An Exploratory Assessment of IT Management Issues in Ontario Hospitals

Dissertation Thesis

Maria Syoufi

M.Sc. Health Systems

Supervisor:

Mirou Jaana, Ph.D.

(Telfer School of Management - Health Systems)

Abstract

Background and context: Given the constant evolving developments in information technology (IT) in healthcare in Canada and Ontario, and the relatively nonexistent body of literature on IT management issues from the perspectives of top IT managers (i.e. Chief Information Officers, IT directors, IT top managers) in hospitals, a follow up study of IT management issues to the study done by Jaana et al. is conducted.

Purpose: To develop an authoritative list of IT management issues in Ontario hospitals and compare the results to the earlier study and the literature.

Methods: Using the Ranking Type Delphi technique, the responses from IT top managers in three main panels of Ontario hospitals were solicited through a controlled iterative feedback process. The hospitals were divided into the academic panel (n = 6), community panel (n = 12), and the rural panel (n = 8) for a total of 26 out of 33 participants who completed the study.

Results: 26 issues were raised and a total of 24 issues were ranked in the study. Among the 14 common issues between the three panels, the top five issues were limited funding, keeping infrastructure current, external security threats, increasing cost, and managing demands for IT projects. Comparing with the study by Jaana et al. (2011), a total of 7 new issues emerged which are concerned with technology, regulatory challenges, and human issues. A total of 10 issues were dropped from the earlier study spanning areas of strategic, technological, organizational, and human issues. The participants in the study did not significantly differ individually based on their background characteristics, where the only significant difference observed between the hospital panels was due to hospital characteristics. During the brainstorming phase a total of 195 issues were provided which were consolidated by two researchers to form a list of 26 IT management issues, with an inter coder reliability of 88%. The issues with a 4.5 out of 7 rating and higher on a Likert scale were retained to narrow down the list. This resulted in 19 issues for the rural and community panels, and 21 issues for the academic panel, with 14 of the 26 issues being

common to all three panels. The ranking phase was conducted with two rounds of ranking due to the low consensus levels during the first round. The consensus level after two rounds was; *W* academic = 0.235, *W* community = 0.254, and *W* rural = 0.381.

Contributions: This study presents a significant contribution to the management of medical informatics field by providing an approach to categorize IT management issues to observe trends overtime as well as present the application of a seminal framework to explain the changes in these issues as organizations change and grow overtime. At the management and practical levels, the list of prioritized issues provides an evidence base for top IT managers to make IT related decisions at the organizational level. The list also acts as a second benchmarking tool to evaluate hospital performance overtime with the various issues. At the policy development level, provincial governments can use the list to devise comprehensive IT management strategies to address the various regulatory issues reported. Future research can focus on exploring the resonating behind the rankings provided and replicating this study over time and across various geographies so that a large survey can be developed to follow the evolutions of IT management issues in healthcare over time.

Keywords: IT management issues, Ranking type Delphi, Chief Information Officers, IT directors, IT top managers, Hospitals, Canada, Ontario

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List of abbreviations

CAHO: Council of Academic Hospitals of Ontario

CEO: Chief Executive Officer

CDSS: Clinical Decision Support System

CHI: Canada Health Infoway

CIHI: Canadian Institute for Health Information

CIO: Chief Information Officer

COO: Chief Operating Officer

CPOE: Computerized Physician Order Entry

DHC: Digital Health Canada (formerly COACH)

EMR: Electronic Medical Record

EHR: Electronic Health Record

HIT: Health Information Technology

HIS: Health Information Systems

IT: Information Technology

IS: Information Systems

LHIN: Local Health Information Network

MOHLTC: Ministry of Health and Long-Term Care

OHA: Ontario Hospital Association

PMO: Project Management Office

W: Kendall coefficient of concordance

1. Introduction

Today, health care organizations are consistently looking for ways to use information technologies (IT) within their institutions. Since the introduction and implementation of IT into the health care system, there has been a continuous effort to use these technologies due to their numerous benefits. The current literature body widely accepts that the use of health information technology (HIT) offers great potential to improve the quality of services offered to patients, the efficiency and effectiveness of health care staff, reducing organizational costs, and better outcome for patients (Chaudry et al., 2006; Kaushal, Shojania, & Bates, 2003; Khatri & Gupta, 2016; Lee & Choi, 2016; Lee, Mccullough, & Town, 2013; Paré, Jaana, & Sicotte, 2010; Poba-Nzaou, Uwizeyemungu, Raymond, & Paré, 2014; Police, Foster, & Wong, 2011).

Emerging IT applications are used in various ways to address difficult challenges, such as providing support in the delivery of care in the healthcare sector. The most prominent of these applications are the Electronic Medical Record (EMR) which is used in individual organizations as a medical chart for the patient within that organization, and the Electronic Health Record (EHR) which contains all patient information and is a medical record that follows the patient rather through various organizations rather than belong to the one organization (Jaana, Ward, & Bahensky, 2012). The use of the EMR and EHR help solve various organizational problems associated with paper systems, they can improve the quality of decision making, and reduce the cost of managing clinical information (Paré et al., 2014). Another useful application of IT is the computerized physician order entry (CPOE) and clinical support systems (CDSS) which aid physicians in decision making and alert them to potential adverse events (Jones, Rudin, Perry, & Shekelle, 2014). Lastly, these IT applications can be used not only as databases to store and access patient information, but also by researchers to enable large scale studies in various fields such as

treatment of resistant depression cases (Perlis et al., 2012). However, the many benefits health information technology brings to hospitals and patients are accompanied with numerous factors that either facilitate or hinder their implementation and integration in health care organizations (Police et al., 2011). This study aims to add to the currently limited knowledge base about key IT issues from top management perspective as well as provide recommendations that aid top managers make investment decisions regarding IT investments and resource allocation.

IT governance in hospitals is a structure of relationships to steer and control the organization to achieve its goals. There are various ways in which IT is governed at various levels in hospitals (Ferguson, Green, Vaswani, & Wu, 2013). IT governance makes decisions for the right system considering the IT systems' potential for optimizing the service but also the risks of harming the patients in the hospital (Liebe & Hübner, 2013). One of the ways top IT management can be directly involved with IT governance in hospitals is through assigning positions of the IT function, such as the Chief Information Officer (CIO), IT directors, IT top managers, and top IT managers; which are terms used interchangeably in this report. These positions provide an indication of the power of the IT function within that organization where the CIO's role is continuously evolving as the needs and expectations of Health Information Systems (HIS) evolve. Since IT devotes more of its initiatives to decrease business costs and increase productivity, the role of the CIO has to evolve in accordance with these expectations (Luftman et al., 2015). The effectiveness of the CIO is based on the strategic influence this executive has within the organization. Usually, the CIO tend to report to the CEO directly, where a shorter distance between the two suggests more influence for the CIO (Ferguson et al., 2013; Smith, Bradley, Bichescu, & Tremblay, 2013). In their work derived from a longitudinal survey of IT executives and top managers, Luftman et al. (2015) note the trends in the HIS industry in the CIO positions. CIO are noted to report to the CEO of the

organization, and more so recently, report to the Chief Operating Officer (COO) and strategic business unit (Luftman et al., 2015). It has been argued that CIOs who have more experience and tenure would have more legitimacy, knowledge and experience that would favor the adoption of new IT technologies in organizations (Paré et al., 2010). The main skills that CIOs possess are reported to be leadership, change management, business analysis, budgeting, oral communications as well as collaboration with others (Luftman et al., 2015). IT strategic planning comes in use especially when hospitals are analyzing their internal and external environments, their IT capabilities and needs, and developing an operational plan for IT adoption and implementation (Jaana, Teitelbaum, & Roffey, 2014). Top IT leaders and managers in hospitals who have the technical informatics skills and prior experience with IT project management are more likely to be proactive leaders and partners with IT professionals which is associated with successful organizational and hospital IT outcomes (Ingebrigtsen et al., 2014). When IT governance is implemented effectively, the top IT managers are placed in a position of authority to influence IT strategy and implementation (Smith et al., 2013).

1.1 Health information technology in Canada and Ontario

Canada's public healthcare system is three times larger than Canada's largest bank in total revenue (Canada Health Infoway, 2009). This healthcare system has recently undergone major transformations alongside its implementation of IT for use in the public healthcare sector (Advisory Panel on Healthcare Innovation, 2015; Anderson, Tang, & Blue, 2007). However, Canada tends to underinvest in healthcare IT relative to other healthcare providers and information management industries where the estimated average Canadian health IT spending is between 1.5 – 2.0 per cent of total budgets and revenues compared with 3.4% of the USA health care providers and 5.4% by the USA banking/ financial services (Canada Health Infoway, 2009). These lower

investment levels could be attributed to the fact that the EHR is not consistently viewed as a political priority (Canada Health Infoway, 2009). Furthermore, in a 2016 recent interview with the Chief Executive Officer (CEO) of Digital Health Canada (DHC), Don Newsham highlights that Canada is currently at an early stage of the implementation of various HIS technologies, such as the EMR. He highlights that Canada is currently at about a 30% - 40% implementation of the EMR, which is the early stages of effectively using the EMR among physicians. Canadians have laid out the infrastructure and set standards for the EMR, they are currently populating it with patient data, and eventually will need to use this data for various activities such as continuing care for patients or research (Canada Health Infoway, 2016). Bonomi et al (2016) evaluated Canada's EMR implementation level at 30.9%, or stage 3, which is an early stage of maturation (Bonomi, Badr, Zardini, & Rossignoli, 2016). They report that implementation has covered main functions, such as nursing, pharmacy, laboratory, radiology alongside partial integration of clinical databases that would provide physicians the opportunity to view and review all orders and results (Bonomi et al., 2016).

In Canada, each province has its own EMR and HIS integration programs and policies since healthcare is organized at the provincial level. For example, Ontario is one of the most populous provinces with the highest number of healthcare organizations and networks in Canada (Conference Board of Canada, 2015). In 2009, Canada Health Infoway (CHI) noted that Ontario, among other provinces, would require more time and more funding in order to complete the implementation of their EHR, and on average, Ontario hospitals spend 1.5% – 2.5 % of their total budgets to develop and maintain EHRs (Canada Health Infoway, 2009). Currently, the province of Ontario reports over 1,900 organizations being connected to the provincial EHR database, with 75% of Ontarians receiving care from a professional using the EHR, better communication

between hospitals and clinics for patient reports and data through EMRs with access to various test results (eHealth Ontario, 2014). For example, hospitals in Ontario have been found to have a higher level of integration of their HIS and IT when compared with hospitals in Québec, which indicated higher IT sophistication levels (Jaana, Paré, & Sicotte, 2009).

IT evolution in the hospital environment is of particular interest since hospitals tend to deliver the majority of healthcare services, and be the primary target for IT integration given the Canadian national agenda for IT integration in the health care system (Canada Health Infoway, 2009; Conference Board of Canada, 2015). The nature of hospitals having many departments, each requiring specialized applications for IT, but also needing to share information with other departments raises a new level of challenges in coordination, interoperability, and integration of IT in such settings. In addition, IT integration in hospitals requires large financial and personnel investments with proper resource allocation, adding to the complexity of successful integration of these applications in such settings (Jaana, Teitelbaum, & Roffey, 2012). The literature calls for one form of assessment of IT in healthcare by looking at the return on investments (Hart, 2013; Lee & Choi, 2016). This concept can be measured by looking at indirectly related patient outcomes by improving various aspects of the care process, as well as measuring outcomes in financial terms (Hart, 2013). Cost – benefit analysis highlights the immediate benefits of IT in hospitals and the return on investments made in various IT projects; however it's argued the current gap in the literature regarding favorable cost – benefit affects top IT managers' informed decisions concerning IT investments in hospitals (Hart, 2013; Lee & Choi, 2016). Furthermore, in an environment where investments are fragmented and one-off leading to the duplication of efforts, investments need to be properly directed in order to return the best benefit, and resources need to be wisely invested in management, education, and research so informed decisions can be made

(Canada Health Infoway, 2009; Jaana, Tamim, Paré, & Teitelbaum, 2011). Lastly, the continuous evolution of integration and increasing sophistication of IT use in Ontario hospitals pose IT issues for top IT managers that require systematic assessment and evaluation to observe the evolution of trends over time and understand the main challenging areas for managers so resources and investments can be allocated more wisely (Jaana et al., 2011).

There has been very little research that examined IT issues in healthcare, and specifically hospitals, from the perspectives of executive and top IT management personnel. This hinders evidence-based decision making and allocation of the appropriate investment of resources in needed areas (Jaana et al., 2011). As explored by the literature review below, the only issues that pertain to IT management have been narrowly considered in relation to specific IT applications at the project level, or from generally surveying end users and middle managers, but there have been very few studies that look at IT management issues in hospitals at the top managers' level. Apart from the work by Jaana et al (2011), Houser & Johnson (2008), and Szydlowski & Smith (2009); few studies have investigated IT management issues in health care organizations.

Understanding IT management issues from the perspectives of top IT management has been explored and studied in the Information Systems (IS) literature as seen in the literature review below. Studying these issues not only sheds light for better understanding of challenges in this area, but it aids informed decision making in organizations and allocation of resources for education, management, and research efforts (Brancheau, Janz, & Wetherbe, 1996; Dekleva & Zupancic, 1996; Li, Huang, Luftman, & Sha, 2010a; Pollard & Hayne, 1996). Furthermore, Luftman et al (2015) noted that the ranking of the importance of issues changes over time based on their global survey among IT managers (Luftman et al., 2015). This incites the question whether there is also a change in IT management issues among hospitals' managers over time. Since Jaana

et al (2011) have conducted a ranking Delphi study to start exploring IT management issues in Ontario hospitals, this study is a follow-up that aims to re-assess the key IT management issues among top management in Ontario hospitals and explore their evolution over time.

1.2 Research problem and objectives

Replication of existing literature to extend knowledge and provide large scale impact on results in a domain where limited knowledge exists has been recognized by various authors as an important and lacking component of published research (Brandt et al., 2014; Crandall & Sherman, 2016; Hüffmeier, Mazei, & Schultze, 2016; S. Schmidt, 2009; Spector, Johnson, & Young, 2015). Furthermore, academic journal editors have put out calls for replication research manuscripts, such as the journal for Educational Technology Research and Development (Spector et al., 2015). Specifically, the type of replication known as conceptual replication under which follow-up studies fall has been recognized as providing the functions of a classical close replication of previous research. While a classical replication aims to test the hypothesis, a conceptual replication adds at least one new element to ensure previous findings were not due to chance and to function (S. Schmidt, 2009). Therefore, conceptual replications function not just as confirmation and affirmation of earlier research, but also as an extension of published knowledge by adding new elements to the study (Crandall & Sherman, 2016; Hüffmeier et al., 2016; S. Schmidt, 2009).

Additionally, there has been recognition in the IT management issues literature for the need of replication and follow up studies to assess the changes in these issues over time (Shi & Bennett, 2001). The IS literature has attempted to sustain these continuous and systematic replication studies and surveys to follow the evolution of IT management issues in that field (Li, Huang, Luftman, & Sha, 2010b; Luftman, 2009; Luftman et al., 2015; Luftman & Ben-Zvi, 2010, 2011; Niederman, Brancheau, & Wetherbe, 1991). Limited knowledge exists on IT management issues

that face top IT managers in hospitals as well as the evolution and changes of these issues over time. In addition to this gap in knowledge and the literature, this limited knowledge hinders the ability of researchers to direct their efforts towards the most prominent issues in this context. Furthermore, it hinders the suggestion of recommendations and potential solutions in various areas that would help overcome these challenges (Shi & Bennett, 2001). The IT management issues faced by top IT managers were first explored by Jaana et al. (2011) in Ontario hospitals using a Delphi study design. To re-explore these issues, the changes and evolution over time, this research aims to carry out a follow-up study following the steps of a conceptual replication of the earlier study by Jaana et al. (2011). This study aims to identify IT management issues in different contexts, compare the IT management issues perceived by various groups in the current study with the earlier study, start the historical analysis of the trends these issues follow, and attempt to hypothesize the factors that affect the importance and perception of these issues.

Specifically, this study, which explores IT management issues at the organizational level, aims to answer the question: what are the current IT management issues among top IT managers (i.e. CIOs/ IT directors/ IT top managers) in Ontario hospitals and how have they evolved since 2011? The study aims to answer this research question by achieving the following research objectives, which can inform future research and investment of resources in this area:

1) Develop an authoritative list of current IT management issues in Ontario hospitals.
2) Assess the differences among the different hospital panels for these issues.
3) Describe the evolution of common and panel specific IT management issues over time.

2. Literature review

Using information technology in the healthcare sector is very promising; however, it comes with various challenges at all stages of using the technology, and those challenges are experienced by everyone in the healthcare organization. Looking at issues among top IT managers in hospitals provides an organizational perspective of the internal and external challenges at the organizational level. This new lens can be used to evaluate and allocate available resources to address challenges in IT integration and implementation in the hospital organization. Seeing as this is a follow-up study to the one done by Jaana et al. (2011), and it aims to take an inductive approach to generating a list of IT management issues, it is important to understand the issues that have been raised and discussed in the fields of Information Systems (IS) literature and medical informatics. The literature review is intended to explore the literature that has been published on IT management issues in the health informatics area since the earlier was published to better contextualize the current study. Furthermore, exploration of the IT management issues from the IS literature presents a contrast to the issues that will be uncovered in this follow-up study because this field has been studying these issues since the 1980s and tracking changes in these issues overtime (Brancheau & Wetherbe, 1987; Dickson, Leitheiser, Wetherbe, & Nechis, 1984). The knowledge-base the IS literature provides will help triangulate and situate the results. The Information Systems field is defined as a discipline combining IT, informatics and management concepts (Academic Dictionaries and Encyclopedias, 2017; Voříšek, Pour, & Buchalcevová, 2015). The main journals reporting these issues from the perspectives of top IT managers in the IS field are the journal of Management of Information Systems (MIS) Quarterly, MIS executive, journal of Global Information Management, Journal of Industrial Management, and Industrial Management & Data Systems. As for the health informatics counterpart, the journals that provide the IT management

issues of interest are the International Journal of Medical Informatics, journal of Hospital Topics, and the journal of Perspectives in Health Information Management.

There is a wealth of literature in the IS field that looks at key IT management issues from the perspectives of top IT managers. The exploration of these issues started by using the Delphi method, used in this study, to explore the main challenges and build a base to create a survey instrument to track changes over time. The IS literature looks at IT management issues from the perspectives of top management in various industries across the globe, such as healthcare, education, and business networking among others. IT impact on businesses, or the business value of IT, have surfaced as a key IT management issue in the business literature where it's argued the most important changes to IT applications and investments in the future will be driven based on the value IT provides for the business (Luftman et al., 2015). This topic also surfaces on the medical informatics side where Jaana et al. (2011) provide various examples of possible resource allocation based on the issues raised by the top IT managers. This study aims to contribute to the base knoweldge that will help build such a survey for IT management issues in hospitals (Jaana et al., 2011; Luftman et al., 2015; Pollard & Hayne, 1996; Shi & Bennett, 2001).

This literature review section first provides an overview of the earlier study by Jaana et al (2011) since this study is a follow up. Second, it introduces the strategy used to search and review the literature in this area, which introduces the broad categorization of issues facing top IT managers. Third, a comprehensive review of IT management issues in the IS and medical informatics literature is presented. Last, a comparison between the two bodies of literature by issue category is presented including a summary of this literature.

2.1 Summary of the earlier study by Jaana et al. (2011)

The main purpose of the study was to develop an authoritative list of key IT issues faced by top IT managers, such as CIO's and IT directors, in public hospitals. The research objective stemmed from the fact that with the benefits that IT brings to healthcare and its continuously increasing role, new challenges and issues emerge where IT top managers need to make informed decisions. Not recognizing and understanding these issues would lead to hindering progress in the evolution of IT in hospital settings. This study was the first of its kind in the health informatics field and as a result, it drew from the work done in the IS literature where issues from the perspectives of top IT managers have been studied extensively.

Due to the importance of understanding IT management issues from top managers' perspectives and the gap in medical informatics literature, the Delphi method was used to elicit the response of top managers and eventually create a ranked list of issues among top IT managers overseeing IT in Ontario hospitals. The data collection took place during 2010, in Ontario, Canada where hospitals are publicly funded and there have been various major transformations to incorporate IT in healthcare settings since 2001. There were three panels for this study, which were academic hospitals (13 hospitals), community hospitals (51 hospitals), and small or rural hospitals (38 hospitals). The top managers in these panels were expected to report different types of issues based on their different context and budgets regarding IT management. The experts who participated in the study were mostly men between 40 and 60 years of age, with a technical IT background and have spent an average of 11 years in their respective hospital and 14 years in the IT field. Only two experts had a background in medical informatics. Most of the experts had the title of IT director in rural and community hospitals, while those in academic hospitals had the title of CIO.

In the first phase of the Delphi study, known as the brainstorming phase, data about participants' characteristics and 5 – 10 key IT management issues were collected. Following the responses, two of the authors worked together to collate the replies and generate a consolidated list of 36 issues with 9 of the issues overlapping between the three panels. This list of randomly ordered issues was emailed to the respondents so they can select the top 10 issues form the list as part of the second phase of narrowing down. This process provided 18 issues for the rural panel, 20 issues for the community panel, and 17 issues for the academic panel. Finally, the list of about 20 items was emailed to the participants asking them to rank the issues for the final ranking phase of the Delphi study. Two rounds of ranking were needed in order to reach moderate consensus levels.

The top issues uncovered in the Jaana et al. (2011) study included managing demand and expectations for IT services, having sufficient funds, recognizing IT as a key stakeholder in major hospital decisions, and implementation of an EMR. Issues relating to sufficient funds, strategic positioning of IT within the hospital, managing demand and expectation, IT competing with other priorities, and IT being a major stakeholder in major hospital decisions were shared among all panels. The authors used these issues to provide recommendations for investments and resource allocation in areas such as management, policy making, education, and research. The findings of this paper are further incorporated into the literature review, and Table 13 in the *Appendix* provides the final ranking results from this study.

2.2 Literature review strategy

SCOPUS, ProQuest databases, Ovid Medline, Web of Science, and Google Scholar databases were searched using combined search terms of "information technology", OR "clinical information systems" OR "hospital information systems" AND "hospital". Those terms were

combined with "managerial level issues" OR "management information system issues" OR "key issues for management" AND "executive" OR "CIO" OR "manager". To obtain a good understanding of the current health care system in Canada, Ontario, and information technologies, the following terms were used, "health care system in Canada and IT" OR "health care system in Ontario and IT" alongside a search of, "uses of IT in medicine" OR "telemedicine" OR "home based eHealth" OR "telecare". The search terms were used without quotation marks to capture all relevant results. SCOPUS, Web of Science, and ProQuest databases were searched due to their multidisciplinary nature, where they capture management, IS, social sciences, and health literature. Additionally, Ovid Medline was searched to capture health related literature. Google Scholar was searched for grey literature using the same search terms to look at various government and organizational reports. Only the results in the English language were examined. Articles and reports included dated as far back as the publication year of 2008 since Jaana et al (2011) examined earlier literature, however a few relevant articles in the field before the year 2008 were also included. Because this study is a follow up to the work done by Jaana et al. that was published in 2011 where the authors reviewed the literature published before 2010 in the field, the extension to look at literature as far back as 2008 was decided upon to ensure all relevant literature is captured.

There were 658 search results that met the search criteria of "information technology" AND "hospital" AND "issues". This number was reduced to 534 when the term "management" was added to the search criteria. Those articles' titles and abstracts were scanned to retain the most relevant articles resulting in 105 articles retained. Articles that explored IT related issues from the perspectives of top IT managers, CIOs, or IT directors were retained and examined in detail. Literature from Europe, Australia, and the U.S.A. was also included due to similar levels of country development to Canada. Alongside the article by Jaana et al (2011) to which this study is a follow

up, articles that discuss management key issues with information technology were reviewed in full details and the abstracts of their references and citing articles were also reviewed. There were various articles that looked at key issues with information technology and ranked them from a general perspective, a few that looked at benchmarks for evaluating information technology and the way it is being used in hospitals. Furthermore, there are a few government reports that address the area of information technology integration and policies, however they do not delve into the details of the issues facing top IT managers in hospitals. The literature review synthesis below reflects literature since 2008 as well as an integration with the Jaana et al, 2011 study and older key articles.

2.3 Categories of IT management issues

Over the years, authors in the IS literature used results from Delphi studies to build and survey various top IT managers globally about key issues they face in their industries, which helped portray differing issues and priorities depending on economic fluctuations and other factors affecting competing IT prioreties (Brancheau et al., 1996; Ifinedo, 2006; Ifinedo & Ifinedo, 2011; Luftman, 2009; Pimchangthong, Plaisent, & Bernard, 2003; Timms, 1975). Key issues and barriers to successful IT implementation in the healthcare sector vary among different settings and environments; however, the main recurring issues tend to focus on funding the IT systems and aligning IT strategic planning with hospital strategic goals. The issues of IT management have been sorted into similar categories across the IS and medical informatics literature using inductive content analysis methods as well as classifications used in by authors in the IS field to compare long term trends (Mayring, 2000; Niederman et al., 1991). However, it is important to note specific issues can be observed depending on the field the literature comes from, and that even though categories of issues may overlap, the issues stemming from the healthcare informatics literature

have their own particularities that make them different from the issues observed by the businesses usually surveyed in the IS literature.

There are various issues facing information technology top IT managers in hospitals at various stages of IT implementation in healthcare organizations. The literature from the IS field provides a respectful body of research that investigates key management issues with information technology and various trends in these issues. However, the medical informatics literature scarcely looks at the issues of IT implementation in hospitals from the perspectives of IT top managers or the trends of change among these issues. For the purposes of this study, key IT management issues have been grouped into categories based on recurring themes in the IS and medical informatics literature, these categories are summarized in Table 1 to aid comparison, and are discussed in more details below. It is important to reiterate that the particularities of the issues differ between the two bodies of literature. However, for simplicity and comparison purposes, the issues have been grouped into these categories.

Table 1 at the end of the literature review provides a high level summary of the IT management issues categories and the literature which reports them. These categories partially stem from authors in the IS literature who classfied IT management issues into four groups based on trends observed in their follow-up Delphi study (Caudle, Gorr, & Newcomer, 1991; Niederman et al., 1991; Swain, White, & Hubbert, 1995). To begind with, Niederman et al. (1991) introduce the classifications of IT management issues into four categories which have been adapted for this literautre review. However, as the classifications by Niederman et al. (1991) do not span all the issues explored in the literature review, especially issues related to the nature of publicly funded healthcare systems, the additional cateogry of “regulatory issues” was deduced based on content analysis and trends observed among these issues (Mayring, 2000) as well as leveraging literature

that explores IT management issues in the public sector (Caudle et al., 1991; Swain et al., 1995). This exercise resulted in the five categories into which the IT management issues have been organized, which are;

1) Technological issues: this category includes issues that relate to the integration of technology components to support basic business needs. Referred to as the technology infrastructure group and includes issues such as information architecture, technology infrastructure, telecommunication systems, distributed systems, and electronic data interchange (Niederman et al., 1991; Pare, Sicotte, Jaana, & Girouard, 2008).
2) Human issues: this category is referred to as the internal effectiveness group of issues in the IS literature and it includes issues such as IT human resources, software development, application portfolio, and IT effectiveness measurement. These issues focus on the internal IT function and are concerned with the essential activities that make up most of the IT function's work (Niederman et al., 1991; Pare et al., 2008; Sligo, Gauld, Roberts, & Villa, 2017).
3) Organizational issues: those are defined as the "management" side of the "management/technology" classification of issues done by Brancheau and Wetherbe (1987). More specifically, they are issues that deal with organizational factors related to structure, accountability, and agility of the enterprise (Brancheau & Wetherbe, 1987; Niederman et al., 1991; Pare et al., 2008).
4) Strategic issues: also called the business relationship group of issues by Niederman et al. (1991). This category refers to issues that deal with concerns external to IT departments since they focus on the management of the relationship between IT and the business. This category includes issues such as data resources, strategic planning, organizational

learning, IT organization alignment, and competitive advantage (Brancheau & Wetherbe, 1987; Niederman et al., 1991; Pare et al., 2008).

