealed several gaps to the researcher, namely; the lack of a structured implementation approach, the lack of a patient centred focus, the lack of intra/inter-organizational considerations, and the lack of explication of data and information flows. The case study will be used to demonstrate the benefits of the HITEQI framework and will highlight the features that address the CMF gaps.

5.2 Virtual Specialist Project - Case Study Description

The Virtual Specialist Project (VSP) is a proposed pilot project to provide Intensivist-led critical care support to rural and remote hospitals lacking this resource. For the first phase, a host hospital site would partner with a rural site and through joint planning, develop and implement a telemedicine service. This would increase access to and improve quality of care for patients and reduce avoidable transports. The pilot project would leverage existing technology at the host and rural sites, existing connections through the Ontario Telemedicine Network (OTN), Criticall, and physician funding support from OHIP for consultations. It would also utilize the Artemis Cloud platform to provide

advanced information support through online health analytics for clinical decision making. The VSP is a patient-focused, quality improvement initiative that would be made possible through the successful implementation of HIT.

The implementation challenges of this complex project required a structured approach that would address the change management aspects associated with implementing HIT. Figure 5.1 below illustrates the HITEQI framework and depicts the required tasks of each of the CM elements. The structured approach provides support to the user by guiding the activities required for the project implementation. A visual reminder to include a patient focus and intra/inter-organizational considerations is added directly underneath the CM element label and is addressed within each task, as appropriate. The case study has been organized into sections for each CM element and its tasks. The section begins with a partial diagram of the associated CM element which is then followed by a written description of the task activities within the case study. Emphasis will be placed on the benefits of the HITEQI framework that have not been addressed by the CMF.

