PHYSICIAN COMMUNICATION VIA INFORMATION AND COMMUNICATION TECHNOLOGY

PHYSICIAN COMMUNICATION VIA INFORMATION AND COMMUNICATION TECHNOLOGY: UNDERSTANDING ITS ROLE IN HEALTH SYSTEM PERFORMANCE

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Lay Abstract

The goal of this doctoral dissertation was to develop a better understanding of how and why physicians are using information and communication technology (ICT) to exchange health care related information, along with the role of such communication in enhancing health system performance. Findings indicate that physicians use ICT in various circumstances as they perceive it to be more convenient and efficient. However, guidelines for the exchange of health information in digital/electronic format vary by jurisdiction and organization, which may result in different uses of ICT by physicians. Moreover, as these guidelines often lack clarity or are not seen as credible/legitimate, some physicians base their use of ICT primarily on what peers/colleagues are doing or by acting in a manner that they believe facilitates task completion and, hence, patient care. The insights gained from this work can be adopted by decision-makers to improve communication among physicians using ICT and, consequently, health system performance.

Abstract

Information and communication technology (ICT) can enhance communication among health care providers which may lead to various health system improvements, such as gains in efficiency. However, there is inadequate evidence regarding the extent to which ICT improves communication among specific groups of health care professionals. This dissertation incorporates a mix of methodological approaches across three interrelated research studies to address this gap. Study 1 consists of a systematic review which suggested that ICT can play an important role in enhancing health care related communication among physicians, but the extent of that benefit is influenced by: 1) the impact of ICT on existing work practices; 2) the availability of adequate resources for ICT implementation and use; and 3) the nature of institutional elements, such as privacy legislation. Study 2 consists of a document analysis that examined guidelines for health information protection when using ICT from the provincial regulatory colleges for physicians. These documents were notable for the considerable variation in the scope and detail of guidance provided, which may result in unequal and inequitable protection of health information across the provinces. Study 3 is a case study that examined the use of a relatively novel form of ICT, smartphones, for communication among postgraduate medical trainees (medical residents). Efficiency and convenience were identified as the main reasons that medical residents use smartphones to communicate health care related information with colleagues. In addition, by applying a neo-institutional perspective, it became clear that medical residents base their smartphone use primarily on normative elements (professional norms; what peers/staff are doing) and cultural-cognitive elements (beliefs/perceptions regarding facilitation of task completion). Regulative elements (guidelines/policies) around smartphone use play a smaller role in shaping behaviour, particularly when they: 1) lack clarity; 2) are not seen

as credible/legitimate; or 3) are viewed as cumbersome and do not align with workflow needs. Taken together, these studies provide timely insights regarding the use of ICT by physicians, which can be drawn upon by a variety of decision-makers as efforts to improve health system performance continue.

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List of all Abbreviations and Symbols

ACM	Association for Computing Machinery
EHR	Electronic Health Record
EMR	Electronic Medical Record
FMRAC	Federation of Medical Regulatory Authorities of Canada
HIT	Health Information Technology
HITECH	Health Information Technology for Economic and Clinical Health
ICT	Information and Communication Technology
IET	Internet-Enabled Technology
MMS	Multimedia Messaging Service
PACS	Picture Archiving and Communication Systems
PIPEDA	Personal Information Protection and Electronic Documents Act
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SMS	Short Message Service

Declaration of Academic Achievement

This dissertation is comprised of three original research studies (Chapters 2-4), as well as an introduction (Chapter 1) and conclusion (Chapter 5). I, Neil Barr, am the lead author of these chapters. I was responsible for the conception and design of each of the three studies in collaboration with my primary supervisor, Dr. Glen Randall. I completed all data collection and analysis for these studies, and prepared the drafts for all chapters. Dr. Randall contributed to the analysis and provided feedback on the written chapters. My other PhD supervisory committee members—Drs. Norman Archer and David Musson—provided comments and suggestions on various drafts, which were incorporated into subsequent revisions and the final version of the dissertation.

Chapter 1

Introduction

This chapter provides an introduction to a doctoral dissertation that includes a series of three chapters containing original research studies (which contribute new knowledge to the field of study), and a concluding chapter (which draws out the overall implications of the research). The introduction begins with an examination of the context for the topic of interest—Physician Communication via Information and Communication Technology (ICT)—followed by identification of the existing gaps in the current body of research literature. Next, the overarching research question, objectives, and the theoretical framework of the dissertation are presented. The chapter concludes with outlines for the studies detailed in Chapters 2, 3, and 4 (including how each study addresses the current gaps).

Background/Context

> *"Information is the lifeblood of modern medicine. Health information technology (HIT) is destined to be its circulatory system. Without that system, neither individual physicians nor health care institutions can perform at their best or deliver the highest-quality care, any more than an Olympian could excel with a failing heart."* (Blumenthal, 2010, p. 382).

Improving health systems is an international priority. To this end, efforts have taken various forms such as increasing access to care, enhancing quality, and reducing costs through greater efficiency in the use of resources. Governments often promote innovations as a means of achieving these goals. One area that has received a great deal of attention in recent years has been the incorporation of ICT (the use of systems for collecting, storing, retrieving, manipulating, and sending information digitally/electronically) into the health system (e.g., Chaudhry et al., 2006; Gagnon et al., 2009; Gentles, Lokker, & McKibbon, 2010; Ontario Telemedicine Network, 2017).

Over the last two decades, numerous governments and organizations have promoted various forms of ICT as a strategy geared toward improving health systems. For instance, Canada Health Infoway, a not-for-profit organization established in 2001 and funded by the federal government of Canada, was established to "improve the health of Canadians by working with partners to accelerate the development, adoption and effective use of digital health solutions across Canada." (Canada Health Infoway, 2017). Similarly, in 2005, the National Health Service in the United Kingdom established *Connecting for Health*, part of the Department of Health Informatics Directorate tasked with developing and maintaining a national ICT infrastructure (The National Archives, 2013). Also in 2005, the 58th World Health Assembly remarked on the potential impact that advances in ICT could have on "health-care delivery, public health, research and health-related activities for the benefit of both low- and high-income countries" (World Health Organization, 2005, p. 109) and encouraged member states to make plans to incorporate ICT into their health systems. Since that time, numerous countries have made substantial investments in infrastructure, education, and implementation related to ICT initiatives. For example, the Health Information Technology for Economic and Clinical Health (HITECH) Act in the United States in 2009 resulted in approximately $30 billion being spent to promote and expand the adoption of ICT in health care (Jha, 2010).

The use of ICT is an important progression in the delivery of health care services as traditional approaches are often limited by practical barriers, such as geography. ICT, on the other hand, may enhance interactions and information exchange among health care professionals, eliminating the barrier of distance and enabling a more patient-centred system (Ontario Ministry of Health and Long-Term Care, 2012). Moreover, greater use of ICT has the potential to address problems of access, quality, distribution of health human resources, and continuity of care

(Demiris, 2006; Lewis, 2010; Ndegwa, 2011). As a result, substantive gains in equity may be realized (e.g., in rural areas; Zanaboni et al., 2009), particularly for the most vulnerable populations (such as seniors living with chronic conditions; Dorr, Wilcox, Brunker, Burdon, & Donnelly, 2008). However, while some forms of ICT have improved access to services, they fall short in terms of demonstrating improvements in other aspects of service delivery (e.g., in reducing emergency room visits; Hopp et al., 2006; Takahashi et al., 2012) or have been inconclusive due to inadequate data (e.g., Hogenbirk, Liboiron-Grenier, Pong, & Young, 2005; Wootton, 2012). In addition, the cost-effectiveness of ICT remains to be established (Lewis, 2010), but appears to be highly dependent upon the type of care provided (e.g., Rojas & Gagnon, 2008). This mix of evidence regarding the benefits of using ICT suggests the need for more research, which can be used to inform policy decisions and efforts to reform health systems.

With the advent of the Internet in the mid-1990s, ICT has undergone a dramatic transformation. We now have the ability to text, e-mail, search websites, and use other online portals for sharing information. These newer forms of ICT that rely on the Internet for most of their functions will be the focus of this dissertation.

The use of ICT can enhance communication among health care providers, which may lead to various health system improvements, such as gains in efficiency (Buntin, Burke, Hoaglin, & Blumenthal, 2011). While ICT has tremendous potential to enhance communication among health care providers—leading to health system improvements—policy and organizational concerns abound. More specifically, the use of ICT can challenge existing work processes and social interactions among providers and patients (i.e., its introduction influences professional and organizational dynamics). To ensure successful integration, the characteristics of patients, providers, and local context need to be taken into account (Lamothe, Fortin, Labbe, Gagnon, &

Messikh, 2006). Due to these challenges, further research focusing on the interactive relationships among technology, health care professionals, and organizational systems is needed (Lamothe et al., 2006; May et al., 2009). Developing a better understanding of how ICT is being used by health care providers for communication may assist in the formation of approaches that aim to maximize efficiency and effectiveness.

Gaps Identified in the Current Literature

Upon review of the current body of literature regarding the use of ICT in health care settings, it became apparent that several research gaps existed.

1. Most studies on this topic have concentrated on a single form of technology, such as e-mail (Goyder, Atherton, Car, Heneghan, & Car, 2015; Walsh et al., 2013), or a single purpose for using the technology, such as e-referrals or e-consults (Esquivel, Sittig, Murphy, & Singh, 2012; Zoll, Parikh, Gallimore, Harrell, & Burke, 2015).
2. Provider perspectives on newer forms of ICT for enhancing communication, such as social media, are limited (Antheunis, Tates, & Nieboer, 2013).
3. There is inadequate evidence regarding the extent to which ICT improves communication among specific groups of health care professionals (Wu et al., 2011, 2012).
4. The use of theory—which can be used to frame research questions, help explain findings, and predict outcomes—is limited.
5. Most studies have been survey-based and, thus, there is a lack of in-depth investigations with providers as to why certain forms of ICT are used or not used in practice (i.e., there is a need to explore factors underpinning use as opposed to effectiveness).
6. Most studies have taken either an organizational/system focus or provider/patient focus, rarely both. Therefore, a closer examination of the interplay between the system and

providers is warranted (i.e., social processes; Mair et al., 2012).

7. There is limited evidence regarding how various forms of ICT affect communication practices (which types are most likely to be incorporated into existing processes; Manojlovich et al., 2015).

Overarching Research Question and Objectives

In an attempt to fill some of the aforementioned gaps in the current literature, this dissertation includes three original research studies. Taken together, these studies—outlined below and presented in Chapters 2, 3, and 4—seek to address the following research question: "To what extent and under what conditions are physicians using ICT for communication of health care related information, and what is its role in enhancing health system performance?" To answer the research question, the objectives of this dissertation are:

1. To examine the current use (scope, impact, rationale) of ICT for communication of health care related information among physicians (Study 1 and Study 3).
2. To explore the potential impact of ICT on enhancing physician-to-physician communication of health care related information (Study 1 and Study 3).
3. To develop a better understanding of the role that institutional elements/structures (rules, norms, and beliefs/perceptions) play in the use of ICT by physicians (facilitators and barriers; Study 2 and Study 3).
4. To generate evidence regarding the use of ICT by physicians, which can be drawn upon by various stakeholders for their respective decision-making (Study 1, Study 2, and Study 3).

Overarching Theoretical Framework of the Dissertation

As Sabatier (2007) has indicated, "Given the staggering complexity of the policy process,

the analyst must find some way of simplifying the situation in order to have any chance of understanding it. One simply cannot look for, and see, everything" (p. 4). Theories and frameworks can be very useful in this regard. They act as tools to help explain political events, outcomes, or policy change, as well as clarify thinking about government, politics, and policy actors. One such theory, neo-institutionalism, considers the processes by which *institutions* become established as authoritative guidelines for social behaviour. Institutions can be informal, such as customs, or formal, such as policies developed by governments. These "structures" or "mechanisms" are important considerations in social science research as they are strong influences on human behaviour.

The key elements of institutions, which Scott (2011, 2014) refers to as *pillars* (i.e., regulative, normative, and cultural-cognitive) are based upon the most prevalent aspects of institutions. Each of these pillars is useful in helping to explain social processes and behaviour by examining what individuals *have to do* (regulative), *ought to do* (normative), and *want to do* (cultural-cognitive). This theoretical framework (neo-institutionalism/the three pillars of institutions) has general application to this entire dissertation, but specific relevance to Study 3 (discussed below and in Chapter 4).

Overview of the Studies

Study 1 (Chapter 2): "Physician Communication via Internet-Enabled Technology: A Systematic Review"

The second chapter describes the findings from a systematic review of the scholarly literature that was conducted to gain a greater understanding of the role that ICT plays in enhancing communication among physicians. More specifically, the review sought to identify evidence regarding how, to what extent, and why ICT is being used for physician-to-physician

communication. First, a diverse set of databases and keywords related to ICT were used to capture multiple forms and uses of ICT (addressing research gap #1). Second, as the review covered the period between 2005 and 2015, this study provides recent information regarding provider perspectives on newer forms of ICT (addressing research gap #2). Finally, as communication among physicians by electronic means is not well understood (Dunn & Markoff, 2009; Horwitz & Detsky, 2011), this study provides additional information that is needed for physicians, a particular group of health care professionals (addressing research gap #3).

In this study, physicians' satisfaction with ICT is examined, and whether their use of ICT affects efficiency and clinical decision-making. In addition, several key aspects that influence the extent to which ICT enhances communication among physicians, and, as a consequence, the impact on health system performance are discussed.

Study 2 (Chapter 3): "Guidance for the Use of Information and Communication Technology: Health Information Protection and Physician Regulatory Colleges in Canada"

To further investigate the overarching research question regarding the conditions under which physicians are using ICT for communication, Study 2 involves the examination of guidelines from provincial regulatory colleges for physicians that govern ICT, as such guidelines can affect the use of ICT. How these guidelines are interpreted by physicians and their associated regulatory bodies can make a difference to health information exchange practices. The protection of health information in digital/electronic format is a concern in many health systems, along with the need to better understand how institutional elements/structures (such as privacy legislation) affect the use of ICT by physicians. Therefore, guidelines related to the protection of health information were the focus of this study. In this vein, the purpose of Study 2 was to examine

guidance from Canada's provincial regulatory colleges for physicians regarding the protection of health information when using ICT, and to assess the associated policy and service delivery implications for health system performance. Through this process, this study examined the relatively understudied area of institutional theory (elements/structures) that may affect ICT use (i.e., policies, guidelines; addressing research gap #4). The study also applied to all forms of ICT potentially used by physicians (addressing research gap #1), while examining relationships between the system and a specific group of providers (addressing research gap #6).

In this study, a comparative analysis of the policies, guidelines, and standards of practice from physician regulatory colleges across the Canadian provinces is described and the characteristics of the included documents are outlined (i.e., variation in the scope and detail of guidance provided among the provincial regulatory colleges). This is followed by a discussion of the possible explanations for variability across the provinces along with policy and service delivery implications for health system performance.

Study 3 (Chapter 4): "Use of Smartphones for Communication by Postgraduate Medical Trainees: A Perspective from Neo-Institutional Theory"

The fourth chapter of the thesis describes a case study that examined the use of a relatively novel form of ICT (smartphones), for communication among postgraduate medical trainees (medical residents; addressing research gap #2). Previous studies of smartphone use in this population have been mainly limited to surveys. The purpose of Study 3 was to gain an in-depth understanding of how and why medical residents are using smartphones to communicate health care related information with other physicians in daily practice (addressing research gap #5). In addition, most previous research has been atheoretical. The application of a neo-

institutional lens in conducting the analysis provides a greater understanding—and more robust explanation—of the conditions under which smartphones are being used for communication by medical residents, which can help predict future effects (addressing research gap #4).

In this study, semi-structured interviews were conducted that were geared toward understanding how/why smartphones were being used in daily practice and the institutional/organizational factors that influenced their use. This study was designed to provide important information regarding the interplay between meso and micro levels of social processes at work and the interplay between the "system" and providers (addressing research gap #6). Using this approach, the various ways in which smartphones are being used for communication by medical residents, and the underlying reasons for their use, are summarized. In addition, using neo-institutional theory, medical residents' experiences with, and opinions of, guidelines governing the use of smartphones are examined. These findings are discussed in connection with the implications for researchers, policy, and practice.

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Chapter 2

Physician Communication via Internet-Enabled Technology: A Systematic Review

Preface

The final, definitive version of this paper has been published in Health Informatics Journal, October 9, 2017, by SAGE Publications Ltd, all rights reserved. © The Authors. The version presented here is the original manuscript that was submitted to the journal (i.e., prior to peer review). The citation for the published paper is:

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I, Neil Barr, was responsible for the conception and design of the study, with input from my supervisory committee (Drs. Randall, Archer, and Musson), and for completing all data collection and analysis. Dr. Randall also contributed to the analysis through continual feedback. I drafted the chapter, and my supervisory committee provided critical comments and suggestions for important intellectual content that were incorporated into subsequent revisions.

Abstract

Governments routinely consider ways to improve health care systems. Communication among health care providers is one area that has received attention as research has demonstrated close links between better communication and service delivery improvements. The use of Internet-enabled technology (IET; information and communication technology such as smartphone apps and videoconferencing) is one approach that may enrich information exchange among providers and, consequently, improve health care delivery. However, evidence is limited regarding the extent to which IET improves communication among specific groups of health professionals. In particular, physician-to-physician communication is a domain that is not well understood. The purpose of this systematic review was to gain a greater understanding of the role that IET plays in enhancing communication among physicians—which may inform current practices and future research—by examining evidence in the scholarly literature. Studies were identified through a search in three electronic platforms: the Association for Computing Machinery Digital Library, ProQuest, and Web of Science (which included 12 databases/indexes). The search identified 5,140 articles; of these, 21 met all inclusion criteria. Through a process of narrative synthesis, it was determined that physicians were more satisfied with IET than conventional communication methods, but a lack of consensus emerged regarding whether health information exchange was more efficient and if communication via IET makes a difference to clinical decision-making. This review suggests that IET can play an important role in enhancing communication among physicians, but the extent of that benefit is influenced by: 1) the impact of IET on existing work practices; 2) the availability of adequate resources for IET implementation and use; and 3) the nature of institutional elements, such as privacy legislation. Inattention to these factors may

result in less than optimal improvements in communication among physicians and, as a corollary, health system performance.