5) Regulatory issues: this category of issues was deduced through content analysis of the themes of the remaining issues which did not fit into any of the above four categories. Since healthcare tends to be treated as a public entity and, especially in Canada and various parts of the world, is a publicly funded institution, the issues of around funding and healthcare governance by various government bodies arise. Because private businesses tend to generate their own revenue instead of depending on tax payers' contributions, they do not necessarily experience these issues (Rocheleau & Wu, 2002). These do not top the list of management challenges in the IS literature as much as they would be among the top priorities of publicly funded healthcare organizations.

In addition to the five categories where the various IT management issues are sorted, the remainder of the literature review is organized to provide a logical progression of comparing these issues between the IS and health informatics bodies of literature.

2.4 Overview of IT management issues in the literature

As early as the 1980s, IT management issues have been examined in the IS literature, especially from the perspective of top IT managers so a better understanding of the challenges and concerns can be obtained and investment decisions can be made to address those concerns (Jaana et al., 2011).

The medical informatics literature is limited compared to the business literature when it comes to discussing issues that pertain to IT from top management perspective. A few studies in the medical informatics literature have broadly exposed some managerial concerns by way of looking at general IT implementation and adoption barriers in hospitals (Houser & Johnson, 2008; Jaana,

Ward, et al., 2012; Lluch, 2011; Sligo et al., 2017; Szydlowski & Smith, 2009). However, limited research has systematically investigated IT management issues from the perspective of top IT managers and IT directors in hospitals, except for the studies by Jaana et al. (2011), Szydlowski & Smith (2009), and Houser et al. (2008). Szydlowski & Smith (2009) examined the trends of healthcare leadership and management regarding IT implementation and management in a hospital setting through conducting interviews with top IT managers and nurse managers. The authors do not observe IT management issues directly, however they assess what IT is used for in the hospital, how the integration is lead, and report on some of the barriers to health IT implementation (Szydlowski & Smith, 2009). Houser et al. (2008) aimed to assess the state of EHR implementation, the factors associated with the implementation, and the benefits, barriers and risks to health IT implementation in Alabama hospitals. These objectives were met through a self-reported mailed survey to directors in the health information management department of Alabama hospitals and the major barrier reported was lack of adequate funding (Houser & Johnson, 2008). All of the in-depth studies on IT management issues have been mostly conducted in the IS literature and not in the healthcare informatics literature. The evidence related to these issues in healthcare informatics is sporadically documented and, other than the study by Jaana et al., no systematic assessment of these issues has been previously conducted. Therefore, any other issues not highlighted by one of the three studies mentioned above have been drawn from the general body of health informatics literature due to their relevance for comparison and context purposes for this study. Using a template of categories created from the IS literature above, key issues that pertain to the medical informatics literature only have been added, Table 1.

It is important to note that key IT management issues are interrelated, and provide a unique insight into the organizational structure and practices of healthcare organizations, where one

category of issues can readily facilitate or inhibit the resolution of other issues in hospitals (Sligo et al., 2017).

2.4.1 Issues pertaining to technology

These issues tend to be inherent in the technology and software development of the technology being used. They address the software and hardware component of IT applications, such as the complexity of these applications and their interdependence (Niederman et al., 1991; Pare et al., 2008). Issues pertaining to technology infrastructure as well as programming and processes fall into this category.

2.4.1.1 Information Systems literature

One of the most prominent and recurring issue in this category is the concern with security and privacy of information technology (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012). The issues of security and privacy are also linked to the quality of communication networks and information sharing capacity of the technology, as well as the security of these networks (Smith, Koohang, & Behling, 2010).

Data and content management issues also resurface throughout the literature, such as ways to store the data, ways to present the data and various ways of integrating the data stored in information technology applications (Luftman et al., 2015; Smith et al., 2010). Data management issues also lend into challenges around using information technology for business innovation purposes, where the full potential of these technologies would be attained (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011).

Having proper infrastructure that lends itself to provide proper support to information technology applications and facilitate the assimilation of new technologies are other recurring

issues discussed in the IS literature (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012). Proper and strong infrastructure also plays a role in providing disaster recovery options so that in the event of information loss or application failure, the business can continue operating by having some failsafe technology to rely on. An example is the emergence of cloud storage and computing which are linked to the decreasing ranking of this issue among IT managers as these options become more available (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012; Smith et al., 2010). Lastly, taking advantage of technology to leverage business analytics tools for continuous reporting on various performance measures has been cited as an emerging challenge (Luftman et al., 2015).

2.4.1.2 Health informatics literature

Privacy and security issues continue to top the list of issues for healthcare use of IT, and these issues tend to be associated with data and content management (Avgar, Litwin, & Pronovost, 2012; Bahensky, Jaana, & Ward, 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011). Another main issue in the medical informatics literature has to do with the quality of infrastructure due to ever evolving applications and added IT functions to IT applications such as the EHR and lab work or imaging technologies (Jaana et al., 2011; Sligo et al., 2017). Furthermore, the issues of ever greening and keeping up with technology changes and improvements is another issue faced by healthcare managers, where the integration of the newer systems with the existing systems in the hospitals provide various technological challenges as these systems continue to evolve over time (Avgar et al., 2012; Jaana et al., 2011; Paré et al., 2010; Sligo et al., 2017). Lastly, the challenges relating to using advanced business intelligence tools to perform various health analytics activities and reports that would aid decision making have also surfaced in this body of literature (Jaana et al., 2011).

2.4.2 Human related issues

Human issues pertain to the challenges experienced by individual users of the IT applications, as well as challenges around human resources. These issues can stem from end users' resistance to change, their attitudes to adopting new technology and processes, and the available supply of talent to work on incorporating and maintaining these applications (Niederman et al., 1991; Pare et al., 2008; Sligo et al., 2017).

2.4.2.1 Information Systems literature

The recent IS literature does not mention many of these issues. The main issues this body of literature discusses under this category are the lack of IT training among end users of the technologies as well as the cost associated with training the staff to be up to speed with new technologies (Peslak, 2012; Smith et al., 2010).

2.4.2.2 Health informatics literature

Human related issues are frequently reported in this body of literature from the perspectives of managers and frontline workers who are the technology adopters and users. The medical informatics literature reports issues that pertain to clear division of labour among hospital departments so that the strengths are focused and drawn upon from each department (Lluch, 2011; Sligo et al., 2017). Furthermore, user resistance and training make an appearance in the medical informatics field where healthcare personnel may resist the adoption and use of IT technologies and maintain that management places unrealistic expectations in attaining specific goals with regards to IT use and training (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). Another prominent issue is the recruitment of specialized IT

personnel who have the proper education and expertise working with IT in the healthcare sector specifically (Jaana et al., 2011).

2.4.3 Organizational issues

Organizational IT management issues deal with the hierarchy and communication between upper management and staff. Support from upper managers for the implementation of various IT projects, ensuring the organizational culture is cohesive, and ensuring appropriate communication among staff all fall under this category of issues (Brancheau & Wetherbe, 1987; Niederman et al., 1991; Pare et al., 2008).

2.4.3.1 Information Systems literature

The IS literature identifies two main issues under this category. The main issue is organizational agility where a business organization is expected to be flexible and have flexible hierarchy in order to accommodate changes in staff positions and roles in response to new IT innovations (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011). Another issue that fits this category is the lack of communication between IT support personnel and end users of the technology, however it is not extensively discussed throughout this body of literature (Peslak, 2012).

2.4.3.2 Health informatics literature

The medical informatics literature identifies organizational agility as being an important challenge with the implementation of IT in hospitals, where the IT and organizational structures need to be flexible to incorporate new technology systems (Sligo et al., 2017). Another very prominent issue is the communication and availability of IT trained personnel who would provide support and guidance to end users regarding the training and use of IT applications. This issue is

one of the most identified issues in the medical IT issues literature where publicly funded hospitals tend to have a hard time competing in the market for attracting talents due to their limited budgets when it comes to IT (Bahensky et al., 2008; Caudle et al., 1991; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011). This body of literature also goes on to discuss challenges around decentralization of management for IT projects, where middle management can take on a role with managing smaller IT projects, as well as concerns and challenges with the lack of support from upper management, where competent leadership strategies act as an enabler of successful IT implementation (Lluch, 2011; Sligo et al., 2017). Lastly, the issue of unrealistic expectations of IT to solve all problems in a department stems from the organizational culture around IT (Jaana et al., 2011). End users expect IT solutions to fix all problems and IT personnel to repair IT related issues very quickly, and the management of these various projects as well as the expectations raise difficulties for top IT managers (Jaana et al., 2011).

2.4.4 Strategic issues

These issues encompass challenges with the long-term vision of the enterprise and how IT can be integrated and used to provide competitive advantage as well as increase efficiencies and reduce costs of operations. The incorporation of IT into hospitals poses various challenges such as mitigating various risks, controlling costs, and ensuring alignment between IT strategy and the overall business strategy as well as using IT for competitive advantage (Brancheau & Wetherbe, 1987; Niederman et al., 1991; Pare et al., 2008).

2.4.4.1 Information Systems literature

These issues have been thoroughly investigated and discussed in the IS literature. The most prominent and recurring strategic challenge IT managers face is the alignment between IT and business strategies with the aim of ensuring that IT applications work towards the business

strategic goals (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012). Other strategic issues centre around the cost that is associated with the utilization and upkeep of these technologies as well as business process management and redesign around IT (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011). Lastly, the concerns with change management have been given less priority in more recent years when compared with previous years in the IS literature. Change management in organizations is still a concern, but it does not appear to be as prominent of a concern as aligning IT and business strategies (Luftman et al., 2015).

2.4.4.2 Health informatics literature

The medical informatics literature defines similar general issues as the IS literature, however they are healthcare context specific. For example, issues pertaining to IT and business strategy alignment are reported, however they are geared towards hospital strategic plans, such as better delivery of patient care (Avgar et al., 2012; Szydlowski & Smith, 2009). Furthermore, there is a significant discussion around the benefits of implementing IT in hospitals and the costs associated with this implementation, especially among publicly funded healthcare settings (Jaana et al., 2011; Sligo et al., 2017). Change management issues and business processes redesign issues are also identified in the context of healthcare settings (Bonney, 2016; Jaana et al., 2011; Lluch, 2011). Lastly an issue that was reported by top IT managers in hospitals was captured as alignment of IT strategy within the hospital with the strategy of the funding body (Jaana et al., 2011).

2.4.5 Regulatory issues

With the use and implementation of IT applications in business organizations comes regulating factors mandatory to businesses using these technologies. These concerns are always present and constitute the accountability that publicly funded organizations need to adhere to. This is especially relevant for publicly funded healthcare institutions where the funding stakeholders agenda as well

as allocation of funds and projects need to be transparent and drive the IT strategic agenda, in contrast to private businesses where profits drive IT investments (Caudle et al., 1991; Pare et al., 2008; Smith et al., 2010).

2.4.5.1 Information Systems literature

The IS literature is rich with different IT management issues that take different priorities depending on the time and implementation stage of these technologies in the business industry and the most prominent regulatory issues center around legal requirements and accountability for data management since the competitive advantage IT provides is the main driver for these businesses (Caudle et al., 1991; Li et al., 2010a; Luftman et al., 2013, 2015).

2.4.5.2 Health informatics literature

There are various ways of funding IT initiatives in hospitals, however most hospitals obtain some financial contribution from external stakeholders in order to facilitate the integration and implementation of IT. The issue of funding and lack of resources is one of the continuously reported challenges for IT implementation in hospitals, and it is especially seen with publicly funded hospitals (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Szydlowski & Smith, 2009). Another major issue for hospitals is that of interoperability where the lack of standards among IT applications makes it difficult to share information across different departments and other healthcare providers for continuous patient care (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). These two issues are unique to hospitals attempting IT implementation since they do not make an appearance in the recent IS literature.

2.5 Comparison between the IS and medical informatics literature

2.5.1 Issues pertaining to technology

Technological issues are evenly expressed throughout the medical informatics and IS literature where the main issues expressed in both bodies of literature centre around privacy, having adequate infrastructure, as well as data and content management. However, the medical informatics literature also highlights the challenges of introducing new applications or updating legacy systems (Jaana et al., 2011; Sligo et al., 2017) however, issues around disaster recovery due to loss of data and innovation opportunities to be achieved do not appear in the medical IT management issues literature.

2.5.2 Human related issues

Interestingly, the medical IT literature appears to report on more human related issues when compared with the recent IS body of literature. This could be due to the way hospitals are integrated and operate or due to the different levels of IT utilization among these two sectors. Both bodies of literature report the lack of training of personnel as a key management issue (Avgar et al., 2012; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017; Szydlowski & Smith, 2009). Even though the medical informatics literature shares some human issues with the IS literature, it also goes well and beyond to identify other prominent components that pertain to hospital operations, such as user expectations and recruitment of specialized health IT staff.

2.5.3 Organizational issues

The issues of communication between IT personnel and end users of IT as well as the issues of organizational agility make an appearance in the IS literature. However, the issue of communication between IT personnel and end users of technology appears more frequently and seems to be of higher concern in the healthcare informatics body of literature when compared to

the IS literature. The healthcare literature stresses the importance of the involvement of managers in IT projects in terms of implementation and training to aid in adoption and uptake of these applications. It also stresses the importance of ensuring that technology meets the expectations of end users as well as the promised benefits (Jaana et al., 2011; Paré et al., 2010; Sligo et al., 2017).

2.5.4 Strategic issues

When discussing strategic IT management issues, the medical IT literature overlaps the issues it reports with the IS literature. However, the issues reported in the medical literature tend be healthcare specific even though they are like the issues reported in the IS literature. From the literature review and Table 1 below, these two bodies of literature share all the reported strategic issues when it comes to IT. The main difference is the challenge with aligning the hospital IT strategy with the strategy of the funding body as these are publicly funded organizations.

2.5.5 Regulatory issues

The issues of meeting legal requirements and accountability for sharing and using patient data are shared among the medical informatics and IS bodies of literature (Lluch, 2011; Luftman et al., 2015). However, the medical informatics literature expands more on regulatory issues and reports more of them due to the public funding and governance structure of the healthcare system in most developed countries, such as Canada. In contrast with the IS literature, the medical informatics literature reports various issues regarding funding availability which do not apply to privately operated enterprises which use IT to drive profits instead of offering IT solutions as public goods (Caudle et al., 1991; Houser & Johnson, 2008; Jaana et al., 2011; Szydlowski & Smith, 2009).

2.6 Summary of literature review

Similar IT management issues between the IS literature and healthcare informatics literature include technological issues such as assimilating new and emerging systems, good quality infrastructure, proper communication networks or knowledge sharing procedures, and data management issues. Also, the healthcare IT literature only resonates IT management issues with the IS literature when it comes to human issues that concern training personnel or end users of IT applications, but not other issues under that category. Organizational issues are also only paralleled between the two bodies of literature when issues concern organizational agility and communication and availability of IT support personnel. A similar case can be seen with regulatory issues where meeting legal requirements and accountability are the common IT management issues across these two bodies of literature. Lastly, all strategic issues that arise in the IS literature have also been raised in the healthcare IT literature, with the exception of aligning organizational IT strategy with that of the funding body. The main strategic issues discussed in both bodies of literature constitute challenges around IT strategy and business alignment, managing demand and expectations of IT, costs due to IT implementation, change management, and business processes management or redesign.

The IS literature raises IT management issues that are not mentioned in the healthcare informatics literature, such as disaster recovery and innovation opportunities under technological issues but all the other issues it raises resonated within the medical informatics body of literature. On the other hand, there are various IT management issues that surface in the healthcare informatics literature but not in the IS literature. These include issues such as division of labour among departments, user resistance to integration, and unrealistic expectations of IT under human issues. Also, issues around decentralized management and lack of support from upper

management. Lastly, issues around funding availability for IT and interoperability standards under regulatory issues only surface in the healthcare IT management literature.

As Table 1 shows, the area of IT top management issues in hospitals has had a small amount of research done by the small number of authors and publications that reported these issues. Furthermore, most of the research that has touched on IT top management issues has looked at them from a broad perspective and not as the detailed focus of this study, therefore a thorough and detailed assessment of these issues is needed to understand managerial concerns and better allocate resources to help managers better address their concerns.

Table 1: Summary of IT management issues in the literature

Categories of IT management issues	IT management issues	IT management issues in the IS literature	IT management issues in the health informatics literature
Technological issues	Ability to assimilate new and emerging systems	(Peslak, 2012)	(Jaana et al., 2011)
	Infrastructure quality	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	(Houser & Johnson, 2008; Jaana et al., 2011)
	Communication networks/ knowledge sharing	(Smith et al., 2010)	(Houser & Johnson, 2008)
	Privacy and security concerns	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012)	(Houser & Johnson, 2008; Jaana et al., 2011)
	Data and content management	(Luftman et al., 2015; Smith et al., 2010)	(Jaana et al., 2011)
	Business intelligence tools	(Luftman et al., 2015)	(Jaana et al., 2011)
	Disaster recovery, business continuity	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012; Smith et al., 2010)	
	Innovation opportunities	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	
Human issues	Lack of training among end users and associated cost	(Smith et al., 2010)	(Houser & Johnson, 2008; Jaana et al., 2011; Szydlowski & Smith, 2009)
	User resistance		(Houser & Johnson, 2008; Jaana et al., 2011)
	Recruitment of trained IT staff		(Jaana et al., 2011)
Organizational Issues	Organizational agility	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	(Sligo et al., 2017)
	Communication and availability of IT support personnel	(Peslak, 2012)	(Houser & Johnson, 2008; Jaana et al., 2011)

	Managing demand and expectations	(Peslak, 2012)	(Jaana et al., 2011)
	Unrealistic expectations		(Jaana et al., 2011)
	Support from upper management		(Lluch, 2011; Sligo et al., 2017)
	Decentralization of IT projects		(Lluch, 2011; Sligo et al., 2017)
Strategic issues	IT – business alignment	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012)	(Jaana et al., 2011; Szydlowski & Smith, 2009)
	Cost due to IT implementation	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	(Jaana et al., 2011)
	Change management	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	(Jaana et al., 2011)
	Business process management/ redesign	(Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011)	(Jaana et al., 2011)
	Alignment with governing body		(Jaana et al., 2011)
Regulatory issues	Legal requirements	(Smith et al., 2010)	(Jaana et al., 2011)
	Standards for interoperability		(Houser & Johnson, 2008; Jaana et al., 2011)
	Funding availability		(Houser & Johnson, 2008; Jaana et al., 2011; Szydlowski & Smith, 2009)

3. Methods

Replication research has been gaining recognition for its importance in the current literature due to its inherent properties of accumulating science and generating and solidifying knowledge and theories (Brandt et al., 2014; Crandall & Sherman, 2016; Hüffmeier et al., 2016; S. Schmidt, 2009; Spector et al., 2015). Furthermore, replication research work to add confidence in earlier literature findings, identify potential biases in earlier studies, and work to generalize the findings of earlier projects and to extend knowledge (Crandall & Sherman, 2016; S. Schmidt, 2009; Spector et al., 2015). This is a follow-up study which also draws on the methods used in the earlier study of Jaana et al (2011). Schmidt (2009) defines follow-up studies as studies which "combine a direct replication with a new experiment in the same publication" (S. Schmidt, 2009). These studies fall under the umbrella of conceptual replications that aim to test hypotheses or results from earlier research with a different experimental set-up (Crandall & Sherman, 2016; S. Schmidt, 2009). More specifically, a follow-up study intends to present as a replication to extend and generalize the findings of the earlier study. In such a study, one experimental condition is a direct replication of the earlier study in order for the study to be a replication, and additionally, one or more other experimental elements can be added, which can function to generalize the findings or test new hypotheses where only one aspect is changed compared to the earlier study (S. Schmidt, 2009). In a typology of replication studies constructed by Hüffmeier et al (2016), this study would be categorized as a "constructive replication" which falls under the umbrella of coenceptual replications where a follow-up study functions as an exact or close replication of the original study to meet the replication condition, but also adds at least one new element to meet the constructive replication condition (Hüffmeier et al., 2016). In order to construct this replication study, Brandt

et al. (2014) outline five steps that make for a successful replication, and these are presented in Figure 1, which this study aims to follow to ensure successful replication.

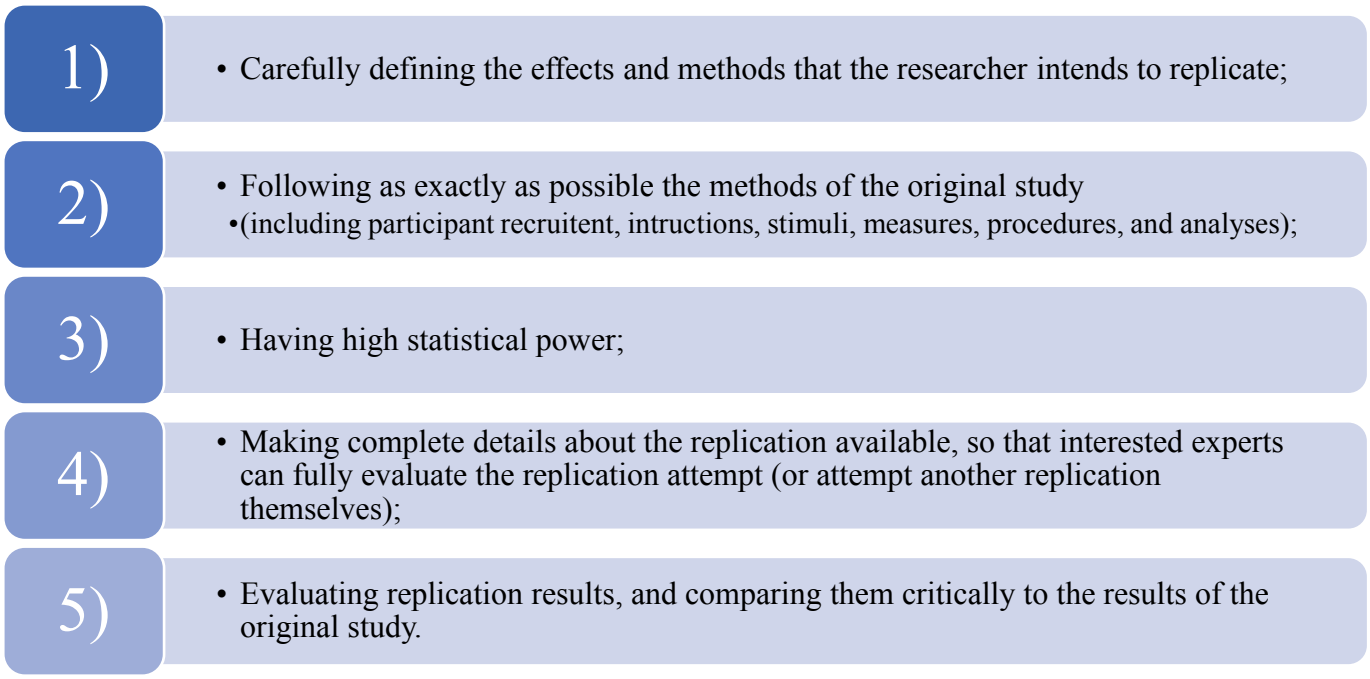

Figure 1: Ingredients for a successful close replication (Brandt et al., 2014)

Following the methods of the earlier study, this study aims to use the Delphi technique for data collection and generation of IT management issues. This technique has been used extensively in the IS literature to explore key IT management issues in this field. This technique is useful when dealing with uncertainty in a domain with a limited amount of knowledge, such as the area of understanding IT management issues from the perspectives of top IT managers in a public healthcare setting, since it acts as an exploratory and forecasting method to create an authoritative list of items through rigorous and controlled iterative feedback (Delbecq, 1975; Gallego & Bueno, 2014; Jaana et al., 2011; Paré, Cameron, Poba-Nzaou, & Templier, 2013). This data driven technique has been used since the early 1960s to investigate a wide range of research questions in various academic fields, such as IT management issues in the private sector (Delbecq, 1975;

Donohoe & Needham, 2009; Jaana et al., 2011; Li et al., 2010a; Luftman, 2009; Luftman et al., 2012, 2015; R. C. Schmidt, 1997). This is an appropriate approach since it incites the responses from experts individually, and through iterative feedback, it works to create an authoritative list of issues that's approved and ranked by the experts, with the main purpose of reaching consensus among the experts regarding a specific topic (Delbecq, 1975; Gallego & Bueno, 2014; Skinner, Nelson, Chin, & Land, 2015). Therefore, the applications of this technique are very broad, particularly for areas which are controversial or deal with multidimensional subjects, such as IT management (Gallego & Bueno, 2014; Kobus & Westner, 2016; Skinner et al., 2015). The Delphi technique has four distinctive characteristics: anonymity, iteration, controlled feedback, and statistical group response (Delbecq, 1975; Gallego & Bueno, 2014). The ranking type Delphi is the most commonly used Delphi method in the information technology field, it involves a set of linked questionnaires with the aim of eliciting responses from a panel of experts through iterative controlled feedback (Brancheau et al., 1996; Delbecq, 1975; Gallego & Bueno, 2014; Paré et al., 2013; R. C. Schmidt, 1997; R. Schmidt, Lyytinen, Keil, & Cule, 2001). The controlled iterative feedback is solicited through three main phases which are brainstorming, narrowing down, and ranking with the goal of reaching consensus about the relative importance of items related to the topic (Brancheau et al., 1996; Delbecq, 1975; Kobus & Westner, 2016; R. C. Schmidt, 1997; R. Schmidt et al., 2001). Since this study is a follow up and replication research to the work done by Jaana et al (2011), who also used a ranking type Delphi technique to create an authoritative list of key IT management issues in Ontario hospitals (Jaana et al., 2011). Therefore, this study aims to create a similar list and compare it to the list created by Jaana et al (2011) and the body of literature in this area as a way of triangulating the results. Since this research looks to further the understanding of these IT management issues in the healthcare setting and observe their

development over the past 7 years, the Delphi technique presents an appropriate approach as it has been classically used in the field of IS management to specifically broaden the understanding in this domain. Ethics approval for this study was obtained from the University of Ottawa's Research Ethics Board, and all statistical analysis were done using IBM SPSS Statistics 23 software.