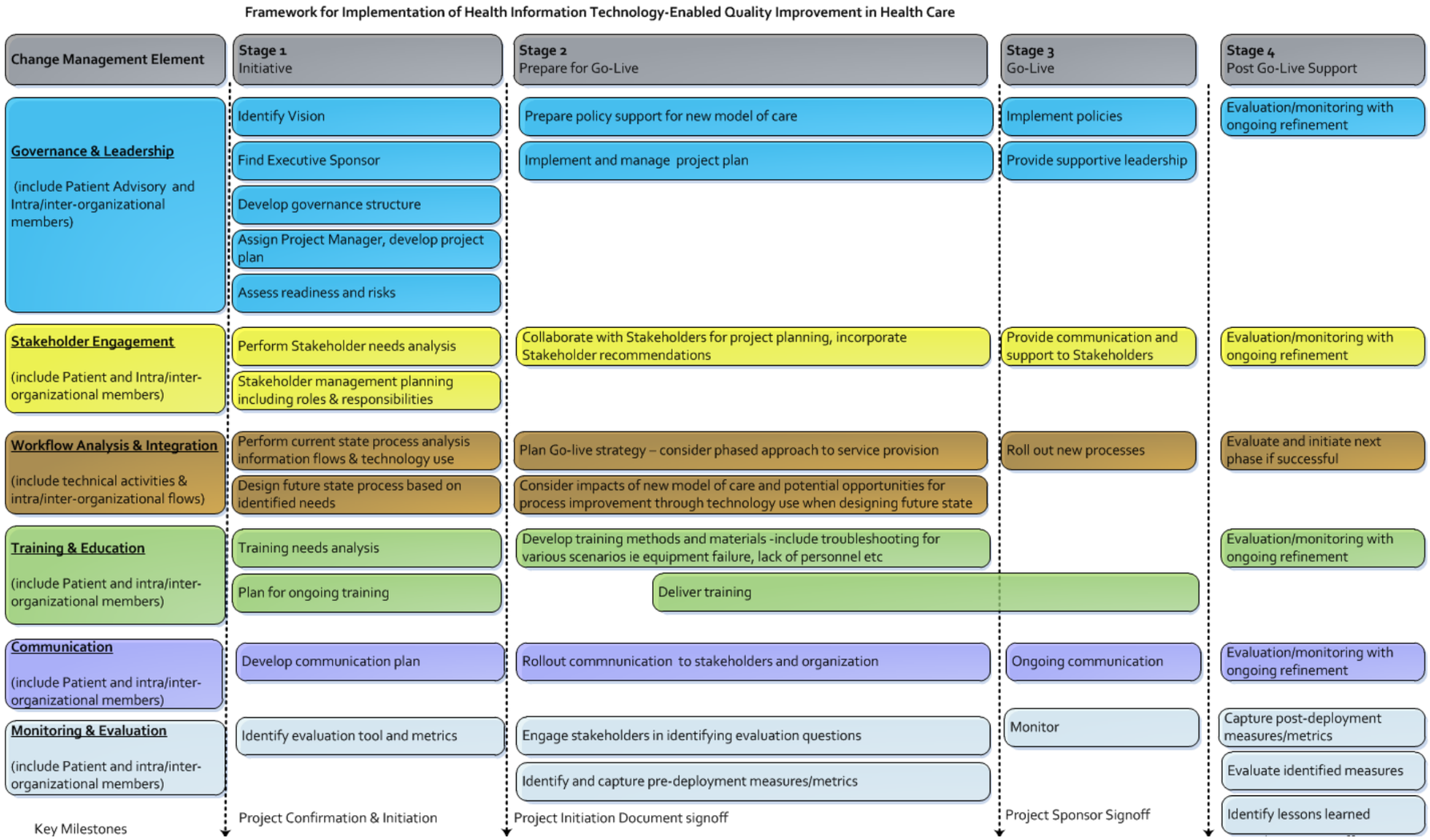

Figure 5.1 - HITEQI Framework

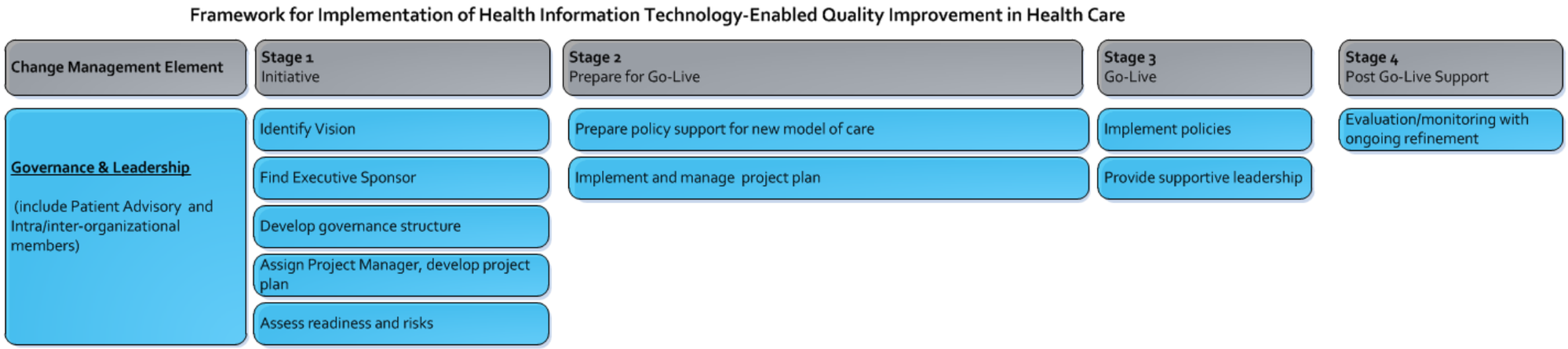

Figure 5.2 - HITEQI -Governance & Leadership

5.3 Governance & Leadership

5.3.1 Stage 1 –Initiative

Identify Vision – The host hospital Intensivist receives a consult request from the rural site's on-call physician. Together, they identify the need for improved access to high quality critical care for rural patients while reducing the number of avoidable transports. This becomes the vision that drives the Virtual Specialist Project (VSP) – a patient-focused, quality improvement initiative to provide a telemedicine Intensivist consultation service to support critical care patients at the rural site.

Find Executive Sponsor – Both physicians approach their respective hospital's senior administrative managers to find an executive sponsor. The host site executive sponsor is the Chief Information Officer (CIO) while the rural site executive sponsor is the Vice President of Patient Services & Chief Nursing Executive (CNE).

The executive sponsor is responsible for formally approving and assigning resources to the initiative, solving problems, and ensuring project success.

Develop governance structure –A formal governance structure is important to provide project steering, guidance, and formal decision making. The appropriate governance structure is often unique to an organization's culture and objectives (Canada Health Infoway, 2011a). Since the case study is an inter-organizational initiative, HITEQI indicates that consideration must be given to the

governance structure to include members from both hospital sites. The steering committee would report to the executive sponsors, ie the CIO from the host site and the VP/CNE of the rural site, and would comprise the senior project sponsors. At the host site this would be the Chief of Critical Care Medicine, the Director of Critical Care medicine and the Director of Information Technology. At the rural site this would be the Chief of Medicine, the Critical Care Director and the Director of Information Technology. As OTN and Criticall will also take part in this initiative, respective senior members from both organizations must also be involved. The steering committee will assign the Project Manager (PM).

Assign Project Manager, develop Project Plan –For the case study -the Project Manager (PM) is the host sites newly hired Telemedicine Coordinator (TC) and, as she is a full time resource, she is assigned the overall responsibility for the project for both sites. She liaises closely with the rural site's Critical Care manager for project planning and implementation and reports to the steering committee on the project progress.

Assess readiness and risks – Using the resource tools provided in Infoway's CMF, the PM performs an Organizational Change Readiness Assessment and a Risk Assessment for the host site, and collaborates on these with the Critical Care manager for the rural site. These are done to help identify possible issues and any areas requiring increased resources in order to better inform the project plan.

5.3.2 Stage 2 – Prepare for Go-Live

Prepare policy support for new model of care – The PM must ensure that organizational policies are developed and approved by the appropriate governing bodies to support the changes in practice and processes brought about by the new initiative at both sites. This may require delegating the assessment and development of required policies to working group members as identified through the Stakeholder Engagement component. For the case study, a thorough assessment of the proposed VSP would reveal the requirement of developing policies at both sites to cover inter-organizational physician privileging and the processes around receiving orders between organizations via telemedicine. The rural site will need to approve any new clinical guidelines and protocols that the Intensivist intends to use.

Implement and manage project plan – The PM is responsible for ensuring that the project plan "progresses as expected" (Canada Health Infoway, 2011a) for both host and rural site. For the case study, the PM will pull together a working group of key stakeholders (as identified in the Stakeholder Engagement component) to meet weekly to work through the objectives of the project plan. The weekly meetings will also help to keep stakeholders involved and engaged.

5.3.3 Stage 3 – Go-Live

Implement policies – The PM or delegate is responsible for ensuring that all policies identified during stage 2 at both sites have been

developed, approved and are implemented in time to support the VSP initiative's go-live. Frequent communication between the PM and the working group assigned to this task will assist the PM to keep track of progress. Assistance from the steering committee may be required to facilitate development. This assistance can be through appropriate resource allocation, problem solving, or formal decision making.

Provide supportive leadership- Senior leadership support has been shown to increase implementation success – for the case study, the original physician champions and other senior leaders, such as the host site CIO and rural site VP/CNE, must be visibly seen to endorse the go-live and be involved in communication and support. This support can be as simple as positive comments about the project in various meetings, a short article in the organization's newsletter, or even a small email roll out to the organization explaining the project and its purpose.