Keywords: systematic review, Internet-enabled technology, communication, physicians, health policy, health services

Introduction

Governments routinely consider ways to improve health care systems such as increasing access to care, enhancing quality, and controlling costs. Communication among health care providers is one area that has received attention as research has demonstrated close links between better communication and service delivery improvements. For example, good communication has been shown to be crucial for advancing coordination of patient care (Walsh et al., 2013), ensuring patient safety (Dunn & Markoff, 2009; Leonard, Graham, & Bonacum, 2004), minimizing duplications in efforts across providers, and limiting inappropriate use of health care services (Reeves & Freeth, 2003).

In the current *digital age*, information and communication technology (ICT) has been widely promoted as a means of achieving health care system improvements (e.g., Chaudhry et al., 2006; Fiander et al., 2015; Gagnon et al., 2009). The general premise is that the resultant "electronic bridges"—which allow for interactions among multiple users either in real-time or asynchronously—can help enrich information exchange among health care providers (Reeves & Freeth, 2003). Some evidence suggests that enhanced communication through the use of ICT can improve health outcomes, health care provider performance, quality of care, coordination and efficiency of services, and patient engagement in care (Blumenthal, 2010; Buntin, Burke, Hoaglin, & Blumenthal, 2011). However, evidence continues to be limited regarding the extent to which ICT improves communication among specific groups of health professionals (Wu et al., 2011, 2012).

Rationale and Purpose

Physician-to-physician communication by electronic means is not well understood (Dunn & Markoff, 2009; Horwitz & Detsky, 2011; Walsh et al., 2013). Most studies in this area have focused on one type of technology, such as e-mail or electronic health records (Goyder, Atherton, Car, Heneghan, & Car, 2015; Walsh et al., 2013). In addition, perspectives on newer forms of ICT for enhancing communication, such as social media and smartphone apps (i.e., Internet-enabled technology; IET), are limited. Given their influence as frontline care providers, physicians can affect work processes (e.g., the implementation of clinical practice guidelines or setting the "climate/tone" of the health care environment). Furthermore, physicians can play an important role in the uptake of new technology as their behaviour may shape that of other physicians and health care providers (de Grood, Eso, & Santana, 2015). The purpose of this systematic review was to gain a greater understanding of the role that IET plays in enhancing communication among physicians—which may inform current practices and future research—by examining evidence in the scholarly literature.

Method

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009), and the guidelines for undertaking systematic reviews in health care from the Centre for Reviews and Dissemination (2009), were used as a model for conducting this literature review. Studies were identified through a search in three electronic platforms: the Association for Computing Machinery (ACM) Digital Library, ProQuest, and Web of Science. Across these platforms, 12 databases/indexes were examined (e.g., MEDLINE), which were selected based on the relevance of their subject content to the

topic of study. Keywords/search terms related to IET, communication, and physicians. The search identified articles with a combination of the specified keywords in—one or more of—the papers' title, abstract, keywords, or full-text.

Study Selection and Eligibility Criteria

To be eligible for inclusion in the study, articles needed to: 1) be published in a peer-reviewed journal; 2) be accessible in English; 3) be published between 2005 and 2015; and 4) have IET for health care communication among physicians as the primary objective of the investigation. Non-primary research articles (e.g., editorials, study protocols) were excluded, with the exception of systematic reviews. The search was limited to the last 10 years to capture more recent forms of ICT (i.e., IET).

Following initial screening (titles and abstracts), the full-text of each remaining article was reviewed to determine if eligibility criteria were met. In addition, the references in the included articles were examined for other eligible studies.

Data Screening and Extraction

The following data were extracted from the articles that met eligibility criteria: article/study author(s) and year of publication; demographic(s); objective(s)/research question(s); study design/method; technology used; and main outcomes (see Table 1).

Quality Assessment

Qualitative and/or quantitative data reported in the articles were assessed for methodological rigour using Kmet, Lee, and Cook's (2004) validated tool *QualSyst*. The tool consists of 14 items/questions for quantitative studies, 10 items/questions for qualitative studies, and a related scoring system (from 0 to 1; higher scores are indicative of greater quality). Items relate to components such as: a clear description of the research question or objective; whether

the sample was appropriate; a description of data collection/analysis; and tying the findings back to theory or the broader literature. While Kmet et al. do not assign specific values to the possible scores (e.g., 0.4 = "poor quality"), they discuss various cut-points for the overall scores (possible cut-off scores included < 0.55, < 0.60, < 0.65, < 0.70, and < 0.75). Based on these cut-points, and for the purposes of this study, less than 0.55 was considered lower quality, 0.55 to 0.75 was considered moderate quality, and greater than 0.75 was considered higher quality.

QualSyst has been used in other health care related systematic reviews (e.g., Di Rezze et al., 2016; Mulvale et al., 2016), and is considered a key resource for appraising evidence in the literature (Booth, Papaioannou, & Sutton, 2012).

Analytic Approach/Synthesis of Findings

Findings were summarized and analyzed through a process of narrative synthesis. A preliminary synthesis consisted of grouping the included studies in a way that helped to describe and analyze the data. This involved looking for patterns within and across groups (Centre for Reviews and Dissemination, 2009). The identified groupings consisted of: 1) the type of IET that was being used, such as mobile devices and web portals; and 2) the reason why IET was being used, such as consultation and notification. To explore relationships within and across studies *idea webbing* and *conceptual mapping* were used, which involved visual methods to aid in the development of groupings and associations. These techniques are used "(i) to group findings that are empirically and/or conceptually similar and (ii) to identify (again on the basis of empirical evidence and/or conceptual/theoretical arguments) relationships between these groupings." (Centre for Reviews and Dissemination, 2009, p. 52). The analysis consisted of identifying the recurrent and/or most prevalent themes across the studies.

Results

Search Outcomes

The search identified 5,140 articles (70 from the ACM Digital Library, 1,609 from ProQuest, and 3,461 from Web of Science). Of these, 5,044 articles were excluded during initial screening (5,042 through title and abstract review; two were duplicates across databases). Of the 96 remaining articles that underwent full-text review, 39 were excluded as IET for health care communication among physicians was not the primary objective of the investigation (i.e., other health care providers were included and the results could not be separated by profession); 16 were not focused on communication; seven did not include IET; and 21 were removed for not being primary research studies (e.g., they were commentaries or they described a protocol). Three systematic reviews were identified by the search, but only one was included. The other two were removed as either: 1) the studies included in the review were older than 2005; or 2) the studies included in the review were already identified in the main search. The references in the 13 remaining articles were examined for additional studies. Thirty-three articles that met the inclusion criteria were identified and eight of these were included, bringing the final number of articles contained in the review to 21 (see Figure 1).

Descriptive Summary (Study Characteristics)

Of the 21 studies that were included for final analysis, 16 used quantitative methods consisting of questionnaires/surveys (n=12), records/transcripts review (n=6), and a cost-effectiveness evaluation (n=1). Three studies used qualitative methods, consisting of interviews and/or focus groups (n=2), and a narrative synthesis from a systematic review (n=1). Two studies used mixed methods, consisting of focus groups and surveys.

The physicians participating in the 21 included studies were from a variety of medical specialties including cardiology, emergency, endocrinology, family/general practice, gerontology, intensive care, internal medicine, neurology, oncology (medical and radiation), psychiatry, pulmonology, radiology (breast, musculoskeletal, neurological, thoracic, vascular), and surgery (general and neurological). Most of the studies were conducted in the United States (n=10), followed by the United Kingdom (n=4), and Canada (n=2); while one study was conducted in each of the Czech Republic, Germany, Malaysia, and Singapore. The included systematic review (i.e., Vimalananda et al., 2015) contained studies from Canada, Finland, England, Ireland, and the Netherlands.

Quality Ratings

Of the 21 included studies, one was not suitable for evaluation as it was a systematic review and narrative synthesis (Vimalananda et al., 2015). Of the 20 studies that were assessed, 18 contained quantitative elements that were rated for quality; scores ranged from 0.50 to 1 (mean score = 0.82, high quality). Two of these studies used mixed methods (de Grood et al., 2015; Hunchak et al., 2015) and, thus, also had qualitative elements (scores = 0.60 and 0.55 respectively; mean score = 0.58, moderate quality). Two studies (Bouamrane & Mair, 2014; Carlin et al., 2010) employed exclusively qualitative methods (scores = 0.80 and 0.75 respectively; mean score = 0.77, high quality).

Quantitative components that were consistently well done across the studies included: a sufficient description of the question or objective; selection of an appropriate design; provision of some variance estimates for the main results; detailed reporting of the results; and results supporting the conclusions. Items that were done less well and received lower scores included (one or more of): a description and appropriate method of subject selection; provision of

participant characteristics; details regarding appropriateness of sample size; and controls for confounding.

Qualitative components that were consistently well done across the studies included: a clear description of the research question or objective; selection of an appropriate design; clear context for the study; and connection to a theoretical framework or wider body of knowledge. Items that were done less well and received lower scores included (one or more of): description of a relevant and justified sampling strategy; a clear, complete, and systematic data collection method; use of verification procedures to establish credibility (e.g., member checks, inter-rater reliability); and reflexivity of the account (i.e., assessment of the researchers' impact of their personal characteristics and the methods used on the data obtained; Kmet et al., 2004).

Narrative Synthesis

Preliminary synthesis. As previously stated, the initial grouping process consisted of categorizing: 1) the type of IET that was being used across the included studies; and 2) the reason why IET was being used. The types of IET consisted of electronic health records (EHRs; 8 studies); mobile devices (5 studies); e-mail (4 studies); image transmission and storage/picture archiving and communication systems (PACS; 4 studies); and web portals (3 studies). The reasons for IET use consisted of consultation and clinical decision-making (7 studies); image transmission (5 studies); notifications (3 studies); quality (2 studies); reporting turnaround time/enhancements in efficiency (2 studies); communication not otherwise specified (2 studies); referral (1 study); transfer of care summary (1 study); access (1 study); and cost (1 study).

Exploring relationships within and between studies. Using idea webbing and conceptual mapping (as discussed earlier), and based on the objectives of the included studies, the reasons for use, and the findings/results), three main groups/themes were identified. Namely,

provider satisfaction with IET (the extent to which physicians perceived IET to be more or less satisfactory than traditional practices), *efficiency of health information exchange* (the extent to which communication using IET was more efficient), and *the impact of IET on clinical decision-making* (the extent to which information provided via IET made a difference to clinical decisions/diagnoses). Each of these classifications will be discussed in turn.

Provider satisfaction with IET. Ten studies reported on physicians' perceived satisfaction with IET use (Abujudeh et al., 2009; Bouamrane & Mair, 2014; Brenke et al., 2014; Dalal et al., 2011; de Grood et al., 2015; Hunchak et al., 2015; Palen et al., 2012; Sadigh et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015). These perceptions were related to different categories of IET, including e-mail notifications (n=3), the transfer of images (n=3), consultations via an EHR/web portal (n=2), electronic referrals (n=1), and the transfer of care summaries (n=1). In general, physicians agreed that these various forms of IET were more satisfactory than conventional methods of communicating, such as e-mail compared to fax (Abujudeh et al., 2009; Bouamrane & Mair, 2014; Dalal et al., 2011; de Grood et al., 2015; Hunchak et al., 2015; Sadigh et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015). The main reasons for greater satisfaction included ease of use/convenience, speed of access/turnaround time, improved information-sharing and clarity, increased awareness of the care that patients received, and improved continuity of care (Abujudeh et al., 2009; Bouamrane & Mair, 2014; de Grood et al., 2015; Hunchak et al., 2015; Sadigh et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015). However, some studies revealed dissatisfaction with certain elements of IET (Bouamrane & Mair, 2014; de Grood et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015), or no difference in satisfaction compared to traditional methods (Palen et al., 2012). The main reasons for dissatisfaction were concerns related to IET being

slow, difficulties with access to information, and associated time consumption (Bouamrane & Mair, 2014; de Grood et al., 2015; Vimalananda et al., 2015).

Efficiency of health information exchange. Ten studies reported on the efficiency of information exchange among physicians and the associated implications, such as whether time or money could ultimately be saved (Callahan et al., 2005; Carlin et al., 2010; de Grood et al., 2015; Filip et al., 2012; Frommelt et al., 2008; Mackinnon et al., 2008; Palen et al., 2012; Sadigh et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015). Across a variety of IET uses, physicians reported a reduction in response time for consults. In addition, questions related to diagnosis and management were answered in less time compared to traditional methods (Callahan et al., 2005; Carlin et al., 2010; Frommelt et al., 2008; Palen et al., 2012; Vimalananda et al., 2015). These reductions occurred despite overall increases in consult requests (Frommelt et al., 2008; Mackinnon et al., 2008). However, in some of the reviewed studies, while health care related information was transferred between physicians faster, it took longer to prepare and complete in digital form, raising questions of whether widespread IET use may waste resources (Carlin et al., 2010, de Grood et al., 2015).

While the speed of access to information may be greater with IET (Sadigh et al., 2015; Tan & Lewis, 2010; Vimalananda et al., 2015), such access does not necessarily translate into actual use of the information that is received. The data available in such mediums may be seen as too time consuming to review (i.e., physician workflow can act as a barrier to reviewing additional information provided by IET; Sadigh et al., 2015). For example, downloading and evaluating images requires significantly more time using a mobile phone compared with a workstation, and viewing images on mobile devices is more time intensive due to the need for

greater image manipulation because of the smaller screen size (e.g., zooming, rotating; Filip et al., 2012).

The impact of IET on clinical decision-making. Seven studies reported on aspects of consultation/clinical decision-making (Bergus et al., 2006; Callahan et al., 2005; Filip et al., 2012; Franczak et al., 2014; Ng et al., 2007; Vimalananda et al., 2015; Waran et al., 2012). There was a lack of consensus across the studies as to whether information exchanged among physicians via IET made a difference to clinical decision-making. In the case of mobile phones, the quality of shared images was often perceived to be similar to those via hospital "workstations"/PACS. One study suggested that multimedia messaging service (MMS) use (i.e., "texting" or "messaging") obviated the need to view the original scans and increased levels of confidence in clinical decisions/diagnoses (Ng et al., 2007); while three studies suggested that the final diagnosis made using a mobile device did not differ from traditional methods (Filip et al., 2012; Ng et al., 2007; Waran et al., 2012). However, the use of conventional systems (i.e., PACS) allows for additional functionality such as variation of contrast and magnification, which may capture smaller structural changes compared to images via MMS (Waran et al., 2012). In the case of adding additional information from an EHR into PACS, or images to consults via a web portal, physicians felt that the extra information would be likely to impact diagnosis and/or medical management, but only in a small minority of cases (Callahan et al., 2005; Franczak et al., 2014).

Discussion

This study examined evidence in the scholarly literature regarding the role that IET plays in enhancing communication among physicians. Three core themes were identified, namely, provider satisfaction with IET, efficiency of health information exchange, and the impact of IET

on clinical decision-making. Here we discuss some of the associated implications of these themes for practice and policy as well as recommendations for future research.

Implications for Practice and Policy

Workflow. Evidence from the studies included in this review revealed that physicians were generally more satisfied with IET than conventional methods of communicating. However, in some instances, communication by electronic means can disrupt workflow and productivity due to interruptions in traditional practices which, consequently, may decrease satisfaction and influence the use of new technology (de Grood et al., 2015; Sadigh et al., 2015). For example, with the evolution of mobile devices, physicians may be more likely to have work-related communication outside of their regular working hours, which can negatively impact work/life balance (Kuhlmann & Steinberger, 2014). Given the ease with which communication can be sent via IET, physicians may feel an obligation to reply to correspondence immediately, as opposed to managing such communication at set times throughout the day when not engaged in other activities. Tending to every message when it is received, regardless of clinical importance, can lead to *alert fatigue* (wherein some messages may be ignored; Kesselheim et al., 2011), which may have adverse consequences for patient care. A potential solution to this problem is establishing configurable rules or flexibility within existing systems (Bouamrane & Mair, 2014; de Grood et al., 2015), such as limiting communication to the most critical and time sensitive information (Dalal et al., 2011; Sadigh et al., 2015). Restrictions on the immediacy of the flow of information may reduce the frequency of information that physicians receive after-hours and, thus, provide adequate down-time.

Resource requirements. While IET has the potential to positively affect health care delivery through more efficient communication (e.g., facilitation of daily work processes,

improvements in decision-making), such innovations require significant resources, which may be a considerable barrier to clinician acceptance. In particular, whether physicians use IET on a regular basis is dependent on financial compensation. Communication among medical specialties via IET is often poor, partly due to the fact that *fee-for-service* payment models lack incentives for information-sharing (Franczak et al., 2014; O'Malley et al., 2015). Without suitable remuneration, physicians may opt for practices they deem most efficient (Callahan et al., 2005). Therefore, if the goal is to enhance electronically mediated communication among physicians, payment structures—such as salaries plus workload based credits—will likely need to be in place to ensure the sustainability of these activities (Palen et al., 2012; Vimalananda et al., 2015).