3.1 Composition of the panels

Respondents from three different group settings were recruited to reflect the variations in public hospitals in Ontario. These three groups are rural hospitals, community hospitals, and academic hospitals. Rural hospitals are single community providers with a total patient acute care, complex continuing care, and day surgery weighted cases under 2,700 (Institute for Health Information, 2016). Academic hospitals include acute and pediatric hospitals that are members in the Council of Academic Hospitals of Ontario (CAHO), that are affiliated with a medical or health science school, provide complex patient care, and support significant research activity and post graduate training (Institute for Health Information, 2016). Lastly, community hospitals are defined as regional hospitals that range in size between rural and academic hospitals, which are not affiliated with medical schools and usually provide less complex care than academic hospitals (Institute for Health Information, 2016). The hospitals in these groups are similar in that they belong to the same jurisdiction and follow the same policies and regulations. However, they differ in their characteristics and environments, such as their size, financial capacity, human resources and their level of IT sophistication (Jaana, Ward, Paré, & Sicotte, 2006; Paré et al., 2010). Therefore, it is expected that IT top managers in these different groups would rank and report different IT management issues, as was observed by Jaana et al. (2011). Mental health and long term care hospitals are excluded from this study due to their significant differences from hospitals

discussed above, such as limited budgets, limited IT capacities, and wide variations in their IT sophistication levels (Jaana et al., 2011, 2006).

In order to compose these panels and identify potential respondents for the study, a list of hospitals in Ontario generated by the Ontario Hospital Association (OHA) was used (Ontario Hospital Association, 2016). A total of 16 academic hospitals, 69 community hospitals, and 47 rural hospitals, were contacted to generate a list of potential respondents within each hospital and the respondents' contact information. It was noted that some top managers service multiple hospitals and as a result, they were contacted at their mainly affiliated hospital and asked to confirm the hospital of their main affiliation. The mainly affiliated hospital was included in the study and the other hospitals a respondent services were disregarded. This procedure was done whether the respondent serviced hospitals within the same panel or in different panels. Furthermore, there were 4 hospitals that contract out their IT services and do not have an overseeing IT manager or executive at the hospital, these hospitals were also excluded from the study. These procedures adjusted the overall number of eligible hospitals to participate to 27 rural hospitals, 59 community hospitals, and 14 academic hospitals. Phone calls were made to all potential respondents in the three groups to introduce the project, explain the Delphi survey process and invite them to participate in the study. Calls were made on different days and times, and if after the third call a potential respondent could not be reached, a voice mail was left with a return phone number and email address to allow them to reply at their convenience. Respondents who declined the invitation or chose to not respond to voicemails left after the third try were excluded from the study. Of the respondents who were contacted, 8 from the academic panel, 20 from the community panel, and 12 from the rural panel agreed to participate. Table 3 in the Results section outlines the number of participants throughout the study.

The main incentive for panelists to participate was that the results from this study will be shared with them and will aid in directing investment decisions they make as well as shed light on issues faced by other hospitals that are similar and different to the panelist's hospital. A brief executive summary of results and recommendations was also provided to participants. Total anonymity of the respondents was ensured at all times during this research.

3.2 Ranking-Type Delphi Survey Stages

The ranked Delphi survey technique will be used as the exploratory approach to understand the key IT issues top IT managers in Ontario hospitals face today (Delbecq, 1975; Gallego & Bueno, 2014; Paré et al., 2013). As mentioned, due to the lack of extensive research done in this area, the ranked Delphi technique, which was used in the IS literature, aids in generating an authoritative list of key issues through a controlled iterative questionnaire (Delbecq, 1975; Paré et al., 2013; Skinner et al., 2015). The ranked Delphi consists of three main stages; brainstorming, narrowing down, and ranking; which were followed when conducting the survey with respondents in the three panels. Participants were asked to respond within two weeks of sending the questionnaire. Personalized reminder emails and voice mails were left as reminders to the participants who went beyond the two weeks period. Due to the nature of the Delphi method, analysis and coding of a certain stage were done before moving onto the next stage, which required each phase of data collection to take between 3 – 4 weeks to complete (Delbecq, 1975; Hsu & Sandford, 2007; Kobus & Westner, 2016). Data were collected directly from the participants in each panel via e-mail, which helped reduce the effect of dominant respondents, and statistical analysis was used to reduce group pressure for respondents to conform and ensure individual experts' responses were reflected in the final round (Delbecq, 1975; El-Gazzar, Hustad, & Olsen, 2016). Data collection was done between February 21, 2017 and September 21, 2017. Figure 2

below provides a presentation of the stages of the ranked Delphi survey and the steps taken during each stage. These stages, which are the same approach taken by Jaana et al. (2011), follow the recommendations set out by Paré et al. (2013) for Delphi studies which are outlined in Figure 3.

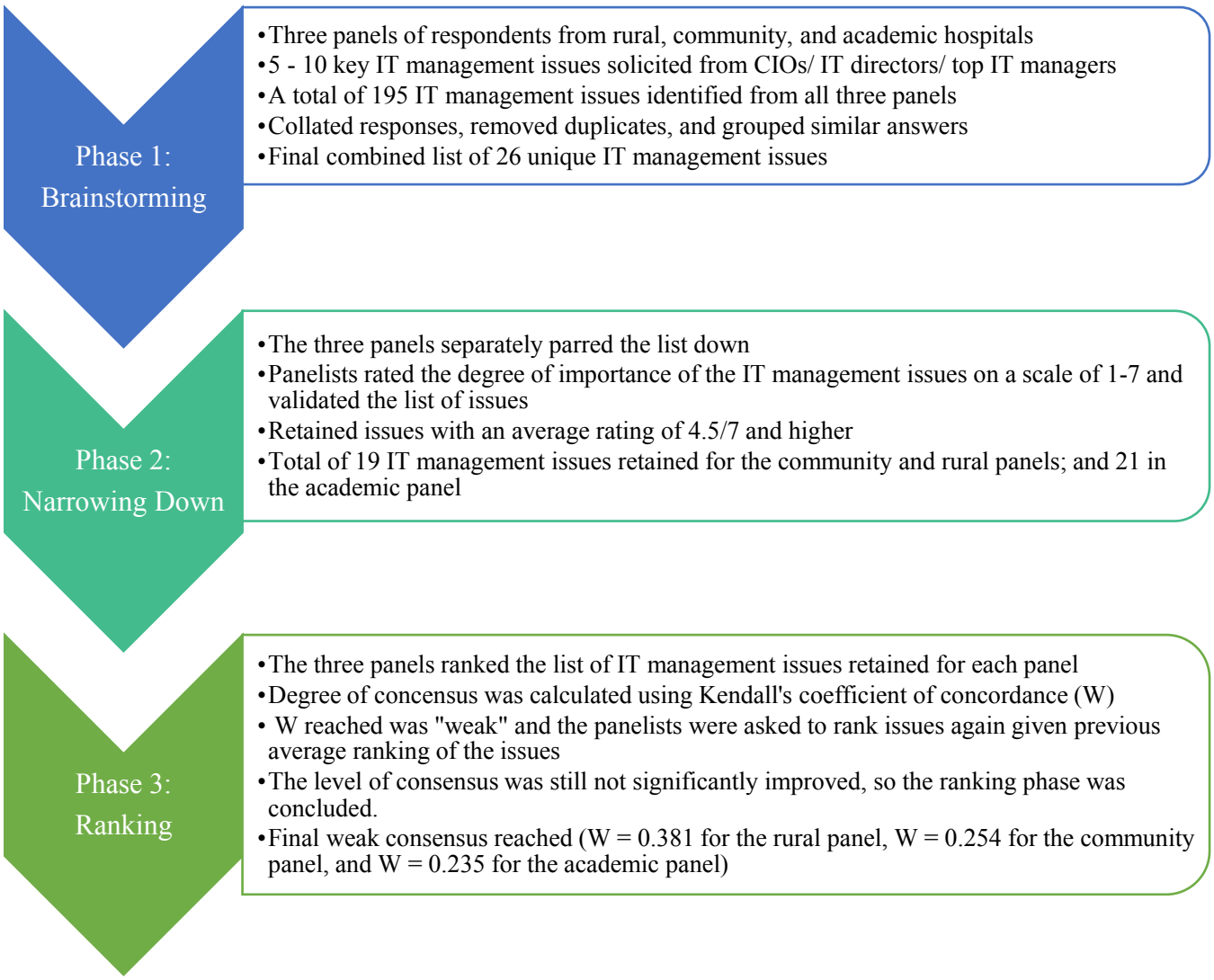

Figure 2: Delphi survey phases

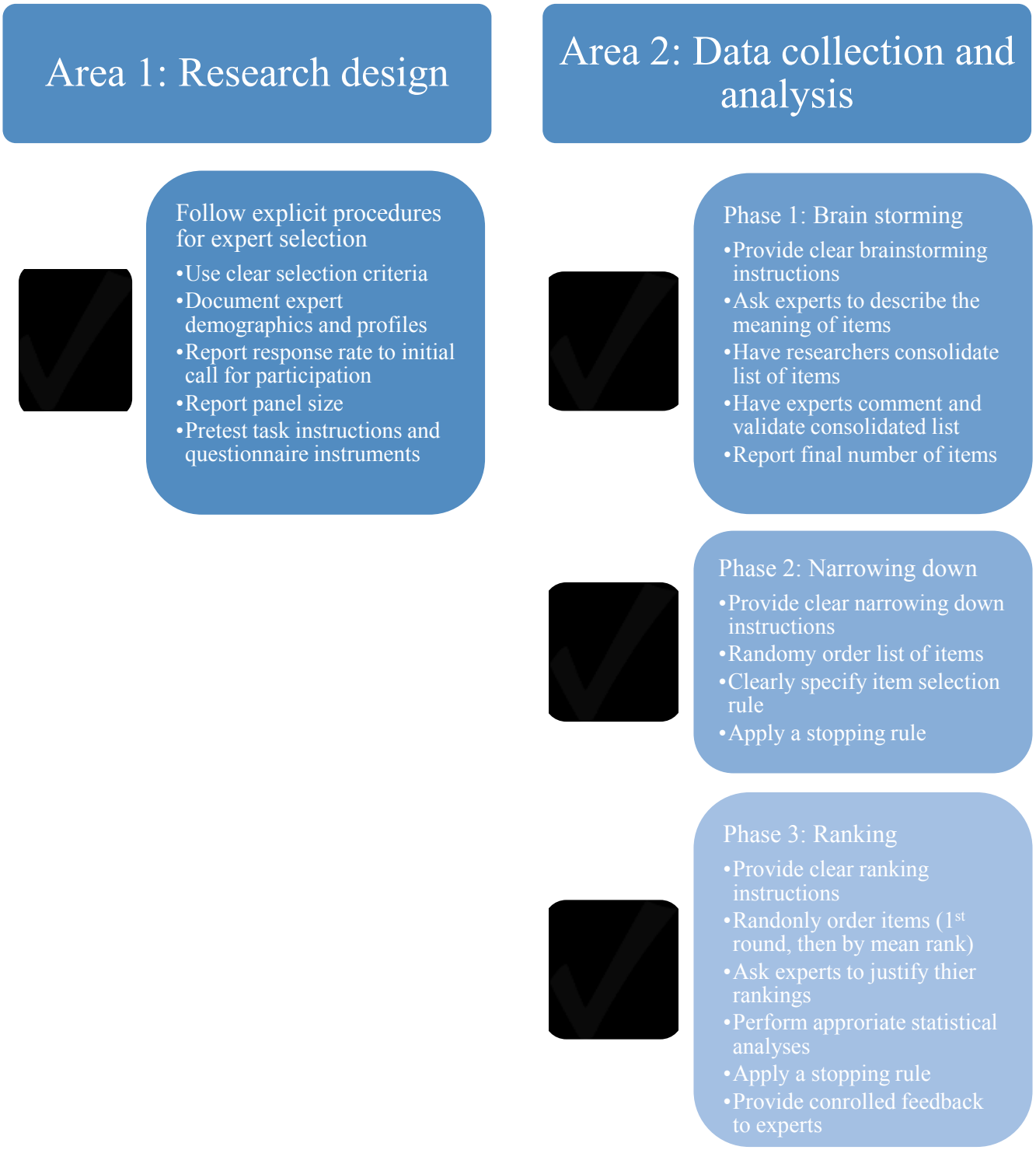

Figure 3: Attributes for assessing a ranking-type Delphi study (Paré et al., 2013)

3.2.1 Phase 1: Brainstorming

During this first phase of the Delphi survey, the respondents were emailed the first questionnaire on February 21, 2017. This questionnaire asked them to generate a list of 5 – 10 key IT management issues which are presently facing CIOs/ IT top managers in Ontario hospitals. The panelists were also asked to provide a brief description of these issues to explain ambiguous responses and support the reconciliation of answers in preparation for the second phase (Delbecq, 1975; Okoli & Pawlowski, 2004; R. C. Schmidt, 1997).

A key issue is defined as a set of main challenges and hurdles that face IT managers , also as a concern or problem that is associated with the effective use of IT in hospitals (Mayring, 2000; Yang, 1996). These challenges or problems would deserve more resources, time, and attention by IT management personnel (Mayring, 2000).

Data collection for the first phase concluded March 16, 2017. A total of 195 issues were identified by all participants from which a clean and concise list of 26 issues was generated through content analysis (Kobus & Westner, 2016). To generate the list of issues, two researchers worked on the coding and categorization, following the steps outlined by Mayring (2000) to carry out inductive content analysis of the IT management issues. This process included identifying similar issues and definitions as reported by the participants, followed by identifying themes or groupings of issues, then categorizing the issues into these themes or categories, and lastly removing duplicate issues or definitions provided (El-Gazzar et al., 2016; Mayring, 2000; R. C. Schmidt, 1997; Skinner et al., 2015). The student and another researcher met to assign categories to the issues reported for approximately 25% of the responses together, then each of the coders assigned categories and themes to the remainder of the responses separately, and finally, they met again to consolidate their analysis.

The coders assigned a category to reflect the theme a certain response addresses which lead to the final categories presented. For example, responses reading as "financial constraints and competing priorities", "competition with other clinical priorities for time, resources, and energy" were combined under the issue of *IT competing with other clinical priorities for resources*. Another example is the issue of *provincial leadership to enhance collaboration* where responses such as "Lack of bridges of communication provincial and across provincial borders", "Fragmented /Siloed systems and resource", and "the will/direction of government to require hospitals serving patients in a geographic region to collaborate" were grouped under its umbrella. The inter-coder agreement proportion between the student and researcher when coding the responses was calculated as the proportion of the total number of issues that were assigned the same code or category to the total number of issues provided by the panelists (Lombard, Snyder-Duch, & Bracken, 2002; Miles & Huberman, 1994) while the differences in coding were resolved through discussion (Lombard et al., 2002). This analysis resulted in a list of 26 IT issues identified by the panelists. A total of 7 panelists from the academic panel, 16 from the community panel, and 10 panelists from the rural panel responded to the first phase questionnaire (Table 3). Figure 6 in the Appendix provides a sample of the questionnaire sent to participants in phase 1.

3.2.2 Phase 2: Narrowing Down

The questionnaire for the second phase of the Delphi survey was sent out on April 20, 2017. During the second phase of the Delphi survey, the consolidated list of issues generated during the brainstorming stage was circulated, via email, to the panelists in the three panels for corrections, additions, validation, and any comments (Delbecq, 1975; Jaana et al., 2011; Kobus & Westner, 2016). The participants of each panel were asked to rate the IT issues according to their relative importance using a 7 – point Likert scale (1 = relatively unimportant issue, and 7 = a very important

issue) (Pare et al., 2008). In order to limit the issues for each panel, as is recommended by Schmidt (1997), we retained the issues that had a rating of 4.5 and higher on the [1-7] scale (Delbecq, 1975; Kobus & Westner, 2016; R. C. Schmidt, 1997). This resulted with 19 issues being retained for the rural and community panels, and 21 issues retained for the academic panel.

Furthermore, background characteristics questions were added in this phase to provide an overview of the respondents and their respective hospitals (Paré et al., 2013). For this phase, 9 participants from the rural panel, 13 from the community panel, and 6 from the academic panel responded. Figure 7 in the Appendix provides a sample of the questionnaire sent to participants in phase 2.

3.2.3 Phase 3: Ranking

In the last phase of the Delphi survey, the experts in each panel were separately asked to rank the IT management issues that were retained from the narrowing down phase in order of importance, after randomly organizing the list of issues (Delbecq, 1975; Kobus & Westner, 2016; Skinner et al., 2015). The purpose of this phase is to identify the relative importance of each of the issues on the list and calculate a final ranking score for each issue (Delbecq, 1975; El-Gazzar et al., 2016; Kobus & Westner, 2016; Paré et al., 2013). This first round of ranking took place between June and August 2017. After the ranking was done, Kendall coefficient of concordance (W) was calculated to determine the level of consensus among the experts in each of the panels, or per type of hospital panel, where consensus is expected within each of the individual three panels due to their seminaries in belonging to the same group of hospitals (Delbecq, 1975; Jaana et al., 2011; Kendall & Gibbons, 1990; Kobus & Westner, 2016; R. C. Schmidt, 1997). This coefficient is used in Delphi surveys versus some other coefficients, such as the Spearman rank order coefficient because W emphasizes the relative importance or order of the ranks rather than the

distance between them (R. C. Schmidt, 1997; Siegel & Jr., 1988; Skinner et al., 2015). *W* is calculated for each of the panel to obtain within panel agreement due to differences across the panels. Table 2 below demonstrates how Kendall's coefficient of concordance can be interpreted and Equation 1 and Equation 2 provide the formula, where a significant *W* indicates the participants are essentially using the same standard to judge the importance of the issues (Siegel & Jr., 1988).

Table 2: Interpretation of Kendall's *W* (R. C. Schmidt, 1997)

W	**Interpretation**	**Confidence in ranks**
0.1	Very weak agreement	None
0.3	Weak agreement	Low
0.5	Moderate agreement	Fair
0.7	Strong agreement	High
0.9	Unusually strong agreement	Very high

$$W = \frac{S}{\frac{1}{12}k^2(N^3 - N)}$$

Equation 1: Calculating Kendall's coefficient of concordance

Where S is the sum of squares of the observed deviations from the mean of R_j

$$S = \sum(R_j - \frac{\sum R_j}{N})^2$$

Equation 2: Sum of squares calculation for Kendall's coefficient of concordance

And K is number of sets of the rankings

And N is number of issues ranked

And $\frac{1}{12}k^2(N^3 - N)$ = maximum possible sum of square deviations (i.e. the sum S that would occur due to perfect agreement among K rankings)

After the first round of ranking of the issues, the consensus was found to be weak among the experts in all three panels, so the ranking questionnaire was repeated to reach a higher level of consensus. During this second round of ranking the IT management issues list was circulated among the experts with the issues listed in order of their average ranking in the previous round within each panel, and the experts were asked to rank the issues again (Delbecq, 1975; Paré et al., 2013; Skinner et al., 2015). The second ranking questionnaire was sent out on August 20, 2017 and data collection was concluded on September 21, 2017. As a general rule, the re-ranking of the issues should be stopped once consensus has been reached (Paré et al., 2013). Furthermore, it has been suggested that the re-ranking should continue until one of these three scenarios has been achieved; 1) a strong level of consensus which is measured by having a Kendall's coefficient $W >$ 0.7, 2) three rounds of rankings have been performed, or 3) the mean rankings for two successive rounds are not significantly different based on the Wilcoxon signed – rank test in this case (Paré et al., 2013). Based on these recommendations, ranking was stopped after completing two rounds. Figure 8 and Figure 9 in the Appendix provide samples of the questionnaires sent to participants for both rounds of ranking in phase 3.

4. Results

During the Delphi process, monitoring and reporting on the number of panelists included in each phase of the study is highly recommended as discussed in the Methods section above. Table 3, presents the number of panelists who participated in each round of the Delphi process. The attrition was moderate during the data collection process where the rate was 20% for the rural panel (2 out of 10), 25% for the community panel (4 out of 16), and 14% (1 out of 7) for the academic panel. Table 4 outlines the background characteristics of the participants who dropped out of the study (after phase 2 since that's when the data was collected) vs. those who completed the study. It is worth noting that the participants who completed the study did not have any statistically significant ($P < 0.05$) differences when compared to those who dropped from the study.

Table 3: Number of participants throughout the data collection process

Hospital panel	**Hospitals contacted and eligible to participate** [a]	**Agreed to participate**	**Responded in Phase 1**	**Responded in Phase 2**	**Responded in Phase 3a***	**Responded in Phase 3b***
Rural	27	11	10	9	8	8
Community	59	20	16	14	13	12
Academic	14	8	7	6	6	6

[a] Hospitals eligible to participate in the study after removing hospitals managed by the same top IT manager (included main hospital of affiliation), and those which outsource their IT services; as discussed in 3.1.

* Two rounds of ranking of IT management issues (phase 3) were conducted to improve consensus among the panelists in each panel.

Table 4: Characteristics of the participants who dropped vs. those who completed the study

Hospitals' characteristics	**Did not drop (N=26)** **Mean [range]**	**Dropped after phase 2 (N=4)** **Mean [range]**	**Total (N=30)** **Mean [range]**	**P value [F ratio] *** **One Way ANOVA**
No. of beds [a]	303 (12-1234)	86 (52-140)	274 (12-1234)	0.308 [1.079]
Hospital budget (millions)	339.80 (6.5-1600)	45.50 (16-75)	316.26 (6.5-1600)	0.401 [0.733]
IT budget (millions)	10.75 (0.2-50)	1.66 (0.3-3)	9.96 (0.2-50)	0.405 [0.723]
No. IT staff	120 (0-1500)	4 (2-6)	111 (0-1500)	0.619 [0.254]
Participants' characteristics	**Did not drop (N=26)** **N (%)**	**Dropped after phase 2 (N=4)** **N (%)**	**Total (N=30)** **N (%)**	**P value*** **[Fisher's Exact test]**
Participant's title				
Director	5 (19)	0 (0)	5 (17)	
CIO	11 (42)	1 (25)	12 (40)	0.485 [1.537]
Other	10 (39)	3 (75)	13 (43)	
Gender				
Male	19 (73)	3 (75)	22 (73)	1.00 [N/A]
Female	7 (27)	1 (25)	8 (27)	
Education				
High school/ College	3 (12)	0 (0)	3 (10)	
Undergraduate	7 (27)	3 (75)	10 (33)	
Masters	11 (42)	0 (0)	11 (37)	0.197 [5.350]
Doctoral	3 (12)	0 (0)	3 (10)	
Other	2 (8)	1 (25)	3 (10)	
Age				
30-39	3 (12)	0 (0)	3 (10)	
40-49	8 (31)	1 (25)	9 (30)	0.713 [1.796]
50-59	13 (50)	2 (50)	15 (50)	
≥60	2 (8)	1 (25)	3 (10)	
Specialization				
Medical informatics	1 (4)	1 (33)	2 (7)	
Networking and development	2 (8)	1 (33)	3 (11)	
Information technology/ systems	13 (54)	0 (0)	13 (48)	0.080 [6.752]
Management/ administration	3 (12.5)	0 (0)	93 (11)	
other	5 (21)	1 (33)	6 (22)	
Participants' characteristics	**Did not drop (N=26)** **Mean [range]**	**Dropped after phase 2 (N=4)** **Mean [range]**	**Total (N=30)** **Mean [range]**	**P value [F ratio] *** **One Way ANOVA**
Years in hospital	9 (1-24)	16 (6-25)	10 (1-25)	0.081 [3.298]
Years in current position	10 (1-34)	22 (15-25)	28 (1-34)	0.048 [4.320]
Years in IT management	15 (1-30)	11 (0-17)	15 (0-30)	0.530 [0.405]

[a] Based on the Ontario Hospital Association 2016 (www.oha.ca); all other data were obtained from the panelists.

* Two-sided P value associated with Fisher's Exact test for categorical variables; P value and F ratio for One Way ANOVA for continuous variables.

4.1 Description of the participants

Table 5 below provides an overview of the experts' profiles who participated in this study as well as the hospitals which they serve. The hospitals in the three panels all differed significantly in terms of number of beds, hospital budget, IT budget, and number of IT staff. The average number of beds in the hospitals of the rural panel was 28 compared with 249 and 779 beds in the community and academic panels respectively. In addition to fewer beds, rural hospitals had lower hospital and IT budgets when compared with community and academic hospitals. This was also seen in the number of IT staff, where rural hospitals had an average of 2 IT staff whereas the community and academic hospitals had significantly more IT staff. Therefore, the hospitals included in the different panels in this study significantly differ in terms of their organizational resources, the environments in which they operate, and their capacities.

As for the participants' characteristics, those only varied among the three panels in terms of the participants' title. Other characteristics such as gender, education, age, specialization, tenure in current hospital and position and IT management did not differ significantly between the three panels (Table 5). Most of the participants were men (73%), between the ages of 40 – 59 years (81%), had IT and information systems specialization (54%), spent an average of 9 years in their current hospital, 10 years in their current position, and an average of 15 years in IT management. It is worth noting that only one participant had a medical informatics background specialization, this respondent is from the community panel and constitutes 4% of the overall sample. The remaining panelists had varied backgrounds, such as networking and development, management and administration, and finance. Majority of the participants had a master's degree (42%) followed by those who had a bachelor's degree (27%).

As for the title of the participants, all the participants from the academic panel had the title of CIO, compared with 5 participants having this title in the community panel, and none of the participants reporting this title in the rural panel (Table 5). Most of the respondents in the rural group reported their title as "other" (87%), which was IT manager or supervisor instead of IT director or CIO, however one participant in that group reported the title director (13%). The community panel participants mostly reported having the title of CIO (42%), followed by director (33%) and "other" (25%). All in all, the only differences were related to the hospitals' characteristics with only the title of the participant being a significant difference with respect to the respondents' characteristics. Therefore, there was no sign of variation between the participants in the three panels which would mean that results obtained during the phases of the study are not due to differences in the background characteristics of the participants.

Table 5: Characteristics of the three panels

Hospitals' characteristics	**Rural hospitals (N=8) Mean [range]**	**Community hospitals (N=12) Mean [range]**	**Academic hospitals (N=6) Mean [range]**	**Overall sample (N=26) Mean [range]**	**P value [F ratio] * One Way ANOVA**
Number of beds[a]	28.13 [12-52]	248.92 [59-1234]	778.83 [133-1223]	303.27 [12-1234]	0.001 [10.234]
Annual hospital budget (millions)	17.70 [6.5-35]	218.50 [40-1000]	850.83 [25-1600]	339.8 [6.5-1600]	0.002 [8.261]
Annual IT budget (millions)	0.39 [0.2-0.7]	8.07 [1.1-50]	22.58 [10-41]	10.75 [0.2-50]	0.037 [3.996]
Number of IT staff	1.63 [0-3]	38.83 [2-300]	383.00 [43-1500]	115.58 [0-1500]	0.039 [3.797]
Participants' characteristics	**Rural hospitals (N=8) N (%)**	**Community hospitals (N=12) N (%)**	**Academic hospitals (N=6) N (%)**	**Overall sample (N=26) N (%)**	**P value* [Fisher's Exact test]**
Participant's title					
Director	1 (13)	4 (33)	0 (0)	5 (19)	
CIO	0 (0)	5 (42)	6 (100)	11 (42)	0.000 [16.497]
Other	7 (87)	3 (25)	0 (0)	10 (39)	
Gender					
Male	6 (75)	9 (75)	4 (67)	19 (73)	1.00 [0.403]
Female	2 (25)	3 (25)	2 (33)	7 (27)	
Education					
High school/ College	1 (13)	2 (17)	0 (0)	3 (12)	
Undergraduate	4 (50)	3 (25)	0 (0)	7 (27)	
Masters	1 (13)	6 (50)	4 (67)	11 (42)	0.224 [9.431]
Doctoral	1 (12)	1 (8)	1 (17)	3 (11)	
Other	1 (12)	0 (0)	1 (16)	2 (8)	
Age					
30-39	3 (38)	0 (0)	0 (0)	3 (11)	
40-49	2 (25)	4 (33)	2 (33)	8 (31)	0.243 [7.274]
50-59	2 (25)	7 (59)	4 (67)	13 (50)	
≥60	1 (12)	1 (8)	0 (0)	2 (8)	
Specialization					
Medical informatics	0 (0)	1 (8)	0 (0)	1 (4)	
Networking and development	1 (17)	1 (8)	0 (0)	2 (8)	
Information technology/ systems	3 (50)	6 (50)	4 (67)	13 (54)	0.661 [6.667]
Management/ administration	0 (0)	1 (9)	2 (33)	3 (13)	
other	2 (33)	3 (25)	0 (0)	5 (21)	
Participants' characteristics	**Rural hospitals (N=8) Mean [range]**	**Community hospitals (N=12) Mean [range]**	**Academic hospitals (N=6) Mean [range]**	**Overall sample (N=26) Mean [range]**	**P value [F ratio] * One Way ANOVA**
Years in hospital	10.86 [6-20]	8.63 [1-24]	7.17 [2-18]	8.90 [1-24]	0.557 [0.601]
Years in current position	13.14 [4-34]	10.54 [1-30]	6.67 [2-12]	10.34 [1-34]	0.460 [0.805]
Years in IT management	13.14 [1-25]	14.33 [5-30]	20.00 [12-28]	15.36 [1-30]	0.251 [1.474]

[a] Based on the Ontario Hospital Association 2016 (www.oha.ca); all other data were obtained from the panelists.
* Two-sided P value associated with Fisher's Exact test for categorical variables; P value and F ratio for One Way ANOVA for continuous variables.