5.3.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement - Once the project deployment has been deemed successful according to criteria defined within the project plan during the Stage 1 Initiative phase, the PM will transition out of the project and handover to the new owner for ongoing support. For the case study – this would involve handing over the governance to the host site's Chief of Critical Care Medicine and the rural site Chief of Medicine, with the respective Critical Care Unit managers providing administrative and maintenance support.

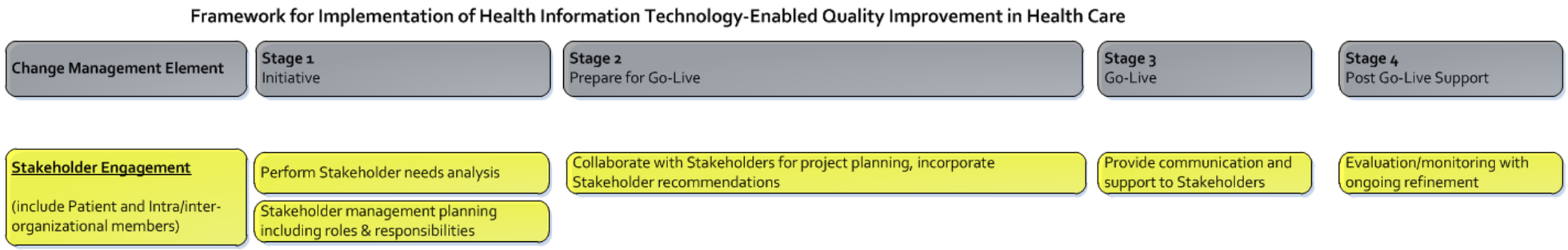

Figure 5.3 - HITEQI - Stakeholder Engagement

5.4 Stakeholder Engagement

5.4.1 Stage 1 – Initiative

Perform Stakeholder needs analysis – Using the resource tools provided in Infoway's CMF, the PM will identify all stakeholders affected by the specified initiative including leadership, frontline staff, support staff, patients/family, and other intra/inter-organizational members and then perform a needs analysis for each of the groups. For the case study –alongside of the senior leader governance structure, the stakeholders would include the host site Intensivists and rural site physicians, the Critical Care unit managers of both sites, the IT Directors and their teams, the Critical Care unit staff involved in providing care to patients and associated administrative support, and representation from the patients and families involved in receiving the services of the VSP. (For the needs analysis, a representative from each of these groups would be interviewed, not all of the individual stakeholders)

Stakeholder management planning including roles & responsibilities – Using the resource tools from Infoway's CMF in conjunction with results of the stakeholder needs analysis, the PM will identify prime concerns/issues for each stakeholder group and develop management plans for engagement and risk mitigation. For the case study, the PM would validate these plans with the project working group. The plans would include identifying the roles and responsibilities of members of the working group and other frontline stakeholders who will be directly involved in the VSP initiative.

5.4.2 Stage 2 – Prepare for Go-Live

Collaborate with Stakeholders for project planning, incorporate Stakeholder recommendations – Involving the stakeholders in planning increases "the likelihood of an initiative's success and minimize the risk of failure"(Canada Health Infoway, 2011a). For the case study, the project working group would have firsthand knowledge and understanding of the potential impacts of the VSP initiative and they would be able to provide recommendations for the project plan. It may take several meetings for the working group to develop consensus around the project plan before the Project Initiation document can be signed off. Having their recommendations incorporated into the plan increases engagement and will improve the probability of adoption (Canada Health Infoway, 2011a).

5.4.3 Stage 3 – Go-Live

Provide communication and support to Stakeholders – Target communication to stakeholders and provide support as required for a successful implementation. For the case study, the PM must ensure that resources have been allocated to providing support to the frontline clinicians using the telemedicine technologies. These resources must include "at elbow" support during the initial go-live until stakeholders feel comfortable with the new technology and processes. This support can then be transferred over to a telephone "Help Desk" service to provide ongoing technical support. Additional training supports such as handout materials or online training modules are

helpful and should be made available. For the principle training plan, please see the Training & Education component.

5.4.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement –Stakeholder feedback is one mechanism for evaluation and can be important for identifying opportunities for improvement (Canada Health Infoway, 2011a). For the case study, stakeholder feedback during the go-live period can lead to rapid refinement of processes or technology to encourage successful implementation. The simplest method is by speaking directly with stakeholders and asking them what they think of the new technology. Issues can then be identified and managed quickly. Surveys and questionnaires can be used approximately 3 to 4 weeks later to solicit further feedback for formal evaluation.

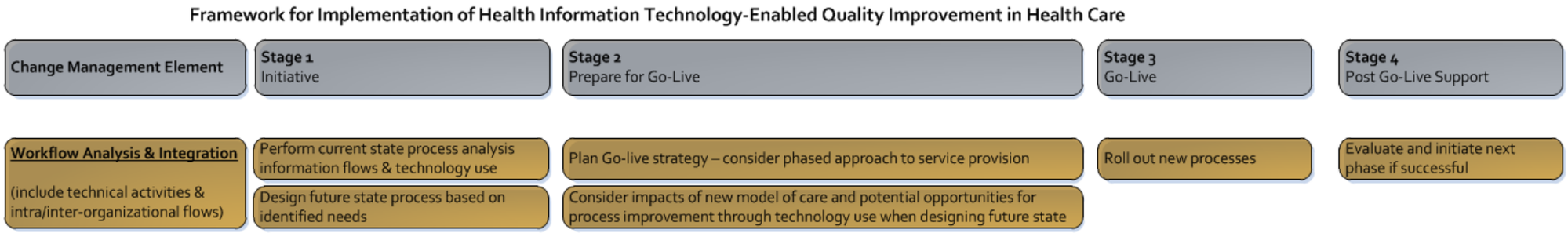

Figure 5.4 - HITEQI Workflow Analysis & Integration

5.5 Workflow Analysis & Integration

5.5.1 Stage 1 –Initiative

Perform current state process analysis to include information flows and technology use – To maintain a patient centered focus; the PM would meet with stakeholders from both the host and rural sites to discuss and identify the current state of the patient journey of an unstable patient without access to Intensivist critical care support. PaJMa mapping would be used to visualize the current processes, information and work flows, and supportive technology used and would

include inter-organizational transfers with ensuing handovers of care. Figure 5.5 shows the case study current state PaJMa model when a patient at the rural site becomes unstable and can no longer be managed there