Institutional structures. IET use is also influenced by institutional elements, such as regulatory processes, policies, and norms (rule-setting, monitoring, how things should be done; Scott, 2014). As concerns regarding the security of health care data are persistent (Callahan et al., 2005), there is a need for safeguards, like data transmission with end-to-end encryption, to ensure compliance with local privacy legislation. Adequate devices and networks also need to be in place (those that have the requisite security features, data transmission speeds, etc.) to ensure that timely, protected, and quality data are available (Brenke et al., 2014; Filip et al., 2012). These measures are particularly important when information is shared across jurisdictions or via short message service (SMS)/MMS (which are less secure forms of IET [Kuhlmann & Steinberger, 2014; Palen et al., 2012]).

Recommendations for Future Research

Following our review, several issues became apparent that warrant further consideration.

1. A small minority of the included studies used qualitative methods, such as interviews or focus groups. The emphasis on quantitative methods comes at the cost of not capturing

important details or nuances related to how and why physicians are using certain types of IET for communication, along with the associated impacts (e.g., disruption of workflow).

2. Only one of the included studies incorporated theory (i.e., Bouamrane & Mair, 2014). Use of theory is important as it provides a means for explaining findings, and affords the opportunity to examine and test theoretical constructs, which help predict behaviour.
3. Most studies focus on IET adoption, use, and gains in efficiency. Better metrics are needed for clinical outcomes, which have thus far been measured primarily by provider perceptions rather than objective criteria (Vimalananda et al., 2015).
4. A small number of the included studies (n=6) discussed the impact of maintaining the security of health information and/or the impact of privacy legislation on the use of IET. Research efforts to gain a greater understanding of how existing privacy legislation affects physician behaviour are needed. Depending on the specifics of such legislation, laws may actually constrain the use of particular forms of IET.
5. Only one of the included studies explicitly discussed the management of physician-to-physician communication by administrative/support staff. It would be helpful to gain a better understanding of how often this form of staff-managed communication occurs, the reasons why it occurs (e.g., are physicians too busy to learn how to use the technology?), and the associated implications.

Limitations

While this review used a systematic approach following established guidelines, numerous types of physician specialties were included across a variety of settings, and exclusion of studies based on design were relatively few, some limitations warrant mention. Firstly, given the heterogeneity of IET used in the included studies, and the diversity of contexts in which IET was

used, it is challenging to arrive at a consensus as to whether IET enhances physician-to-physician communication (based on satisfaction, efficiency, and clinical decision-making). Secondly, the overarching search strategy consisted of peer-reviewed academic literature from three electronic platforms (12 databases/indexes). The inclusion of other sources of information, such as gray literature, may have revealed additional relevant information and resulted in a more comprehensive assessment (other sources were not included for practical reasons/feasibility). Finally, the studies included in this review did not examine clinical communication among physicians in urgent circumstances, which limits the scope of our findings. However, acute patient care constitutes more complex informational exchange than non-acute care and, as a result, may require different forms of communication, such as telephone conversations or in-person meetings (i.e., some technology can limit "meaningful interactions"; Nguyen, McElroy, Abecassis, Holl, & Ladner, 2015).

Conclusion

Effective communication among physicians is important to the success of high performing health care systems. IET can help facilitate effective communication, but cannot ensure that it occurs. Failure of IET initiatives is often related to a focus on technology at the expense of social and organizational factors that will impact its use (e.g., attitudes, training time; Syväjärvi, Stenvall, Harisalo, & Jurvansuu, 2005). Therefore, as new technology is adopted, there is a need to understand and manage these domains. Depending on the context, IET use may lead to more but not necessarily better communication (Nguyen et al., 2015).

This review reveals that IET can play an important role in enhancing communication among physicians, but the extent of that benefit is influenced by: 1) the impact of IET on existing work practices (e.g., if it disrupts normal processes); 2) the availability of adequate resources for

IET implementation and use; and 3) the nature of institutional elements, such as privacy legislation. Inattention to these factors may result in less than optimal improvements in communication among physicians and, as a corollary, health system performance.

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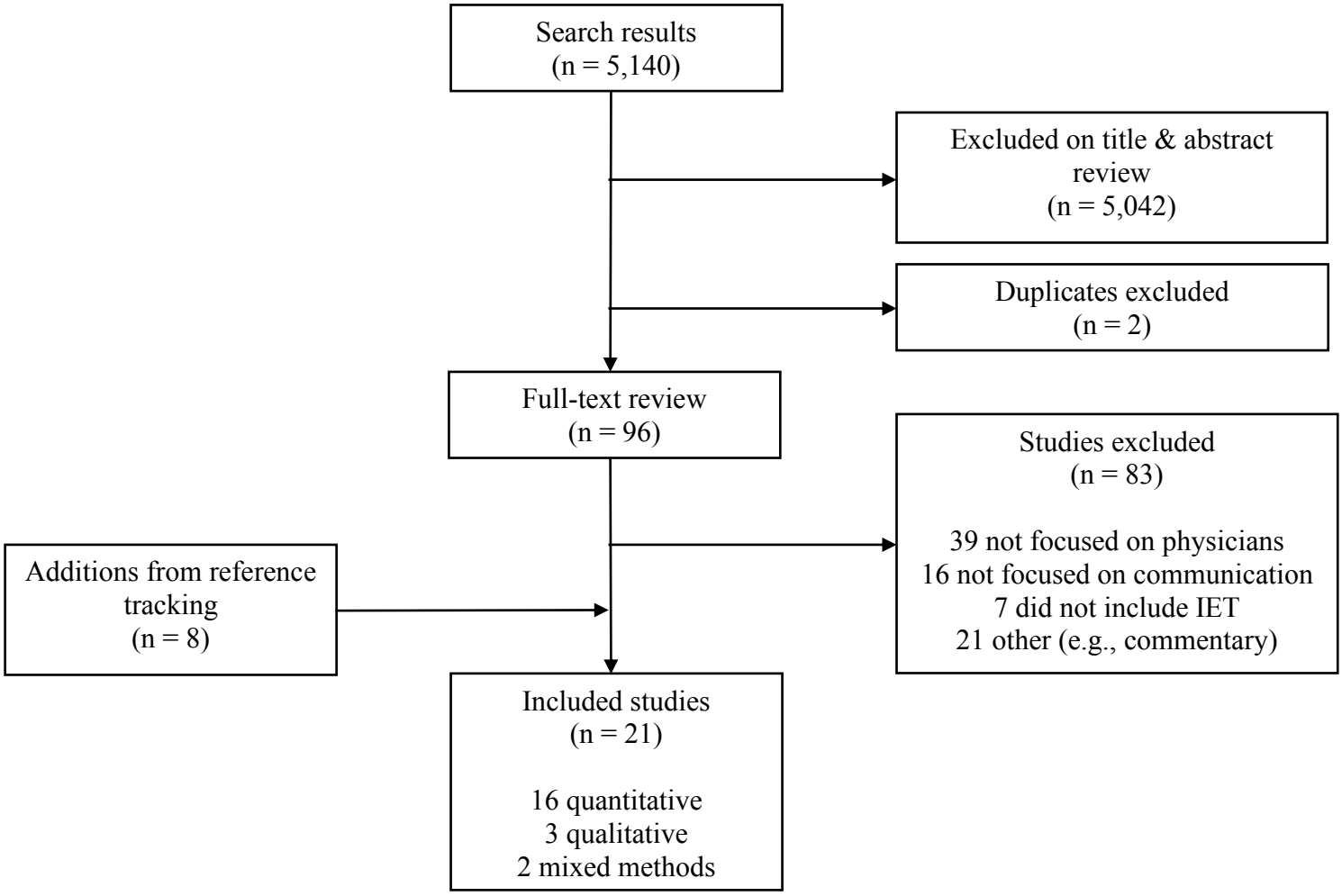

Figure 1. Flowchart of the search results. IET = Internet-enabled technology.

Table 1

Article Summaries

Study (First Author and Year)	Demographics	Objective(s)/Research Question(s)	Design/Method	Type of Technology Used	Main Outcomes
Abujudeh et al., 2009 Quality score: quantitative, 0.88	Massachusetts, USA. Radiologists and referring physicians.	To evaluate the effectiveness of a system that uses e-mail to alert referring physicians to an imaging finding.	Review of electronic records; physician survey to assess user satisfaction.	Important Finding Alert (IFA) system: for communicating radiologic findings via e-mail.	74.6% of the notifications were viewed by referring physicians. Most physicians felt that the IFA system was more satisfactory than conventional methods of communicating (e.g., messages arrived promptly and contained information that was important for patient care).
Bergus et al., 2006 Quality score: quantitative, 0.91	Iowa, USA. Over 100 family physicians and 34 different specialties.	To understand the conditions under which specialists asked for clinic consultations (and if the structure of questions influenced the likelihood of a specialty consultation).	Examination of e-mail transcripts between family physicians and specialists.	E-mail consult service.	A specialist's request for a clinical consultation is strongly dependent on how family physicians formulate their clinical questions (e.g., was an intervention or outcome included). Just over one-third of the e-mail questions could be categorized as "well formulated".
Bouamrane & Mair, 2014 Quality score: qualitative, 0.80	Scotland, UK. Primary care practitioners.	To identify factors that influenced the adoption and embedding of the Scottish Care Information (SCI) Gateway.	25 semi-structured interviews and one focus group.	Electronic referral; transmission of patient data and clinical requests (SCI Gateway).	Benefits: - automatic data population, immediate transfer of requests, improved use of guidelines/protocols, improved follow-up/tracking. Drawbacks: - administratively cumbersome, breakdown/loss of data, time consuming.
Brenke et al., 2014 Quality score: quantitative, 0.64	Germany. 187 neurosurgeons.	To assess: 1) the structure of on-call services in Germany; 2) rate of use and range of image transfer systems; 3) acceptance of modern technologies.	Nationwide survey of 141 neurosurgical units.	Teleradiology: image transfer via mobile phones and computers.	57% of the departments used a teleradiological connection to a physician's personal computer at home (62% used them). 41% of neurosurgeons were concerned that a smartphone display would be too small to detect relevant lesions.

					47% of neurosurgeons had a smartphone, but approximately 1% used it for image communication with the hospital.
Callahan et al., 2005 Quality score: quantitative, 0.72	USA. Primary care providers and 18 pediatric specialties.	To study a teleconsultation system regarding its impact on: - access to specialty care - quality of care - cost savings	Surveys, review panel, cost-effectiveness evaluation.	A web-based, store-and-forward, asynchronous, teleconsultation system.	The panel review determined that 32 routine air evacuations (12%) were avoided, with an estimated cost savings of $185,408. Diagnostic and management questions were answered in far less time than if patients and their families had to travel for specialty care.
Carlin et al., 2010 Quality score: qualitative, 0.75	Sussex, England, UK 16 consultant radiologists (CRs), 31 general practitioners (GPs).	To explore GPs' and radiologists' views on the use of a Picture Archiving and Communication System (PACS) in primary care.	Semi-structured interviews.	PACS.	Nearly half the CRs expressed concerns: access to images may increase GPs consulting time with patients, GPs lacked the skill to interpret images. Most GPs saw potential benefits of PACS including sharing the image with patients during a consultation, but all expressed anxiety about interpreting images.
Dalal et al., 2011 Quality score: quantitative, 0.71	Massachusetts, USA. Inpatient-attending physicians and network primary care physicians (PCPs).	To describe the design and implementation of a notification system for tests pending at discharge (TPADs).	Survey of attending physicians regarding their satisfaction with the system.	E-mail notification system.	E-mails were not copied to a PCP in 48% of cases. 84% of attending physicians stated that they were satisfied or very satisfied with receiving automated e-mail notifications of TPAD results.
de Grood et al., 2015 Quality score: quantitative, 0.83; qualitative, 0.60	Calgary, Alberta, Canada. Acute care physicians (ACPs) and community care physicians (CCPs).	To assess physicians' perceptions on an electronic transfer of care (e-TOC) communication tool.	Surveys with free text questions.	e-TOC; summary is uploaded to the provincial electronic health record (EHR).	ACPs Barriers: takes more time to complete the e-TOC summary compared to dictation; difficult to navigate. Opportunities: improved continuity of care and patient safety. CCPs Barriers: difficulty accessing the e-TOC summary through the provincial EHR. Opportunities: the addition of consultant notes, which would provide greater context for CCPs.

Filip et al., 2012 Quality score: quantitative, 0.82	Czech Republic. Neurosurgeons.	To compare the quality and efficacy of remote consultations between mobile phones and hospital workstations.	Clinical study (prospective).	Mobile phones and hospital workstations.	No differences were found in the quality of spinal images between the two modalities. Use of mobile phones is more time consuming and less comfortable due to screen size (i.e., more zooming and rotating of images is required). Final diagnoses did not differ based on modality.
Franczak et al., 2014 Quality score: quantitative, 0.95	Milwaukee, USA. Emergency department physicians; radiologists.	To determine how often the electronic health record (EHR) was perceived to provide relevant additional information for interpreting imaging studies.	Retrospective EHR data collection and analysis.	Teleradiology: EHR; computed tomography (CT; head); picture archiving and communication system (PACS).	Additional clinical information was rated as "possibly" having a clinically significant impact on interpretations in 22.3% of cases. Consensus agreement that additional clinical information would "very likely" influence the interpretation and medical management in 6.1% of patients.
Frommelt et al., 2008 Quality score: quantitative, 0.82	Wisconsin, USA. 5 cardiologists and 5 sonographers.	To compare the efficiency of phone-based transcription services with Digital Structured Reporting (DSR) for pediatric echocardiography.	Echocardiography study duration and time to report completion were retrospectively compared between phone-based transcription and DSR.	DSR - integrate and streamline health information for imaging.	Report generation time with DSR was significantly less than with transcription, coupled with a decrease in report completion time (up to 150 hours using transcription and only 24 hours using DSR). Decrease occurred despite an increase in monthly volume by 12%.
Hunchak et al., 2015 Quality score: quantitative, 0.75; qualitative, 0.55	Toronto, ON, Canada. 9 community family physicians.	To develop and pilot a communication tool, obtain physician feedback on usability, and compare family physician awareness of patients' ED visits pre- and post-system implementation.	Focus groups and written surveys.	A web-based communication tool consisting of a standardized e-mail notification.	During the study, 100% of the physicians received an e-mail notification of their patient's visit to the ER. Specific patient records were subsequently accessed online 60.7% of the time. There was a strong preference for receiving post-ED visit notifications by e-mail rather than by fax (78%).
Kuhlmann & Steinberger, 2014	USA. Pediatric hospitalists.	To evaluate whether text messaging is being used as a means of communication by	Electronic survey (16 questions) assessing use of	Cell phones: text messaging.	61% sent text messages (51% sending 1–10 text messages per shift, 5% sending 11–20, and 5% sending more than 20).

Quality score: quantitative, 0.88		pediatric hospitalists in the work environment.	cell phones and work-related text messaging.		60% receiving text messages: 47% receiving 1–10 text messages per shift, 9% receiving 11–20, 3% receiving in excess of 20. 53% received text messages when they were not on call.
Mackinnon et al., 2008 Quality score: quantitative, 0.90	London, England, UK. Radiologists at a teaching hospital.	To evaluate the impact of a picture archiving and communication system (PACS) on reporting times and productivity.	Mean reporting times, productivity, total department workload, and unreported film rates were compared pre and post PACS.	PACS.	Over 5 years, the number of studies performed per month increased by about 30%. Productivity, defined as number of films reported per whole time equivalent radiologist, increased by 18%. Despite the increases in the number of plain radiographs performed, there was an overall reduction in reporting times.
Ng et al., 2007 Quality score: quantitative, 0.50	Singapore. Tertiary neurosurgical service.	To determine: - how frequently a Multimedia Messaging Service (MMS) system was used. - whether the system facilitated clinical decision-making. - whether the quality of images was sufficient for clinical decision-making.	Questionnaire regarding the usefulness of MMS.	Mobile phones.	For most of the senior staff (4/7), the use of MMS significantly increased their level of confidence in clinical decision making. Most senior staff (6/7), suggested that the MMS images were sufficient to make a sound initial decision.
O'Malley et al., 2014 Quality score: quantitative, 1.00	USA. Primary care providers and various types of specialists.	To examine whether health information technology (HIT) use facilitated the care processes for ambulatory care–sensitive conditions (ACSCs).	Physician survey assessing the extent of HIT use.	Any HIT used by physicians (e.g., e-mail, electronic health record).	When more consistent interspecialty communication occurs, particularly with the support of HIT, rates of hospitalizations are lower among patients with ACSCs. HIT alone did not have significant main effects on ACSC rates.
Palen et al., 2012 Quality score: quantitative, 0.82	Kaiser Permanente Colorado, USA. Internal medicine and family physicians.	To compare primary care referring physician perceptions on the value of virtual consultations (VCs) compared to traditional consultations (TCs).	Surveys.	An integrated electronic health record along with a computerized	While less than 7% of all the consults were virtual, when used, 40% of the time a face-to-face consultation with the specialist was not needed.

				physician order entry.	Physicians received information from consultants more quickly using VCs than TCs.
Sadigh et al., 2015 Quality score: quantitative, 0.95	USA. 200 academic and community physicians representing four specialties.	To evaluate referring physicians' perceptions of multimedia-enhanced radiology reporting (MERR) as an alternative to traditional text-only reporting.	Web-based survey on satisfaction with text-only reports and the perceived value MERR.	MERR; text-based reporting.	Benefits: "Improved understanding of radiology findings by correlating images to text reports" (86%). "Easier access to images while monitoring progression of a disease/condition" (79%). Drawbacks: "too time intensive" (53%); "clinic workflow didn't allow for viewing" (42%). 80% of physicians indicated an increased likelihood of preferentially referring patients to facilities that offer MERR.
Tan & Lewis, 2010 Quality score: quantitative, 0.78	UK. Clinical physicians and radiology consultants.	To identify the main advantages and disadvantages of PACS as perceived by the users.	Questionnaires.	PACS.	Most agreed that PACS has advantages over the hard copy system in terms of: the speed of access; the ease of use; the reliability of the system; the ability to manipulate the digital images; the ability to discuss images with colleagues; images not getting lost.
Vimalananda et al., 2015 Quality score: NA	USA, Canada, Finland, England, Ireland, and the Netherlands Primary care providers (PCPs) and specialists.	To determine what is known about how e-consults are being implemented, what benefits they offer and what research gaps exist.	Systematic review.	E- consult: communication between providers within a shared electronic health record (EHR).	Benefits for PCPs: improved access to specialty input, avoidance of unnecessary patient travel. Concerns of PCPs: increased workload, being unable to select the specific consultant. Benefits for specialists: fewer inappropriate clinic visits, initial diagnostic testing or treatment had been completed prior to a clinic visit, and reduced disruption compared to phone or page. Concerns of specialists: persistence of unclear clinical questions, medicolegal liability due to the risks of providing advice on a patient who was never evaluated in person, and the need for adequate protected time and credit.