4.2 Phase 1: Brainstorming

The goal of this phase was to elicit the response of the panelists to develop a comprehensive list of IT management issues faced by top IT managers in Ontario hospitals. The number of issues provided by each respondent ranged between three and ten issues. In total, all three panels generated 195 separate issues. The rural panel generated 56 issues, 46 by the academic panel, and 93 by the community panel. The student worked with another researcher to code, generate categories, and consolidate the responses provided using content analysis discussed above (Mayring, 2000). This included removing duplicates and originating inductive codes to create the categories for the issues as well as the definitions based on the descriptions provided by the panelists. Each of the two coders used an anonymized list of all responses to analyse the responses provided by the panelists. They first met to code and categorize the first 50 responses together and subsequently finished the coding of the remaining 145 issues separately. The student and researcher met again to consolidate the coding and categories of the responses, where differences in the categorization and coding were resolved through discussion and reconciliation. The inter-coder reliability was calculated to be 87.8 % by taking the proportion of the responses that were categorized under the same category by both coders (171) to the total number of responses provided (195). Differences in the consolidation and coding of the responses were resolved through reconciliation and a final list of 26 unique IT management issues with their descriptions was created and is presented in Table 6.

Table 6: Final list and descriptions of IT management issues, validated by the participants

IT Management Issue	Brief Description
Limited funding	The financial pressure on hospitals with the operational funding cuts from the Ministry, the limited available capital budgets, and the difficulty in attracting alternative funding sources present challenges for implementing and sustaining IT solutions.
Keeping infrastructure current ("ever greening")	The continuously evolving IT environment, the required updates and licenses by systems' vendors, and the necessity to ensure systems resilience present challenges in keeping IT software and hardware current.
External security threats	Enhanced connectivity and advancement in IT present challenges related to security attacks and cyber threats (e.g., encryption attacks, viruses and ransomwares), which hospitals have limited resources to address.
Increasing cost	The increasing cost related to technology capital investments, implementing and maintaining IT infrastructure, and upgrading and supporting software presents challenges to keeping up with technology needs of clients and users.
Managing demands for IT projects	There is constant struggle to meet requests for IT projects, with unrealistic turnaround time, as well as the need for policies to address regulations surrounding IT.
IT competing with other clinical priorities for resources	With current provincial funding models and IT being viewed as an “overhead” expense, it is difficult for IT projects to obtain additional financial resources and justify spending at the expense of other frontline clinical priorities.
Ensuring privacy of patient information	As information is increasingly shared between providers over wireless networks and platforms, it is difficult and expensive to monitor information exchange and prevent internal and external privacy breaches.
Need for provincial IT investment leadership and strategy	A centralized provincial IT investment strategy is needed for sustainable IT solutions, which avoids penalizing hospitals deploying expensive IT initiatives (as with case costing) and provides incentives for the adoption of IT that support sharing of information across providers.
Meeting end-users’ expectations	The increased complexity of IT solutions available for end-users, and their increased dependency on these technologies are leading to unrealistic expectations of IT staff to fix IT issues quickly and attend immediately to requests.
Leveraging partnerships between hospitals	Partnerships between smaller and larger hospitals provide opportunities for reducing isolation, sharing expertise, consolidating shared IT services functions, and leveraging economies of scale.
Recruiting IT staff with appropriate skillsets	The scarcity of specialized IT personnel, the aging and retiring IT workforce, and the lack of attractive financial compensation present challenges to recruiting and maintaining skilled IT personnel.
Provincial leadership to enhance collaboration	Provincial governance and leadership can create a common service organization framework, standardize policies and agreements, and enhance collaboration across providers in an environment dominated by siloed funding, and limited sharing of resources.
Internal security threats	End users constantly use devices, open and download suspicious programs, and communicate via unmonitored platforms compromising the security of the network; enforcing security measures (e.g., complicated passwords, regularly resetting passwords, restrictions) meets resistance.

Time and cost of training IT staff and users	The time and cost involved in training IT staff and end users, in light of increasing complexity and ever-changing technologies and applications, is challenging given the limited resources; training budgets are among the first to be hit with cutbacks.
Recognizing IT as a key stakeholder	The misguided perception that IT represents operational cost (i.e. expense), rather than a strategic investment / department, limits the justification of new IT that can lead to business process improvements.
Reliability of IT infrastructure	The inadequate reliability of wireless networks, the limited bandwidth in remote areas (e.g., telemedicine), the lack of redundancy available to hospitals on the eHealth network, and the pressure of the Internet of Things (e.g., connecting more devices) present challenges and necessitate reconfiguration of the IT architecture for partner hospitals.
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	There is a need to align goals, as well as portfolio and project management across hospitals, Local Health Information Networks (LHINs) and the province to ensure consistent direction and reduce disparities in initiatives and priorities.
Developing a comprehensive change management strategy	The adoption of IT and implementation of EMRs necessitate comprehensive change management strategies, which can also mitigate the disagreement between senior management and clinicians on how and what solutions should be implemented.
Building a cohesive corporate culture around IT	Sharing of Chief Information Officers across multiple sites, the competing cultures in organizational partnerships, and the perception of IT personnel as "support staff" excluded from corporate priorities, make it difficult to build a high performing corporate IT culture.
Limited standardization and integration across care providers	Limited standardization of platforms and infrastructure between health care providers and agencies increases the cost and resources required to integrate business processes and share patient clinical information.
Increasing demand by the Ministry / province and health IS clustering	Government regulations in relation to information sharing, and Ministry requirements to "merge IT shops" and combine data into one repository, are stressing hospitals that have to absorb the related cost and struggle to find adequate resources to meet the same IT security requirements.
Leveraging advanced analytics tools to report on performance	With increasing requirements by the Ministry for reporting on hospital performance, and the demand for "live reporting" of information for decision making, it is important to leverage advanced analytics tools to optimize the use of available data.
"Consumerization" and mobile platforms	The growing public demand (end users and patients) for increasing access to information and functionality on mobile platforms (e.g., appointment booking, results viewing) requires resources to meet and mitigate risks associated with it.
Effects of IT errors	Small errors when developing IT and systems may have significant impacts in relation to patient safety incidents.
Choice of systems	Hospitals face the choice of best of breed or single vendor solutions, which involve tradeoffs between better functionality (best of breed) and lower initial and implementation cost (single vendor) and may compromise the adequacy of the implemented solutions.
Resistance to IT adoption	Poor and fragmented IT adoption, paralleled by a gap in clinicians' knowledge and interest in EMR, is observed in hospitals and marked by change resistance among health care workers.

Fourteen IT management issues were common to all three panels in phase 1 (Table 7). This overlap of reported issues highlights the importance and relevance of these issues regardless of the type of hospital by which they are experienced. Despite the differences among these settings, these issues appeared to resonate among all the managers in those settings. These issues revolve around provincial leadership, collaboration with other healthcare providers, availability of funds, keeping up with technology and demands placed by the province and end users are all shared by the panelists across Ontario.

In addition to the overlapping issues, certain issues were reported only by two of the three panels or unique to one panel. During phase 1, the rural panel did not raise any unique issues, the community panel uniquely reported the issue of *need for provincial IT investment leadership and strategy* as well as the issue of *choice of systems*, and only the academic panel reported on the issue of *effects of IT errors*. There were several issues reported by two of the three panels in various combinations. For example, the issue of *IT competing with other clinical priorities for resources* was mainly by the academic and community panels; and the issue of *time and cost of training IT staff and users* was reported by the community and rural panels. The reporting panel for the unique issues is further demonstrated in Table 7.

Table 7: Differences in the panels reporting the IT management issues between phases 1 and 2

IT Management Issue	**Phase 1 reporting panel(s)**	**Phase 2 retaining panel(s)**
Limited funding	All	All
Keeping infrastructure current ("ever greening")	All	All
External security threats	All	All
Increasing cost	All	All
Managing demands for IT projects	C, A	All
IT competing with other clinical priorities for resources	C, A	All
Ensuring privacy of patient information	All	All
Need for provincial IT investment leadership and strategy	C	All
Meeting end-users' expectations	All	All
Leveraging partnerships between hospitals	R, C	All
Recruiting IT staff with appropriate skillsets	All	All
Provincial leadership to enhance collaboration	All	All
Internal security threats	R, C	All
Time and cost of training IT staff and users	R, C	All
Recognizing IT as a key stakeholder	R, C	R, C
Reliability of IT infrastructure	All	R, A
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	All	R, C
Developing a comprehensive change management strategy	R, C	R, A
Building a cohesive corporate culture around IT	R, A	R
Limited standardization and integration across care providers	All	C, A
Increasing demand by the Ministry / province and health IS clustering	All	C, A
Leveraging advanced analytics tools to report on performance	C, A	C, A
"Consumerization" and mobile platforms	All	A
Effects of IT errors	A	A
Choice of systems	C	Not retained in Phase 2
Resistance to IT adoption	All	Not retained in Phase 2

All = All panels (common issue), R = Rural panel, C = Community panel, and A = Academic panel

4.3 Phase 2: Narrowing down

During the second phase of the Delphi survey, the list of all 26 issues and their descriptions was circulated to the panelists for validation and comments as well as to narrow down the list of issues so that the most pertinent issues remain for the ranking phase. The panelists were also asked to rate each of the issues on a scale of 1 – 7 where a rating of 1 meant an issue is relatively unimportant and a rating of 7 meant a very important issue (Pare et al., 2008). Usually, issues with a mean rating in the top 50% are retained, however, when a 3.5 out of 7 cut off was used, none of the issues were discarded. Therefore, to limit the number issues for each panel, issues that had a rating of 4.5 out of 7 and higher scale were retained, top 64%, (Delbecq, 1975; Kobus & Westner, 2016; R. C. Schmidt, 1997). This resulted in 21 issues being retained for the academic panel and 19 issues retained for each of the rural and community panels. The top five highest rated issues by all panelists were (in descending order); *limited funding, external security threats, increasing cost, keeping infrastructure current ever greening*, and *need for provincial IT investment leadership and strategy*. Table 8 below lists all 26 of the IT management issues, their mean rating out of 7, the standard deviation (SD) and range of rating by each of the panels. The academic panel provided the highest mean rating of 6.67 for the issue of *limited funding* with the smallest range, and both the community and rural panels also rated this issue as most important with mean ratings of 6.25 and 6.56 out of 7 respectively. Two issues received the lowest mean rating of 4.11 out of 7 for the rural panel, those are the *increasing by the Ministry/ province for IS clustering* and *"consumerization" and mobile platforms*. The community panel rated the issue of *provincial leadership to enhance collaboration* as least important with a 4.00 out of 7 and the academic panel rated the issue of *choice of* systems as least important with as 3.67 out of 7, Table 8.

Table 8: Phase 2 mean rating of IT management issues by each of the panels

IT Management Issue	Rural panel		Community panel		Academic panel	
	Mean	[range]	Mean	[range]	Mean	[range]
Limited funding	6.56	[5-7]	6.25	[5-7]	6.67	[6-7]
Keeping infrastructure current ("ever greening")	5.33	[4-7]	5.50	[4-7]	5.67	[4-7]
External security threats	5.78	[3-7]	5.50	[3-7]	6.17	[4-7]
Increasing cost	6.11	[4-7	5.58	[3-7]	5.00	[3-7]
Managing demands for IT projects	5.44	[3-7]	5.75	[3-7]	5.50	[5-6]
IT competing with other clinical priorities for resources	4.67	[2-6]	5.42	[3-7]	6.50	[5-6]
Ensuring privacy of patient information	5.44	[3-7]	5.00	[3-7]	5.83	[3-7]
Need for provincial IT investment leadership and strategy	4.89	[1-7]	5.50	[3-7]	6.00	[5-7]
Meeting end-users' expectations	5.33	[2-7]	5.33	[3-7]	5.00	[4-6]
Leveraging partnerships between hospitals	5.56	[3-7]	5.04	[3-7]	5.40	[4-7]
Recruiting IT staff with appropriate skillsets	5.00	[3-6]	4.83	[2-7]	5.33	[3-7]
Provincial leadership to enhance collaboration	4.89	[2-7]	4.00	[2-7]	4.67	[2-7]
Internal security threats	5.22	[2-7]	4.83	[3-7]	5.50	[3-7]
Time and cost of training IT staff and users	4.56	[3-5]	4.92	[3-7]	4.67	[3-6]
Recognizing IT as a key stakeholder	4.89	[2-7]	4.83	[2-7]	4.17	[3-6]
Reliability of IT infrastructure	4.89	[1-7]	4.75	[3-7]	5.17	[4-7]
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	5.22	[3-7]	4.92	[1-7]	4.17	[2-7]
Developing a comprehensive change management strategy	5.11	[2-7]	4.50	[2-7]	4.67	[2-6]
Building a cohesive corporate culture around IT	4.89	[2-7]	4.42	[2-6]	4.33	[3-6]
Limited standardization and integration across care providers	4.33	[2-7]	4.83	[2-7]	5.17	[5-6]
Increasing demand by the Ministry / province and health IS clustering	4.11	[1-7]	4.92	[2-6]	5.50	[4-7]
Leveraging advanced analytics tools to report on performance	4.50	[3-6]	4.75	[3-7]	5.33	[4-7]
"Consumerization" and mobile platforms	4.11	[1-6]	4.33	[2-6]	5.50	[3-7]
Effects of IT errors	4.33	[1-7]	4.50	[2-6]	5.00	[4-6]
Choice of systems	4.50	[1-7]	4.20	[2-7]	3.67	[1-7]
Resistance to IT adoption	4.33	[2-6]	4.42	[2-7]	4.17	[2-5]

The various issues retained by the different panels in this phase differed from the issues the panels reported in phase 1, Table 7 above provides an overview of the common issues reported by all the panels in phases 1 and 2 as well as the changes in those common issues from phase 1 to phase 2. The common issues retained by all panelists in this round were quite different, however their number remained the same (14 common issues). Out of the 14 issues retained in this phase by all panelists, only 8 of the issues commonly reported by all panelists in phase 1 were also given a rating of 4.5 out of 7 or greater by all the panelists in phase 2. This means, 6 additional issues surfaced as common to all panels in phase 2 (Table 7). For example, *IT competing with other clinical priorities for resources* which was only mentioned by the academic and community panels in phase 1, was given a rating greater than 4.5 out of 7 and retained by all panels in phase 2. A similar pattern is seen with the panelists retaining issues which they did not initially report in the previous phase. For example, the issue of *managing demands for IT projects* was initially reported by the community and academic panel in phase 1, however all three panels gave it a high enough rating to retain it in phase 2 making it a common issue. The issue of *building a cohesive corporate culture around IT* was initially reported by the rural and academic panels in phase 1, however only the rural panel retained this issue in phase 2. Interestingly, the issue of *resistance to IT adoption* was reported by all panels in phase 1, however none of the panels rated it high enough for it to be retained in phase 2 (Table 7).

As for the validation of the list of issues and their descriptions, a few comments were received for minor edits to the naming of the issues and their descriptions. Only six of the issues required minor modifications in wording to better reflect the respondents' comments. This resulted in the final list of the 26 unique IT management issues and the descriptions in Table 6 above.

4.4 Phase 3: Ranking

During the final phase of the Delphi survey, each of the participants was asked to rank the retained IT management issues, from phase 2, in terms of importance. Each panel's participants were emailed a list of randomly ordered issues that were retained in the previous phase. W is calculated for each of the panel to obtain within panel agreement due to differences across the panels.

During this first round of ranking, the agreement was poor for all the panels, where the rural panel had a coefficient $W = 0.180$, the community panel had a $W = 0.188$, and the academic panel had a $W = 0.210$. This prompted a second round of ranking to achieve a better consensus among the panelists. For the second round of ranking, the list of IT management issues was circulated for each panel, however the issues were ordered in terms of importance by the mean rank provided in the first ranking round. After this second round of ranking, the level of agreement remained relatively weak for all the panels, with the rural panel seeing most of the improvement in consensus with a $W = 0.381$. The community and academic panels had slightly improved consensus levels of $W = 0.254$ and $W = 0.235$ respectively, Table 14. Additionally, both the community and rural panels had a significant Chi Square Test (P = 0.000) for the agreement level, meaning the rankings provided are associated with each other, whereas the non-significant level of agreement among the academic panel members (P = 0.106) means there is not enough evidence to conclude the rankings provided by members of this panel are associated and not due to chance. The reason for the failure to reject the null hypothesis in the academic panel is the decision to include an outlier in the data, where if the outlier was removed, the sample size would become 5 and Kendall's W would be 0.464 with Chi-Square of 46.41 and P = 0.00.

Since the agreement levels were not significantly improved, the Wilcoxon Ranked Signed tests were used to determine if the rankings of any of issues were significantly different between the two rounds of ranking. The ranking phase was concluded after the second round with the community panel achieving weak agreement and the rural and academic panels achieving very weak agreement (Table 2). Table 14 in the Appendix shows this test for the difference in ranking between the two rounds for all the panels as well as the common issues.

From Table 14 in the Appendix, none of the common IT management issues had a significantly different ranking in the second ranking round when compared with the first ranking round, and the positioning of the ranking of these issues stayed relatively the same between both ranking rounds. As for panel specific differences in ranking, there was one issue *building a cohesive corporate culture around IT* that had a significant difference in ranking in the rural panel (P = 0.042) even though its mean rank stayed at 19th out of 19 issues for both rounds of ranking, however the range for the second round of ranking for this issue was much smaller compared with the first round. Similarly, the community panel had one issue that had a significantly different ranking in the second round compared with the first round, the issue *IT competing with other clinical priorities for resources* went from being ranked 8 out of 19 in the first round to 2 out of 19 in the second round (P = 0.021). Even though this issue is one of the 14 common issues among all panels, its overall rank across all panels did not change between the two ranking rounds, where it stayed ranked 6th out of 14 by all panelists. Interestingly, there were other large jumps in ranking for various issues even though their test statistic was not significant. For instance, there were no IT management issues with significant differences in rankings for the academic panel, however some of the issues did have a large change in ranking, even if not statistically significant. For example, the issue of *managing demands for IT projects* changed from being ranked 17 out of 21 in the first

round to being number 7 out of 21 in the second round, however the test statistic was not statistically significant. Another interesting change happened with the academic panel ranking of the issue *Increasing demand by the Ministry / province and health IS clustering* where this issue was ranked 17 out of 21 in the second round compared to having been ranked as 6 out of 21 in the first round. This change was not statistically significant as with both rounds of ranking for this issue, the range was quite large [3-21]. Indeed, the ranking exercise highlights the similarities and differences among the three panels and the lack of moderate to strong consensus further emphasizes the complexity of these issues.

4.4.1 Overall Results

Overall, there were 14 issues common to all panelists in the study and Table 9 below provides the final rankings for the IT management issues reported in this study as well as the proportion of participants in each group who ranked the issue among the top 10 in the list. The top 5 issues dealing with *funding availability, the ever greening of technology, increasing cost, security threats,* and *the demands for IT projects*, all of which were ranked among the top 10 by over 80% of the participants in the study. Beside the *limited funding* and *increasing costs of maintaining IT infrastructure*, the top common IT management issues span various areas of concern for top IT managers. For example, when it comes to the strategic positioning of IT within the hospital, the top issues are *managing the demand for IT projects, IT competing with other clinical priorities*, and *meeting end users' expectations*. The technology related issues are also a priority for the participants, especially the *ever greening of technologies, the safety of patient information*, and *security*, both from external hackers and internal staff who may unknowingly breach patient privacy electronically. Additionally, less than 50% of the participants ranked the bottom two common issues of *internal security threats* and *time and cost of training IT staff* among

the top 10 issues in this study, with the 12th common issue of *provincial leadership to enhance collaboration* being ranked among the top 10 by 50% of the participants.

In addition to the common issues reported by all panelists in the study, some issues were common to two of the three panels. Figure 4 depicts an overview of the various IT management issues as they are reported and ranked by the panels, with the final ranking in parenthesis. From the figure, the rural and community panels share some of the issues such as, the issue of *aligning IT strategy along hospitals and various governing bodies*, which is ranked as being more important by the community panel and less important by the rural panel. Another issue common to these two panels is that of *recognizing IT as a key stakeholder* where the rural panel ranks it among top 10 and the community panel ranks it among the 5 least important issues. A similar contrast in ranking is seen on the issue of *leveraging advanced analytics tools to report on performance* which is common to the academic and community panels, however the community panel ranks it as less important whereas the academic panel ranks it among the top 10 issues. Other common issues among two of the panels have similar rankings for the most part, those are issues shared by the rural and academic panels which are technological and strategic in nature; and two issues shared by the academic and community panels which are regulatory in nature (Figure 4). Interestingly, the community panel in this study have not retained and ranked any unique issues, but participants in this panel share their issues with either the rural or the academic panel.

Table 9: Phase 3 final ranking results

IT Management Issues	2017 Ranks and percentage of participants who ranked issue among top 10 in their lists							
	O	**%**	**R**	**%**	**C**	**%**	**A**	**%**
Limited funding	1	92.31	4	75.00	1	83.33	1	83.33
Keeping infrastructure current ("ever greening")	2	80.77	6	75.00	4	75.00	2	83.33
External security threats	3	88.46	1	87.50	10	50.00	3	66.67
Increasing cost	4	80.77	3	100.00	3	91.67	13	50.00
Managing demands for IT projects	5	88.46	5	75.00	5	75.00	7	50.00
IT competing with other clinical priorities for resources	6	80.77	14	37.50	2	75.00	5	66.67
Ensuring privacy of patient information	7	69.23	2	75.00	11	50.00	15	33.33
Need for provincial IT investment leadership and strategy	8	76.92	11	62.50	6	75.00	6	66.67
Meeting end – users' expectations	9	88.46	17	25.00	8	75.00	4	83.33
Leveraging partnerships between hospitals	10	61.54	13	25.00	9	50.00	11	66.67
Recruiting IT staff with appropriate skillset	11	53.85	7	75.00	16	25.00	14	16.67
Provincial leadership to enhance collaboration	12	50.00	18	12.50	14	33.33	12	33.33
Internal security threats	13	42.31	8	50.00	18	0.00	19	33.33
Time and cost of training IT staff and users	14	46.15	9	62.50	19	16.67	21	16.67
Recognizing IT as a key stakeholder	--	--	10	62.50	15	33.33		--
Reliability of IT infrastructure	--	--	12	50.00		--	9	66.67
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	--	--	15	25.00	7	58.33	--	--
Developing a comprehensive change management strategy	--	--	16	25.00	--	--	16	50.00
Building a cohesive culture around IT	--	--	19	0.00	--	--	--	--
Limited standardization and integration across care providers	--	--	--	--	12	50.00	10	33.33
Increasing demand by the ministry/ province and health IS clustering	--	--	--	--	13	50.00	17	33.33
Leveraging advanced analytics tools to report on performance	--	--	--	--	17	33.33	8	50.00
"Consumerization" and mobile platforms	--	--	--	--	--	--	18	16.67
Effects of IT errors	--	--	--	--	--	--	20	0.00
Kendall's *W*			0.38		0.25		0.24	
O = Overall Rank; **R** = Rural Panel; **C** = Community Panel; **A** = Academic Panel								

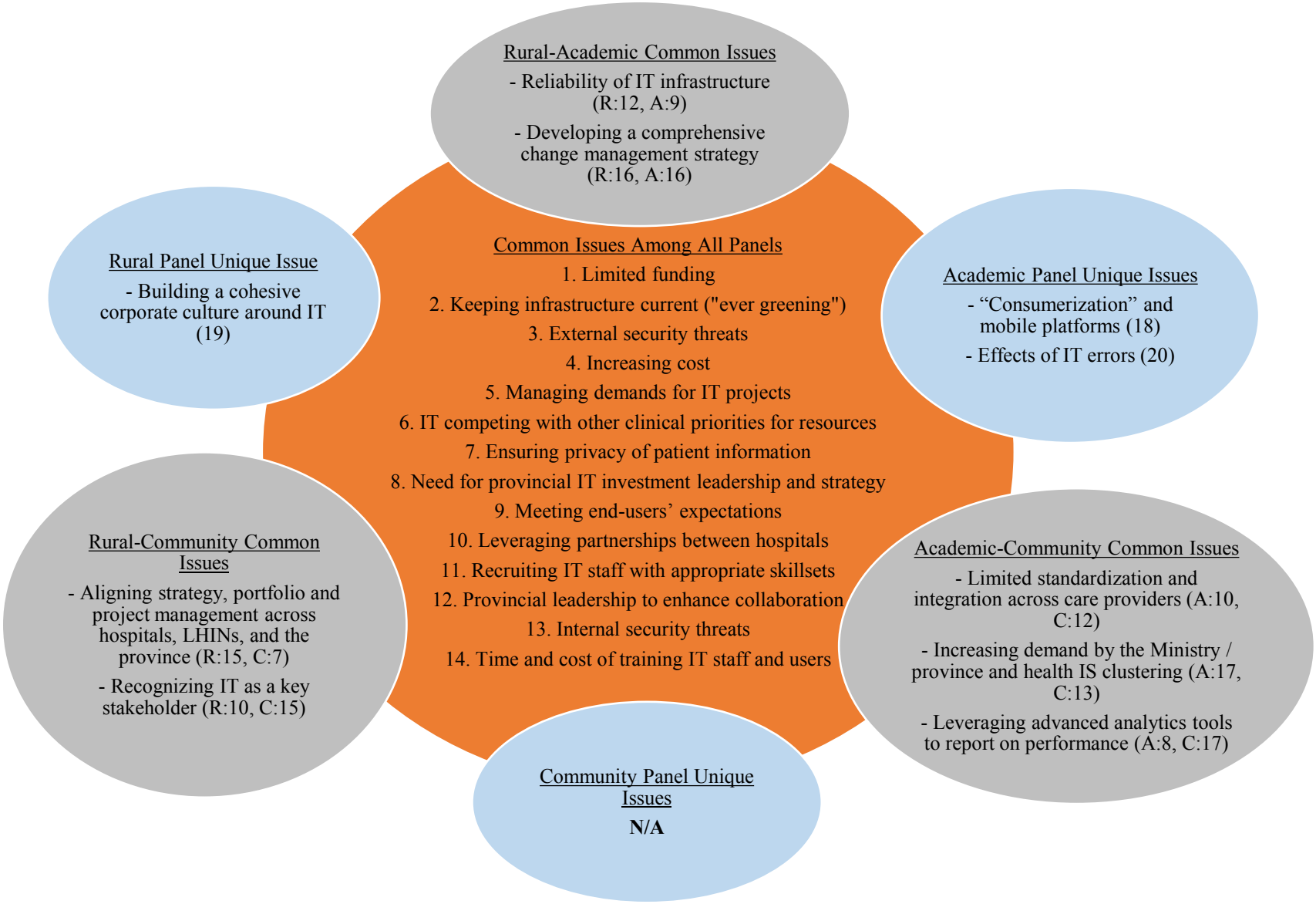

Figure 4: Common and unique rank ordered IT management issues among the three panels

4.4.2 Rural Panel Issues

The Rural panel retained and ranked a total of 19 issues in this study, 14 of these issues were shared by the other two panels, 2 issues were shared with the community panel and 2 issues were shared with the academic panel (Figure 4). This leaves one issue that was only retained and ranked by the rural panel, the issue of *building a cohesive culture around IT* which was ranked in last place, among the other issues and the only issue in this panel where none of the panelists placed it among the top 10 issues, Table 9. The top 5 issues for the rural panel in this study include concerns with *security, cost of IT,* and *managing the demands for IT projects* which are technological, strategic and regulator issues in nature, and were ranked among the top 10 issues by more than 75% of the panelists in this group. As for the 5 least important issues for this panel, those center around the *IT culture within the hospital* and *developing a comprehensive change management, provincial leadership for collaboration, meeting end users' expectations*, and *aligning IT strategy with governing bodies*, all of which were among the top 10 issues by fewer than 38% of the panelists, Table 9.