The first phase of the model (see red number “1”) shows the processes around identifying the patient’s unstable state and the physician’s decision to transfer when the patient’s condition exceeds the care resources available at the rural site. The second phase of the model (see red number “2”) shows the processes around contacting Criticall to coordinate the transfer. The third phase of the model (see red number “3”) shows the handovers of care from rural site clinicians to transfer medics to receiving site clinicians.

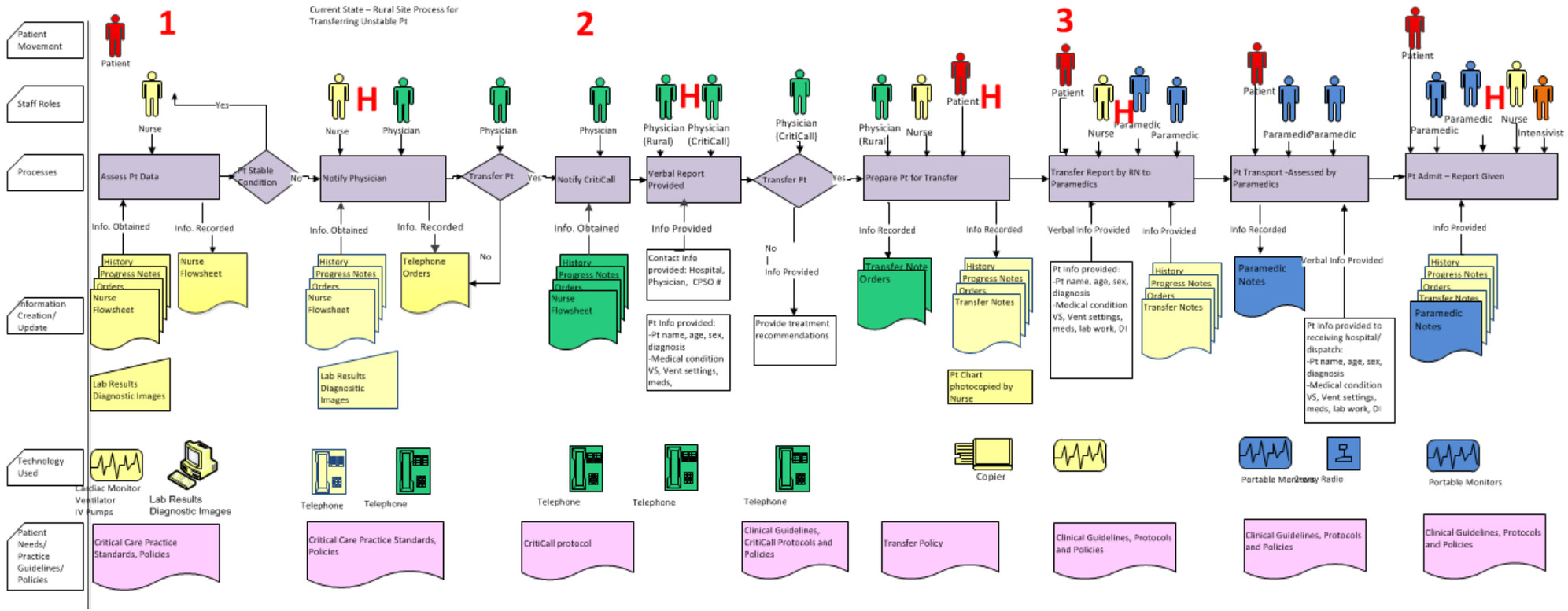

Figure 5.5 - PaJMa Current State –Unstable Patient at Rural Site and Transfer Process

Analysis of the maps by the stakeholders helps to identify gaps and risks that need to be addressed, and also, indicate potential opportunities for improvement (McGregor et al., 2008b). For example, in this PaJMa model it is noted that there are a minimum of five instances where “hand-over” of patient information is reported to other caregivers via telephone or as photo-copied charts along the patient journey as the patient is prepared for transport (see red letter “H”). This risk must be addressed when designing the future state.

Design future state processes based on identified needs – Based on the findings of the current state analysis, a proposed patient journey map can be drawn that visualizes the desired future state as provided through the implementation of telemedicine supported Intensivist consultations. The new PaJMa map would show the proposed improvements in processes of care and information flow, and would help to identify technology requirements to support these improvements. This work would be done as a collaborative effort with the working group and then shared with other key stakeholders for feedback and validation.

In the case study, the telemedicine technology does not just comprise video conferencing capability; it also includes the Artemis Cloud platform that supports the transmission of real time physiological data streams from the patient’s biomedical devices and provides the Intensivist with access to the Clinical Information Management System (CIMS). The CIMS includes the patient’s electronic medical record (EMR), laboratory results, and diagnostic

imaging (McGregor, 2011). All this technology would increase the information directly available to the Intensivist for clinical decision making and reduce the reliance on verbal handover with its associated risk of information loss and communication failure (Bates & Gawande, 2003; Kilbridge, 2008). The desired future-state PaJMa map will be used to inform the project plan and help stakeholders envision the future thus promoting acceptance of the proposed new telemedicine technology (MacDougall, Percival, & McGregor, 2009).