Waran et al., 2012 Quality score: quantitative, 0.83	Malaysia. Junior doctors in a neurosurgical unit and consultants on-call after hours.	To assess the accuracy and usefulness of sending short video clips using mobile phones.	Prospective review of patient images (sent using mobile phones and a standard viewer).	Mobile phones.	Agreement between the senior author and radiologists was reached over the primary diagnosis in 55 of the 56 patients (98%). There was a difference in the management of six patients (11%). In all six cases, the diagnosis made was similar between both observers; thus, it was concluded that the difference in management was due to professional opinions and not the modality used for diagnosis.

Chapter 3

Guidance for the Use of Information and Communication Technology: Health Information Protection and Physician Regulatory Colleges in Canada

Abstract

The use of information and communication technology (ICT) has tremendous potential to enhance communication among physicians, leading to improvements in health system performance. However, the protection of health information in digital/electronic format is an ongoing concern. The purpose of this study was to examine guidance for the protection of health information when using ICT from all 10 of Canada's provincial regulatory colleges for physicians and to identify the associated policy and service delivery implications for health system performance. The regulatory college website search identified 522 documents; 12 of these documents (from 8 of the 10 provincial regulatory colleges) met eligibility criteria for inclusion in the study. These documents were notable for the considerable variation in the scope and detail of guidance provided across the provincial regulatory colleges. While the federal-provincial division of powers in Canada enables different approaches to health service delivery based on jurisdiction and, thus, opportunities for policy learning, this governing structure may also contribute to a lack of incentive for collaboration, leading to an absence of standardized guidance for health information protection when using ICT. This, in turn, may result in unequal and inequitable protection of personal health information across the provinces. This suggests that a macro level approach to policy development in this area that involves multiple stakeholders—such as the Federation of Medical Regulatory Authorities of Canada—may hold the greatest promise for enhancing the protection of health information and doing so in a more standardized manner in federal systems.

Keywords: information and communication technology, physician communication, health information protection, document analysis, health system performance, health policy

Introduction

The use of information and communication technology (ICT) has tremendous potential to enhance communication among physicians, leading to improvements in service delivery and, thus, health system performance. Guidelines that govern ICT usage help determine how such technology will impact communication of health care related information among physicians. Consequently, such guidelines warrant examination. More specifically, how such guidelines are interpreted by physicians and their associated regulatory bodies can make a difference to health information exchange practices, which can affect the health system overall.

An instructive yet understudied aspect of ICT guidance in the domain of communication among physicians is maintaining privacy of health information when it is collected, used, stored, and disposed of in digital/electronic format. While advances in ICT have provided new ways for physicians to interact, the digitization of health information represents additional challenges for health systems. The risk of privacy breaches may be greater when information is shared online, as compared to traditional paper-based methods, given the potential breadth of data dissemination to outsiders and the permanency of digital "footprints" (Rindfleisch, 1997). Consequently, the development of privacy and security policies are needed that take such novel modalities of information-sharing into account (Meingast, Roosta, & Sastry, 2006; Rothstein, 2010) if the potential improvements in health system performance are to be realized.

The Protection of Privacy in Canada

Canada has two federal privacy laws to protect personal information: the *Privacy Act*, which applies to federal government agencies, and the *Personal Information Protection and Electronic Documents Act* (PIPEDA), which applies to the private sector (Office of the Privacy Commissioner of Canada, 2014). While the principal activities of public hospitals or publicly

funded long-term care facilities are not subject to PIPEDA, health care providers in private practice, such as physicians, are subject to PIPEDA, unless there exists specific provincial legislation that is substantially similar (Office of the Privacy Commissioner of Canada, 2015a).

While the Privacy Act and PIPEDA provide general guidance for the collection, use, or disclosure of personal information, they are not specific to health data and provide limited detail or guidance regarding how such data in digital/electronic form should be protected. The greatest direction provided in this regard suggests that "protection should include technological measures, for example, the use of passwords and encryption." (Minister of Justice, 2016, p. 51). In addition, these laws pertain to an array of activities. For example, an itemized receipt from a grocery store is covered under the same umbrella legislation as a report from a biochemistry laboratory. As a result, most provinces have established their own legislation to fill in the gaps with respect to the protection of health information (e.g., the Personal Health Information Protection Act in Ontario).

The "Patchwork" of Privacy Regulations Across Canada

The *Constitution Act, 1867* (formerly known as the *British North America Act, 1867*) lays out provincial and federal responsibility (Government of Canada, 2016). Health care in Canada falls primarily under provincial control as opposed to being a federal responsibility. As part of this division of powers, all provinces have the right to create and enforce their own privacy laws specific to health information (for a detailed list of provincial privacy legislation, refer to Office of the Privacy Commissioner of Canada, 2015b). Thus, there is a "patchwork" of regulations across Canada pertaining to issues of health information privacy.

The Regulatory Colleges for Physicians

The model governing physician practice in Canada is that of self-regulation, described as "the ability of a profession to predominantly control its own admission standards and requirements as well as the norms for its practice." (Schiller, 2015, p. 96). The premise is that, given their expert knowledge, members of a profession are themselves in the best position to set, maintain, and monitor standards for training and clinical practice, as well as hold individuals accountable for their behaviour. Canada has 10 medical regulatory colleges that were created by provincial governments to govern physician practice in their respective province. Working at arm's-length from government, these regulatory colleges are mainly self-funded through physician membership and licensing fees. They set standards for practice and are responsible for ensuring that their members provide health services in a safe, professional, and ethical manner (Federation of Health Regulatory Colleges of Ontario, no date; Ontario Ministry of Health and Long-Term Care, 2016). A primary objective of these regulatory colleges is to ensure public protection through the delivery of quality health services. As part of this mandate, the colleges interpret various pieces of legislation—as that legislation relates to the profession—and then provide guidance to their membership. In the case of privacy legislation, as discussed above, each college has their own collection of provincial legislation from which to develop such guidance (or federal legislation in those provinces that do not have legislation deemed substantially similar).

Rationale and Purpose

As federal and provincial legislation are often written in "legalese", and the direction provided in these documents is often ambiguous/vague, they may not be readily understood by medical practitioners. For instance, while some of this legislation provides information on the

collection, use, and disclosure of health information, limited direction is provided regarding how to protect such information. In most cases, reference is made to the need for "reasonable" measures to be in place. As the regulatory colleges set standards for the profession, they may choose to go further by providing more detailed guidance to their members regarding the protection of health information when using ICT.

The purpose of this study was to examine guidance for the protection of health information when using ICT from all 10 of Canada's provincial regulatory colleges for physicians. Specifically, we sought to assess the nature of the aforementioned guidance, to determine which colleges provided their members with information beyond federal and provincial legislation, and to identify the associated policy and service delivery implications for health system performance.

Method

Websites of all 10 provincial medical regulatory colleges were searched in September 2016 for documents that provided guidance to their members regarding the use of ICT. A comprehensive approach was taken such that any documents in the following areas were examined: advice, bylaws, guidelines, policies, positions, regulations, and standards. This collection of material formed the basis of the initial screening process, which entailed selecting documents according to their title (insofar as it appeared to fit with the eligibility criteria of the study; see below). Documents were then screened for eligibility and subsequently analyzed for content. These steps are described in the following sections.

Eligibility Criteria

To be eligible for inclusion in the study, documents needed to: 1) provide specific direction regarding the maintenance of confidentiality, privacy, or security of health data; 2)

mention a type of ICT used for (or electronic/digital means of) data collection/transfer/use, storage, or destruction; and 3) be available in English. The categories of data (i.e., collection/transfer/use, storage, and destruction) were selected based on the preliminary finding that the regulatory college documents typically discuss data protection across these three broad classifications.

Analytic Approach/Synthesis of Findings

A document analysis was performed, based on the recommendations of Bowen (2009) and Coffey (2014). This approach consisted of an initial evaluation of the documents, followed by a more thorough examination and interpretation. This process "combines elements of content analysis and thematic analysis." (Bowen, 2009, p. 32). Content analysis involved organizing the information from the documents into categories that related to the purpose of the study (e.g., the nature or type of guidance provided). Thematic analysis involved the identification of patterns among the data (e.g., information on storage of digital/electronic data).

For each document included, the precise wording relating to the inclusion criteria was extracted and examined to determine the extent of guidance given. In addition, each guideline was assessed to determine if it discussed procedures for collection/transfer/use, storage, and destruction of digital/electronic data. Content and themes were then compared and contrasted across the regulatory colleges.

Results

Search Outcomes

The search identified 522 documents across all the provincial regulatory college websites. Of these, 474 were excluded during title review. Of the 48 remaining documents that underwent full-text review, 36 were excluded as they did not provide specific direction for the maintenance

of confidentiality, privacy, or security of health data. In total, 12 documents across eight provincial regulatory colleges were included in the final analysis; three from Quebec, two from Alberta, two from British Columbia, and one each from Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, and Saskatchewan (see Figure 1, Tables 1 and 2). Although two provincial regulatory colleges—Manitoba and New Brunswick—did not have documents included in this study as they lacked specific instruction, members were directed to other sources of information, such as resources provided by the Canadian Medical Protective Association, the provincial offices for access and privacy laws (Office of the Ombudsman, Manitoba; Office of the Integrity Commissioner, New Brunswick), or provincial legislation.

Document Characteristics

Of the 12 documents included, there was considerable variation in the scope and detail of guidance provided across the provincial regulatory colleges. For example, regarding scope, the regulatory colleges for Alberta and Ontario offered several guidelines for their members, including information on passwords, mobile device storage, email, encryption keys, and disposal of electronic information. Other colleges gave information that was far more limited (e.g., Nova Scotia's guidelines consisted of encouraging physicians to use "encrypted email" when referring or consulting).

Regarding detail, while some regulatory colleges provided specific direction, others went a step further to provide explicit procedural direction. For example, the colleges in Prince Edward Island and Saskatchewan indicated that records should be password protected, but did not go further to describe how to create adequate password protection. Alberta's college, on the other hand, provided specific procedures related to the creation of strong passwords (e.g., they should be "made up of a random combination of letters, numbers and symbols", "they can be

replaced with biometric devices to provide a higher level of authentication"). In addition, the regulatory colleges provided variable guidance related to the collection/transfer/use of digital/electronic health data, the storage of data, and the destruction of data. Eight out of the 12 documents discussed procedures related to collection/transfer/use and storage, while four documents discussed measures related to destruction. Alberta, Ontario, and Prince Edward Island were the only colleges that provided guidance across all three categories, while Saskatchewan was the only regulatory college that did not provide guidance specific to any of the three categories. Overall, 6 out of 8 colleges mentioned collection/transfer/use, 5 out of 8 mentioned storage, and 3 out of 8 mentioned destruction. Colleges with multiple documents were consistent across each in terms of addressing the three categories (e.g., if a regulatory college provided information on storage, but not on destruction, this was the same across all documents). For a description of the guidance provided to physicians in each document by college (as well as information on collection/transfer/use, storage, and destruction), see Table 3. For a list of examples of guidance that was not deemed to contain specific direction, see Appendix.

Discussion

Given the potential of ICT to improve health system performance, along with the inherent security risks of using digital/electronic devices, guidelines for governing the use of ICT by physicians—in particular those that discuss protecting the privacy of health information—warrants further examination. The present study examined guidance provided by the Canadian provincial regulatory colleges for physicians in this regard. Across these colleges, there was considerable variation in both the scope and detail of guidance provided. While there was some consistency in terms of guidance related to the collection/transfer/use and storage of digital/electronic data, considerable inconsistency related to the storage and destruction of such

data was evident. In the sections that follow, we discuss possible explanations for this variability, as well as associated policy and service delivery implications for health system performance.

Potential Factors Contributing to Variability in Guidance Across the Regulatory Colleges

The availability of resources. It would be reasonable to assume that "capacity", such as level of funding or staffing, could impact a college's ability to develop and implement policies and guidelines. Annual physician membership and licensing fees paid to the regulatory colleges account for the great majority of revenue for each college. As provincial population increases, so typically does the number of physicians working in that province. Correspondingly, larger provinces are more likely than smaller provinces to have adequate resources to develop detailed guidelines. However, as our results suggest, there does not appear to be a discernable relationship between the population size of each province/college and the extent of guidance provided by the colleges. For example, Ontario, the largest province by population, has approximately 14 million people (Statistics Canada, 2016) and 30,000 physicians (Canadian Medical Association, 2017). The regulatory college in this province has an operating budget of roughly $65,000,000 (College of Physicians and Surgeons of Ontario, no date). On the other hand, Alberta, which provided more explicit procedural guidance than Ontario, has a population of approximately 4.3 million people, 9,300 physicians, and a regulatory college operating budget of roughly $30,000,000 (College of Physicians & Surgeons of Alberta, no date). In contrast, Prince Edward Island, by far the smallest province with approximately 150,000 people and 285 physicians, provided a wider range of guidance than Quebec (a province with more than 55 times the population size and 72 times the number of physicians).

Legacy effects. As Pierson (1993) has argued, policies passed at one point "encourage individuals to act in ways that lock in a particular path of policy development." (p. 606). This *path dependence* or *legacy effect* is based on the notion that historical events matter; decision-making in a given circumstance is strongly influenced by past knowledge and experience, which creates societal commitments that set expectations (Hacker, 1998). For example, as it pertains to this study, Alberta established the Health Information Act in 2000, which, as of 2010, regulates electronic health records. Similarly, British Columbia has had an E-Health (Personal Health Information Access and Protection of Privacy) Act since 2008. At the regulatory college level, although this study only represents a snapshot in time, Manitoba and New Brunswick were the colleges with the lowest and third lowest number of distinct documents overall (i.e., all policies and standards from the college, not just those related to privacy and ICT), while those colleges with more distinct documents for their members tended to have more instances of explicit procedural direction for health information protection when using ICT. Therefore, in this study, there was a tendency for explicit procedural direction for ICT use and health information protection (i.e., Alberta, British Columbia, and Ontario) to come from colleges in provinces with a recent history—and perhaps broader philosophy—of updating legislation and policies related to the regulation of health professions. The associated provincial initiatives and priorities then act as a legacy effect, driving future policy action and, correspondingly, the policies of the regulatory colleges.

Similar to legislation/policies of the past (legacy effects), it could be expected that those provinces that have a recent history of ICT infrastructure development and, thus, greater ICT use, would have more developed guidelines for ICT use than those provinces with a shorter history and less developed infrastructure. In other words, as infrastructure grows, so does the

need for guidance and regulation. While the use of electronic medical records (EMRs) is not a definitive indicator of ICT infrastructure status, given its widespread use in health care and the associated requirements for adequate hardware, software, networks, etc., it serves as a useful illustration. Alberta, British Columbia, and Ontario have the highest rates of EMR adoption, while one of the two provinces that did not have documents included in this study (New Brunswick) has among the lowest rates of EMR adoption (Chang & Gupta, 2015). Accordingly, it may be that provinces which do not have strongly developed ICT infrastructures lack incentive for developing laws specific to health information protection when using ICT, which may then filter down to the health profession regulatory colleges.

Other possible factors. Some additional explanations for variability in guidelines across the colleges can be linked to commonly found concepts in the broader policy literature that are thought to influence government decision-making. These concepts include the influence of public opinion/pressure, the presence or absence of a *policy entrepreneur*, and the impact of competing interests (Downs, 1972; Kingdon, 2003). Heightened attention for an issue, brought about through public opinion/pressure, can cause governments to act. It is possible that some provinces/colleges have experienced greater public pressure related to health information privacy and ICT. For example, numerous complaints of confidentiality breaches (and/or media attention to breaches) may persuade regulatory colleges to update or create new guidelines. While a plausible explanation, the sheer number of privacy breaches (e.g., approximately 1,000 complaints over 2015 and 2016 in Ontario; Information and Privacy Commissioner of Ontario, 2017), the spectrum of health care providers involved, as well as unreported incidents makes it difficult to assess the connection between these events and changes in college policies. Complicating matters is establishing a temporal relationship between a series of breaches—

which seem to occur weekly—and the presence or absence of a specific guideline (some documents are less than a year old, while others are more than 10 years old).

Policy entrepreneur is a term used to describe an individual with political connections, and/or negotiating skill, who has interest in a political issue (a "champion"). Given their power and knowledge of the policy process, these individuals are able to push their agenda, prompting decision-makers to pay attention. It is possible that in some provinces/colleges, a policy entrepreneur was instrumental in promoting the challenges of health information privacy when using ICT, spurring the development (or change) of laws, regulations, or guidelines.