It is worth noting the rural panel was at odds with the ranking of some of the top common issues in the current study. For example, the panel provided a rank of 14 out of 19 (37.5 % of participants ranking it among the top 10) for the issue of *IT competing with other clinical priorities* whereas the community panel ranked it 2 out of 19 and the academic panel ranked it 5 out of 21 for an overall rank 6 out of 14. Other instances of this occurrence are observed with the issues of *meeting end – users' needs* and *provincial leadership to enhance collaboration* where the rural panel provided a considerably lower rank than the other two panels in the study, Table 9. On the other hand, this panel ranked the issue of *ensuring patient privacy* as 2 out of 19 (with 75% of the participants ranking it among the top 10) which is at odds with the ranking provided by the

community and academic panels, where both panels ranked this issue among the least 10 important issues; similar to the issue of *internal security threats*, which was ranked among the bottom 5 by the community and academic panels but among the top 10 by the rural panel. An interesting finding is seen with the issue *external security threats*, ranked as number 1 by the rural panel, echoing the importance given by the academic panel but contrasting that provided by the community panel.

4.4.3 Community Panel Issues

The community panel retained 19 issues after phase 2 and provided the ranks for them in phase 3. 14 of these issues were shared with the other two panels in the study, 3 of these issues were shared with the academic panel, and the remainder 2 issues were shared with the rural panel. Interestingly, the community panel did not retain any issues that were not also retained by one or two of the other panels during phase 2 (Figure 4). The top 5 issues for this panel reported deal with *funding and cost*, *the strategic issue of IT competing for clinical resources, the technological issue of evergreening,* and *the organizational issue of managing demands for IT projects*, all of which were ranked among the top 10 issues by at least 75% of the panelists. Whereas the bottom 5 issues reported in this study are *time and training of staff, internal security threats, leveraging advanced analytics, recruitment of IT staff,* and *recognizing IT as a key stakeholder*, ranked among the top 10 by less than less than 34% of the panelists in this group, Table 9.

Only three issues were given striking ranks by the community panel. The panel provided a relatively low rank for the issue of *external threats*, 10 out of 19, which was ranked among the top 5 issues by the rural and academic panels. Similarly, this panel provided a rank among the top 10 for the issue of *aligning IT strategy with other hospitals and governing bodies* which is at odds with the ranking provided by the rural panel for that issue among the 5 least important issues. The scenario is reversed for the issue of *recognizing IT as a key stakeholder* where the community

panel ranked it among the 5 least important issues, but the rural panel ranked it among the 10 most important. Other than these two issues, the community panel's ranking of the issues it reported were very close to the rankings by the academic panel among the 14 common issues as well as the issues shared between these panels.

4.4.4 Academic Panel Issues

The academic panel retained the largest number of issues after phase 2, a total of 21 issues. Of those, 14 issues were commonly shared with the other two panels, 3 issues shared with the community panel, 2 with the rural panel, and 2 issues were uniquely reported by this panel (Figure 4). The unique issues to the academic panel are the *"consumerization"* and *"mobile platforms* as well as the *effects of IT errors"*, both ranked as least important by the panelists. The top 5 issues reported by this panel focus on *funding, evergreening of technology, external security threats, meeting end – users' expectations,* and *IT competing with other clinical priorities* with more than 67% of the panelists ranking these issues among the top 10. In contrast, the bottom 5 issues ranked by this panel revolved around *time and cost of training staff, effects of IT errors, internal security threats, "consumerization" and mobile platforms,* and *increasing demand by the ministry regarding IS clustering,* and were ranked among the top 10 issues by fewer than 34% of the panelists, Table 9.

When observing the ranking provided by the academic panel, there are similarities with the ranking provided by the community panel for most of the issues, however a few particularities also exist. The academic panel provides a very low rank for the issue of *increasing cost* (13 out of 21) when compared with the ranks provided by the other two panels (both 3 out of 19). Similarly, for the issue of *increasing demand by the ministry for IS clustering*, the academic panel provides a rank that's 4 points lower than what is provided by the community panel (17 out of 21 and 13 out

of 19 respectively). The opposite scenario is observed with the issue of *limited standardization and integration across care providers*, where the academic panel provides a slightly higher ranking than the community panel (10 out of 21 vs. 12 out of 19). Similarly, with the issue of *meeting end – users' expectations*, the academic panel ranks it among the top 5, whereas the other two panels rank the issue as 8 out of 19 for the community panel and a striking 17 out of 19 for the rural panel. These observations further contribute to the different ways these panels see the various IT management issues.

4.4.5 Organizing the IT management issues

To better conceptualize and situate the IT management issues raised in this study, a cross reference between the issues reported in this study and the categories presented in the Summary of literature review section. Table 10 below presents this mapping of the issues raised in this study with the categories from the literature following the same logic and using the literature presented to guide the mapping exercise. The table below, shows that most of the issues raised center around technological aspects, strategic alignment between IT and business, as well as regulatory issues related to the province governing the hospitals. Overall, a total of 6 issues were raised that deal with the technology itself, 5 issues deal with managing the human capital, 3 issues pertain to the organizational dimension, 7 issues discuss the strategic relationship between IT and the hospital, and 5 issues discuss the role and challenges when the governing bodies and regulations are concerned.

Table 10: Categorization of the IT management issues raised in this study

Categories of IT management issues	IT management issues reported in current study	Overall ranking of the common issues
Technological issues	Keeping infrastructure current ("ever greening")	2
	External security threats	3
	Ensuring privacy of patient information	7
	Reliability of IT infrastructure	
	Leveraging advanced analytics tools to report on performance	
	"Consumerization" and mobile platforms	
Human issues	Recruiting IT staff with appropriate skillset	11
	Internal security threats	13
	Time and cost of training IT staff and users	14
	Effects of IT errors	
Organizational Issues	Managing demands for IT projects	5
	Meeting end – users' expectations	9
	Building a cohesive culture around IT	
Strategic issues	Increasing cost	4
	IT competing with other clinical priorities for resources	6
	Leveraging partnerships between hospitals	10
	Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	
	Recognizing IT as a key stakeholder	
	Developing a comprehensive change management strategy	
Regulatory issues	Limited Funding	1
	Need for provincial IT investment leadership and strategy	8
	Provincial leadership to enhance collaboration	12
	Limited standardization and integration across care providers	
	Increasing demand by the ministry/ province and health IS clustering	

Interestingly, human and organizational issues were not reported as often or did not have as much emphasis as the other issues. For example, only 3 issues pertaining to the organizational aspect of IT management were reported, and unconventional human related issues were reported, such as the issues of *internal security threats* and *effects of IT errors* however they were ranked as less important than other issues that are more regulatory, technological, and strategic in nature Table 10.

To rule out the effects the background characteristics of the participants might have on the ranking of the different IT management issues; a cross tabulation between the background characteristics of the participants and the ranks they provided for the issues was done for each of the panels. Fisher's Exact Test was used due to the smaller sample sizes. There were very few significant associations found ($P < 0.05$), and those are reported in Table 15 in the Appendix. Only the community panel had any significant interactions between the background characteristics the ranking of the IT management issues, therefore the individual background characteristics did not significantly influence the overall ranking of all the issues as only 3 of the 19 issues in the Community panel had a significant interaction with those characteristics. For the issue of *limited funding*, participants who are female all gave a rank of 5 out of 19, and 5 out of the 6 participants who have a specialization of information technology/ systems provided a rank of 1 or 2 out of 19 for this issue. As for the issue of *increasing cost*, 3 out of the 4 participants the younger participants who are between 40 and 49 years old ranked this issue 2 or 3 out of 19, whereas the older participants (over 60 years old) ranked this issue 19th out of 19. This analysis shows that the dispersion in these rankings is not significantly associated with the individual characteristics of the panelists. Furthermore, some significant associations are expected to be seen in the community

panel as it is the largest and has more variability in the hospitals that are a part of it, as shown in the ranges for the background hospital characteristics for this panel in Table 5 above.

4.5 Comparison with Jaana et al. (2011) Study

Overall, the earlier study reported a total of 35 issues with their descriptions. It had a total of 28 participants with an attrition of 2 participants between phase 1 and end of the data collection. In contrast, the current study has 26 participants with an attrition of 7 participants between phase 1 and the end of data collection. Furthermore, when comparing the number of issues retained and ranked, the panelists in the earlier study retained a total of 28 issues to move onto the ranking phase. In contrast, during the current study, the participants only narrowed down the list by 2 issues, keeping 24 out of the 26 issues for the ranking phase, Table 16 in the Appendix. Table 11 below presents the final overall ranking of issues, as well as the ranking and agreement level per panel, for the current study as compared to the same levels observed in the study by Jaana et al (2011), with new issues highlighted in yellow.

Most of the issues raised in this study were also raised in the previous study by Jaana et al (2011), with an additional 7 new issues raised in the current study; Table 11 and Table 12.

Table 11: Final ranking of key IT management issues in the current and earlier studies

IT Management Issues	2017 Ranks				2010 Ranks			
	O	**R**	**C**	**A**	**O**	**R**	**C**	**A**
Limited funding	1	4	1	1	1	3	2	2
Keeping infrastructure current ("evergreening")	2	6	4	2	9	13	19	16
External security threats	3	1	10	3		13		
Increasing cost	4	3	3	13			13	
Managing demands for IT projects	5	5	5	7	2	1	1	3
IT competing with other clinical priorities for resources	6	14	2	5	3	7	3	1
Ensuring privacy of patient information	7	2	11	15	New Issue			
Need for provincial IT investment leadership and strategy	8	11	6	6		11		
Meeting end – users' expectations	9	17	8	4		5	4	
Leveraging partnerships between hospitals	10	13	9	11	7	6	20	12
Recruiting IT staff with appropriate skillset	11	7	16	14	8	15	16	10
Provincial leadership to enhance collaboration	12	18	14	12	New Issue			
Internal security threats	13	8	18	19		12		
Time and cost of training IT staff and users	14	9	19	21		14		
Recognizing IT as a key stakeholder		10	15		4	4	6	5
Reliability of IT infrastructure		12		9	New Issue			
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province		15	7		5	9	14	4
Developing a comprehensive change management strategy		16		16				8
Building a cohesive culture around IT		19					7	6
Limited standardization and integration across care providers			12	10	New Issue			
Increasing demand by the ministry/ province and health IS clustering			13	17	New Issue			
Leveraging advanced analytics tools to report on performance			17	8			10	14
"Consumerization" and mobile platforms				18	New Issue			
Effects of IT errors				20	New Issue			
Kendall's *W*		0.38	0.25	0.24		0.41	0.54	0.43
O = Overall Rank; **R** = Rural Panel; **C** = Community Panel; **A** = Academic Panel								

4.5.1 Current VS. Earlier Study Overall Results

To help with the comparison with the earlier study, Table 12 presents a mapping exercise that places the lists of issues raised in both studies side by side. The table presents the issues raised in this study that were not echoed in the earlier study, the issues that were echoed and their counter parts in the earlier study, and lastly, the issues from the earlier study that were not mentioned during the current study. In total, there were 7 new issues reported by the current study, 17 of the issues reported in this study overlapped with 18 issues from the earlier study, and there was a total of 10 issues reported in the earlier study but not raised in the current research. Even though majority of these issues persist from 7 years ago, they present slightly different particularities and descriptions when compared to the earlier list of issues, and many of these issues have changed in ranking over the years, Table 11.

Of the 7 new issues raised in the current study, 3 of those issues are regulatory by nature, such as those around the *demand of the Ministry regarding IS clustering, limited standardization across providers,* and *the need for provincial leadership for collaboration*. Two of the new issues are concerned with technology, such as the *reliability of IT infrastructure* and the increasing *consumerization* of patient data and the associated risks with it. The issue relating to human or employees deals with the damaging effects the result form *errors made while programming IT applications* for the systems in the hospitals, and the last new issue deals with the technology required to *ensure the privacy of patient information* as it is being interchanged among various care providers.

Table 12: New, unmentioned, and parallel issues between the current and earlier study

2017 New Issues	**Parallel Issues**		**2010 Issues Dropped in 2017**
	2017	**2010**	
Ensuring privacy of patient information	Limited funding	Having sufficient funds	Implementing an EHR
Provincial leadership to enhance collaboration	Keeping infrastructure current ("ever greening")	keeping infrastructure current ('evergreening')	Staying current with the rapid changes in technology
Reliability of IT infrastructure	External security threats	Managing external technological threats such as malware and viruses	Merging and integrating many different systems within the hospital
Limited standardization and integration across care providers	Increasing cost	Ensuring cost containment	Maximizing resource potential to manage IT with minimal staff
Increasing demand by the Ministry / province and health IS clustering	Managing demands for IT projects	Managing demand and expectations for IT services	Adoption of IT by clinicians and staff
“Consumerization” and mobile platforms	IT competing with other clinical priorities for resources	IT competing with other clinical priorities for scarce resources	Prioritizing short-term fixes over strategic execution
Effects of IT errors	Need for provincial IT investment leadership and strategy	Availability of provincial standards and best practices for technology	Dependence on online systems in the absence of redundant solutions
	Meeting end-users’ expectations	Unrealistic expectations for IT to solve all problems	Leveraging portfolio and project management

	Leveraging partnerships between hospitals	Prioritizing and implementing IT initiatives with other health organizations	Immature software industry
	Recruiting IT staff with appropriate skillsets	Recruiting and developing IT staff with the appropriate skill set (i.e. PM, HL7)	Deploying foundational technology services (e.g., RFID, kiosks)
	Internal security threats	Enforcing security policies through appropriate security measures	
	Time and cost of training IT staff and users	Time and cost involved in training IT staff and users	
	Recognizing IT as a key stakeholder	Recognizing IT as a key stakeholder in major hospital decisions Ability to recognize the value of IT in improving care	
	Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	Aligning strategy across the hospitals, LHINs, and the province	
	Developing a comprehensive change management strategy	Establishing capabilities for process redesign	
	Building a cohesive corporate culture around IT	Engaging clinical leadership in IT projects	
	Leveraging advanced analytics tools to report on performance	Leveraging business intelligence (BI) tools to report on performance and outcomes	

There was a total of 10 issues that were dropped from the earlier study (Table 12); 5 of those were technology related, such as staying current with technology, merging systems across hospital departments, absence of redundant solutions for systems, the software industry, and ensuring the deployment of essential technology applications. A total of 3 strategic issues did not appear in the current study; those center around the implementation of and EHR, using portfolio and project management, and the challenges with implementing short term fixes over strategic execution of solutions. Only one issue related to staff did not appear in this study and it deals with the adoption of IT by clinicians. The remaining issue deals with organizational challenges, such as maximizing resources to manage IT with minimal staff.

A total of 14 common issues to all panels were raised in this study, whereas this number was only 9 in the earlier study. Only 6 of the common issues raised in the current study were echoed in the earlier study by all panelists and 2 of the common issues raised were new issues not reported in the earlier study (*ensuring privacy of patient information* and the *need for provincial leadership*), Table 11. Some of the common IT management issues raised in this study but not echoed by all panelists in the previous study include *external security threats, increasing costs, the need for provincial IT investment leadership, meeting end users' expectations, internal security threats,* and *time and cost of training staff*. Even though these issues are echoed throughout the earlier study, they were not retained by all panelists after phase 2 alluding to their lower importance 7 years ago. Indeed, the ranking changed considerably for most of these issues. While the issue of *limited funding* holds first place in both studies, the issue of *evergreening the IT infrastructure* has jumped in ranking from 9th (last place) in the earlier study to second place, and an opposite trend can be seen with the issues of *managing demands for IT projects* and *IT competing with clinical priorities* which were ranked as second and third in the earlier study but have dropped in ranking

in the current study to fifth and sixth places respectively. Interestingly, the issues of *leveraging partnerships* and *recruiting IT staff* have not had major changes in ranking between the two studies as they are both ranked less important among the common issues. While various issues raised in this study were echoed by Jaana et al. (2011), the issues around the *involvement of the province to enhance collaboration among hospitals* and *lead IT investment strategies tying into collaboration* among hospitals are some of more prominent issues raised by all the panelists in the current study. Even though some of those issues around the need for provincial leadership were echoed in the earlier study, they were not common to all panelists and were ranked lower among the other issues in the study.

Beside the limited funding and increasing costs of maintaining IT infrastructure, the top common IT management issues span various areas of concern for top IT managers. When it comes to the strategic positioning of IT within the hospital, the top issues are *managing the demand for IT projects, IT competing with other clinical priorities,* and *meeting end users' expectations*. Technology related issues are also a priority for the participants, especially the *ever greening of technologies, the safety of patient information,* and *security*, both from *external hackers and internal staff* who may unknowingly breach patient privacy electronically. When compared with the earlier study, some of the top strategic issues are similar to the current study, such as *managing the demands for IT projects, the strategic positioning of IT as a key stakeholder and its role in major hospital decisions*. Other strategic issues are less important or do not appear in the current study, such as the *implementation of an EHR* as well as other technological applications. As for technological issues, the top issue raised is the *evergreening of IT* and *staying current with rapid technology changes,* just as is reported in the current study for the *evergreening of technology* issue. However, the issue of *internal and external security threats* as well as the *safety of patient*

information which are technological related issues are not common to all panelists in the earlier study (Table 11 and Table 13).

4.5.2 Current VS. Earlier Study Rural Panel Issues

The Rural panel retained and ranked a total of 19 issues in this study, only one issue that was only retained and ranked uniquely by the rural panel, the issue of *building a cohesive culture around IT* which was ranked in last place, 19 out of 19 among the other issues. This issue was paralleled with the issue of *engaging clinical leadership in IT projects* which was not reported by the rural panel in the earlier study but rather by the community and academic panels, which presents an interesting development. In contrast to the one unique rural panel issue, the earlier study had a total of 4 issues unique to the rural panel, which centered around security threats, training of staff, and the need for provincial standards for IT best practices.

The top 5 issues for the rural panel in this study are regulatory, technological, organizational, and strategic in nature. As for the 5 least important issues for this panel, those center around the *IT culture within the hospital and developing a comprehensive change management, provincial leadership for collaboration, meeting end users' expectations,* and *aligning IT strategy with governing bodies*. Interestingly, some of these bottom 5 issues in the current study were some of the top issues in the earlier study for this panel, such as *meeting end users' expectations* and *aligning IT strategy with governing bodies*. The least important issues in the earlier study for the rural panel are *the time and cost for training staff, recruitment of IT staff, adoption of IT by clinical staff, managing external threats*, and *enforcing security policies*. The main change is the rise of the issue of *external security threats* and threats due to staff (*internal security threats*) which were ranked in the bottom 5 in the earlier study but are ranked in the top 10 for the rural panel in the current study. The starkest differences in rankings for this panel are seen with the issues of *keeping*

infrastructure current (gained 7 points in importance) and *external security threats* (now ranked 1st compared to 13th in earlier study). A few issues have dropped in importance for this panel, such as *IT competing with other clinical priorities for resources* (dropped by7 points), *meeting end – users' expectations* (dropped by 12 points) and *leveraging partnerships between hospitals* (dropped by 7 points). Furthermore, in contrast to the earlier study, the rural panel had a slightly lower consensus in the current study, $W = 0.381$ versus $W = 0.41$ for the earlier study, however both can be interpreted weak agreement levels, Table 2.

4.5.3 Current VS. Earlier Study Community Panel Issues

The community panel retained 19 issues after phase 2 and provided the ranks for them in phase 3. 14 of these issues were shared with the other two panels in the study, and this panel did not report any of the issues uniquely (Figure 4). Alternatively, in the earlier study, the community panel ranked 3 unique issues that were not ranked by the other panels in that study. Those issues were strategic and technological in nature, such as *prioritizing short term over strategic solutions, ensuring cost containment*, and *dependence on online systems in the absence of redundant solutions*. All these issues were ranked in the bottom 6 by the community panel in the earlier study, alluding to their lower importance among the other issues reported. The issue of *ensuring cost containment* that was only raised by the community panel in the earlier study was raised by all the panelists in the current study and ranked among the top 5 overall as well as by the community panel (Table 11), whereas the other two issues uniquely reported by this panel in the earlier study were not raised in the current study.

Interestingly, there has not been much change in the top issues reported by this panel in the past 7 years. The top 5 issues for this panel reported in the current study echo the top 5 issues reported in the earlier study for the community panel. They center around *available funds,*

managing demands for IT, IT competing with other clinical priorities, unrealistic expectations for IT, and *evergreening of technologies.* A slightly similar trend is observed for the least important issues for this panel. The least important 5 issues reported in the earlier study by this panel were *time and cost of training staff, recruiting IT staff, adoption of IT by clinicians, managing external security threats*, and enforcing security policies among staff (*internal security threats*). The issue of *external security threats* has risen to be among top 10 for the community panel in the current study, the issue of *IT adoption is not reported* in the current study, and the remainder of the least important issues were also ranked as less important in the current study by this panel. A couple major changes in ranking for this panel are seen with the issues of leveraging *partnerships between hospitals* and *aligning strategy, portfolio and project management across hospitals, LHINs, and the province* have increased in importance since 2010 by 11 and 7 points respectively, Table 11. The opposite is seen with the issue of *recognizing IT as a key* stakeholder which was ranked 9 points lower than 8 years ago by this panel. There was a significant drop in the agreement in this panel on the ranking of the issues form 7 years ago, where the earlier study reported a $W = 0.54$ which is moderate agreement, the panelists in the current study achieved a $W = 0.25$, signifying a very weak agreement level, Table 2.

4.5.4 Current VS. Earlier Study Academic Panel Issues

The academic panel retained the largest number of issues after phase 2, a total of 21 issues. Of those, 14 issues were commonly shared with the other two panels, and 2 issues were uniquely reported by this panel (Figure 4). The unique issues to the academic panel are the *"consumerization" and mobile platforms* as well as the *effects of IT errors*. It is interesting that this panel uniquely reports these two issues since they are both new issues raised in the current study, Table 11.

Some similarities exist between the top issues raised by this panel in the current and earlier study. The top 5 issues raised by this panel 7 years ago consisted of *IT competing with other priorities, funding, managing demands and expectations, recognizing IT as a major stakeholder in hospital decisions*, and *aligning strategic IT planning with other hospitals and governing bodies*. Most of these issues are similar to the top 5 in the current study, it is interesting to see that the academic panel ranked the issue of *aligning IT strategy with that of governing bodies* in the top 5 in the earlier study but did not even retain this issue at the end of phase 2 for this panel to rank it in the current study. This alludes to the lower importance of this issue for this specific panel in the current study. An interesting finding was observed when comparing the least important 5 issues for this panel. The bottom 5 issues raised in the earlier study by the academic panel included *deploying foundational technology services*, *staying current with the rapid changes in technology, leveraging portfolio project management, leveraging business analytics tools*, and *the immature software industr*y. Most of the issues ranked as least important in the earlier study by this panel do not appear in the current study, such as *foundational technology services, leveraging portfolio management,* and the *immature software industry*, rendering these issues not so relevant 7 years later. Lastly, there was a stark difference in the agreement level in this panel compared to the earlier study, where panelists had a weak consensus level of $W = 0.43$ seven years ago, the calculated very weak agreement level is $W = 0.24$ in the current study, Table 2.

5. Discussion of Findings

This is a follow up study, under the umbrella of conceptual replication, to the research done by Jaana et al. (2011), which took an inductive approach to elicit a list of key IT management issues among executive or top IT managers in Ontario hospitals. This type of conceptual replication through inductive research aiming to investigate the changes in key IT management issues from the perspectives of top IT managers over time is the first of its kind in the medical informatics field replication adds at least one new element to ensure previous findings were not due to chance and to function (S. Schmidt, 2009). As stated earlier, there has been a call for replication research to further solidify earlier research, increase its generalizability, and investigate changes in results (Brandt et al., 2014; Hüffmeier et al., 2016; S. Schmidt, 2009; Spector et al., 2015). Changes in key IT management issues over time have been well documented in the IS literature however the medical informatics literature lacks in documenting these issues (Jaana et al., 2011; Luftman et al., 2015; Peslak, 2012). It is important to document these changes in issues to follow their evolution over time, such as new issues, dropped issues, and changing priorities of issues for IT top managers in publicly funded hospitals. It is important for IT top managers and organizational managers to understand these issues so that concise and appropriate solutions can stem from this better understanding. Furthermore, shedding light and understanding of these challenges can contribute towards finding solutions, which could be through education or training, researching potential solutions, and informing policy makers. Additionally, this list of issues can act as a second benchmark to measure the value IT brings to hospitals. Due to the nature of the public healthcare system in Canada, it is expected to see changes in IT management issues in hospitals as various governmental legislations change, which would have differing implications. The striking low to moderate consensus level in this study after two rounds of ranking, and the insignificant change in

ranking between both rounds highlights the complexity of the issues raised by the panelists as well as the complexity associated with prioritizing certain issues over others in the current environment for these hospitals. Since the main objective of a Delphi survey is to incite an authoritative list of issues and not necessarily achieve a high consensus level, where a low consensus is a finding in itself, this study has provided that list of issues (Paré et al., 2013). Overall, the issues raised by the panelists in this study show some changes compared to the previous study, whereas other issues appear to persist after 7 years. It is worth noting that the participants did not differ based on their background characteristics, where the only significant difference between the three panels was attributed to the differences between the hospitals in terms of size, budgets, and number of IT staff (Table 5). Therefore, the findings in this study are a true reflection of what hospitals in these settings face and are not dependent on the individual profile of the individual participants who responded. This point is further strengthened if as there was no significant difference between the participants who completed the study and those who dropped out. Below is a discussion of these findings.