The first phase of the future state model (see red number “1”) shows the processes at the rural site around identifying the patient’s unstable state and the physician’s decision to seek Intensivist support. The second phase of the model (see red number “2”) shows the processes for initiating the remote consult and the exchange of information between the rural physician and the remote Intensivist. The third phase of the model (see red number “3”) shows the Intensivist’s clinical decision not to transfer the patient and instead provide care to the patient at the rural site through a continuation of the remote telemedicine technology. “Handovers” of care are reduced (see red “H”) as the Intensivist has direct access to the CIMS for care decisions. A comparison of the two models shows the current model being shorter than the future state model. This is due to the episode of care at the rural site not being cut off by the patient’s unnecessary transfer out. Instead, the patient remains at the rural site receiving Intensivist-provided care.

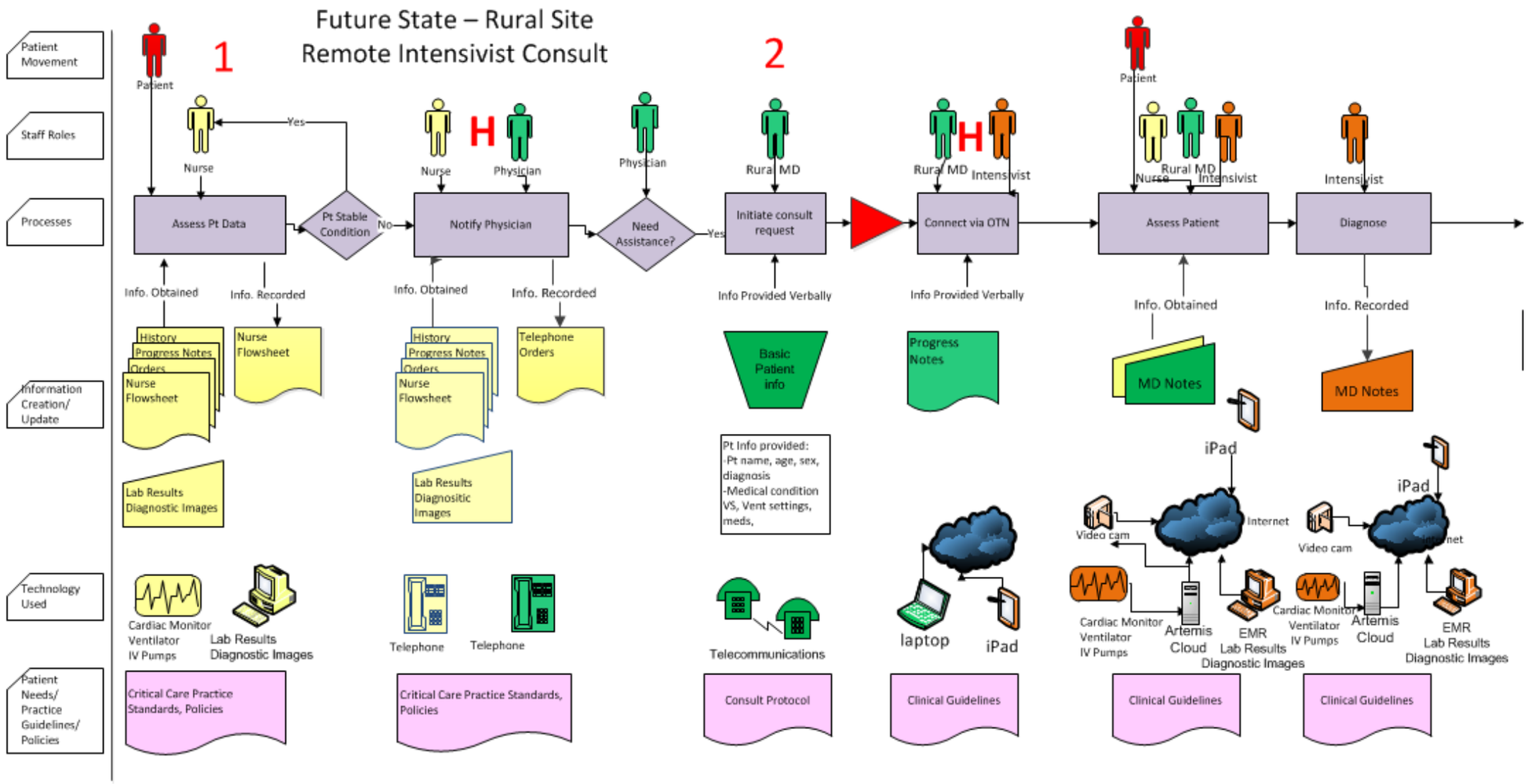

Figure 5.6 - PaJMa Future State – Providing Care to Unstable Patient at Rural Site (Continued on next page)