Issues can also fall off a government's agenda due to competing interests. In some jurisdictions, other issues may have taken priority, causing political concern of privacy and ICT matters to decline. In addition, initiatives that were implemented may have failed (prompting a focus of efforts in another area) or there could have been movement through an "issue attention cycle" (i.e., a gradual decline of interest in the condition; Downs, 1972). Further research is necessary to determine the extent of influence the aforementioned factors might play in the development and implementation of health information protection guidelines when using ICT.

Policy and Service Delivery Implications for Health System Performance

To achieve some uniformity across Canada in terms of health care services, the federal government provides financial incentives (transfer of funds) for compliance with the tenets of the Canada Health Act. While this arrangement applies to health insurance coverage for *medically necessary* services, such a system does not exist at the health regulatory college level. In other words, federal money is not going to be transferred to the colleges to encourage conformity. This circumstance presents several challenges as health information is likely the most sensitive of any

data collected (Gostin et al., 1993) and, thus, access to it needs to be tightly controlled (disclosure can lead to embarrassment, stigmatization, and discrimination; Hodge, Gostin, & Jacobson, 1999; Meingast, Roosta, & Sastry, 2006; Rindfleisch, 1997; Rothstein, 2010).

Equality and equity in information protection. As part of the Canadian Constitution Act, 1982, the Canadian Charter of Rights and Freedoms carries the provision that, "Every individual is equal before and under the law and has the right to the equal protection and equal benefit of the law" (Government of Canada, 2017). Thus, Canadians expect all citizens to have the same rights (i.e., equal treatment across all 10 provinces). As this study has demonstrated, there are noteworthy differences across the regulatory colleges in terms of guidance for collection/transfer/use, storage, and destruction of digital/electronic records. More specifically, less than half of the colleges provided direction for the destruction of records, and just over half provided information on storage. These inconsistencies may result in disparate security behaviour based on location, threatening the equal protection of health information across Canada, leading to questions of fairness (why should level of information protection differ by province?). This would be consistent with other research suggesting that differences in health system arrangements, such as policies related to clinical practice, may contribute to inequity in care across the provinces (Allin, 2008; Organisation for Economic Cooperation and Development, 2014).

Efficiency. Decisions about how to allocate resources not only depends on equality and equity, but also on efficiency, which emphasizes getting the most out of the resources that are available to generate as much benefit as possible (Hurley, 2010). The division of powers being "institutionalized" among the provinces results in a lack of incentive for collaboration (they all want to maintain jurisdictional control), which may, in turn, influence medical regulatory

colleges. These circumstances could set the stage for duplication of efforts, which wastes resources. If the colleges were to cooperate and take advantage of sharing best practices, it would be possible to improve technical efficiency (i.e., get more output with the same inputs, or the same output with less inputs; Hurley, 2010). Not only could this approach save time, it could also be a more cost-effective way of producing guidelines for the medical profession.

Additional Considerations for Health System Performance

Policy learning. One benefit of a federal system of government, such as Canada's, is the opportunity for policy learning across provinces; a component of policy evaluation in which, "improvements or enhancements to policy-making and policy outcomes can be brought about through careful and deliberate assessment" (Howlett, Ramesh, & Perl, 2009, p. 180). As the provinces and territories have primary control over health care, different policies can be "tested" in different jurisdictions (*policy experimentation*; Howlett et al., 2009). The successes and failures of these policies can then inform and improve future policy-making. A possible barrier to this process is the governance model of self-regulation for health professionals in Canada. This circumstance could complicate policy learning as the regulatory colleges may have different interests than the federal/provincial governments when it comes to health care. For example, the colleges may choose to focus on policies for matters that are familiar to them, such as those related to clinical practice and education, as opposed to matters in which they may be less accustomed, such as administration or legal matters. In the latter case, the regulatory colleges may need a stimulus from governments to reinforce the importance of these broader system issues.

Policy-makers would be advised to take advantage of opportunities for policy learning and, thus, mechanisms to help facilitate this process are a worthwhile investment. The Federation of Medical Regulatory Authorities of Canada (FMRAC) has stated their mission is "To advance medical regulation on behalf of the public through collaboration, common standards and best practices." (FMRAC, 2016). An organization like this appears to be ideally suited to capitalize on policy experimentation—and subsequent learning—related to health information protection when using ICT.

The pace of technology change. While there has been a rapid advancement in ICT, which has transformed the way individuals communicate, unfortunately, there has been an "inability of the legal, social, and cultural forces to maintain pace." (Chin & Mishra, 2013, p. 286). Regulations tend to fall behind technological innovation (Butenko & Larouche, 2015), a condition that is likely to apply to the development of guidelines for ICT use. For example, PIPEDA received royal assent on April 13, 2000; since that time, it has undergone numerous changes. Last amended on June 23, 2015 to incorporate the *Digital Privacy Act*, the latest version provides enhanced powers for the Privacy Commissioner, and a requirement for breach reporting, notification and recordkeeping (among other updates). However, while many of the amendments came into force upon royal assent, those relating to breaches of security safeguards (data breaches) "will come into force following associated regulations being developed and put into place by the federal government." (Office of the Privacy Commissioner of Canada, 2015c). Situations like these are likely causing the provision of vague advice as there is a lack of legislation from which to draw clear guidelines. Unclear direction may place physicians in the position of having to decide what measures constitute adequate protection of digital/electronic health data, leaving them at risk of inadvertently disclosing patient information.

Limitations

While this study examined guidelines provided by the provincial regulatory colleges for physicians, documents and guidance provided at the provincial level (e.g., Health Information Acts, Information and Privacy Commissioners) or by national associations (e.g., the Canadian Medical Protective Association, the Canadian Medical Association), to which physicians may have been directed to for further information were not considered. Therefore, the documents included in this review may not be an accurate indicator of the extent of guidance provided to physicians in each province. In addition, as the regulatory colleges routinely update guidelines, standards, policies, etc., it is possible that this cross-sectional study did not capture more recent developments. Finally, although efforts were made to be inclusive at the full-text review stage, there is a possibility that documents which would have met eligibility criteria were excluded at the title review stage.

Conclusion

The federal-provincial division of powers in Canada, with provinces having primary responsibility for health care, may contribute to a lack of incentive for collaboration among both governments and provincial regulatory colleges. This has led to an absence of standardization of guidance for physicians to maintain health information protection when using ICT. As a result, the regulatory colleges have missed an opportunity to work together, learn from each other, and potentially develop policies in a more cost-effective manner. Moreover, the variation in guidance across provinces is likely to have resulted in unequal and inequitable treatment for members of the public. More informative guidance (i.e., explicit procedural direction) appears to be associated with regulatory colleges in provinces that have had a recent history of modernizing

legislation and policies related to the regulation of health professions and enhancing ICT infrastructure.

While federalism affords the opportunity for policy learning, the coexistence of a self-regulating model of governance for the health professions may complicate matters and challenge the likelihood of this process occurring. This suggests that a macro-level approach to policy development in this area—involving multiple stakeholders such as FMRAC, the Canadian Medical Protective Association, or Information and Privacy Commissioners—may hold the greatest promise for both enhancing the protection of health information as well as doing so in a more standardized manner across Canada.

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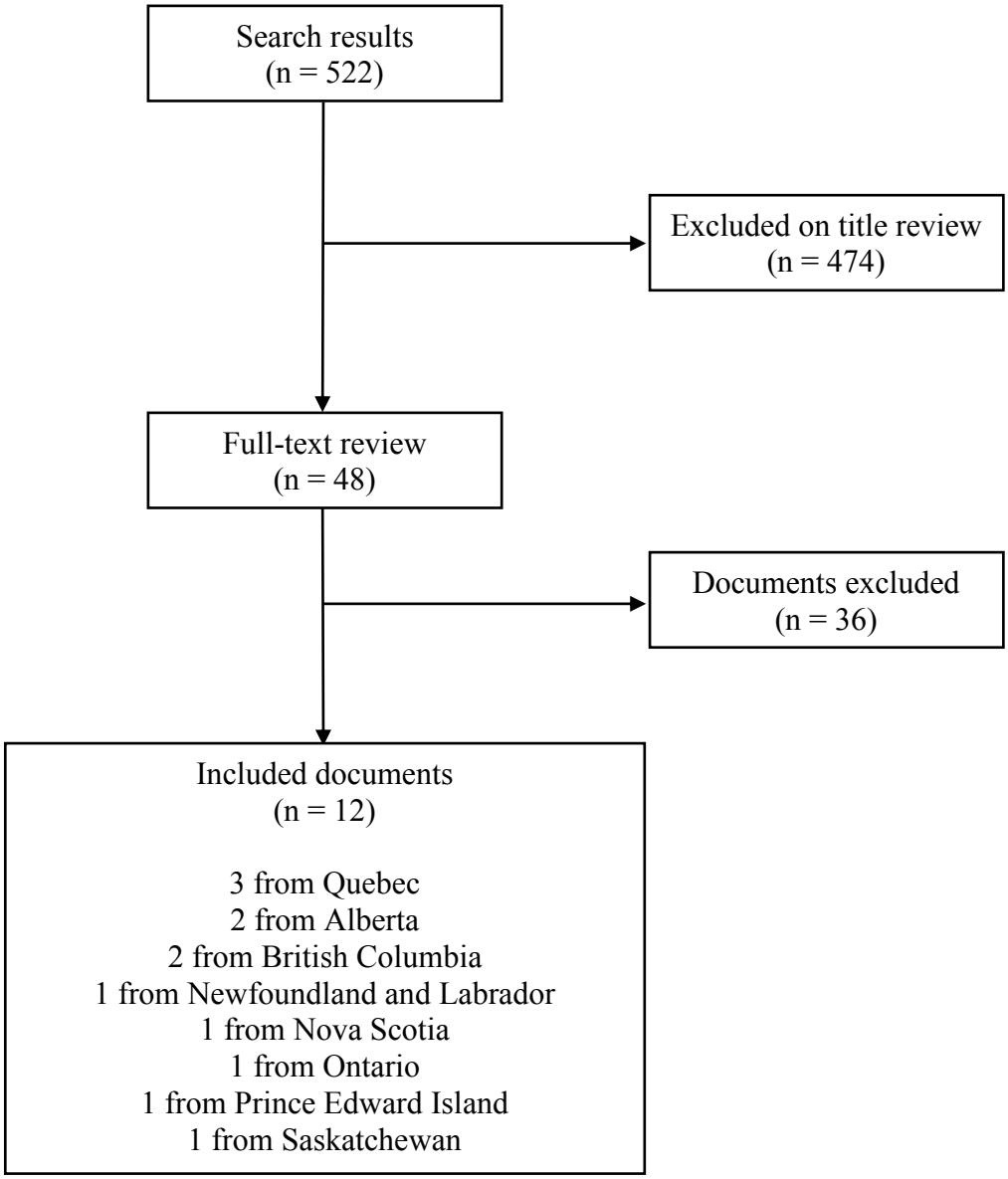

Figure 1. Flowchart of the search results.

Table 1

Number of Documents from the College Websites by Province

	Total Number of Documents for Title Review*	Number of Documents Possibly Related to Privacy and Communication via ICT (Retrieved for Examination)	Final Number of Documents Included
British Columbia	62	9 (15%)	2 (3%)
Alberta	68	5 (7%)	2 (3%)
Saskatchewan	45	4 (9%)	1 (2%)
Manitoba	7	2 (29%)	0
Ontario	72	6 (8%)	1 (1%)
Quebec	103	6 (6%)	3 (3%)
New Brunswick	31	6 (19%)	0
Nova Scotia	41	3 (7%)	1 (2%)
Prince Edward Island	29	5 (17%)	1 (3%)
Newfoundland and Labrador	69	2 (3%)	1 (1%)
	522	**48 (9%)**	**12 (2%)**

*Document types from the College websites that were included in the title review: Advice, Guidelines, Bylaws, Policies, Positions, Regulations, and Standards.

Table 2

Documents Included and Excluded by Province

	Included (n=12)	Excluded (n=36)
British Columbia	Emailing Patient Information (2013) Expectations of the Relationship between the Consulting Physician and Consultant Physician (2009)	Medical Records (2014) Telemedicine (2015) Data Stewardship Framework (2009) Photographic, Video and Audio Recording of Patients (2015) Prescribing Practices, Countersigning Prescriptions and Internet Prescribing (2009) Social Media and Online Networking Forums (2010) Privacy Legislation for the Private Sector (2009)
Alberta	Electronic Communications & Security of Mobile Devices (2016) Transition to Electronic Medical Records (2004)	Telemedicine (2014) Social Media (no date) Code of Conduct (2010)
Saskatchewan	Privacy of Health Information (2013)	Guideline - Confidentiality of Patient Information (2015) Patient-Physician Communication Guidelines Using Electronic Communication (2015) Policy - The Practice of Telemedicine (2015)
Manitoba	NA*	Standards of Practice of Medicine (2016) Code of Ethics (2015)
Ontario	Medical Records (2012)	Confidentiality of Personal Health Information (2006) eHealth Statement (2013) Social Media - Appropriate Use By Physicians (no date) Telemedicine (2014) Test Results Management (2011)
Quebec	Regulation Respecting Records, Places of Practice and the Cessation of Practice by a Physician (no date) The physician, telemedicine and information and communications technologies (2015) Record keeping by physicians in non-hospital settings (2013)	Code of Ethics of Physicians (no date) Medical Act (no date) Professional Code (no date)

New Brunswick	NA*	The Patient Medical Record (1996) Telemedicine (2008) The Patient Medical Record (2010) Towards Informed Consent (2014) Consultations/Referrals (2014) Confidentiality and Risk of Harm (2011)
Nova Scotia	Guidelines for Physicians Regarding Referral and Consultation (2013)	Medical Records (2016) Provision of Telemedicine Services (2013)
Prince Edward Island	The Application of the Principles of Privacy (2004)	Code of Ethics (2004) Minimal Requirements for Office Records (2009) Telemedicine (2016) Licensure of Visiting Consultants (2013)
Newfoundland and Labrador	By-Law 6: Medical Records (2012)	Advisory - Privacy, Confidentiality, and Disclosure of Patient Information (no date)

*Members were directed to other sources of information, such as resources provided by the Canadian Medical Protective Association, the Office of the Ombudsman (Manitoba), Office of the Integrity Commissioner (New Brunswick), or provincial legislation.

Table 3

Specific Direction Provided in the Included Documents by Provincial Regulatory College

	Document Name	Specific Guidance/Procedures*	Collection/Transfer/Use	Storage	Destruction
British Columbia	Emailing Patient Information (2013)	"Confidential and sensitive patient information sent by email should be encrypted or, at a minimum, password protected with access provided only to designated individuals. The password or cryptographic key must be sent separately to the intended recipient, preferably by phone or other non-electronic communication."	Yes	No	No
	Expectations of the Relationship between the Consulting Physician and Consultant Physician (2009)	"…encrypted email"	Yes	No	No
Alberta*	Electronic Communications & Security of Mobile Devices (2016)	"Passwords should be 'strong', made up of a random combination of letters, numbers and symbols difficult for individuals or password-guessing programs to guess or decipher." "Passwords can be replaced with biometric devices to provide a higher level of authentication." "…recommends that information transmitted via unsecured networks be encrypted; at a minimum, emails should be password protected." "It is critical to protect the security of the encryption keys (the encoded value used to encode and decode the source data) and to keep them physically separate from the device."	Yes	Yes	Yes
	Transition to Electronic Medical Records (2004)	"…email messages that contain patient information are encrypted and are supported by a patient consent to utilize email. Other options include the use of password protected attachments within an email."	Yes	Yes	Yes

		"Disposal of storage media (including redundant hardware, temporary storage, back-up media, etc.) must be complete. This would include physical destruction of the media and/or re-formatting to prevent unauthorized access – deleting the information does not physically delete the data, only the indexing information."			
Saskatchewan	Privacy of Health Information (2013)	"Electronic records should be password protected, and electronic systems should have appropriate firewalls and other electronic security mechanisms. Consider handcuffing (limiting access to portions of the electronic record to defined users)"	No	No	No
Ontario*	Medical Records (2012)	"Physicians should use a secure e-mail system with strong encryption." "All identifiable personal health information accessed and/or stored on mobile devices (even temporarily) must be de-identified or strongly encrypted." "Electronic records must be permanently deleted from all hard drives, as well as other storage mechanisms. Hard drives must either be crushed or wiped clean with a commercial disk wiping utility."	Yes	Yes	Yes
Prince Edward Island	The Application of the Principles of Privacy (2004)	Storage of information: "Computer files: pass word protected" Transfer/sharing of information: "…encrypted to a secure computer" Destruction of records: "Electronic records are to be erased and physically destroyed"	Yes	Yes	Yes
Nova Scotia	Guidelines for Physicians Regarding Referral and Consultation (2013)	"… encrypted email"	Yes	No	No

Newfoundland and Labrador	By-Law 6: Medical Records (2012)	"...appropriate virus protection and encryption"; "where patient records are kept in or copied into mobile technology, such as a laptop computer or USB key, the record shall be, at minimum, protected with a password and encryption, and consideration shall be given to implementation of other safeguards which may be available to protect against unauthorized access."	Yes	Yes	No
Quebec	Regulation Respecting Records, Places of Practice and the Cessation of Practice by a Physician	"protect access to the data, specifically by using a security key and user authentication."; "store, in another location, an encrypted backup copy of data so collected."	No	Yes	No
	The physician, telemedicine and information and communications technologies (2015)	“The electronic record should have the following features - it is protected by a user-specific access code." "Protect access to the data, specifically by using a security key and user authentication."	No	Yes	No
	Record keeping by physicians in non-hospital settings (2013)	"protect access to data, specifically by using a security key and user authentication"; "store an encrypted copy of the data at another location"	No	Yes	No

*Documents from Alberta and Ontario had numerous explicit guidelines/specific procedures for maintaining the privacy and security of health information. Therefore, only a few examples are provided.

Appendix

Examples of guidance that did not provide specific direction.