5.1 Participants and Delphi phases

5.1.1 Participants

The study had a low-moderate attrition rate of 20% for the rural panel, 25% for the community panel, and 14% for the academic panel even though there was great interest in participating in the study as can be seen from the number of participants who agreed to participate when they were contacted (Table 3) (Paré et al., 2013). When contacted to be reminded of the study questionnaires throughout the various stages of the data collection, most of the participants indicated busy times at their respective institutions, such as those undergoing audits at the time of the study. Additionally, the extensive and time consuming iterative Delphi process also places demands on

the participants' time which also contributes to attrition (Paré et al., 2013; Skinner et al., 2015). This would explain the rates of attrition as well as the initial great interest in the study, which indicates the need for this research from the perspectives of the participants. Furthermore, there was no significant difference in the participants' characteristics between those who dropped out of the study during the various stages of the data collection and those who remained to finish the second round of ranking. The participants in the study did not differ based on their individual characteristics; however, the panels did differ significantly based on the hospitals' characteristics which validates the findings from the study in that the panels are different based on different hospital environments and not based on the individual characteristics of the participants. The participants did differ significantly in their titles between the different panels, which is expected due to the differing levels of IT sophistication and budgets among the different panels. Additionally, when observing the participants' scope of experience, it can be seen that they are on average tenured professionals in their positions, where on average they have over 10 years in IT management positions, which further validates and adds weight to the findings of this inductive research (Caudle et al., 1991; Paré et al., 2013, 2010; Skinner et al., 2015). Lastly, from the in-depth and comprehensive explanations received in the first phase, it could easily be seen the participants were invested in the research and providing meaningful responses.

5.1.2 Delphi study stages

The first phase of brainstorming led to the creation of a list of 26 issues from inductive content analysis, and the high inter-rater reliability (88%) provides confidence in the results. Indeed, the data analysis for this phase took a considerably longer time than the other phases due to the nature of qualitative analysis and the generation of descriptions of the issues that reflect the respondents' input. An interesting point in the analysis came about when conducting the analysis for the

narrowing down phase. Whereas the expectation was that issues rated 3.5 out of 7 during this phase would be retained, an adjustment was needed to only include issues rated 4.5 out of 7, to ensure adequate number of issues per panel, because all the issues in the study had a rating of 3.5 out of 7 or higher during this phase. This speaks to the importance of these issues to the participants. Whereas some issues were clearly rated higher than a 6 out of 7 by the panelists, such as issues about cost, funding, and security concerns, the other issues were rated not too far less than those top concerns.

Lastly, the last phase of the Delphi included the ranking phase where two rounds of ranking were needed. Typically, some consensus can be reached after two to three rounds of ranking and the last phase can be concluded (Paré et al., 2013). However, in the case for this study, the ranking phase was concluded after only two rounds due to insignificant changes in consensus and rankings of the issues. This is a relevant and significant finding, as it speaks to the complexity of the issues and the difficulty of reaching a consensus among the experts for the ranking. Indeed, some of the issues were consistently among the top ranked or rated (phase 2), such as security and cost, but other issues were more difficult to rank among each other given the environments from which these panelists worked. Due to the lower than expected consensus among the panelists, a cross tabulation test was conducted between the ranks provided as well as the background characteristics of the panelists. As assumed earlier, the background characteristics of the panelists had virtually no effect on the ranking of the issues, and the low consensus found is a true low consensus where the experts appear to have difficulties in agreeing on the importance of the various issues. In addition, Kendall's coefficients of concordance for both rural and community panels were found to be statistically significant, with a $P < 0.00$ for the Chi Square test associated. This provides the conclusion that the agreement levels found, even though weak, is not due to chance but is a true

finding, adding to the power of this study. It can be noted that Kendall's coefficient of concordance was found to not be significant (P = 0.106) for the academic panel, meaning that the low consensus reached was due to random chance. However, this is the case because of the inclusion of an outlier in the data for that panel. One participant provided ranks that were greatly at odds with the other five participants in that panel which brought the level of consensus down and the P value for the Chi Square tests up due to the smaller sample size of this panel. It is worth noting that when said outlier is removed from the data from this panel, the coefficient of concordance improves to 0.464 with a $P < 0.00$. However, the decision was to include the outlier in the data and analysis even though the consensus level would be affected because the aim of this inductive research is to understand the perspectives of the participants, and while one of the objectives of the Delphi technique is consensus building, it is not the ultimate goal. This technique is used to understand the issues the experts in the field face, as well as provide a ranking to their importance, where the absence of consensus on the ranking of these issues points towards the complexity and difficulties with their prioritization (Paré et al., 2013; R. C. Schmidt, 1997; Skinner et al., 2015). The lack of consensus is a finding by itself as it indicates that the issues faced by hospitals in the province, although similar in some respects, have varying degrees in terms of priorities.

5.2 Current study findings

Given that the hospitals in this study differ in their characteristics, environments and capacities, certain IT management issues were common to all IT top managers. Even though the panels had most of their issues in common, there were particularities to the issues raised by certain panels that reflect their uniqueness in terms of their preoccupations and challenges. This uniqueness of issues to each type of hospital further contributes to the value of the findings and the importance of assessing these three panels separately due to their differing environments. It is

important to keep in mind that issues reported, and the importance provided by the participants are influenced by the progress they are making on the different facets of their IT portfolios in the hospital as well as what is happening in the news when it comes to IT, such as the different hacking scandals that took place in 2017 around the globe.

5.2.1 Common IT management issues

The 14 common IT management issues appear to persist regardless of the capacity and size of the hospital, which highlight their relevance to IT top managers everywhere in Ontario and publicly funded hospitals in general. The *limited funding* available and the difficulties encountered with the *recruitment of qualified IT staff* adds to the struggle of managing the IT portfolio well with its increasing demands given the economics of *limited funds, limited staff,* and *the challenges of obtaining funds for IT when it competes with other clinical priorities.* This is an interesting finding because one would not expect it to appear among the larger hospitals that have more funding, such as the academic hospitals; however, it is voiced by those participants as well as by the participants who represent the smaller rural hospitals that have limited budgets, where it has been argued that managing IT in hospitals is a complex systems problem (Aubry, Richer, & Lavoie-Tremblay, 2014; Jaana et al., 2014; Lavoie-Tremblay et al., 2017; Ward & Daniel, 2013).

Indeed, the number one issue ranked by the panelists centers around *available funds* for hospitals with provincial cuts to operational and capital budgets as well as the challenges in attracting alternative sources of funding to implement and sustain IT solutions. This regulatory issue has been raised throughout the medical informatics literature by top IT managers and middle managers, especially in publicly funded institutions (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Szydlowski & Smith, 2009), whereas it does not pose as much of an issue for private business, and tends to not be raised in the IS literature where most top

IT managers surveyed work in private, for profit institutions (Caudle et al., 1991; Rocheleau & Wu, 2002; Shi & Bennett, 2001). Other regulatory issues that were raised by all the panelists include *the need for provincial IT investment strategy*, ranked 8th place and placed among the top 10 by 76% of the participants, and *provincial leadership to enhance collaboration*, ranked 12th out of 14. Just as with the issue of funding, these two issues require provincial leadership or intervention to help hospitals achieve their IT portfolio goals. A provincial framework to enhance and encourage collaboration among hospitals which could be aided by establishing standardized policies and agreements to facilitate the sharing of resources in an environment where hospitals are funded by silos and can be led by the province or the LHINs as a way to facilitate the process. Collaboration can be identified as "an evolving process whereby two or more social entities actively and reciprocally engage in join activities aimed at achieving at least one shared goal" (Bedwell et al., 2012). Since shared goals among collaborating entities are the cornerstone for collaboration, the province can provide a framework through which hospital top IT managers can establish strategic collaborative plans as well as their shared goals to bring these two entities together to achieve said goals (Bedwell et al., 2012). Additionally, the province may decide to implement operational steps that would facilitate and reward collaboration, such as some of the strategic goals mentioned by the OHA and Ontario MD (Ontario Hospital Association, 2018; Ontario MD, 2017). As for IT investment strategies, a centralized investment strategy will not penalize hospitals that employ expensive IT solutions and would ideally support the adoption of IT software and support the sharing of information across providers (Jaana et al., 2011). This need for collaboration among hospitals is evident through the Ministry of Health and Long-term Care (MOHLTC) of Ontario's published plans and annual reports where one of the difficulties mentioned in relation to IT is that hospitals are funded in silos and tend to operate in silos of each

other (Government of Ontario, 2016). Since this is the case, the participants voiced their opinions to call the Province and the Ministry to put together incentives or a plan for hospitals to collaborate more. Additionally, the province of Ontario has started accepting applications for a $20 Million fund to spur health technology innovation in Ontario, where "Government, health sector, academics, private sector and other partners are working with the Office of the Chief Health Innovation Strategist to coordinate province wide efforts to help ensure Ontario's major investments in innovation improve health outcomes, enhance economic competitiveness and create jobs" (Ministry of Health and Long-Term Care, 2016).

The strategic issues were related to increasing costs, competition between IT and other clinical priorities, as well as leveraging partnerships among hospitals, as one participant reports;

> *"Competing and the duplication of efforts to build and implement solutions amongst hospitals and other health care institutions and agencies eats away at the provincial healthcare budget. Examples of data sharing agreements and privacy/security policies has costed the province millions of $$$ in legal consultation services…."*

As expected, the top strategic issue of *increasing cost* related to capital investments in IT, implementing and maintaining IT infrastructure, and keeping up with the needs of clients and users has been echoed throughout various IS and medical informatics literature bodies (Houser & Johnson, 2008; Jaana et al., 2011; Luftman et al., 2013, 2015; Luftman & Ben-Zvi, 2011; Szydlowski & Smith, 2009). As is observed by studying IT management issues in the IS field over the span of 30 years, issues such as cost reduction for IT and the business tend to not evolve with time but be directly be affected by the economic status of the region, unlike the other issues reported by top IT managers (Luftman et al., 2015). When it comes to cost reduction or cost control regarding IT in hospitals, Szydlowski & Smith (2009) argue that making a purchase decision and

implementation are long processes where top IT managers may use Dieter's model call the *Four Fs Systems* to support their purchase decision making process (Szydlowski & Smith, 2009). This approach focuses on considerations around the functionality, fit, future, and finance when deciding to invest or purchase in IT solutions (Szydlowski & Smith, 2009).

The other strategic management issue is that *IT tends to be viewed as an overhead expenditure* both by the province as well as the institution which adds to the challenge of obtaining financial resources and justifying spending on IT related projects, as was observed in earlier literature (Jaana et al., 2011, 2014). This issue tends to not be present in the IS literature and is only echoed by Jaana et al. (2011) in the medical informatics literature. For strategic planning when it comes to IT projects, Jaana et al. (2014) developed a framework with a set of seven concrete steps for top IT managers to follow when developing a strategic plan for IT solutions. The framework, which was grounded in the literature, outlines the steps as developing a table of contents for the final report, defining the current state, developing the vision of the future state, conducting Gap analysis, developing the plan, communicating and obtaining approval of stakeholders, and lastly implementing the plan (Jaana et al., 2014). Such a framework can potentially be applied towards planning and resource allocation challenges when it comes to funding allocation between IT and other clinical projects.

Lastly, the issue of *leveraging partnerships among hospitals* was raised especially in the context of partnerships between smaller and larger hospitals to reduce isolation, share expertise, consolidate shared IT applications, and leverage economies of scale. This issue has been discussed previously in the medical literature but not in the IS literature, Table 1. These opportunities will help smaller hospitals, such as those in the rural and community panels, who ranked this issue among the top 5. These hospitals would typically obtain smaller funding and budgets from the

regulatory body to share projects with larger hospitals who would have more resources and more sophisticated IT applications, such as the academic hospitals who ranked this issue 13th out of 21 (Bahensky et al., 2008; Jaana et al., 2011; Peslak, 2012). One area of potential partnerships is through leveraging the Project Management Office (PMO) at these various hospitals to work on various IT projects together to achieve shared goals. In this context, the PMO is "an organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. The responsibility of a PMO can range from providing project support functions to actually being responsible for the direct management of a project" (The Project Management Institute, 2008). Even though the PMO provides more of a middle management approach to project management, the shared goal setting as well as the strategic plan for the projects can be established by the hospitals to find a solution to a common issue, such as a particular security threat, after which the PMO's can take on the responsibility of sharing various resources to find solutions that meet the needs of their respective top IT managers. The strategic goal setting and planning can happen at the executive or top management level where the various dimensions of collaboration on IT initiatives are accounted for and the PMOs between the organizations can work together to focus on implementing the overall project plan, delivering the communication strategies to all stake holders, and provide hands on governance for the project (Heath, Appan, & Gudigantala, 2017).

Issues that are more organizational in nature also surfaced where the two issues in this category were ranked among the top 10 overall and were not mentioned in the IS literature body. These issues deal with *managing the demands for IT projects* and *meeting end – users' expectations*. There is constant struggle to meet the requests for IT projects accompanied with unrealistic turnaround times. Additionally, with users becoming more dependent on IT solutions

with more complex applications there is are unrealistic expectations for IT staff to fix issues quickly as well as implementing the policies needed to address the regulations around these projects in a quick turnaround time. Unlike the IS literature, these organizational types of issues have been echoed throughout the health medical informatics literature. They have been reported from the perspectives of managers as well as end users where there is frustration with the expectation of solutions IT promises to deliver, the reality of what is delivered in the immediate terms after adoption, as well as the miscommunications and misunderstandings between IT staff and end users that lead to these unrealistic expectations (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). An organizational change tends to occur in such a political environment, where there is a need for organizational reconfigurations with major transformations. Seeing as these issues are rooted in the working level of end – users and potentially middle management levels for IT and various hospital departments creating tensions due to these organizational level changes, a PMO can be reconfigured to integrate these dimensions of organizational change to alleviate some of these tensions among the various players in said change (Hobbs, Aubry, & Thuillier, 2008). The PMO can function as a source of expertise to facilitate innovation and implementation of change by addressing tangible needs throughout the life of the IT projects (Aubry et al., 2014; Darling & Whitty, 2016; Lavoie-Tremblay et al., 2012, 2017).

Among the 14 common issues to all panelists, human related challenges provided three common issues for the panelists and were ranked among the bottom 4 issues for the most part. The issues around *recruiting competent and specialized IT staff*, while not reported in the recent IS literature, came about due to the scarcity of specialized medical informatics professionals, the retiring current IT workforce coupled with the not so lucrative financial incentives that hospitals

can offer so they may compete for these personnel (Caudle et al., 1991; Jaana et al., 2011). Additional human related issues center around the *time and cost involved in training IT staff and end – users* to new and more complex IT applications provided the limited available resources where training budgets tend to be the first to be hit have been mentioned in the IS and health informatics fields (Jaana et al., 2011; Smith et al., 2010). Tied in with this issue is the issue of *internal security threats* where end-users would use various devices to access patient data, open and download suspicious programs, and communicate via unmonitored platforms leading to compromises of the network security and patient data. The enforcement of various security measures to ensure privacy as well as protection from scammers tends to be met with resistance. This is an interesting development, especially in a field where patient information security and privacy tend to be of paramount importance (ranked among the top 10 by all panelists in the current study). However, the challenge appears to be in communicating the effectiveness as well as the importance and implication of these potential privacy breaches with end users, as is usually one of the main inhibitors of implementing IT applications or changes to the status quo (Jaana et al., 2014; Sligo et al., 2017). A potential configuration of how these end-users work and who they interact with could potentially help alleviate some of the resistance experienced when requiring strict privacy protocols through the sharing of knowledge and transfer of skills among professionals. This would also help reduce some of the time and cost associated with training for IT applications by providing peer to peer training. These teams are known as trans-professional collaborations among individuals where these team members tend to be consensus seeking and have open and flexible professional boundaries (Chiocchio & Richer, 2015). This type of collaboration among individuals involves deliberate exchange of knowledge, skills, and expertise in a fashion that transcends traditional disciplinary professional boundaries (Chiocchio & Richer, 2015). The value

of these teams where peers help peers with learning and understanding technology cannot be underscored, where such teams have been used in Denmark where data consultants as well as physician champions go in to train colleagues on the use of advanced EMR functionalities (Protti, Edworthy, & Johansen, 2007).

The last category of the common IT management issues deals with issues that pertain to the technology itself and have been discussed in the medical and IS literature. There were three such issues raised by all the panelists and all three issues were ranked among the top 10 by at least 69% of the panelists, pointing to their importance. These issues revolve around the *ever greening of technology* in an environment where IT solutions are continuously evolving, requiring new software updates and licenses accompanied with the need to ensure the current systems' resilience to ensure continuity of use, where the strategic planning for purchasing and renewing these applications can be helpful (Jaana et al., 2011, 2014; Luftman et al., 2015; Szydlowski & Smith, 2009). The other major issue is the challenges presented with the enhanced connectivity of IT applications and the evolution of *security* and cyber-attacks for which hospitals have limited resources to address (Houser & Johnson, 2008; Jaana et al., 2011; Luftman et al., 2015). The issue of *security* is ranked third in this study, and has been ranked among the top 10 issues in the IS literature as well over the past 30 years, and authors predict that it will continue to be ranked among the top 10 issues with the emergence of new IT applications such as cloud computing that allow more connectivity and storage of information in a cloud space (El-Gazzar et al., 2016; Luftman et al., 2015). Authors reported that experts feel that concerns with security can be largely addressed when the appropriate costs are addressed, and that most of these security concerns stem from end users' and clients' lack of competence and skills at security management, which in the case of the current study closes the loop with the internal security threats posed by end users which further

inter-relate these IT management issues adding to their complexity (Aubry et al., 2014; El-Gazzar et al., 2016; Heath et al., 2017). These issues are summarized by this participant's comment;

> *"Data security threats / privacy breaches. [Hospital's] IT department is increasingly required to upgrade SW and infrastructure to address potential hacking, malware, ransomware, etc. Most auditing processes are manually intensive. In addition, clinicians are communicating more and more via texting and other platforms and forums that are difficult to monitor. Automated monitoring tools are expensive and may require additional SW/HW upgrades to implement. Nevertheless, breaches do occur, many by internal hospital staff, and [hospital] requires specific responses that must be followed."*

Many of the strategic issues raised in this study have been previously discussed in the IS literature body, especially issues reported by prior Delphi studies in this field, however there are various issues that are specific to the healthcare setting, and specific to the context of Canadian hospitals. For example, the issues such as *knowledge sharing, managing demand and expectations, change management processes* have all been echoed in the IS literature (Luftman et al., 2015; Peslak, 2012; Smith et al., 2010). Other issues raised in this study were also echoed throughout the IS literature, such as the *quality of IT infrastructure, privacy and security concerns, data and content management, training for end users, managing demand and expectations, costs associated with IT, business processes redesign, legal requirements* and *accountability* (Luftman et al., 2012, 2013, 2015; Luftman & Ben-Zvi, 2011; Peslak, 2012; Smith et al., 2010). As it can be seen, some of the issues raised in the study are shared with the IS literature, and those tend to be mostly at the strategic level. However, the environment of the healthcare environment raises a new set of issues and adds particularities to the shared issues with the IS literature that are partially addressed from the perspective of top IT managers in healthcare which further contributes to the relevance of this study. As for comparing the top issues raised in this study and those raised by the most recent study of IT management issues in the IS literature, which was a global survey of

various firms, those included *IT business alignment, business agility, business cost reduction/ control, business productivity,* and *security/ privacy* (Luftman et al., 2015). For this study, the top five issues ranked by all panels included *limited funding, keeping the infrastructure current ever greening, external security threats, increasing costs,* and *managing demand for IT projects.* Evidently, two of the issues raised in this study were among the top five global issues. Those are issues related to *funding and cost containment*, as well as the issues relating to the *strategic alignment of IT or the management of IT projects within the hospitals*. *Security and privacy* issues do come up however they are ranked lower, and the issues around *business agility and productivity* are not explicitly raised by the panelists. Therefore, as discussed above, the shared issues between the two bodies of literature tend to be strategic, organizational, and human related in nature whereas the healthcare environment adds various unique challenges related to regulatory and funding bodies not experienced by private businesses who use IT for competitive advantage and generating profit (Caudle et al., 1991; Ward & Mitchell, 2004). For example, *establishing relationships for collaboration, aligning LHINS and provincial goals, funding availability,* and *the need for provincial leadership* have not been discussed in the IS literature due to the nature of the businesses surveyed, and due to the context in which the studies have been conducted. Private business, such as banks, usually do not need to secure funds from governments as they are not publicly funded, and due to the competitive nature of these firms, it is rare to see a relationship established between two firms who do the same line of work. Provincial leadership and alignment of goals are also more of a publicly funded organization issue as these hospitals have to be accountable to the public and the province (Caudle et al., 1991; Ward & Mitchell, 2004). So, the leadership of the province and the LHIN in establishing connections to facilitate sharing of resources across hospitals as well as sharing technological innovations and advancements is crucial

for these hospitals, as is evident by the overall rank of 8 out of 14 for leadership in IT strategy and 12 out of 14 for the leadership for hospitals to collaborate.

5.2.2 Rural panel IT management issues

The rural panel ranked only one issue exclusively, the issue of *building a cohesive culture around IT* and it was ranked it 19 out of 19, and not reported in the IS literature. The issue observes the necessity of sharing top IT managers, such as CIOs or IT directors, across multiple sites due to funding limitations, the competing organizational cultures in these partnerships, and the perception of IT personnel as "support staff" leading to their exclusion from corporate priorities all feed into the challenges around building a high performing corporate IT culture (Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). Even though this issue is ranked as the least importance among the other 19 issues for this panel, it might signify that rural hospitals are having a difficult time incorporating IT into the overall culture of the hospital, which could be due to lower staff turnover, fewer talents attracted, and fewer resources to fully integrate IT into hospital functions (Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). A trans – professional team where IT personnel are part of both entities can act as facilitators at all levels of management to build this cultural cohesion and understanding around IT and the role it plays to bring IT concerns to the executives' table when making strategic decisions (Chiocchio & Richer, 2015; Hobbs et al., 2008; Lavoie-Tremblay et al., 2012).

As reported, there were a few odd rankings for the common issues provided by this panel when compared with the community and academic panels. The rural panel ranked the issues of *IT competing for resources, meeting end-users' expectations* and the issue *of provincial leadership to enhance collaboration* among the bottom 5, whereas the overall ranking for these issues was among the top 12 out of 14 common issues. This may be reflective of the differences in stages of maturity in terms of IT in these settings, where this panel has different priorities compared to the

two other panels. Additionally, this oddity could also stem from the sentiment expressed while on a telephone call with one participant from this panel who stated that the provincial approach of "one size fits all" for funding models for hospitals tends to not work for the rural hospitals and as a result, a considerable number of these hospitals either end up having to share top IT managers or share outsourcing of IT services to meet their IT needs. This new approach is a unique practice that appears to work for these smaller hospitals where IT solutions are not as sophisticated as larger hospitals and have smaller budgets to work with (Jaana et al., 2006; Peslak, 2012; Smith et al., 2013).

Even with these oddities in rankings, this panel shares a couple of issues with the academic panel, which was not expected provided the differences in IT sophistication, capabilities, and funding the hospitals in these two panels have. Both of these panels raise the technology issue of *reliability of IT infrastructure* such as wireless networks, bandwidth issues, and the lack of redundant solutions available to hospitals using the eHealth network, echoing both medical and IS literature (Houser & Johnson, 2008; Jaana et al., 2011; Luftman et al., 2015; Sligo et al., 2017); as well as the strategic issue around the *development of a comprehensive change management strategy* that would aid in the adoption of IT and implementation of EMRs to mitigate disagreements between senior management and clinicians, also raised by the IS and medical informatics literature (Bonney, 2016; Jaana et al., 2011; Luftman et al., 2015). The issue of having an adequate IT infrastructure is relevant to the hospitals in rural settings since connectivity in general tends to be more difficult in these areas, however academic hospitals tend to be in larger cities which have good networks and bandwidths. One of the reasons this issue was retained by the academic panel is that it ties in with the *"consumerization" and mobile platforms issue*, whereas more patient data moves to be available on mobile platforms, ensuring the availability of

strong IT infrastructure that can take on the additional pressure of these connections in a secure manner is paramount. The issue of developing a *comprehensive change management strategy* would be expected to be a common issue among three panels, however, this issue was only retained by the academic and rural panelists, who did not rank it among the top 15 issues. This issue appears to be less of a priority for the participants in the study even though change management is reported as extremely important in the organizations behavior literature (Ash & Lorenzi, 2017; Long & Spurlock, 2008; Weick & Quinn, 1999). This issue usually concerns difficulties around the adoption of various IT applications, such as EMRs, by staff which can lead to disagreements between top IT managers and end users of these applications. Strategic change management plans tend to mitigate these disagreements by engaging end users in how IT solutions should be implemented. Since this issue appears to be ranked lower and only in two panels, it appears that disagreements among hospital staff and top IT managers regarding IT implementation and adoption are starting to dwindle. However, the reason this issue makes an appearance in the academic panel could be due to the nature of continuously adding new IT applications in these settings to keep up with technological changes and education needs. A potential reason this issue appears in the rural panel could be due to current finalization of implementing some IT applications, such as EMRs, which are necessary to their daily operations. One participant frames this challenge as follows;

> *"Change management in healthcare is always a big challenge in hospitals. Quite often senior management and Physicians are not in agreement with how or what technology solutions will be implemented. We see push back from physicians and clinicians alike in the adoption technology as hospitals transition from paper-based charts to electronic medical/health record systems. Without a comprehensive change management strategy that has the support of the senior management team and chiefs of staff the implementations of such technology solutions will see little benefit and ultimately fail."*

5.2.3 Community panel IT management issues

An unexpected result in this study is the lack of exclusive issues solely ranked by the community panel. This could be due to the larger sample size of the panel, as well as the diverse hospital characteristics captured in the panel, Table 5. However, this panel did rank one of the top five common IT management issues in tenth place out of 19. That issue was the one concerning *external security threats*, which is an additional unexpected finding in this study, given the high importance and rank placed on this issue by the other two panels. This could very well be because this panel appears to be ranking issue relating to organizational, regulatory, and strategic challenges as more important. The preoccupation appears to be with *cost/ resource allocation, managing demands and expectations for IT projects*, and *the competition of IT with other clinical projects for resources.* Other issues pertaining to *privacy and security* were also given lower ranks in this panel, which is an unexpected finding.