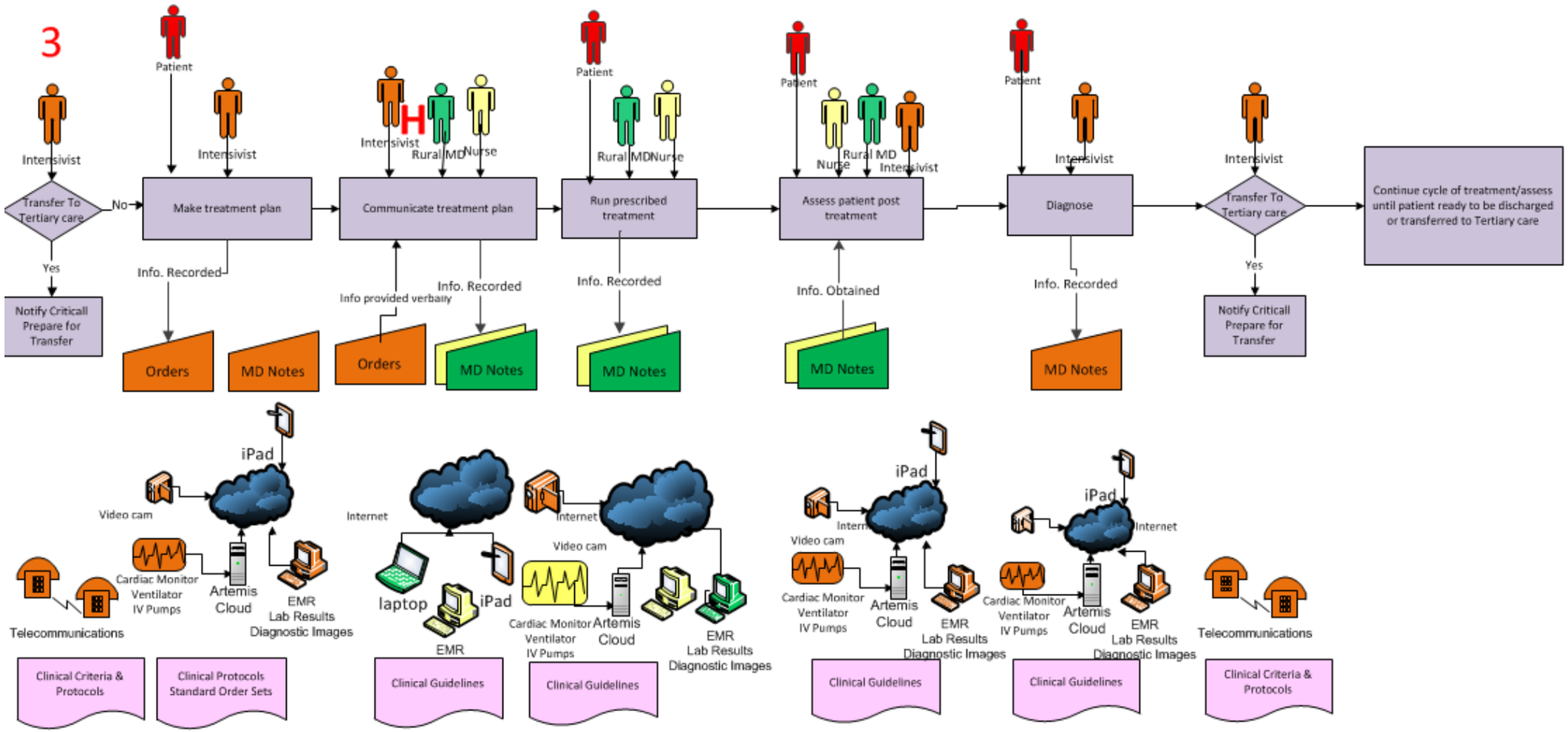

Figure 5.7 - Continued from previous page

5.5.2 Stage 2 – Prepare for Go-Live

Plan Go-live strategy – consider a phased approach to service provision – With the future state identified, the PM and working group may choose to break up the implementation plan into an incremental phased approach if the project is large and complex. For the case study, the first phase of the project would provide daytime telemedicine consultations. This would allow for testing of telemedicine technologies in a controlled manner with full resource support available. Future phases would expand to include round-the-clock availability for consultations and daily rounding as clinicians become comfortable with the process and technology changes. Timelines for these phases would require careful planning to ensure resource availability and must include consideration of other organizational initiatives that may impact end user acceptance.

Consider impacts of new model of care and potential opportunities for process improvement through technology use when designing future state – As planning progresses from the conceptual to the more concrete; further opportunities for improvement may become apparent. With the case study, as the working group members become more familiar with each other, the inter-organizational opportunities to share other aspects of telemedicine supported care become apparent. An example that could be implemented after the first phase of the project is rolled out would be for the host site Critical Care nurses to

provide a report handoff via telemedicine to the rural unit nurses when the patient is being repatriated back from a transfer.

5.5.3 Stage 3 – Go-Live

Roll out new processes –During go-live, it is vital to provide support to stakeholders as new processes and technologies are rolled out. In the case study, the PM is also the Telemedicine Coordinator for the host site and would provide technical support there while the rural site IT technical staff would provide support at their site.

5.5.4 Stage 4 – Post Go-Live Support

Evaluate/refine and initiate next phase if successful –For the case study, once implementation is deemed successful and stable, the project could enter the next phase to expand the hours per day that the Intensivist service was available.

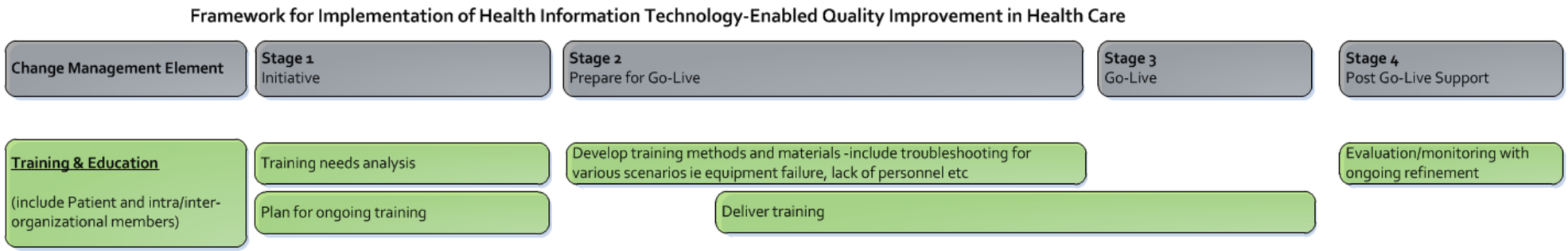

Figure 5.8 - HITEQI - Training & Education

5.6 Training & Education

5.6.1 Stage 1 –Initiative

Training needs analysis –As part of the project plan, the PM will delegate the training and education components to a training coordinator, a member of the working group. It would be their responsibility to identify the intended recipients of training, their education/training needs, and the required resources for providing this training. This should include information materials for patients and their families also. As part of the required resources for the case study, trainers will need to be provided at each organization. The main recipients of training would include the

Intensivists and physicians involved in the telemedicine sessions themselves and any personnel that would be required to help provide administrative support to the physicians.