- Must take reasonable measures to preserve professional secrecy when the physician uses, or persons working with the physician use, information technologies.
- Be familiar with provincial and federal privacy legislation.
- Be familiar with technology standards.
- Choose a technology that meets expected privacy and security standards and is appropriate for the use.
- Technology doesn't change professional obligation to protect patient information.
- Must be guarded in the same way as traditional paper records.
- There should be protocols in place to address physical security.
- Physicians must ensure they maintain professional standards when using social media.
- Electronic systems should have appropriate firewalls and other electronic security mechanisms.
- A member must maintain safeguards to protect confidentiality and to protect against reasonably anticipated threats to the security, integrity, loss, or unauthorized use, disclosure, modification or unauthorized access to personal health information
- The same standards apply to electronic records as apply to paper records
- The mode of transmission is secure and maintains confidentiality
- Comply with all legal and professional obligations to maintain patient privacy and confidentiality.
- Read, understand, and apply the strictest privacy settings necessary to maintain control over access to their personal information.
- If there is any transmission of information contained in the medical records, including by technological means, the physician shall use methods, devices or systems protecting the confidentiality of this information.

Chapter 4

Use of Smartphones for Communication by Postgraduate Medical Trainees: A Perspective from Neo-Institutional Theory

Abstract

Smartphones offer several advantages for communication among health care providers compared to traditional means, including timely access to information and potential increases in efficiency. However, this technology can have disadvantages, such as disruptions to workflow and an increased risk of breaches in health information privacy. To date, the examination of smartphones among certain groups of providers, such as physicians, has been relatively narrow in scope. Moreover, researchers typically have not incorporated an underlying theory of adopting smartphone technology, which limits their ability to explain outcomes and predict future effects. The purposes of this study were: 1) to gain a greater understanding of how and why postgraduate medical trainees (medical residents) are using smartphones to communicate health care related information in daily practice; and 2) to provide insights regarding the role that institutional structures—regulative, normative, and cultural-cognitive—play in their use. A case study was conducted with data being acquired through 10 semi-structured interviews with medical residents. Through qualitative content analysis, efficiency and convenience were identified as the main reasons that medical residents use smartphones to communicate health related information with colleagues. In addition, by applying a neo-institutional perspective, it became clear that medical residents base their smartphone use primarily on normative elements (professional norms; what peers/staff are doing) and cultural-cognitive elements (beliefs/perceptions regarding facilitation of task completion). Regulative elements (guidelines/policies) around smartphone use play a smaller role in shaping behaviour, particularly when they: 1) lack clarity; 2) are not seen as credible/legitimate; or 3) are viewed as cumbersome and do not align with workflow needs. Consequently, there is a need to promote knowledge exchange between "developers/providers" and "consumers/users" of guidelines/policies pertaining to the use of smartphones by medical

residents. However, improving guidelines/policies in this manner, while necessary, is likely insufficient given that professional norms and medical residents' beliefs/perceptions are important influences on behaviour. Therefore, the implementation of future guidelines/policies should consider the use of mentorships throughout postgraduate medical training whereby staff physicians (or a champion within the medical staff) educate, model, and promote behaviour in accordance with the associated guidelines. Future research should examine the outcomes of such efforts and explore strategies for standardizing these initiatives across organizations.

Keywords: smartphones, physician communication, institutions, interviews, health policy

Introduction

The use of smartphones in health care has become commonplace. Smartphones offer several advantages for communication among health care providers compared to traditional means, including timely access to information and potential increases in efficiency (Mickan, Tilson, Atherton, Roberts, & Heneghan, 2013; Wu et al., 2011). However, this technology can have disadvantages, such as disruptions to workflow and an increased risk of breaches in health information privacy (Katz-Sidlow, Lindenbaum, & Sidlow, 2013; Tran et al., 2014; Whipple, Allgood, & Larue, 2012). Physicians are heavy users of smartphones for transmitting health information (Mobasheri et al., 2015; Ventola, 2014) and are therefore an important group to consider in assessing smartphone use.

To date, the study of smartphone use for communication of health information among physicians has been relatively narrow in scope. Most existing studies are survey-based (e.g., Katz-Sidlow et al., 2013; Plant & Fish, 2015; Prochaska, Bird, Chadaga, & Arora, 2015) and have failed to provide an in-depth understanding of how and why physicians are using smartphones to exchange health care related information with colleagues, and their perceptions of the guidelines/policies governing smartphone use. In addition, most studies do not incorporate an underlying theory of adopting smartphone technology, which limits the ability of researchers to explain outcomes and predict future effects. Research in this area would benefit from the use of qualitative approaches, such as interviews, and the use of theoretical perspectives to help understand and shed light on some of these important factors.

Existing theories in the social sciences have been used to explain individual differences in attitudes toward new technologies and practices (e.g., Theory of Planned Behavior; Ajzen, 1985), and how innovations flow through various social networks (e.g., Diffusion of Innovations

Theory; Rogers, 2003) or become embedded in everyday work (e.g., Normalization Process Theory; May & Finch, 2009). However, these do not consider the processes by which *institutions* become established as authoritative guidelines for social behaviour. Institutions are sets of rules, practices, and beliefs that shape the meaning and the perceived appropriateness of social behaviour. They organize states, societies, and international systems (e.g., governments, courts, constitutions) and, thus, are resistant to change. Along these lines, institutions "represent constraints on the options that individuals and collectives are likely to exercise, albeit constraints that are open to modification over time." (Barley & Tolbert, 1997, p. 94).

Neo-institutional Theory and The Three Pillars of Institutions

Neo-institutional theory has been conceptualized in several ways across the social sciences. In an attempt to bring some clarity to the heterogeneity that seems to dominate neo-institutionalist perspectives, Scott (2001, 2014) distilled the various arguments down to a few central ideas. Initially he proposed a broad definition of institutions so as to take into account the various arguments, and then sought to identify key elements that existed across the diverse perspectives. These key elements, called *pillars*, were based upon the most prevalent aspects of institutions, with the ultimate goal of constructing an analytic framework, which facilitates examination of these factors in different contexts. This paper applies his three pillar framework to examine institutional influences on smartphone use in a health care context.

The regulative pillar. This element of institutions focuses on regularizing behaviour through rule-setting, monitoring, and sanctioning (e.g., force, coercion). Incentives can also be used to encourage compliance (e.g., through payments). Rules can be written/unwritten, and formal/informal (similar to etiquette in sport).

The normative pillar. This element is based on social obligations, with a focus on values

(ideas regarding what is desirable/preferred) and norms (how things should be done). These constructs define the appropriate ways of obtaining desired goals (i.e., the rules of the game; March & Olsen, 1984). Shared values and norms result in social order and the stability of that order, since institutions are seen as having moral roots (Scott, 2001).

The cultural-cognitive pillar. This element focuses on the interplay between cultural frames and individual cognition. In other words, to explain and understand behaviour one needs to take into account how an individual interprets/perceives his or her conditions/environment.

Each of these pillars is useful in helping to explain social processes and behaviour by examining what individuals *have to do* (regulative), *ought to do* (normative), and *want to do* (cultural-cognitive). Neo-institutionalism suggests that social behaviour is controlled/guided not only by rules, but also by norms and cognitions. As Meyer and Rowan (1977) argue, while formal structures (e.g., policies, rules) act as a "blueprint" for societal activity, neo-institutionalization involves the blending of rules, normative obligations, and social meaning. Although change may be brought about by developments outside of an organization (e.g., smartphones as a common way to communicate), these developments are ultimately filtered and shaped through an organization's culture and the manner in which they are used by members of the organization (Lecours, 2005). Therefore, the relative influence of each of the three pillars of institutions is context dependent.

Study Rationale and Purposes

Given postgraduate medical trainees' (herein referred to as medical residents) status within a hospital setting (e.g., frequently changing team/work environments, overload of information), there is reason to believe that the relative influence of the three pillars of institutions on smartphone use may be different for this group of health care professionals

compared to others (i.e., regulative elements may play less of a role). Therefore, the application of a neo-institutional perspective could provide a greater understanding of the social processes driving the use of smartphones for communication among medical residents, which could help inform the development of future policies.

The purposes of this study were: 1) to gain a greater understanding of how and why medical residents are using smartphones to communicate health care related information in daily practice; and 2) to provide insights regarding the role that institutional structures—regulative, normative, and cultural-cognitive—play in the use of smartphones for communication of health care related information by medical residents. These structures can be drawn upon by stakeholders to better facilitate policy development and implementation.

Method

Study Design

A case study was conducted with data being acquired through semi-structured interviews of medical residents. The need for case studies arises out of a desire to understand complex social phenomena. This approach allows investigators to gain an in-depth understanding of real-life events (e.g., small group behaviour), and to ask penetrating questions that seek to capture the richness of organizational behaviour (Yin, 2014). This technique is recommended when an investigation: 1) seeks to answer "how" and "why" type questions; 2) does not attempt to control behavioural events; and 3) focuses on contemporary phenomena (Yin, 2014). Likewise, individual semi-structured interviews were chosen as this technique "allows the interviewer to delve deeply into social and personal matters" (DiCicco-Bloom & Crabtree, 2006, p. 315). In addition, by seeking open-ended responses (as opposed to structured interviews), they provide the opportunity to explore new avenues of information through probes and follow-up questions

(Kelly, 2010). This approach is commonly used by researchers to obtain interviewee perceptions of experiences related to health care delivery (DiCicco-Bloom & Crabtree, 2006).

Participants

Purposeful sampling was used to select participants. The strength of this technique stems from studying information rich cases in-depth, in which a researcher can learn "a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling" (Patton, 2002, p. 273). Medical residents from a single specialty training program in Ontario, Canada were chosen for this study based on the following:

1. In the current body of literature that has examined smartphone use by physicians, most studies have focused on medical residents. Therefore, findings from this study will be comparable from a participant standpoint.
2. Due to their familiarity with smartphones, medical residents are more likely to use these devices in clinical practice than other groups of physicians (e.g., those who have been practicing for many years and, thus, have not used smartphones for most of their careers).
3. Given their status within a hospital setting, the relative influence of institutional structures may be different for medical residents compared to other health care professionals (i.e., regulative elements may play less of a role). Therefore, medical residents represent a unique case and, thus, may reveal valuable insights about both unusual and typical behaviour.

The sample size/recruitment target for the study was based on the recommended number of participants needed to reach informational redundancy or theoretical saturation (i.e., data adequacy, operationally defined as collecting data to the point that no new information/themes

are obtained; Kelly, 2010; Morse, 1995).

Materials and Procedure

Recruitment. Following research ethics approval, an invitation to participate in the study was sent via e-mail as per the postgraduate training program's policy. The information in the e-mail introduced the investigators and provided a brief description of the study, including what study participation by the individual involved (see Appendix A for a copy of the invitation). If individuals were interested in participating, or had any questions before making a decision about participating, they were asked to e-mail or phone the Principal Investigator (PI). A more detailed letter of information and consent form for the study was sent to all potential participants.

Information and consent processes. Prior to the interview, the PI reviewed the letter of information/consent form with each participant and gave them the opportunity to ask any questions or raise any concerns. The PI reaffirmed the participant's willingness to be involved in the study and reminded them that they were free to not answer any question and could withdraw at any time. Subsequently, the participant and PI signed the consent form (a digital copy of which was sent to the participant after the interview via e-mail).

Data collection and analysis. Interviews occurred in June and July 2017. They were approximately 30 minutes in length and took place at a time and location convenient for the participant (two interviews were conducted over-the-phone). The interviews consisted of open-ended questions related to how and why smartphones are being used for communication of health care related information among physicians, as well as awareness and knowledge of guidelines governing the use of smartphones (see Appendix B for a copy of the interview guide). Following the recommendations put forth by Roulston (2014) for analyzing interviews, each interview was audio recorded and then transcribed. The transcripts were imported into NVivo 11

(software that supports the analysis of qualitative data). Based on Roulston's (2014) description of the three phases of analyzing interview data—reduction, reorganization, and representation (outlined below)—as well as Schreier's (2014) suggestions for qualitative content analysis, the content of each interview was coded into themes with the aid of a coding guide. The guide was created prior to the analysis (based on the research/interview questions and anticipated themes), but was subject to modification (i.e., coding was an iterative process).

Data reduction. The idea behind this step in the analysis is lessening the volume of content to obtain the essence or meaning of the descriptions provided by the participants. This was accomplished through open coding of the transcripts (i.e., a process of "associating a conceptual label with a section of transcript that conveys an idea about the topical features of the talk"; Roulston, 2014, p. 13). While categories/labels were created based on the coding/interview guide, open coding allowed for additional classifications to emerge based on the nature of the data.

Data reorganization. The processes in this stage involve making connections among ideas, combining codes into larger concepts (i.e., creating themes or categories; collapsing categories that are similar; Schreier, 2014), and to begin developing arguments related to the research purposes and topic of study. The ultimate goal of this stage is to generate themes that represent patterns observable across the data set.

Data representation. In this stage of the analysis the main themes developed during the reorganization phase are conveyed by presenting data excerpts or stories to support the related claims (i.e., choosing quotes that represent a particular idea or pattern).

Results and Discussion

Participants

Ten medical residents from postgraduate years 2 to 4 of a single specialty training program in Ontario, Canada took part in the study. Most participants stated that they worked approximately 60 hours per week (with 50 being devoted to clinical activities and 10 to research, studying, and/or teaching).

Smartphone Details

Most participants (9/10) used iPhones (5c, 5s, SE, 6, and 6s). One participant owned a Samsung S6. All were personal devices. Participants were not sure if there was a policy stipulating that their smartphones be passcode protected (or another form of "locking"), but they all used some sort of authorization protection (e.g., fingerprint scan/biometric recognition).

The remaining findings are organized by the purposes of the study. The first purpose is addressed in two sections: 1) how are smartphones being used for communication; and 2) why are smartphones being used for communication. The second purpose is addressed in a single section: the three pillars and smartphone use.

How are Smartphones Being Used for Communication?

Participants reported using several applications/features of their smartphones for communication with other physicians. The most commonly used was text messaging (mainly with the messaging application entitled, "WhatsApp"), followed by e-mail, phone, and photos.

Text messaging. Text messages were used for relaying small pieces of information as quick updates to keep colleagues informed of various day-to-day activities, such as sharing clinically relevant lab results and ordering of tests.

> *"I would say* [*text messaging*] *is used as something to communicate with either my staff or other residents about patients, consults, etc., when it's snippets of patient information.*

> *So, it's more just a heads up that we have a consult; 'This is the diagnosis that the patient is presenting with,' or something like that." (Participant 4)*

> *"So, texting I would use more for giving quick updates or checking in on where my team is, for example. So saying like, 'I am going to go see a patient in bed three in acute.' If there's a lab value that comes back you can say, 'Potassium was 6.4,' and then you can say, 'Okay, let's order this or this or this,' or something like that. So it's sort of quick blurbs" (Participant 7)*

Participants also described using text messaging because they believed it would be less disruptive to their colleagues than other forms of communication.

> *"Usually texting is sort of the go-to because people are obviously in patient rooms, and you don't want to be calling or paging and disturbing them, especially if it's a non-urgent thing." (Participant 10)*

E-mail. Participants described using e-mail mainly for administrative tasks, as opposed to communication about patient care (e.g., information about medical rounds, research, residency training program updates).

> *'*[*E-mail is*] *our primary contact for all sorts of information about our rotations and administrative things and evaluations… rotations and start times and scheduling and that sort of thing." (Participant 5)*

> *"It's definitely scheduling, academic-type information that's exchanged by email." (Participant 4)*

Phone calls. Participants discussed using the telephone feature of their smartphones for more urgent clinical issues, or for exchanging relatively complex information that could not be conveyed by other means effectively.

> *"If I'm trying to give someone a more detailed context of a situation for a medical decision to be made, I probably will not use email or text messaging. I'd probably call them and have that actual direct communication." (Participant 3)*

Photos. Participants discussed taking photos on their smartphones as a way of sharing information—such as X-rays or ECGs—with other physicians (as it was perceived to be more convenient and timely to do so than by other means).

> *"Sometimes we get an admission who is transferred and their X-ray is not necessarily on our system, but we have the disc, so we'll take a picture of the X-ray, and send it to our staff so that they can see an image in a timely manner." (Participant 7)*

In addition, pictures were taken with smartphones to document—or track the progress of—interesting clinical findings for teaching purposes.

> *"Photos I've used occasionally for things like teaching purposes, like if it's a patient with an interesting sort of physical finding, we can take a photo, but for that we require permission from the parents/patient and so we would get that before taking a photo." (Participant 5)*

Why are Smartphones Being Used for Communication?

Participants described several reasons for using their smartphones instead of other communication methods. Based upon the analysis of interview data, two main themes emerged: 1) efficiency; and 2) convenience.

Efficiency. Many participants stated that smartphone use saved time and allowed for faster communication (compared to other methods of communication).

> *"So I find that it's more efficient, and it's just easier to use, particularly for those short questions because really the other alternative is paging someone and waiting for them to page you back. And that can sometimes turn into a little bit of phone tag, whereas if it's sort of short kind of quick things, it's way more efficient to text them and say, 'Hey, this is what happened.' Then you move along with your day, and they get it when they get it. And everyone has their phone on them, so it seems to be a lot quicker." (Participant 8)*

> *"So essentially, the worst days of work is when you figure out you left your phone at home. You wear a pager and then you have to page someone if you need to access them, which, like I described, is you paging them through a paging system, them receiving the page, them getting to a phone, and paging you back on that phone… it feels like the day goes slower. And things just seem a lot more inefficient." (Participant 3)*

Convenience. Participants also alluded to the fact that smartphones were easier to use than other methods of communication.