Given that community hospitals tend to be larger than rural hospitals, they have more resources, capabilities and tend to form working relationships with academic hospitals. Therefore, community hospitals have similar preoccupations as their academic hospital counterparts, especially around using *advanced business analytics tools* to routinely report on performance, coping with the *increasing demands by the ministry and health IS clustering*, and the *limited standardization and integration across care providers*. These issues are expected to be raised given the context in which these two panels work together, where the Ministry requires hospitals to "merge IT shops" to combine data into one repository, standardization is a must for smooth transfer to information and processes (Bahensky et al., 2008; Houser & Johnson, 2008; Jaana et al., 2011; Lluch, 2011; Sligo et al., 2017). The processes of standardization and merging IT data poses significant security risks and additional required personnel to take on these activities,

however the main challenge lie in the expectation that hospitals will have to absorb the cost associated with such provincial initiatives and have to struggle to find adequate resources to meet these requirements, as one participant from one of these two panels highlights;

> *"Government regulation related to sharing of patient information requires both resources and a level of sophistication not always available, especially in smaller hospitals."*

The community panel hospitals also shared some issues with the hospitals in the rural panel, which is expected provided that these two panels do create partnerships and share resources sometimes, such as expensive medical devices. The issues that were shared by both these panels are the strategic issue of *recognizing IT as a key stakeholder*; and the regulatory issue of *aligning strategy, portfolio and project management across hospitals, LHINs, and the province*. These two issues deal with *considering the IT perspective in decision making* in hospitals as well as ensuring that *IT goals at the hospital level are aligned with those at the LHIN and province* levels to ensure resources are well spent on IT (Jaana et al., 2011). Even though these two issues are common between these two panels, the importance of them is different which highlights the stage of IT adoption and integration these two panels face (Jaana et al., 2011). *Resistance to IT adoption and integration* is part of the earlier IT adoption phases and feeds into the organizational culture around IT. As for the alignment, this is relevant at all level of IT adoption and integration in a hospital since these hospitals are held accountable for their IT investments, and is a very prominent and highly ranked issue in the IS literature, where IT and business alignment tends to be among the top five issues (Luftman et al., 2015). A potential for collaboration can be seen when top IT managers from these two panels are trying to address these two issues, where the sharing of

expertise and executive planning strategies can help align local IT strategies with the overall aim of regulatory bodies (Heath et al., 2017; Szydlowski & Smith, 2009).

5.2.4 Academic panel IT management issues

The academic panel exclusively ranked two of the IT management issues and provided ranks among the bottom five issues this panel. The first issue is the technology issue of *"consumerization" and mobile platforms* where the growing public demand for increasing and easier access to information on various mobile devices requires additional resource to mitigate the various risks associated with it (Luftman et al., 2012, 2015; Luftman & Ben-Zvi, 2010). This issue being retained by the academic panel is not surprising as this panel tends to attract younger generations of students and workers who have internalized mobile platforms as part of their daily routines. However, the interesting observation is that this issue is only retained by the academic panel from the perspectives of patients. This could mean that the patients who visit teaching hospitals could be more literate in IT and expect to have access to their medical information through their mobile platforms, where a potential solution to this demand can require cloud computing strategies where patient data is readily available (El-Gazzar et al., 2016; Luftman et al., 2015). The second issue belongs to the human issues category, which is the *effects of IT errors* that are done when developing IT systems which can cause significant impacts on patient safety. IT errors are important to teaching hospitals where errors made by the coders developing the applications or by staff entering incorrect information can lead to devastating events in a hospital setting, and since academic hospitals tend to train students in various fields, errors are more prone to take place. These two issues could be reflective of the more advanced portfolio that academic hospitals have in terms of IT. One way to mitigate such errors is through training for IT personnel, as well as positioning some of the IT personnel who oversee IT solution development in a trans-

professional team where they can experience first-hand the way end-users use the applications and the type of errors that can emerge in various settings (Chiocchio & Richer, 2015).

5.3 Comparisons with earlier study

Several IT management issues generated in this study have been echoed in the medical and IS literature before, as discussed above. To observe the changes over time in these issues, this section will compare the issues raised in the current study to the earlier study done by Jaana et al. (2011), to which the current study is a follow up. The discussion will focus on the issues that were not raised in the earlier study, and the new issues raised in the current study will be addressed. Furthermore, the retained issues between both studies will be discussed when striking changes in ranking and importance, as well as reporting panels are noteworthy. Where some of the issues could have changed due to the change in players in these hospitals, such as new top IT managers having a different strategic plan and issues arise, changes in other issues can be attributed to the growth hospitals have undergone since the earlier study seven years ago.

5.3.1 Organizational Development and Change theories

By understanding how organizations change and develop over time, the trends of these IT management issues as the hospitals grow and change due to various factors that are internal and external. In order to understand how these issues are changing, the framework of process theories of Organizational Development and Change will be used (Van de Ven & Poole, 1995), Figure 5. The framework addresses four types of development theories, also known as models, to explain the process of progression of events in an organizational entity's existence over time (Van de Ven & Poole, 1995). The four models are classified along two dimensions which are the unit of change and the mode of change. The unit of change dimension depicts if the process focuses on the development of a single organizational entity (such as life cycle, teleological) or an interaction

between two or more entities (evolution, dialectic). The mode of change dimension depicts whether the sequence of change events is prescribed by deterministic laws producing first order change (life cycle, evolution) or if the sequence is constructed and emerges as the process of change unfolds to generate novel second order change (dialectic, teleology) (Martin, Metcalfe, & Harris, 2009; Van de Ven & Poole, 1995; Weick & Quinn, 1999). The motors of change are further explained below.

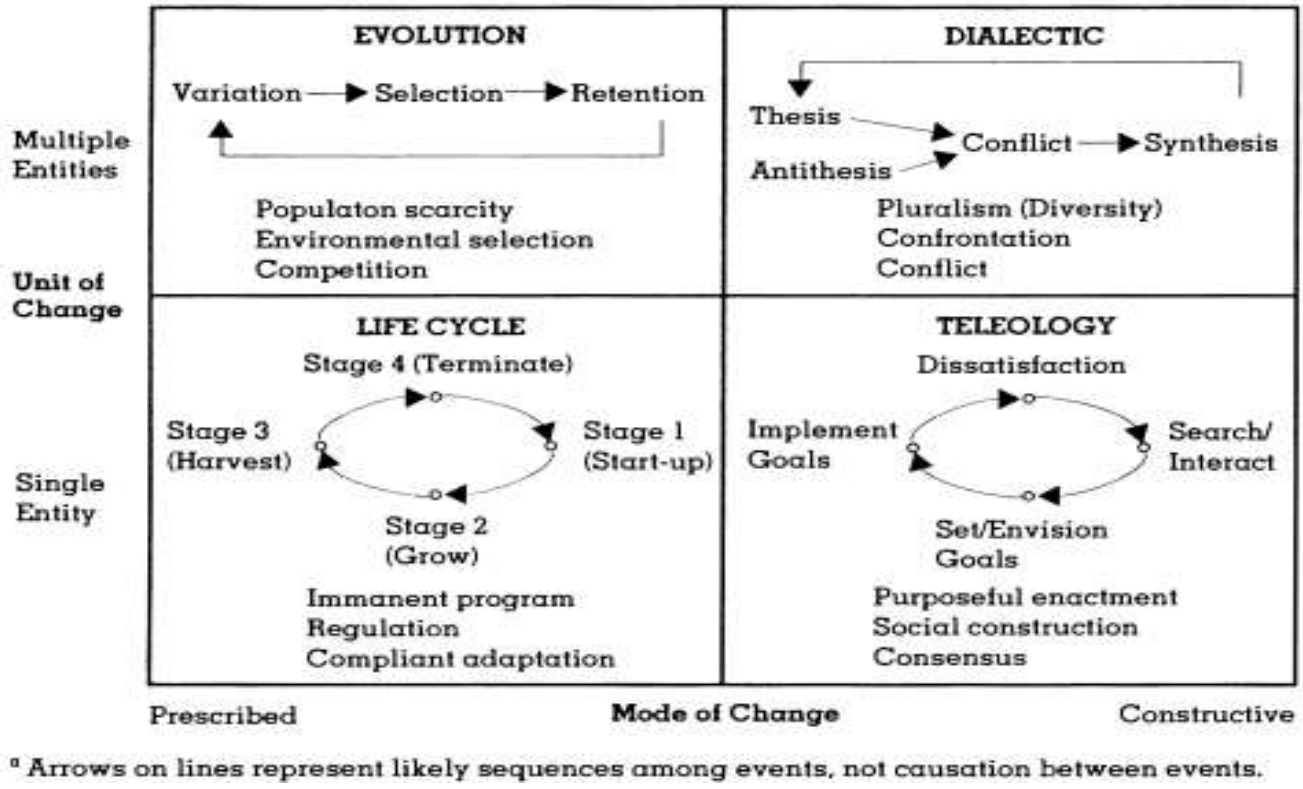

Figure 5: Process theories of Organizational Development and Change (Adapted from Van de Ven & Poole, 1995).

1) Life cycle theory: stages in the development of organizations, products, projects, individual careers, and groups. Those tend to include start up births, adolescence growth, maturity, and decline or death; all of which follow a preconfigured sequence through

linear and irreversible progression of events (Van de Ven & Poole, 1995). This type of change tends to operate on single organizations, from within. A typical progression of change events in this model tends to be a unitary sequence, following a single sequence of events or phases; which is cumulative where characteristics acquired in earlier stages are retained and built upon; and conjunctive so that the stages are derived from a common underlying process (de Rond & Bouchikhi, 2004; Van de Ven & Poole, 1995). An example of this model is institutional programs that requirement developmental activities that follow a prescribed sequence to progress, such as USA food and drug administration regulating a sequence of steps that all firms must follow to develop and market a new drug (Martin et al., 2009; Van de Ven & Poole, 1995). Another application of this model is used with the discussion of the process of emergence of industry wide information infrastructures, where the authors recommend policies initiatives for the development of information infrastructure take into account the life cycle of industries in this process (Reimers, Li, Xie, & Guo, 2014).

2) Teleological theory: relies on the philosophy that a set purpose or goal is the final cause for guiding movement of an organization by assuming the organization is purposeful and adaptive in silo or through the interaction with other entities (de Rond & Bouchikhi, 2004; Van de Ven & Poole, 1995). Development of an organization proceeds towards a goal or an end stage under the assumption that an organization is purposeful, adaptive, and can afford creativity. Therefore, change takes place through recurrent, discontinuous sequence of goal setting, implementation, and adaptation of means to reach desired status quo within the single organization or with other entities that are similar minded or have a shared goal. Once an entity gains its goal, it does not mean it stops changing since goals tend to be

socially constructed and enacted on past actions (March & Simon, 1958; Van de Ven & Poole, 1995). An example of this change process can be seen with processes involved in collaborations where relationships are recurring sequences of negotiation, commitment, and execution where each phase is governed by formal, legal, and informal process (e.g. social-psychological) (de Rond & Bouchikhi, 2004; Van de Ven & Poole, 1995).

3) Dialectical theory: references the balance of power between opposing entities to explain stability and change, where change occurs when opposing values gain sufficient power to confront and engage the status quo (Van de Ven & Poole, 1995). Here, change happens through recurrent, discontinuous sequence of confrontations, conflict, and synthesis between contradictory values or events typically among multiple organizations. Maintenance of the status quo represents stability whereas its replacement, due to a shift in underlying tensions, represents a change that could be for better or worse (de Rond & Bouchikhi, 2004; Martin et al., 2009; Van de Ven & Poole, 1995). One area where this theory has been applied is when forming strategic alliances where a better understanding of the alliance's stability or instability would be gained by accounting for internal tensions such as cooperation versus competition, rigidity versus flexibility, and short-term versus long-term (de Rond & Bouchikhi, 2004). Another example is benchmarking where the interaction between an external standard and the internal way an organization operates, either to improve the organization's operations or to rank itself against its competitors, creates tensions through defining problem areas and searching for applicable solutions to change the status quo (Martin et al., 2009).
4) Evolution theory: this change happens through the continuous cycle of variation, selection, and retention where the metaphor used for this change is natural selection of the

organization among its competitors (Van de Ven & Poole, 1995). Under this theory, change is a recurrent, cumulative, and probabilistic sequence of variation, selection, and retention of events among multiple organizations. The environment is the principal cause of change and only organizations that best fit its evolving nature are retained (de Rond & Bouchikhi, 2004). This theory often depicts global changes in organizational populations, and this model can be used to explain changes in strategic decision making and the social-psychological processes of organizing (Van de Ven & Poole, 1995). An example of this model can be the attempts of various organizations to find niches in markets for their new technology (Nielsen, 2008). Similarly, not all attempts to introduce new organizational forms are successful and some could only be successful in the short run (Nielsen, 2008).

Because the IT management issues span various categories and domains and hospitals are complex entities, not one theory presented can explain the changes observed alone. The interaction of these issues as well as the way the hospitals are growing and changing in response to external and internal factors will help shed light on the changes observed for the IT management issues. Since any one perspective offers only a partial account of a complex phenomenon, multiple perspectives provide a more comprehensive understanding of organizational change (Van de Ven & Poole, 1995). Using narrative and content analysis of the individual responses received during data collection, the framework was applied to aid in understanding how the organizational changes the hospitals have undergone could have contributed to the evolution of the IT management issues over the past seven years (Miles & Huberman, 1994; Myers, 2013). A participant in the study provided insightful comments around the overall complexity of these issues as they are faced by IT top managers in publicly funded hospitals;

> *"Increase complexity of the IT environment: Hospitals are asked to deliver services more efficiently with less resources. IT is supposed to aid in this task (and it does for most) but it also brings a new level of load and complexity into the IT environment. Also, many hospital departments launch their clinical/administrative IT initiatives without involving IT and then IT is required to cope with it (lack of planning, unsecured solutions selected, unplanned/insufficient IT resources available for the initiative). Since IT is also often considered a commodity, getting the additional resources to deliver those new and improved services is extremely difficult."*

5.3.2 New IT management issues

Seven new issues raised in the current study by all participants did not appear in the earlier study, Table 11 and Table 12. These issues tend to be regulatory and technological in nature for the most part.

The technology related issue of *ensuring privacy of patient information* (ranked 7th out of 14) and the regulatory related issue of *provincial leadership to enhance collaboration* (ranked 12th out of 14). The emergence of the patient information protection issue can be seen as part of the teleological and life cycle growth hospitals are going through (Van de Ven & Poole, 1995). As hospitals advance more in health technology applications and share patient information among various care providers over IT networks, they work towards the goal of improving their infrastructure and security so that the patient information is protected from external and internal breaches of privacy. This next stage in the life cycle of IT implementation requires the process of goal setting for hospitals to ensure they adequately protect the privacy of the patients by ensuring their technological systems are secure from various security threats. The issue of provincial leadership for collaboration is emerging as part of the interaction between the hospitals' life cycle and dialectical change. As hospitals move through the life cycle of fully incorporating IT into their organizations, the need for collaboration arises due to the limited resources and siloed models of funding provided by the province. This will and desire to collaborate and share resources among

the hospitals can be facilitated by the province who has set the external context under which these hospitals must adapt and manage their IT portfolios. As participants have voiced their concerns;

> *"Developing and maintaining privacy & security in the ever-evolving IT industry";*
>
> *"Ontario Case costing. Ontario is gradually adopting a case costing approach for the financing of its healthcare services. Institutions deploying new expensive IT initiatives to support clinical effort see their financing penalized compare to those using less (expensive) technology. On the long run, those not embracing new technology will eventually fall behind (nonperformance) but during this transition period, investment is not paying up (short term financing being cut for investing in technology)."*

The new technology related issue of the *reliability of IT infrastructure* was ranked by the rural and academic panels in the current study and was not ranked in the earlier study. The emergence of this issue can be tied to the teleological changes the hospitals are undergoing. top IT managers envision a reliable IT infrastructure that would support all the complex IT activities carried out by end users and patients using increasing more complex systems as well as sharing data across various providers (de Rond & Bouchikhi, 2004). Having adequate infrastructure is paramount to support all these activities while ensuring the security of patient data.

The community and academic panels both ranked two new regulatory issues which are the *limited standardization across care providers* and the *increasing demand by the Ministry/ province and heath IS clustering*. Some of the reasons these issues are coming to light could be due to the current push towards using, the increasing pressure to merge IT shops among hospitals and have a "one size fits all" approach to IT adoption by the ministry, as one participant indicated. Where the province may view these changes as the next part in the life cycle of implementing a provincial IT strategy and portfolio. These regulations and requirements by the ministry provide new forces for hospitals to push them to change in a dialectical manner to incorporate the new regulations for

their IT portfolios (Van de Ven & Poole, 1995). For the demand of clustering information systems across hospitals to be met, standardization needs to be achieved across the various providers to systems can communicate and coding as well as data entry into the systems can be done in a systematic and standard way. As participants have indicated;

> *"The MOHLTC push on hospitals is creating pressure to Share/Merge IT shops. While this may be the right thing to do, a significant amount of my time as CIO is spent developing options, talking with potential partners, creating business cases, partnership documents etc. We are now merging three IT departments, and this merger is coupled with a significant upgrade for all parties on a short time scale. The worry is that the time scale to merge and implement will result in an inferior product."*

The last two new issues raised in the current study were ranked by the academic panel. The human related issue of the *effects of IT errors* can be linked to the changes in the complexity of the technology used due to various drivers discussed earlier. The technology related issue of *"consumerization" and mobile platforms* can be attributed to the increasing demand by end users and patients for the convenience of having their medical data easily accessible and sharable. This appears to stem from the current state of affairs with everyday technology, such as using smart phones and with smart devices becoming more common, which appear to set this expectation for hospitals. This push towards mobile platforms will work towards teleological change in the hospital organization where hospitals would like to provide this service and must undergo the various steps necessary such as ensuring security, privacy as well as the infrastructure before such mobile platforms can be attainable (Nielsen, 2008). As one participant reports the expectations from patients;

> *"Patient engagement – so far hospital IT has been enabling clinicians with technology, not patients. With patients owning technology (mobiles, home computers) there is patient demand to access their hospital data (results), book hospital services, or receive hospital services online. Patients also generate and contribute back their own data. Patient engagement requires an appropriate IT platform."*

5.3.3 Dropped IT management issues

A total of two issues reported by all panelists in the earlier study did not arise in the current study, those are the strategic issue of *implementing an EHR* and the technology issue of *staying current with the rapid changes in technology*. The issue of *EHR implementation* is having been mostly taken care of as EHR implementation and adoption projects move through the various stages of their life cycles from early adopted using the technology to virtually every member of the team using the software (HIMSS Analytics, 2017; Van de Ven & Poole, 1995). The finding that the issue of *staying current with the technology* did not resurface in the current study is very interesting. While this issue was hinted at in the participants' reposes by what was provided for the issue on *evergreening of the technology*, it was not explicitly mentioned or addressed to warrant its own category during the analysis. This change can be simply due to the different participants in this study and the earlier study. Since the issues elicited in both studies were derived using an inductive approach, it is expected that the deferring participants in both studies would provide different themes in their responses.

Four technology related issues were dropped from the earlier study by various panels. The rural and community panels dropped the issue of *merging and integrating the different systems across the hospital*. Part of the resolution of this issue could have been accomplished by the teleological process of change, where various systems vendors currently offer solutions to integrate legacy systems with new systems as well as different systems together (Canada Health Infoway,

2017). This issue ties in with the *immature software industry issue* that was also dropped, also due to the *availability of new more complex solutions to help link the various system*s and better respond to the needs of end users. The non-emergence of the issues of *deploying foundational technology services* and *dependence on online systems in the absence of redundant solutions* speaks to the maturing and evolution of the IT infrastructure within the hospitals over the past 7 years. Where continual improvements and progression of various IT projects have helped move though these stages of IT implementation (HIMSS Analytics, 2017).

The organizational issue of *maximizing resource potential to manage IT with minimal staff* was also not ranked in the current study. While this issue is not easily resolved, it appears it is currently not as much of a priority as was reported in the earlier study. Indeed, the issue of managing IT with minimal staff resonates with the current study when discussing IT staff recruitment, limited resources, as well as the unrealistic expectations of IT staff by end users. It appears the current preoccupation of top IT managers is with security, collaboration, as well as meeting regulatory requirements with the limited budgets they have that this issue is not as much of a priority currently.

The human related issue of *adoption of IT by clinicians* has been dropped, which, as discussed above, could be due to hospitals moving onto the next stage in the life cycle of IT implementation and adoption. While the issue resonated throughout the various respondent's responses, not enough importance was placed on it to warrant its ranking among the panelists, which further alludes to its decreasing importance.

Lastly, the strategic issue of *leveraging portfolio and project management* to manage the many various IT projects within the hospital has been dropped as well. This issue appears to have been largely resolved with the increase in the number of top IT managers across hospitals, the

increase in their recognition as well as their roles as top IT managers, and the emergence of project management offices in hospitals to aid with overseeing the IT projects (Canadian Healthcare Technology, 2016; Ward & Daniel, 2013).

It can be seen that most of the issues dropped were related to life cycle and teleological changes within the hospitals over the past seven years, where even if the issues were not necessarily resolved, they appear to be less important in the present day. Moving through the various stages of the life cycle of technology adoption and implementation stages appears to have addressed various technology related issues, whereas the teleological change of achieving the various milestones relating to human and strategic type issues appear to have contributed to the non-emergence of these issues.

5.3.4 IT management issues with changed importance

As an indication of the varying importance of the parallel issues between both studies, there was a total of 6 issues in the earlier study which were ranked by one or two of panels but were ranked by all three panels in the current study. This alludes to the increasing importance of these issues across the different types of hospitals.

The strategic issue of *increasing cost* related to technology capital investments as well as the maintenance activities was ranked as relatively not important only by the rural panel in the earlier study but is ranked as 4th out of 14 in the current study. This major change in ranking can be due to the more advanced and complex technology applications that are being developed currently, which offer new solutions but are expensive to purchase, implement and upgrade various systems in use, and are expensive to maintain through the training of staff and providing proper the IT infrastructure. The hospitals will have to change to find ways to mitigate these costs (Jaana et al.,

2011), which will involve a change based on the evolution theory where the various external pressures the evolving IT solutions will force organizations to adapt. As indicated by a participant;

> *"Keeping up with changing technology. It is challenging for IT staff to stay abreast of new technology in order to advise Senior Management appropriately. Also, upgrades are required frequently and periodically software becomes obsolete and unsupported. This is costly for hospitals – it would be great to have a provincial advisory board to help hospitals in this area. Consultants are very costly."*

These changes in the nature around IT solutions give more importance to the regulatory issue of the *need for provincial IT investment leadership and strategy*, which was only ranked by the rural panel in the earlier study but is ranked among the top 10 by all panellists in the current study. Having help from the province through an established IT investment strategy and framework can help guide investment decisions when the costs of IT solutions are ever increasing. Additionally, other healthcare governing bodies, such as the OHA and Ontario MD, are working closely with the province to ensure policies reflect the needs of the practitioners they serve (Ontario Hospital Association, 2018; Ontario MD, 2017).

Two of the human related issues have gained more importance over the past 7 years. The issues of *internal security threats* and *time and cost of training IT staff and users* were only ranked by the rural panel in the earlier study, however they are ranked by all panels in the current study, alluding to their increasing importance. As more complex IT solutions are being purchased and used by hospitals, as part of their evolutionary and teleological change, end users need to be trained to ensure proper use of these applications as well as the mitigation of errors resulting from misuse by these end users (Houser & Johnson, 2008; Jaana et al., 2011). The goal setting of ensuring patient privacy and the reduction of errors due to internal staff will require the ongoing training of

end users so that any risks to patient privacy can be reduced and mitigated (de Rond & Bouchikhi, 2004; Martin et al., 2009). Whereas 7 years ago the CIOs were preoccupied with the adoption and implementation of IT, today they are preoccupied with reducing the risks due to end users' errors with more complex systems.

Other interesting changes occur with the increased priority placed on two issues. The issue of *keeping infrastructure current ("evergreening")* which received an overall rank of 9 out of 9 in 2010 and has risen to an overall rank of 2 out of 14 in 2017, Table 11. Similarly, the issue of *leveraging partnerships between hospitals* was ranked second last (7 out of 9) in 2010, ranked last by the community panel (20 out 20), and ranked as more important by the rural panel (6th out of 15). However, in the 2017 rankings the issue is prioritized among the top 10 overall (10 out of 14), is ranked 9th out of 19 by the community panel and is given lower priority by the rural panel (ranked 13th out of 19), Table 11. The higher importance placed on these two issues from 7 years ago is not surprising especially with IT systems becoming more dated now and requiring legacy systems to support new technology within the one organization as well as across organizations for collaboration to take place. It appears with the current funding models and expectations by the province for hospitals to 'merge IT shops', collaboration becomes the cornerstone of taking on various projects in partnerships with other hospitals as well as ensuring that the available infrastructure can support such collaborative efforts.

Two other issues appear to have decreased in priority since 2010. The issue of *recognizing IT as a key stakeholder* was a common issue in 2010 and ranked 4th out of 9 however it is only ranked by the rural and community panels in the current study, where both panels provide it a lower rank (10th out of 19 for rural and 15th out of 19 for community). A similar trend is seen with the regulatory issue of *aligning strategy, portfolio and project management across hospitals, LHINs,*

and the province which was given an overall rank of 5th out of 9 in 2010, however is only ranked by the rural (15th out of 19th) and community (7th out of 19th) panels in the current study. These changes where only the community and rural panels retain and rank these issues in the current study could be attributed to the growth and maturity of the IT portfolio across the academic hospitals. Where these two issues were deemed important seven years ago, it appears that the academic hospitals have moved along this agenda and since the community and rural panels place lower importance of these rankings, they also appear to be following suit of the academic hospitals but at a slower rate. This could be due to the financial, talent, and human resources that academic hospitals have which are not as readily available to the community and rural hospitals. One facilitator to the advancement on the issue of *recognizing IT as a key stakeholder* is the increasing importance of IT in healthcare as well as the advancements made in its implementation and adoption. As IT systems become more integrated with end users, as part of the life cycle of implementation as well as due to the efforts of various governing bodies such as Ontario MD, both end users and decision makers being to recognize its importance to routine operations (de Rond & Bouchikhi, 2004; Ontario MD, 2017; Van de Ven & Poole, 1995). As for the issue of *aligning strategy, portfolio and project management across hospitals, LHINs, and the province*, in their recent strategic plan, the OHA appear to have surveyed hospitals in Ontario and have incorporated their feedback into the strategic plan. Furthermore, the OHA stresses that it is and will continue to be involved in policy making in Ontario's healthcare system as a voice for hospitals (Ontario Hospital Association, 2018). These efforts and communication with the hospitals could have contributed to advancing the issue around aligning IT strategies across various levels of governance in the province.

5.4 Implications of the findings

There is limited understanding and rigorous assessment of the IT management issues from the perspectives of top IT managers in healthcare organizations, which has hindered appropriate investment efforts and resources to much needed areas. This study aims to contribute to the base knoweldge that will help build a survey to observe the evolution of IT management issues in hospitals overt time (Jaana et al., 2011; Luftman et al., 2015; Pollard & Hayne, 1996; Shi & Bennett, 2001). The diverse sample of the participants increases the generalizability of the findings and their relevance to a variety of hospitals in industrialized countries, especially where health care is publicly funded. Although the list of IT management issues emerged in the context of Ontario hospitals, it is a comprehensive list that has been echoed throughout the medical informatics and IS literature and adds new insights to descriptions of these issues and to some emerging issues not previously considered. This makes the list of generated issues generalizable to publicly funded healthcare organizations, as there is no evidence that it is unique to Canadian hospitals and the list fits right with most of issues discussed by the medical and IS literature, while adding new insights to the issues and a second benchmark to assess the challenges from the perspectives of IT top managers.

This study presents a significant contribution to the management of medical informatics field by providing an approach to categorize the IT management issues to observe trends overtime as well as present the application of a seminal framework to explain the changes in these issues as organizations change and grow over time. The study also provides a second benchmark to identify new and emerging IT management issues over a 7-year period, as well as issues that have persisted over this time. Although some of the prioritized issues may not be surprising to top IT managers directors in hospitals, the rigor and thoroughness in which this study was conducted support the

use of these findings as a second benchmark, after the one developed by Jaana et al. (2011). By broadening the understanding of the issues faced by IT top managers in hospitals, a more systematic evaluation of these challenges over time would be supported which would allow resources at the management, educational and research levels to be invested wisely.