Plan for ongoing training – The PM must consider and plan for ongoing training requirements for future sustainability of the initiative. In the case study, after the initial training phase has been completed, the Telemedicine Coordinators at each organization will be responsible for ongoing training of any new personnel involved in the VSP.

5.6.2 Stage 2 – Prepare for Go-Live

Develop training methods and materials – include troubleshooting for various scenarios eg equipment failure, downtime, lack of personnel etc – The training coordinator must consider learning styles and unique requirements of various stakeholders when developing various training materials. For the case study, the training coordinator will collaborate with the Telemedicine coordinators and trainers at both sites to ensure training material content is robust and addresses contingency procedures in the event of potential failures of equipment.

Deliver training –The training coordinator and trainers will deliver training as close to Go-live date as possible for better retention and provide materials for quick-reference and memory aids.

5.6.3 Stage 3 – Go-Live

Deliver training –The training coordinator and trainers will continue providing and reinforcing training as support during Go-live.

5.6.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement – The training coordinator will update and refine training materials incorporating go-live findings to provide materials for future training sustainability.

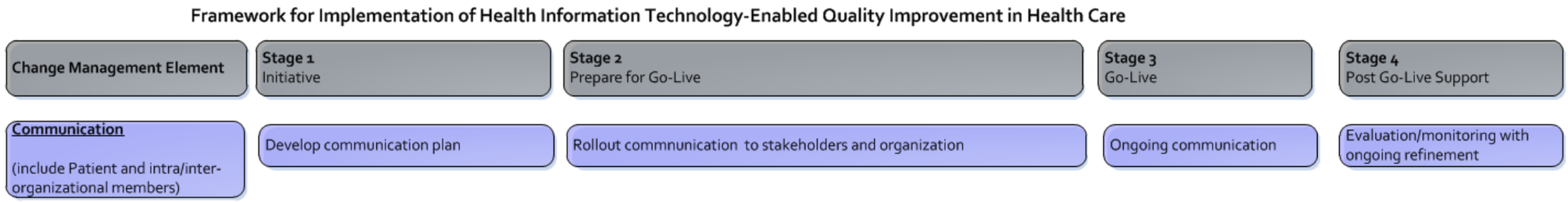

Figure 5.9 - HITEQI - Communication

5.7 Communication

5.7.1 Stage 1 –Initiative

Develop communication plan –-For the case study, the host hospital has a Communications department and will provide a member to the working group. This member will become a resource for the project for both sites with the rural site's Critical Care manager taking on the responsibility of disseminating communication at the rural site The communications member will develop a targeted communication plan in order to inform and "prompt appropriate responses and/or actions" (Canada Health Infoway, 2011a).

5.7.2 Stage 2 – Prepare for Go-Live

Rollout communication to stakeholders and organizations –the magnitude of change implementation required will drive the scale of communication effort to promote success. For the case study, the main focus for communication will be towards the critical care units of each site, the affected physicians, and the patients and families who will benefit from the service provided.

5.7.3 Stage 3 – Go-Live

Ongoing communication –continued communication is important to project success as it promotes project involvement and motivation. For the case study, the challenge will be to ensure that communication goes out equally to both organizations and all stakeholders.

5.7.4 Stage 4 – Post Go-Live Support

Evaluation/monitoring with ongoing refinement – Evaluate communication effectiveness and address gaps if necessary.

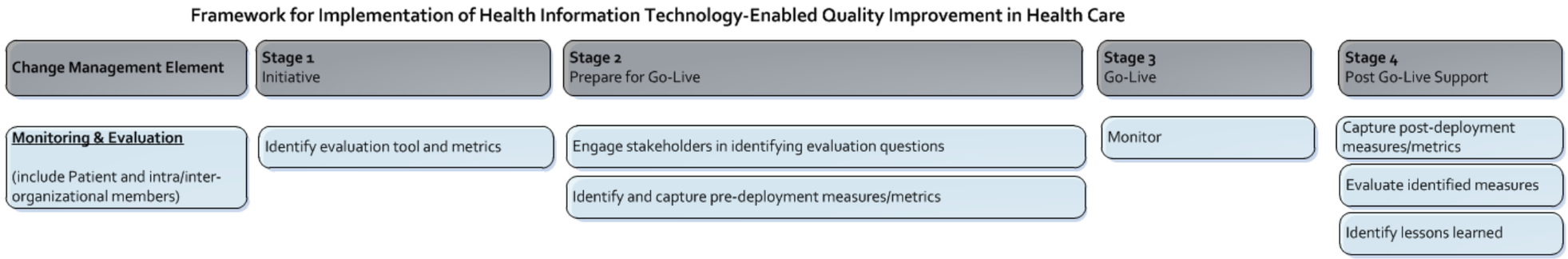

Figure 5.10 - HITEQI - Monitoring & Evaluation

5.8 Monitoring & Evaluation

5.8.1 Stage 1 – Initiative

Identify evaluation tool and metrics – use Infoway's "Benefits Approach to Evaluation"(BAE) which was developed specifically for evaluating Information & Communication Technologies (ICT) for health care (Canada Health Infoway, 2012). The BAE has a specific section on identifying and evaluating Telehealth Program indicators. The BAE tool can help shape the development of specific indicators based on the case study vision to improve access to high quality critical care and reduce avoidable transports. The indicators can then be used to determine whether project objectives have been met

or not. The number of indicators chosen to be evaluated must be in line with evaluation goals and available resources and timeline (Canada Health Infoway, 2012).