> *"The amount of time that I'm in a single place on any given day is very small… it's much easier to carry this* [*a smartphone*] *around than my laptop. And it's just quicker than any of the institutional computers. I can't emphasize enough how slow it is to log into an*

institutional computer… particularly on busy services, it's just not feasible to do that between every single patient." (Participant 9)

"Having it [*a smartphone*] *with me at all times it very convenient. We're always walking around going back and forth between wards and the emerg, so having it on our person saves time because we communicate while we're walking. If I was to use a workstation, I would have to then log in to my email probably, and email a question, and check my email again, in order to get any sort of feedback, but with a smartphone, it's sort of instant messaging and feedback and you know that someone has received your message and they're going to reply quickly. So it's sort of ease and convenience of communication." (Participant 5)*

Greater efficiency and convenience in communication (through the use of smartphones) were perceived by participants to be associated with benefits related to the facilitation of patient care. These perceived benefits included improvements in communication, team function, and quality of care.

Improved communication. Several participants noted that smartphone use may help facilitate better communication.

"I think that the number one reason that mistakes get made in medicine is communication errors. So, having a good tool for communication is really helpful. And I think nothing replaces face-to-face communication, but I think especially when you're sort of on a team of people and trying to interact, it really does help to have that sort of instant feedback and instant communication; smartphones allow for that." (Participant 5)

"I think it [*smartphone use*] *facilitates better communication. Honestly, there's less issues with cell phones, like people usually know how to work their cell phone properly versus pagers which are always messing up." (Participant 2)*

Improved team function. Given the volume of information that is exchanged among team members, interviewees felt that smartphones facilitated teamwork by keeping colleagues up-to-date with various patient care activities.

"We all work in team-based format so a lot of the times it's just checking in to make sure that everyone is either doing their job or what has been done so that the team can actually function as a team. Otherwise, you're not always sure if so-and-so ended up going and reviewing that blood work that we were supposed to do at 8 o'clock.

Otherwise, I wouldn't know whether or not they're doing that. So I'd say it's mostly about that, having to do with keeping up with what's going on with the patients amongst the team." (Participant 3)

Improved quality of care. Some participants felt that using smartphones enhanced the quality of care that they provided.

"So the expectation of patients now, or for as long as I've been practicing which is not very long—maybe they've always had this expectation—is that they get timely, appropriate, informed care. Smartphone use helps us meet that expectation." (Participant 9)

The Three Pillars and Smartphone Use (A Neo-Institutional Perspective)

As an initial step toward gaining insight into the role that regulative, normative, and cultural-cognitive institutional elements play in the use of smartphones for communication of health care related information by medical residents, participants were asked to recall any guidance they received regarding the use of their smartphones. Most participants stated that training in this capacity was mainly informal, such as conversations among colleagues.

"I don't know if I've ever had formal training. But just from being around other physicians, just general professionalism with cell phones of not using it when you're having a discussion with other physicians or with other colleagues or definitely with patients. And also the privacy issues that comes with cell phones. So we've had lots of talk about that, and I think (the institution) has some policy about not… I haven't read it, but I've heard the gist of it is not including any type of patient identifiers in any kind of emails, text messaging, those kinds of things… it's more sort of you see what others are doing, and it's more verbal and they sort of tell you whether it's appropriate or not." (Participant 1)

However, some participants mentioned receiving guidance about the use of smartphones during medical school, although this varied with the University that they attended.

"In medical school, we did have a few sessions on professionalism surrounding accessing your phone when interacting with patients, and just general kind of phone etiquette for the physician, that was a few scheduled teaching sessions that we had. That would be formal curriculum. Other than that, I think it's more informal sort of conversation amongst peers

and staff as to kind of what's acceptable and what isn't." (Participant 4)

When delving deeper into the possible reasons why medical residents were not aware of the specific guidelines available regarding smartphone use (i.e., the extent or nature of direction provided), several participants noted that the number of guidelines they are expected to know is so large that, inevitably, some will receive more attention than others.

> *"I think for me, personally, it's just the volume of information we're inundated with, and that there's a guideline for everything under the sun, and there's a regulation for everything under the sun. And it's just so hard to keep on top of it. And as a resident, not only are you trying to not break any rules, you're also trying not to kill anyone, and trying to maintain some sort of sense of sanity in your work and in your life. And the volume of it's so high that things get forgotten and things get missed." (Participant 10)*

Given that medical residents are not well versed in the specific guidelines governing smartphone use, how do they determine appropriate ways of using their smartphones? Throughout the interviews it became evident that smartphone use was based primarily on normative elements (professional norms; behaviour of peers/staff) and/or cultural-cognitive factors (medical residents' beliefs/perceptions regarding facilitation of task completion and, hence, patient care), while regulative elements (guidelines/policies) were less impactful. Based on further examination of these findings through an analysis of interview data, three themes emerged that help to explain some of the circumstances under which regulative elements may play a smaller role in shaping behaviour. These are: 1) when there is a perceived lack of clarity in rules; 2) when guidelines/policies are not seen as credible/legitimate; and 3) when guidelines/policies are viewed as cumbersome and do not align with workflow needs. Each of these themes will be discussed in turn.

When there is a perceived lack of clarity in rules. When there is uncertainty and/or ambiguity in guidance for social behaviour (i.e., smartphone use), medical residents appeared to rely on senior staff to know what is best (i.e., the most appropriate way of behaving).

> *"So first of all, I base a lot on being a resident and a trainee. I base a lot of what I do on what my staff's comfortable with, because I think there's a lot of ambiguity in all of this. And nobody's really sure what they can do. Nobody's really sure if they can send patient initials or room numbers. And so because of that, different staff have different preferences, so a lot of what I do is because my staff want me to." (Participant 2)*

> *"I think there is a lot of modeling by staff behaviour, it's sort of example-based." (Participant 6)*

When guidelines and policies are not seen as credible/legitimate. Many participants expressed the view that some of the guidelines for smartphone use seemed illogical as they did not take into consideration the applied or real-world (clinical) applications of the technology. This appeared to lead to the perception that such guidance was not convincing or justified.

> *"I think if you want people to be aware of guidelines and use those guidelines, you have to harmonize the guidelines with the reality of what's happening. And having an administrator that I've never met, who feels very far away from the day-to-day life of being in the hospital, come down from Internet heaven and tell us how to use our smartphones is, I think, a little bit… I don't think you'll have a lot of success with that method. Like telling a group of residents, 97% of whom use iPhones, to all start using BlackBerry Messenger. That sort of thing I think really undermines credibility of those guidelines." (Participant 9)*

This perceived lack of credible or legitimate guidelines appeared to cause a lack of trust in those who developed the guidelines. In these situations, medical residents look to what senior staff are doing (norms), as they feel they can trust them:

> *"But that's what I mean with the guidelines that don't seem justified. The same people who make clearly insane decisions like that, I'm not necessarily interested in what they say about how I should use my smartphone when the people that I work with, who are senior to me, who I trust, use their smartphone in this way." (Participant 6)*

In addition, some participants felt that they knew how to behave appropriately based on common sense and the broader everyday culture surrounding smartphones (culture/cognitions):

> *"I think it's common sense. You don't really answer a phone call when you're in the middle of seeing a patient, asking permission to take pictures if it's possible, and getting their consent, especially if it's going to be used for particular purposes, right? And then obviously not texting in front of people, or informing them that, 'I'm just contacting my staff,' or something like that, so that at least they're aware, that you don't seem rude when you're in front of them. Everybody uses a smartphone, like we used it in undergrad, we used it in medical school, I don't think anybody has taken the time to say, 'Am I using my phone correctly?' It's just kind of a thing that we do. It's part of the culture now" (Participant 7)*

Other participants illustrated the idea of already knowing how to behave appropriately by comparing the difference between clinical guidelines and guidelines for smartphone use.

> *"There's many clinical guidelines that people ignore, and people ignore clinical guidelines when they feel like they know what the right thing to do is. I think physicians ignore smartphone guidelines when they don't align with what physicians need to do to get through the day. So I go to a guideline, a clinical practice guideline, when there's no good evidence to tell me what the right thing to do is. I think a lot of people feel like they have very good common-sense evidence about how to use their smartphone." (Participant 9)*

This finding is in keeping with Scott's (2001) claim that, to be seen as legitimate, institutions—or institutional carriers such as standards and guidelines—need social acceptability and credibility.

When guidelines/policies are viewed as cumbersome and do not align with workflow needs. Interviewees also indicated that using the existing information and communication technology (ICT) resources within the hospital inhibited efficient completion of various tasks.

> *"So an ECG gets done on a machine that is DOS-based from 1979 or something like that. I'm being facetious, but old. And then the only record of that ECG is the one that prints out of the ECG. So to communicate that with a person who is not in-house, the only options available to me quickly is to just take a picture and text or email to them. But text is, I don't know, the convention I guess. I suppose I could scan the ECG to my (hospital) email and then forward it from my (hospital) email to somebody else's email,*

> *but again, that involves realistically another 20 minutes of time… everyone works around the processing like crazy, but nobody acknowledges how insane that is." (Participant 9)*

Given the growing complexity and sophistication of ICT, it appears as though some components of hospital ICT infrastructure are unable to match the "capability" of smartphones. As previous research has indicated, current university and hospital policies governing the use of digital devices may be outdated, confusing/vague, and do not align with day-to-day patient care activities (Plant & Fish, 2015). Therefore, to meet the expectations of a complex health system, medical residents implement "workarounds" to traditional (hospital based) communication methods (i.e., the use of personal mobile computing, which has been shown to increase workflow efficiency; Patel, Chapman, Luo, Woodruff, & Arora, 2012).

Summary of Findings

The responses from medical residents provided several insights regarding their use of smartphones for health care related communication among colleagues including how they are used, the underlying reasons for use, and the relative influence of regulative, normative, and cultural-cognitive institutional elements on use. Interview data suggested that medical residents are aware that there are guidelines that govern the use of smartphones for work-related activities. However, when it comes to formalized documents such as legislation or organizational policies, they are unsure of the specific direction that is provided. Given their focus on efficiency and convenience, coupled with guidelines/policies for smartphone use that are perceived as not providing clear direction for appropriate behaviour or are not seen as credible/legitimate, this study suggests that medical residents model their behaviour based on what colleagues are doing, or act in a manner that they believe facilitates task completion and, hence, patient care. Regarding the latter, existing alternatives to smartphone use for communication are less

appealing (the hospital infrastructure/resources conflicts with day-to-day practice/workflow). In this way, the normative (behaviour of colleagues/staff; what an individual ought to do) and cultural-cognitive (medical residents' beliefs/perceptions; what an individual wants to do) elements of institutions appear to influence the use of smartphones by medical residents more so than regulative elements (guidelines/policies; what an individual has to do) of institutions.

Implications for Researchers

From a practical standpoint, given the apparent disconnect between guidelines/policies regarding the use of smartphones and the use/need of smartphones by medical residents, there is a need to examine the prospect (and outcomes) of shared decision-making among policy-makers and health care providers. Furthermore, as the use of ICT challenges existing work processes and social interactions among providers and patients, further research focusing on the interactive relationships among patients, professionals, and organizational systems is needed (Lamothe, Fortin, Labbe, Gagnon, & Messikh, 2006; May et al. 2009). This avenue would be in keeping with suggestions from other authors that institutional researchers should explore how micro-level organizational cultural dynamics influence, and are influenced by, the macro-level institutional context (e.g., Zilber, 2012).

It would also be fruitful to examine the perspectives of patients and health care managers to gain an understanding of how the use of smartphones by medical residents is viewed; in the case of patients, whether they are actually concerned with their health information being sent through potentially unsecure smartphone channels, and if the etiquette used by medical residents is acceptable; in the case of managers, what the unique challenges are in governing the use of smartphones.

From a theoretical standpoint, a considerable impediment to the use of an institutional perspective is that the term has been interpreted in numerous ways (Kato, 1995; Peters, 2000). The application of a comprehensive interpretation of institutions, such as the one used in this study, will help strengthen the contribution of this perspective when explaining social phenomena. Such an expansive viewpoint, particularly in the ICT domain, has been recommended for some time. As King et al. (1994) asserted, "long-established intellectual perspectives on innovation from neoclassical economics and organization theory are inadequate to explain the dynamics of actual innovative change in the IT (information technology) domain. A broader view adopted from economic history and the new institutionalism in sociology provides a stronger base for understanding the role of institutions in IT innovation." (p. 139). However, in the case of the three pillars of institutions, it is difficult to tease apart the relative influence of norms and cognitions/cultural influences as they are to some extent intertwined. For instance, are medical residents truly wanting to behave in a particular manner based on their own beliefs and perceptions or do the norms of the environment in which they work instill these beliefs and perceptions? Future research could be geared toward unpacking and further delineating these constructs.

Implications for Policy and Practice

The findings from this study suggest that medical residents perceive guidelines for smartphone use as not taking into account the day-to-day clinical and practical applications that these devices provide. As a result, there is a mistrust of associated policies. This circumstance may create resistance from medical residents and, correspondingly, a negative perception of "rules" related to the use of smartphones. Therefore, to ensure successful integration of ICT, such as smartphones, the characteristics of providers and of the local context need to be taken

into account (Lamothe et al., 2006). Organizations start by adopting required ICT changes and then begin internalizing such changes, which leads to an incremental impact of additional institutional influences occurring (Chin & Mishra, 2013). Therefore, there is a need to routinely take stock of, and account for, the day-to-day use of new technology by providers. By doing so, guidelines can be developed that "resonate" with the associated clinical uses of the technology, fostering their uptake.

As medical residents frequent multiple teams and locations in the hospital as part of their training, in a sense they lack the structure of other health care providers; the workplace climate changes relatively frequently, which requires a certain amount of adaptation on their part. In the absence of such consistency, there may be a greater likelihood of basing one's behaviour on what others are doing in similar circumstances, or what one believes to be the most appropriate behaviour (i.e., the logic of appropriateness that individuals acquire through their membership in institutions; March & Olsen, 1984). Consequently, the implementation of future policies could consider continuing education via physician mentors (or a champion within the medical staff) to model and promote behaviour in accordance with the associated guidelines.

Some researchers have recommended that a greater emphasis be placed on *digital professionalism* in medical education (i.e., there is a need for a comprehensive model of proper use of ICT in a health care context). By ignoring the challenges that medical trainees face when using ICT, there is a risk of perpetuating "a hidden curriculum of digital media use, framing the use of digital media in terms of problems and risks while ignoring the ways in which it can support and shape medical practice." (Ellaway et al., 2015, p. 848). Health care managers and senior staff (physician mentors) could play a central role in promoting digital professionalism, preparing medical residents for the anticipated cultural changes, and lending support to them as

they proceed through their training. In this vein, organizations should employ strategies to help individuals working within them to use technologies in the most appropriate way (Tran et al., 2014; Mobasheri et al., 2015; Charani, Castro-Sánchez, Moore, & Holmes, 2014) and could look to other organizations/hospitals or industries for insight.

Strengths of the Study

Firstly, to the author's knowledge, this is the first study to qualitatively explore the perceptions of medical residents regarding their day-to-day use of smartphones while analyzing these perceptions through a broad neo-institutional lens (i.e., regulative, normative, and cultural-cognitive elements). Existing studies of organizations tend to focus on fewer institutional elements, such as regulative and cognitive pressures (Palthe, 2014). As a result, "significant attention to the interplay between regulative, normative, and cognitive pressures to affect organizational change has not been as forthcoming" (Palthe, 2014, p. 59). The insights gained from such as wider-ranging perspective could be used to inform studies examining other health professionals and areas of care, and has the potential to help researchers gain a greater understanding of the "design, use, and consequences of technologies, either within or across organizations." (Orlikowski & Barley, 2001, p. 153).

Secondly, by enrolling medical residents as the participant sample, this study has provided insight into how and why a pervasive new technology is being used by the next generation of physicians. Such information is valuable as it can be used in the development of practice guidelines while taking into account the unique characteristics of this group of providers, including their expectations and future needs. Thirdly, this study has provided a richer understanding regarding the use of smartphones by medical residents; previous studies have been

mainly survey-based, thereby limiting opportunities for participants to delve into their experiences and perceptions in greater detail.

Limitations of the Study

While purposeful sampling was used to study an information rich case in-depth, medical residents from only one specialty at one institution were enrolled in the study. As a result, a broader array of experiences and opinions were not captured. While the goal of a case study is to "expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)"; Yin, 2009, p. 15), the inclusion of other medical specialties at other institutions may have provided additional insights (as alluded to earlier in this paper, the influence of institutional elements is context dependent). In addition, member-checking was not employed. This process involves bringing the data back to the participants with the identified themes and asking them if they would like to provide further explanations or greater detail (Charmaz, 2006). Such a procedure ensures that what the researcher has developed fits with the experiences of the participants. Given the busy schedules of medical residents, member-checking was not conducted to avoid overburdening the participants (i.e., it was viewed as not being feasible).

Conclusion

As this study has shown, medical residents rely heavily on the use of personal smartphones to communicate health care related information with colleagues as they perceive these devices to be more efficient and convenient than traditional means. In addition, by applying a neo-institutional perspective, this study has provided a greater understanding of the relative influence of regulative, normative, and cultural-cognitive institutional elements on smartphone use by medical residents. More specifically, medical residents base their smartphone use

behaviour primarily on normative elements (professional norms; what peers/staff are doing) and cultural-cognitive elements (beliefs/perceptions regarding facilitation of task completion). Regulative elements (guidelines/policies) around smartphone use play a smaller role in shaping behaviour, particularly when they: 1) lack clarity; 2) are not seen as credible/legitimate; or 3) are viewed as cumbersome and do not align with workflow needs. In this vein, findings from this investigation indicate that there is a disconnect between perceived constraints of policies/guidelines for smartphone use and the realities of daily life for busy junior physicians in complex health care teams. Consequently, there is a need to promote knowledge exchange between "developers/providers" and "consumers/users" of guidelines/policies pertaining to the use of smartphones by medical residents.