At the practical and management levels, the list of prioritized issues provides evidence for creating appropriate strategies and approaches for addressing these issues. The participants have also expressed interest in obtaining access to the results of this research given its comprehensive and grounded nature in generating the list of issues. In hospitals, where provisions are driven by evidence-based care, this list can be used internally to observe the changes in IT management issues a specific hospital has seen over the past 5 – 7 years and assess its progress against its peers, or IT top managers can use the list to negotiate with their coworkers the top IT issues which could have been overlooked otherwise (such as funding and security threats). This list can be used to support internal negotiations by providing an evidence base to the experiences and opinions of IT top managers in hospitals, adding more support and weight to their decision-making processes. Furthermore, using the list of IT management issues as a benchmarking tool aids the evaluation of the business value IT brings to the hospital. This evaluation can be done from a financial perspective through cost – benefit analysis or from a patient safety perspective (Hart, 2013; Lee & Choi, 2016). The evaluation of current IT processes in hospitals and the effectiveness of solutions implemented to address various challenges can be more systematically evaluated so that evidence-based progress can be made. The list can also be used as a guideline by IT top managers to continually evaluate where their hospital stands compared to other hospitals with similar

environments by using the issues and the organizational changes framework as a method to track the evolution and change of their organizations. As one participant has indicated;

> *"I find there is little support and information available to assist CIOs with going to Senior Leadership Teams and Boards for more money due to the rising costs."*

Additionally, at the policy development level, provincial governments can use the list to devise comprehensive IT management strategies to ensure alignment with the experience of hospital top IT managers so that shared goals can be achieved. Governing bodies can use the list to identify and fulfill leadership opportunities that the participants would like to see from the province. This could be done through new legislation, various engagements with these top IT managers, or targeted programs all of which would be backed by the evidence of changing IT issues in hospitals provided by this study. The evidence generated in this study can be used to support the development of a province-wide or hospital-specific IT strategic plan, while ensuring that IT goals align with the strategic business goals of the province and the hospital. The main issues raised in this study appear to be the call on the province to lead the way for IT investment strategy, ensure standardization and integration across providers, and work to foster collaboration among hospitals. For example, the Toronto Central LHIN has released its 2015 – 2018 strategic plan which addresses the issue of using IT applications to carry out effective planning. Some of the strategies they aim to take include sharing of patient data across sectors and providers, as well as the use of enhanced data analytics tools by improving access to information and facilitating integration, comprehensive data reports can be generated and informed decisions can be made (Toronto Central LHIN, 2015). Furthermore, few of these issues raised around provincial leadership have been recognized by the MOHLTC by appointing a Chief Health Innovation

Strategist who ensures that Ontario is taking the best approaches to deliver innovative healthcare solutions and champion Canada as a leader in healthcare technology (Government of Ontario, 2016). This individual works towards meeting the various ministerial mandates and help create a bridge between the Ministry and healthcare providers in relation to IT. At the National level, Canada Health Infoway is viewed as the leading agency that supports various eHealth initiatives in the country. Since Canada is still building its health IT infrastructure, the development of an interoperable EMR and EHRs through standardization is regarded as a main building block of this movement (Advisory Panel on Healthcare Innovation, 2015).

As for educational and training resources, new opportunities for training IT top managers can be identified through the list of issues. These areas can include training around project management skills, such as managing projects with limited resources, managing multiple projects at the same time, consulting with end users to ensure their needs are understood and can be met in a reasonable fashion without over extending the resources available (Jaana et al., 2014). One area of potential engagement of the LHIN can be through providing workshops and retreats for IT top managers to help them brainstorm solutions to common issues, ensure their strategic plans are aligned with the LHIN and provincial goals, open the door to meet other IT top managers to enhance potential collaboration opportunities, and develop customized solutions based on their specific hospital's needs and capacities.

The high proportion of common issues reported by these panelists build a strong case to their relevance and importance in hospitals in general, regardless of environmental differences. As for research, it is important to monitor the evolution of these issues over time, and to investigate the different ways to support IT top managers so that progress towards IT development, use and impact

can be made by being built on an evidence base. Further elaboration on future research opportunities is available at the end of this thesis.

5.5 Strengths, challenges and limitations of the study

Although this study was based on a number of self-selected participants, it was based on a systematic approach to provide a rigorous authoritative list of IT management issue (Paré et al., 2013). The study followed the steps necessary to ensure successful conduction of a follow-up study as was provided in the recipe (Brandt et al., 2014). This rigor was carefully ensured throughout the study so that a second benchmark to the assessment of these issues can be available. The follow up study provides a successful replication attempt as per the recipe provided earlier, Figure 1. This study defines the methods being replicated following the exact methodology of the earlier study (with the except of phase 2 data analysis), the study provides a high statistical power by providing statically significant coefficients of concordance for the ranking of the issues among the panelists (with the exception of the academic panel), the study completely and transparently provides all the details about the replication undertake, and finally a thorough discussion of the results as they compare to the earlier study is undertaken.

As for the rigor of the Delphi methodology, the study further succeeds at following the recommendations set out for this methodology, Figure 3. First, the study follows the recommendations set out for the research design portion by providing detailed descriptions of the recruitment process of the panelists and hospitals who participated, and the selection criteria used. This highlights the breadth of experience and perspectives the participants bring from three different panels in three different settings, which ensures the validity of the results and reduce potential distortion of the data (Okoli & Pawlowski, 2004; Paré et al., 2013). The study also explicitly reports the number of participants during each phase and has a moderate retention rate,

with very minimal attrition in the narrowing down and ranking phases so that the same experts who narrowed down ranked the issues as well. This contributed further to the validity of the results (Donohoe & Needham, 2009; Hsu & Sandford, 2007; Paré et al., 2013; R. C. Schmidt, 1997; Skinner et al., 2015).

Second, the study followed the recommended steps in the Ranked Delphi method for the data collection steps and provided clear and detailed instructions to experts during the data collection process (Delbecq, 1975; Paré et al., 2013; Skinner et al., 2015). In the brainstorming and narrowing down phases the researchers consolidated the reposes to generate the list of items with a high level of inter-coder reliability, circulated the random list for validation and comments as well as for rating. The researcher also provided a clear rule for the issues retained after this phase. For the last phase of ranking, controlled feedback to the experts was used for both rounds, with the list randomly ordered in the first round and then ordered by mean ranks in the second round. A clear stopping rule was used which was the presence of insignificant changes between ranking rounds. The researcher did not ask the participants to justify their rankings as it was too taxing since a number of the participants stressed being extremely busy during the time the ranking phase was taking place (Paré et al., 2013). A limitation to the study is the inclusion of the validation of the list of issues step with Phase 2 ranking questionnaire instead of conducting the validation separately before moving onto Phase 2 (Paré et al., 2013). This was done to reduce the burden on the participants who were reporting being extremely busy and not able to complete the questionnaires on time. Furthermore, seeing as the comments and adjustments to the list of issues were extremely minor, it is highly unlikely that this step interfered with the validity of the list or the rigor of the study (Paré et al., 2013; Skinner et al., 2015).

Just as was expected, the sizes of the rural and academic panels were smaller due to the smaller population from which recruitment took place, therefore the sizes of these panels were below the recommended 10 – 15 participants per panel, however it is worth noting that only 1 participant from the academic panel was lost to attrition, and only 2 participants were lost to attrition in the rural panel, so the results remain valid even with the smaller panel sizes and moderate attrition rates (Paré et al., 2013; Skinner et al., 2015). Furthermore, it is important to note the repetitiveness of the participants of the overall population of hospitals eligible to participate where 30% of the rural hospitals, 20% of the community hospitals, and 86% of the academic hospitals eligible to participate in the study completed all phases of the study. Additionally, it is worth noting the number of participants who have agreed to participate in the study and who, when the first questionnaire was sent, could not reply (Delbecq, 1975; Paré et al., 2013; Skinner et al., 2015). A total of 6 participants said they'd like to participate however they did not respond to the first phase questionnaire, which signals the nature of work these individuals do, with their extremely busy and stressful schedules. However, since there was this interest, this further signaled that this study is observed as needed by the participants to ensure these issues are better understood. Furthermore, when contacting the various respondents of the study, most of them stressed their interest in obtaining the executive summary of the results to see the issues raised by their peers and how they compare with other hospitals. Therefore, there is great interest in this study from the participants' perspective. Since data collection for phase 3 had to take place over the summer months, it was difficult to get a hold of the participants and collect the responses in as a timely manner as possible due to the summer holidays, and many participants told us they were undergoing audits of their IT departments over the summer to prepare for EMR changes coming to hospitals in early fall.

Other limitations that are inherent to the Delphi technique include conformity of the participants, which did not necessarily happen in this study based on the fact that consensus levels remained relatively unchanged, even with the iterative feedback provided, as well as the absolute anonymity that was maintained throughout the study (Paré et al., 2013; Skinner et al., 2015). As for the concerns around potential manipulation of the list of issues by the researchers, two researchers, one of whom is the student, worked together to generate the list of issues and their descriptions with a high agreement rate of 88% (Lombard et al., 2002). In conclusion, the study was conducted with utmost anonymity, the issues were randomly re – ordered after each phase, and none of rakings were disclosed to the participants, except for average ranks in the second round of ranking, to ensure that no influence of the research or other participants had any effect on responses received.

6. Conclusions and future research

This study has provided findings of a Ranked Delphi Survey that was conducted with top IT managers in rural, community, and academic hospitals in Ontario, one of the most populous provinces with the highest number of healthcare organizations and networks in Canada. The study followed a systematic and rigorous approach to develop an authoritative list of IT management issues from the perspectives of IT top managers in publicly funded hospitals. Since the list is grounded in the experiences of tenured IT top managers in these hospitals, it has strong validity and foundation. Furthermore, as this is a follow-up study, this study provides a second benchmarking tool to assess emerging IT management issues, as well as issues that are no longer a concern by comparing with the first study.

Next steps for future research can focus on exploring reasoning behind the rankings of the issues provided, such as the unexpected low ranking of issues pertaining to privacy and security by the community panel. An additional area for future research can look at replicating this study in other Canadian provinces and other industrialized countries to gain a better understanding of the similarities and differences of the IT management issues faced by hospitals. This will help confirm the findings in this study and create additional benchmarks which would be more comprehensive by eliciting the feedback of more IT top managers and test the application of the organizational change framework presented to address the temporal changes. Furthermore, just as was the case in the IS literature, a next step to the Delphi studies could be the development of a large-scale survey of CIOs/ IT directors and IT top managers in hospitals in Canada to gain a more comprehensive understanding of the importance of these issues as well as their evolution over time within the context of the environments of these hospitals (Shi & Bennett, 2001). This survey of IT

management issues can be leveraged in Canada and countries with similarly operating healthcare systems to track the evolution of the issues faced by top IT managers in the healthcare setting.

In terms of health IT management solutions research, resources can be devoted towards researching ways of applying solutions from the IS field into healthcare settings. An example of developing solutions is through focus group research, where IT top managers can participate in focus group discussions to suggest solutions which could be used to inform policy development at a provincial or national level. Lastly, research resources can be put towards looking at ways hospitals can enhance their level of IT sophistication, or their IT maturity, given the limited resources. This could be through researching new and innovative ways hospitals can use their limited resources to achieve higher efficiencies and develop more affordable IT solutions that hospitals can leverage.

This field of IT management in healthcare research is still in its infancy, and the potential for demystifying the issues faced by hospitals and tracking them over time through evidence-based research presents opportunities for addressing these issues, as is the case in the IS literature. The Delphi studies in the IS literature were the cornerstones upon which large scale global surveys were built to track the changes in IT management issues throughout various economic crisis, differing geographies, and varying levels of development. Additionally, the field benefited greatly by providing researchers with the top challenges they can address to ensure ongoing research is relevant at the practical level. This study aims to contribute to the knowledge base in the health informatics literature and potentially contribute towards evidence-based progress in hospital IT development and a bright future for IT in hospitals.

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Appendix

Table 13: Final ranking of key IT management issues in Jaana et al. (2011) study

IT management issues	Ranks			
	O	R	C	A
Having sufficient funds	1	3	2	2
Managing demands and expectations for it services	2	1	1	3
IT competing with other clinical priorities for scarce resources	3	7	3	1
Recognizing it as a key stakeholder in major hospital decisions	4	4	6	5
Aligning strategy across the hospitals, LHIN, and the province	5	9	14	4
Implementing an EHR	6	6	8	9
Prioritizing and implementing IT initiatives with other health organizations	7	6	20	12
Recruiting and developing it staff with the appropriate skill set	8	15	16	10
Staying current with the rapid changes in technology	9	13	19	16
Merging and integrating many different systems within the hospital		2	15	
Unrealistic expectations for it to solve all problems		5	4	
Keeping infrastructure current "evergreening"		8	5	
Maximizing resource potential to manage it with minimal staff		10	9	
Availability of provincial standards and best practices for technology		11		
Enforcing security policies through appropriate security measures		12		
Managing external technological threats such as malware and viruses		13		
Adoption of it by clinicians and staff		14		11
Time and cost involved in training it staff and users		16		
Engaging clinical leadership in it projects			7	6
Leveraging bi tools to report on performance and outcomes			10	14
Prioritizing short-term fixes over strategic execution			11	
Ability to recognize the value of it in improving care			12	7
Ensuring cost containment			13	
Dependence on online systems in the absence of redundant solutions			17	
Leveraging portfolio and project management			18	15
Establishing capabilities for process redesign				8
Immature software industry				13
Deploying foundational technology services (e.g., RFID, kiosks)				17

Table 14: Phase 3 both rounds detailed results

IT Management Issue	Computed Rank (reported Mean Rank) [Range]											
	Common Issues			Rural Panel			Community Panel			Academic Panel		
	3a	3b	P value* [Z stat]	3a	3b	P value* [Z stat]	3a	3b	P value* [Z stat]	3a	3b	P value* [Z stat]
Limited funding	1 (4.54) [1-14]	1 (4.08) [1-14]	0.318 [0.999]	3 (6.38) [1-19]	4 (5.88) [1-15]	0.414 [-0.816]	1 (4.58) [1-12]	1 (4.92) [1-14]	0.766 [-0.298]	3 (7.33) [1-19]	1 (4.67) [1-19]	0.285 [-1.069]
Keeping infrastructure current ("ever greening")	4 (6.58) [2-14]	2 (5.85) [2-14]	0.172 [-1.366]	8 (9.50) [4-19]	6 (7.25) [4-13]	0.345 [-0.943]	5 (8.50) [2-15]	4 (7.42) [1-14]	0.370 [-0.897]	4 (8.00) [2-18]	2 (6.33) [2-18]	0.144 [-1.461]
External security threats	2 (5.50) [1-14]	3 (5.92) [1-14]	0.362 [-0.911]	1 (5.75) [1-16]	1 (4.75) [1-18]	0.713 [-0.368]	9 (8.83) [1-17]	10 (9.75) [2-17]	0.400 [-0.842]	2 (5.83) [2-9]	3 (7.00) [2-20]	1.000 [0.000]
Increasing cost	5 (6.81) [1-13]	4 (6.08) [1-13]	0.168 [-1.379]	5 (8.00) [3-18]	3 (5.38) [1-8]	0.116 [-1.572]	2 (7.67) [1-13]	3 (6.67) [2-19]	0.352 [-0.931]	12 (11.67) [2-20]	13 (12.17) [8-21]	1.000 [0.000]
Managing demands for IT projects	3 (6.54) [1-14]	5 (6.46) [1-14]	0.930 [-0.087]	4 (7.38) [2-14]	5 (7.13) [1-18]	0.684 [-0.406]	3 (7.67) [1-18]	5 (8.08) [3-16]	0.481 [-0.704]	17 (12.83) [1-21]	7 (9.67) [4-18]	0.416 [-0.813]
IT competing with other clinical priorities for resources	6 (6.92) [1-14]	6 (6.69) [1-14]	0.716 [-0.363]	13 (11.63) [5-18]	14 (11.88) [5-18]	0.752 [-0.315]	8 (9.50) [2-18]	2 (6.58) [1-15]	0.021 [-2.316]	1 (5.33) [1-17]	5 (8.33) [1-20]	0.416 [-0.813]
Ensuring privacy of patient information	7 (7.00) [1-14]	7 (6.96) [1-14]	0.959 [-0.052]	2 (6.25) [1-12]	2 (5.25) [1-17]	0.588 [-0.542]	10 (9.33) [1-16]	11 (9.83) [1-16]	0.609 [-0.512]	14 (11.83) [5-21]	15 (12.67) [7-21]	0.450 [-0.756]
Need for provincial IT investment leadership and strategy	9 (7.81) [1-14]	8 (7.58) [1-14]	1.000 [0.000]	12 (11.13) [4-18]	11 (11.13) [4-18]	0.345 [-0.943]	6 (8.42) [1-18]	6 (8.08) [3-16]	0.779 [-0.281]	8 (10.83) [2-20]	6 (9.33) [2-17]	0.593 [-0.535]
Meeting end-users' expectations	8 (7.73) [1-14]	9 (7.81) [1-14]	0.839 [-0.203]	16 (11.88) [7-19]	17 (12.50) [5-19]	0.686 [-0.405]	7 (9.25) [1-17]	8 (8.92) [5-17]	0.933 [-0.085]	5 (8.33) [2-20]	4 (7.67) [1-15]	0.786 [-0.271]
Leveraging partnerships between hospitals	10 (8.62) [2-14]	10 (8.35) [2-14]	0.632 [-0.479]	11 (11.13) [3-19]	13 (11.38) [5-16]	0.916 [-0.105]	11 (9.83) [4-18]	9 (9.58) [2-19]	1.000 [0.000]	9 (10.83) [4-17]	11 (11.00) [2-19]	0.686 [-0.405]
Recruiting IT staff with appropriate skillsets	11 (8.62) [2-14]	11 (8.88) [2-14]	0.725 [-0.351]	7 (9.13) [3-14]	7 (9.00) [3-17]	0.715 [-0.365]	15 (12.08) [3-19]	16 (12.42) [5-18]	0.959 [-0.051]	10 (11.00) [5-18]	14 (12.50) [7-16]	0.686 [-0.405]
Provincial leadership to enhance collaboration	12 (8.96) [1-14]	12 (9.69) [1-14]	0.180 [-1.340]	18 (12.50) [5-19]	18 (14.75) [8-19]	0.080 [-1.753]	12 (10.17) [1-17]	14 (11.58) [1-19]	0.351 [-0.933]	18 (13.50) [3-19]	12 (11.67) [2-16]	0.285 [-1.069]

Internal security threats	14 (9.81) [2-14]	13 (10.04) [2-14]	0.416 [-0.813]	9 (10.50) [2-17]	8 (9.88) [2-19]	0.269 [-1.105]	18 (13.67) [7-18]	18 (14.83) [11-18]	0.091 [-1.691]	20 (15.00) [9-21]	19 (14.00) [5-21]	0.686 [-0.405]
Time and cost of training IT staff and users	13 (9.58) [2-14]	14 (10.62) [2-14]	0.154 [-1.427]	10 (10.63) [6-15]	9 (9.88) [6-18]	0.343 [-0.949]	17 (13.58) [7-19]	19 (15.33) [7-19]	0.138 [-1.483]	21 (15.67) [11-21]	21 (16.50) [10-21]	0.854 [-0.184]
Recognizing IT as a key stakeholder	--	--	--	6 (8.63) [1-18]	10 (10.13) [2-18]	0.115 [-1.577]	16 (13.83) [1-19]	15 (11.83) [1-19]	0.944 [-0.070]	--	--	--
Reliability of IT infrastructure	--	--	--	17 (11.88) [3-18]	12 (11.25) [3-18]	0.498 [-0.677]	--	--	--	16 (12.83) [6-19]	9 (10.67) [6-19]	0.285 [-1.069]
Aligning strategy, portfolio and project management across hospitals, LHINs, and the province	--	--	--	15 (11.75) [1-18]	15 (12.13) [1-17]	0.786 [-0.271]	4 (8.42) [1-18]	7 (8.75) [1-16]	0.674 [-0.421]	--	--	--
Developing a comprehensive change management strategy	--	--	--	14 (11.75) [2-16]	16 (12.50) [7-16]	0.395 [-0.850]	--	--	--	13 (11.83) [6-16]	16 (12.83) [3-21]	0.498 [-0.677]
Building a cohesive corporate culture around IT	--	--	--	19 (14.25) [7-19]	19 (18.00) [16-19]	0.042 [-2.032]	--	--	--	--	--	--
Limited standardization and integration across care providers	--	--	--	--	--	--	13 (10.50) [11.67]	12 (10.58) [2-18]	0.944 [-0.071]	7 (10.33) [1-21]	10 (11.00) [1-19]	0.715 [-0.365]
Increasing demand by the Ministry / province and health IS clustering	--	--	--	--	--	--	14 (11.67) [5-19]	13 (11.08) [3-19]	0.944 [-0.070]	6 (9.33) [3-21]	17 (13.50) [3-21]	0.273 [-1.095]
Leveraging advanced analytics tools to report on performance	--	--	--	--	--	--	19 (14.50) [4-19]	17 (13.75) [4-19]	0.725 [-0.352]	15 (12.67) [10-19]	8 (10.67) [6-19]	0.141 [-1.473]
“Consumerization” and mobile platforms	--	--	--	--	--	--	--	--	--	11 (11.17) [3-18]	18 (13.83) [9-17]	0.279 [-1.084]
Effects of IT errors	--	--	--	--	--	--	--	--	--	19 (14.83) [6-20]	20 (15.00) [11-20]	1.000 [0.000]
Kendall’s coefficient of concordance (*W*)	--	--	--	0.180	0.381	--	0.188	0.254	--	0.210	0.235	--

Table 15: Significant results from cross tabulation of background characteristics of participants and ranking of the issues

Significant interaction	**P value [Fisher's Exact Test Statistic]**
Rural Panel	
No significant interactions	
Community Panel	
Gender and "Limited funding"	0.045 [N/A]
Specialization and "Limited funding"	0.016 [N/A]
Age and "Increasing cost"	0.023 [N/A]
Academic Panel	
No significant interactions	

Table 16: Comparison of study parameters between 2018 and 2011 studies

Study parameter	**Current study**			**Jaana et al. (2011) study**		
	Rural	Community	Academic	Rural	Community	Academic
Phase 1 participants	10	16	7	13	9	8
Phase 2 participants	9	14	6	12	9	8
Phase 3a participants	8	13	6	12	9	8
Phase 3b participants	8	12	6	12	8	8
Attrition rate	20 %	25%	15%	8%	11%	0%
Total issues reported in phase 1	26			35		
Total issues retained in phase 2	24			28		
Number of common issues	14			9		
Total issues ranked	19	19	21	18	20	17
Kendall's *W*	0.38	0.25	0.23	0.41	0.54	0.43

Delphi Study (Key IT Management Issues): "Brainstorming" - Question #1

Question
Please generate a list of 5-10 key issues that, in your opinion, are presently facing Chief Information Officers / IT executives in hospitals in Ontario.

A key issue is considered as an opportunity, threat, or problem that is associated with the effective use of IT in hospitals. Hence, it may relate to a management concern, an investment (application/technology), or organizational considerations (IT budgets, IT organizational structure etc.).

Instructions
- Use this document to generate your list.
- The list may include **5-10 key issues** in total.
- **Provide a brief description/explanation** for each issue.
- Save your list and return it by e-mail to **------@uottawa.ca**.

Below are two examples of key issues in IT management
1. *Attracting, developing, and retaining IT professionals*
2. *Developing and implementing an information architecture*

Please present below your list of key issues facing Chief Information Officers / IT executives in hospitals in Ontario and their description:

1.

2.

3.

4.

5.

6.

Etc.

Figure 6: Sample Questionnaire for the Brainstorming phase of the Delphi process

Delphi Study: Validation and relative importance of the key IT management issues – Questionnaire #2

Following the first stage of « brainstorming », which was conducted during the past month, we combined the responses of the 33 Chief Information Officers / IT executives participating in this study. During the analysis of the responses, we grouped some items together in order to simplify the comprehension of the most critical issues in IT management. The results and brief description of the issues are presented in random order in the table below.

In this second stage of the Delphi survey, we ask you to perform the following two tasks:

1) First, read carefully and **validate each of the key IT management issues and their respective description**. If you do not agree with the label and/or description of an issue, please provide your suggestions in « track change » mode or in the comments box below the table.

2) Second, and based on your personal experience, check the « **Degree of importance of each issue**» in IT management in hospitals. In order identify the importance of each issue, we ask you to use a **(1-7) scale**; 1= « Least Important» and 7= « Most Important».

Please remember that there is no right or wrong answer. Your individual opinion is the one that matters. Once you completed the table below, and answered the general respondent characteristics questions at the end, please save the document and return it by e-mail to Maria Syoufi (------@uottawa.ca), by **Thursday, May 4**. Thank you for your collaboration on this important research project.

Figure 7: Sample Questionnaire for the Narrowing Down phase of the Delphi process

Delphi Study: Ranking of IT management issues – Questionnaire #3

Following the second stage of this Delphi survey, we combined the responses of all Chief Information Officers / IT directors participating in this study. The resulting list of the most critical issues facing IT executives in hospitals in presented below **in random order** (a more detailed description is also provided at the end for your reference).

In this third and last stage of the Delphi survey, we ask you to **rank from 1 to 21** the issues according to their importance. In order to simplify this task, please complete the questionnaire as follow:

1) As a first step, identify the 5 most important issues among the 21 issues below. Then, rank these five issues in order of important (1=most important to 5=least important). You may indicate the letter corresponding for each IT management issue in the boxes under Group I.

2) Repeat this exercise with the remaining IT management issues on the list and indicate the letter corresponding to boxes 6 to 10 under Group II (6= most important, 10= least important).

3) Repeat the exercise until all IT management issues in the list are ranked.

Please remember that there is no right or wrong answer. Your individual opinion is the one that matters. Once you completed the table below, please save the document and return it by e-mail to Maria Syoufi (------ **@uottawa.ca)** by **Friday, June 23**. Thank you for your collaboration on this important research project.

Figure 8: Sample Questionnaire for the First Ranking round of the Delphi process

Delphi Study: Ranking of IT management issues (Round 2)

We conducted the data analysis based on the answers to the final question (ranking of the IT management issues), and the level of agreement between the panellists was low. In order to ensure rigor in the analysis according to the standards for the Delphi methodology, I kindly ask you to take 5 minutes to rank the IT management issues again in order of importance.

To facilitate the process, the 21 issues in the table are presented according to the average ranking obtained from all the panellists (i.e. from the highest to the lowest average ranking of importance obtained in the previous ranking). Please follow the steps below to complete your ranking:

1) Identify the 5 most important issues among the 21 issues below. Then, rank these five issues in order of important (1=most important to 5=least important). You may indicate the letter corresponding for each IT management issue in the boxes under Group I.

2) Repeat this exercise with the remaining IT management issues on the list and indicate the letter corresponding to boxes 6 to 10 under Group II (6= most important, 10= least important).

3) Repeat the exercise until all IT management issues in the list are ranked.

Please remember that there is no right or wrong answer. Your individual opinion is the one that matters. Once you complete the table, please save the document and return it by e-mail to ------@uottawa.ca by **Friday, August 25**. Thank you for your collaboration on this important research project.

Figure 9: Sample Questionnaire for the Second Ranking round of the Delphi process