For the case study some key indicators would include stakeholder satisfaction, clinical effectiveness outcome measures such as ICU and Hospital mortality rate and Length of Stay (LOS), number of transports pre and post deployment, and number of Intensivist consults provided.

5.8.2 Stage 2 – Prepare for Go-Live

Engage stakeholders in identifying evaluation questions/metrics – Stakeholders have the first-hand knowledge and experience to identify key measures involved in the proposed initiative. In the case study, stakeholder satisfaction surveys would include the various components involved in providing the service. This would include not only an assessment of the technology and equipment ease of use and performance, but would also include an assessment of the satisfaction with the clinical services provided.

Identify and capture pre-deployment measures/metrics –Pre-deployment measures are captured to generate a baseline for comparison. For the case study –baseline data such as; transport rates, ICU and Hospital mortality rates, LOS, can be retrieved from the Critical Care Information System (CCIS), a Ministry of Health & Long Term Care (MOHLTC) database that ICUs in Ontario are mandated to submit data to on all admitted patients (Government of Ontario, n.d.).

5.8.3 Stage 3 – Go-Live

Monitor –Evaluate measures at frequent intervals to gauge effect of the initiative. For the case study, during go-live, the PM will monitor stakeholder's feedback regarding their experiences with the telemedicine technology and clinician interaction.

5.8.4 Stage 4 – Post Go-Live Support

Capture post-deployment measures/metrics – Capture accurate measures/metrics after deployment of initiative is complete.

Evaluate identified measures/metrics -Use post-deployment measures for comparison to baseline to show effectiveness and make recommendations based on findings.

Identify lessons learned-Share findings so future initiatives can gain by lessons learned.

6 Chapter 6 – Conclusion

6.1 Summary

This thesis has presented a Framework for Implementing Health Information Technology-Enabled Quality Improvement in Health Care (HITEQI). A modification and extension to Infoway's CMF, the proposed framework promotes technology adoption by providing a structured implementation approach incorporating proven change management tools. The proposed framework addresses inherent gaps noted by the researcher in Infoway's CMF, namely the lack of patient-centred focus, intra/inter-organizational considerations, and explicit data and information flows. The research contribution was demonstrated in Chapter 5 through a case study of a proposed remote Intensivist Consultation service using an advanced telemedicine technology.

In the case study, the HITEQI framework provided the structured approach for planning and implementing the proposed technology. PaJMa process modelling, embedded within the framework, addresses the main gaps in the CMF. As illustrated by the current and future state PaJMa models in the case study, PaJMa shifts the focus towards the patient. It explicates the information and data requirements for providing patient care while identifying opportunities for the proposed technology. Additionally, PaJMa reveals where the patient journey crosses intra/inter-organizational boundaries and the associated potential areas for quality improvement. The robustness of information provided by

PaJMa supports the inclusion of all of these considerations for thorough analysis and planning which improves the prospects for a successful implementation.

A literature review was performed on ICU telemedicine and is described in Chapter 3 to provide the context for the case study. The review revealed there was very limited information about the implementation and use of this technology. This lack of information drove a second literature review on the themes of QI initiatives in health care, HIT adoption, and change management. Chapter 2 describes this review and reveals the high failure risk for HIT implementations in general. HIT can support QI initiatives in health care but requires careful consideration and structured implementation supported by change management in order to reduce the risk of failure of adoption. Gaps exposed by this literature review resulted in the following research hypothesis for this thesis:

That a framework to utilize health information technology for patient centred care within an inter and intra organizational context incorporating explicit representation of data and information flows can be quantified to enable measureable quality improvement in healthcare.

The proposed framework was developed in response to the research hypothesis and was introduced in Chapter 4. .

6.2 Contributions

Lack of a structured approach for implementation of a remote ICU consultation service was the underlying problem that provided the research motivation for this thesis. This drove the design and development of the proposed framework, however, the framework takes a generalized approach to HIT implementation. Within the framework, the use of PaJMa process modelling makes it possible to customize the technology implementation to support the proposed QI initiative in its health care context.

The proposed framework provides a structured, pragmatic, approach to support the change management processes necessary for clinicians to adopt the implementation of new technology required for a quality improvement initiative in health care.

6.3 Limitations

Several limitations to the framework are identified. The context of the researcher's healthcare experience and exposure has been to publicly funded, non-profit, North American acute care hospitals, a homogenous environment. This may lead to researcher bias that reflects the lack experience/exposure to other forms of healthcare environments. A small number of people were consulted during the framework development which may limit the framework's validity and generalizability. Finally, while the framework was demonstrated through the case study, action research has not been done to test the validity of the research construct and evaluate its effectiveness.

6.4 Future Research

Future research will focus on implementing the case study as action research to test the validity and evaluate the effectiveness of the research construct. Once validity can be demonstrated within the telemedicine context, the Framework can be tested using various other HIT implementation contexts to determine the generalizability of the construct. Other areas of research would be to trial various healthcare contexts and cultures outside of North America. Implementation of the Artemis platform in China is currently occurring (W. Huang, 2013) and may provide an opportunity to trial the framework in a different country.

6.5 Conclusion

Within the thesis, the research construct was demonstrated through the context of the remote Intensivist consultation service, known as the “Virtual Specialist Project” case study. Quality improvement in health care can be supported through the thoughtful deployment of HIT. Considering clinician information requirements and workflows, combined with a patient centred focus and structured CM approach, the proposed research construct can promote the implementation of health information technology-enabled quality improvement in health care.

This thesis has presented a framework that will facilitate the implementation of Health Information Technology-Enabled Quality Improvement (HITEQI) in health care.

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