However, improving guidelines/policies, while necessary, is likely insufficient given that professional norms and medical residents' beliefs/perceptions are important influences on their behaviour. Therefore, the implementation of future guidelines/policies should consider the use of mentorships throughout postgraduate medical training whereby staff physicians (or a champion within the medical staff) educate, model, and promote behaviour in accordance with the associated guidelines. Future research should examine the outcomes of such efforts and explore strategies for standardizing these initiatives across organizations.

As efforts to improve health systems continue, the role that smartphones play cannot be underestimated. This claim is exemplified in the following words of one study participant:

> "*If you took away all the smartphones from the residents at least in the hospital, the hospital would grind to a halt." (Participant 9)*

This is but one indication that the smartphone may one day be recognized as a tool that is "as irreplaceable as the stethoscope has been in the practice of medicine." (Ozdalaga et al., 2012, p. 11).

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Appendix A – Brief Summary for Recruitment

A study is being conducted to gain a greater understanding of how and why medical residents are using smartphones to communicate in daily practice. In addition, the study seeks to provide insights regarding the role that institutional structures—regulative, normative, and cultural-cognitive—play in the use of smartphones for communication by medical residents (e.g., awareness and adherence to organizational policies), which can be drawn upon by stakeholders for their respective decision-making (e.g., to better facilitate policy implementation).

Participation involves sharing your experiences and views about the use of smartphones for health information communication during an interview that will take approximately 30 minutes to complete. Interviews may take place in person, by phone, or video call (Skype, FaceTime) at a time and location that is agreeable to you.

Participants will receive a $20 coffee card/gift card for their time.

If you are interested in participating and would like to obtain the letter of information and consent form, which contain more details about the study including potential benefits and risks, please contact the Principal Investigator, Neil Barr (PhD candidate, Health Policy Program), by phone or email (905-741-5622; barrn@mcmaster.ca).

Appendix B – Semi-structured Interview Guide

Preamble

Thank you for agreeing to be interviewed as part of this research project. The purpose of this study is to develop a better understanding of how and why smartphones are being used for health information communication among physicians, and to determine how this information can be used to facilitate the optimal use of this technology.

I will be asking questions related to your views on:

- the ways in which smartphones are being used for communicating health information with other physicians (e.g., e-mail, text messaging, reference applications);
- the reasons for smartphone use (e.g., convenience, efficiency);
- potential barriers and facilitators to the use of smartphones.

We have received your signed consent form. Before we get started, do you have any questions about the information that has been provided about the study or about the consent form? I want to remind you that you may decline to answer any questions and you can stop the interview at any time without penalty.

Also, we will be audio recording the session to make sure we have an accurate record of our conversation. I'd like to reassure you that any information you share with me will remain anonymous in any reports or publications. A summary of the results will be available to you at the completion of the study.

Do you have any questions before we begin?

Questions

Participant background

1. To start, could you tell me a bit about your educational and professional backgrounds?
    - Degrees, diplomas, organizations where you have trained/worked.
    - Has any of your medical training occurred outside of Ontario? Canada?
    - What is your current area of clinical focus (subspecialty; what kind of patients do you see?
    - How many patients do you see on an average workday?

Smartphone details

2. What type of smartphone do you currently use?
    - Brand and operating system (e.g., iPhone, iOS 10)?
    - Is it a personal device (one that you have purchased) or one issued by the university or another institution (or both)?
    - Personal device: do you use it for any work-related activities (why)?
    - Institutional device: do you use it for any personal activities (why)?

- How do you usually connect to the Internet, cellular or WiFi?
- What type of security features are available on your smartphone (e.g., passcode protection, encryption)?
- What security features do you use on your smartphone (why/why not)?
- Are these measures required by the hospital/practice (institutional security policies)?

Smartphone use

3. What applications/features do you use on your smartphone for communicating with other physicians?
    - E-mail, text messaging, phone, photos, other "apps" (3rd party), Internet-based programs?
    - In what circumstance/context would you use each application/feature (and why)?
    - What type of features do you use most often on your smartphone (and why)?
    - What features do you wish you had (and why)?
    - If you have both a personal and an institutional smartphone, do you use different features/applications on each (why)?

4. Can you describe the type of information that you exchange with other physicians using your smartphone?
    - Reports, graphical data, questions, requests
    - Discharge summaries, handover, consultation, referral
    - Why do you use your smartphone for these purposes (convenience, efficiency, timeliness, ease of use, quality of care)?
    - If you didn't have a smartphone, how would you communicate with other physicians for the purposes you described?
    - What types of physicians do you communicate with using your smartphone (medical students, residents, staff physicians, community physicians)?

5. In your experience, is your use of a smartphone typical of other physicians?
    - What are the most common uses (why)?
    - Do other physicians use their smartphone more or less than you (why)?
    - What different uses have you seen (for what purposes and why)?

Barriers and facilitators to the use of smartphones

6. What guidance has been provided to you during medical school and your residency regarding the use of your smartphone (personal or institutional device)?
    - Professional conduct (e.g., not answering calls when you are with a patient)?
    - Maintaining privacy of health information?
    - Other?

7. How was this guidance provided?
    - Documents, formal curriculum, verbally

- Other residents, staff physician

8. What guidelines governing the use of smartphones are provided by the…
    - Hospital/University
    - College of Physicians and Surgeons of Ontario
    - Provincial government
    - Professional organizations (Ontario Medical Association, Canadian Medical Association)
    - Federal government

9. Is there any reason that you don't use your smartphone as much as you would like?
    - Are there any barriers/restrictions to overcome (explain)?
    - How is your smartphone use affected by these reasons/restrictions?
    - How does this impact the potential benefits of smartphone use (convenience, efficiency, timeliness, etc.)?

Recommendations for change

10. In your view, what changes could be made that would improve the use of your smartphone?
    - Different policies or guidance?
    - Different features?
    - Education?

That is all the questions I have. Thank you for participating in the study. Is there anything else you think we should know about the use of smartphones for communication among physicians?

Chapter 5

Conclusion

The goal of this doctoral dissertation was to develop a better understanding of the extent to which and under what conditions physicians are using information and communication technology (ICT) to convey health care related information, along with the role of such communication in enhancing health system performance. This goal was accomplished by designing and conducting three interrelated original research studies that contribute new knowledge to the area. In this chapter, the main findings of the studies presented in Chapters 2-4 are highlighted, followed by their substantive, methodological, and theoretical contributions to the field. The chapter ends with a description of the relationship among the studies and a summary of how this work contributes to the field.

Main Findings

Study 1 (Chapter 2) consists of a systematic review of the academic literature that sought to gain a greater understanding of the role that ICT plays in enhancing health care communication among physicians. In reviewing 21 studies that were identified through electronic database searches, it was discovered that physicians were generally more satisfied with ICT than conventional methods of communicating, but that consensus was lacking regarding whether ICT improved the efficiency of health information exchange, or whether it made a difference to clinical decision-making.

Study 2 (Chapter 3) presents a document analysis that built on the institutional-related factors of ICT identified in Study 1 (i.e., privacy legislation) by examining guidelines that govern ICT from the provincial regulatory colleges for physicians. A search of the regulatory college websites resulted in the identification of 522 documents; 12 of these documents (from 8 of the 10 provincial regulatory colleges) met eligibility criteria for inclusion in the study. By conducting a comparative analysis of the policies, guidelines, and standards of practice from

physician regulatory colleges across the Canadian provinces, considerable variation in the scope and detail of guidance provided was found. Of the eight colleges that addressed protection of health information when using ICT, six discussed procedures related to the collection/transfer/use of digital/electronic health data, five discussed procedures related to the storage of data, and only three discussed destruction of data.

Study 3 (Chapter 4) describes a case study that examined the use of a relatively newer form of ICT, smartphones, for communication among postgraduate medical trainees (medical residents). Building on the studies presented in Chapters 2 and 3, this study involved the use of semi-structured interviews of medical residents to examine how and why they use smartphones to communicate health care related information in daily practice. In addition, using neo-institutional theory, medical residents' experiences with, and opinions of, guidelines governing the use of smartphones were examined. Through qualitative content analysis of the interview transcripts, efficiency and convenience were identified as the main reasons that medical residents use smartphones to communicate health related information with colleagues. In addition, by applying a neo-institutional perspective, it became clear that medical residents model their smartphone use based on what peers and staff are doing (normative), or act in a manner that they believe (cultural-cognitive) facilitates task completion and, hence, patient care. Institutional guidelines/policies (regulative) for smartphone use play a smaller role in shaping their behaviour particularly when they: 1) lack clarity; 2) are not seen as credible/legitimate; or 3) are viewed as cumbersome and do not align with workflow needs.

Contributions of the Dissertation

Collectively, the three studies presented in this dissertation represent important steps toward a better understanding of the use of ICT by physicians to communicate in daily practice

and, thus, advances knowledge in this domain. More specifically, they consist of substantive, methodological, and theoretical contributions that begin to fill important gaps in the scholarly literature. These contributions will be discussed within the context of each study.

Study 1. The first study of this dissertation expands the current literature by providing an up-to-date systematic review on the role of ICT in enhancing communication among physicians. The findings from this review help to move the field forward by demonstrating that ICT can play an important role in enhancing communication among physicians. Furthermore, the extent of that benefit is influenced by: 1) the impact of ICT on existing work practices; 2) the availability of adequate resources; and 3) the nature of institutional elements, such as privacy legislation.

In some instances, communication by digital/electronic means can disrupt physicians' workflow, productivity, and negatively impact work/life balance. These circumstances may have adverse consequences for patient care. In light of these findings, decision-makers would be advised to develop strategies geared toward limiting digital/electronic communication to the most critical and time sensitive information, which would afford physicians the requisite time for other activities and adequate rest.

The use of ICT may also require significant resources, which can be a considerable barrier to clinician acceptance. Currently, fee-for-service payment schemes lack incentives for information sharing (Franczak et al., 2014; O'Malley et al., 2015) and, therefore, alternative payment structures (e.g., a blend of salaries and workload based remuneration) may increase the uptake of ICT and encourage its long-term use. Finally, as there are ongoing concerns regarding the security of health care data (Callahan et al., 2005), decision-makers should ensure that the requisite infrastructure is in place to comply with privacy legislation.

From a methodological standpoint, this study began to address some of the limitations of existing research. First, by using a diverse set of databases and keywords related to ICT (to capture multiple forms and uses of ICT) this review provides a more comprehensive investigation than previous work. More specifically, most studies on this topic have focused on a single type of technology (Goyder, Atherton, Car, Heneghan, & Car, 2015; Walsh et al., 2013), or a single purpose for using the technology (e.g., Esquivel, Sittig, Murphy, & Singh, 2012; Zoll, Parikh, Gallimore, Harrell, & Burke, 2015). In addition, as the review period was between 2005 and 2015, this study examined provider perspectives on newer types of ICT; viewpoints that have been lacking from the research base (Antheunis, Tates, & Nieboer, 2013). Finally, as communication among physicians by electronic means is not well understood (Dunn & Markoff, 2009; Horwitz & Detsky, 2011), this study provides important information that is needed for this particular group of health care professionals.

From a theoretical standpoint, findings from this review revealed the very limited use of theory in this area (i.e., 1 out of 21 studies incorporated theory). This is an important finding as without theory, a coherent discussion/explanation of results, and the ability to predict future behaviour, is hindered.

Study 2. The second study presented in this dissertation provided a recent overview of the guidance for the protection of health information when using ICT across all 10 of Canada's provincial regulatory colleges for physicians. The study advances knowledge in this area by contributing to a greater understanding of potential factors that may play a part in the observed variability in scope and detail of the guidance provided. Possible explanations for variability in guidance across the provinces included the availability of resources, legacy effects (e.g., legislation/policies of the past), the influence of public opinion/pressure, the presence or absence

of a *policy entrepreneur* (an individual with political connections and/or negotiating skill), and the impact of competing interests. Moreover, this study draws attention to the potential effect of inconsistencies in guidance, such as disparate security behaviour based on location, which threatens the equal protection of health information across Canada.

These findings also highlight some of the significant health system challenges that arise under a federal system of government. For instance, health care in Canada falls primarily under provincial control as opposed to being a federal responsibility. This division of powers results in a lack of incentive for collaboration, which may, in turn, set the stage for duplication of efforts, which wastes resources. However, one benefit of a decentralized system of government is the opportunity for policy learning whereby different policies can be "tested" in different jurisdictions (*policy experimentation*; Howlett et al., 2009) and, as a result, the successes and failures of these policies can then inform and improve future policy-making. For this reason, policy-makers would benefit from taking advantage of opportunities for policy learning.

Methodologically, this study contributes to the current literature through the use of a comparative document analysis of the policies, guidelines, and standards of practice from physician regulatory colleges across the Canadian provinces. This type of investigation is well suited to the exploratory nature of qualitative research methodology, which seeks to describe, interpret, and understand the complexities of various phenomena (Creswell, 2007; Creswell & Plano Clark, 2011; Mantzoukas, 2008; Yin, 2014), while discovering relevant variables and/or experiences (Onwuegbuzie & Leech, 2006). Similar to the methodological gap filled by Study 1, this study applied to all forms of ICT potentially used by physicians. In addition, as most studies have taken either an organizational/system focus or a provider/patient focus, this study begins to provide a closer examination of the interplay between the system and providers (i.e., how

federal/provincial policies are interpreted and distributed to a specific group of health care providers).

From a theoretical standpoint, this study contributes to the current literature by examining the relatively understudied area of institutional elements/structures that may affect ICT use (i.e., policies, guidelines). In addition, explanations for variability in guidelines across the colleges were linked to commonly found concepts in the broader policy literature that are thought to influence government decision-making (e.g., competing interests, the presence or absence of a policy entrepreneur; Downs, 1972; Kingdon, 2003).

Study 3. The third study of this dissertation is a case study that examined the use of a relatively novel form of ICT (smartphones), for communication among medical residents. This study has contributed new knowledge by providing a greater understanding of how/why smartphones are being used in daily practice and the institutional/organizational factors that influence their use. The findings from this investigation indicate that medical residents perceive guidelines for smartphone use as not taking into account the day-to-day clinical and practical applications that these devices provide. Therefore, to ensure successful integration of ICT, such as smartphones, the unique characteristics of providers need to be taken into account. Accordingly, there is a need to promote knowledge exchange between "developers/providers" and "consumers/users" of guidelines/policies pertaining to the use of smartphones by medical residents. By doing so, guidelines can be developed that "resonate" with the associated clinical uses of the technology, fostering their uptake. Furthermore, given that peer/staff behaviour are important influences on the use of smartphones by medical residents in the professional context, the implementation of future policies could consider the use of mentorships throughout

postgraduate medical training whereby staff physicians (or a champion within the medical staff) model and promote behaviour in accordance with the associated guidelines.

From a methodological standpoint, a case study approach was chosen as it allows investigators to gain an in-depth understanding of real-life events (e.g., small group behaviour), and to ask penetrating questions that seek to capture the complexities of organizational behaviour (Yin, 2014). This procedure represents a contribution to the literature as existing studies of smartphone use in this population have been mainly limited to surveys (e.g., Plant & Fish, 2015; Prochaska, Bird, Chadaga, & Arora, 2015). As a result, they have failed to provide an in-depth understanding of how and why physicians are using smartphones to exchange health care related information with colleagues, and their perceptions of the guidelines/policies governing smartphone use.

In terms of theoretical contributions, this study qualitatively explored the perceptions of medical residents regarding their day-to-day use of smartphones while analyzing these perceptions through a broad neo-institutional lens (i.e., regulative, normative, and cultural-cognitive elements). Existing studies of organizations tend to focus on fewer institutional elements, such as regulative and cognitive pressures (Palthe, 2014). The application of a comprehensive interpretation of institutions, such as neo-institutionalism as used in this study, will help strengthen the contribution of this perspective when explaining social phenomena. Furthermore, the insights gained from such a comprehensive perspective could be used to inform studies examining ICT use in other health professions, organizations, and areas of care.

Relationship Among the Studies

This thesis is comprised of three interrelated studies. The findings from Study 1 (the systematic review) suggest that ICT can play an important role in enhancing communication

among physicians, but the extent of that benefit is context specific. In addition, a small number of studies included in the review: 1) used qualitative methods (such as interviews); and 2) discussed the impact of maintaining the security of health information and/or the impact of privacy legislation on the use of ICT. These findings were used to develop Study 2 (the document analysis), which compared guidelines for maintaining health information privacy when using ICT across the provincial physician regulatory colleges in Canada. Study 3 went further through the use of a case study that allowed for an in-depth understanding (via semi-structured interviews) of how and why physicians are using a specific and novel form of ICT, and how institutional/organization guidelines affect their behaviour. Taken together, these three studies contribute to addressing the objectives of the dissertation as well as answering the overarching research question: "To what extent and under what conditions are physicians using ICT for communication of health care related information, and what is its role in enhancing health system performance?"

Summary

Overall, the studies presented in Chapters 2-4 form important steps forward in an important area of health systems and policy research. These studies contribute new knowledge about: 1) how physicians are using ICT for health care related communication with colleagues, including the potential impact of ICT for enhancing such communication; 2) the rationale physicians have for using ICT as a communication tool; and 3) how neo-institutional theory can be applied at the micro and meso organizational levels to help explain the conditions under which a particularly novel form of ICT (smartphones) is being used by medical professionals in training. This work sets the foundation for future investigations into ICT use, such as obtaining a greater understanding of ICT's effectiveness/efficiency or examining its cost-effectiveness.

Moreover, results from this study provide timely information and insights to support policy-makers in determining which services to support as efforts to improve the delivery of health care services continue.

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