# The Impact of E-Health Adoption and Investment on Health Outcomes:

## A Study using Secondary Analysis

by

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# ABSTRACT


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The overall goal of this research study is to determine if there is a correlation between electronic health (e-Health) adoption, e-Health investment and better health outcomes in a hospital setting. To carry out this research, data with respect to e-Health spending, e-Health adoption and relevant health outcome indicator results for Ontario hospitals were analyzed to determine if there is a correlation between the variables.

There were significant positive correlations between e-Health adoption and investment variables; indicating that higher e-Health investment is associated with greater e-Health adoption.

There were significant correlations between variables related to e-Health adoption, investment and certain health outcomes. For example, increased e-Health adoption was significantly and negatively correlated with variables related to Length of Stay (LOS), which suggests that increased e-Health adoption is associated with lower LOS.

This study attempts to create a foundation upon which Return On Investment (ROI) may be calculated for e-Health technology.

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# EXECUTIVE SUMMARY

In healthcare, there is a need to justify expenditure on Information Technology (IT) or electronic health (e-Health) applications. This justification may also be referred to as Return On Investment (ROI), whereby costs are related to benefits. There is a lack of research surrounding ROI with respect to IT implementation or usage in the healthcare industry.

The primary focus of this research study is to determine if there is a relationship between e-Health adoption, e-Health investment, and better health outcomes in a hospital setting. This study was carried out by performing statistical analysis on data retrieved from three separate data sources (related to e-Health adoption, e-Health investment, and specific health outcome indicators).

Many interesting findings emerged from this study and are discussed below.

1) Relationship between IT usage and spending across reports

   There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Use of Clinical IT indicator (Based on the Acute Care Hospital Report). This indicates that higher adoption of IT is associated with greater usage of IT (for example, the 2008 adoption score; p-value=.000). While the above finding may seem intuitive or obvious, this correlation confirms that adoption[1] of IT is associated with usage of IT. Essentially, hospitals that are implementing IT are actually using the functionality associated with the IT application(s). This finding also confirms accuracy or similarity between the two data sources used to report on usage of IT (namely the OHA e-Health Adoption Report and the Acute Care Hospital Report).

   There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Use of Clinical IT indicator (Based on the Acute Care Hospital Report). This indicates that higher investment in IT Capital Expense is associated with greater usage of IT (for example, the 2007 percent IT Capital Expense; p-value=.012). Once again, while the above finding may seem intuitive or obvious, this correlation confirms that investment in IT Capital Expense is actually associated with IT usage within hospitals.

   There were significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and 2007 percent IT Capital Expense. As the value of the IT Capital Expense increases, so does the value of the adoption scores (for example, the 2008 adoption score; p-value=.005). While the above finding may seem intuitive or obvious, this correlation

[1] For this research project, adoption is defined as self-reported usage or functionality

confirms that investment in IT is associated with usage of IT. Essentially, hospitals that are investing in IT are actually using the functionality associated with the IT application(s).

There were significant positive correlations between Subsections 1.2 (Point-Of-Care Order Entry), 1.3 (Clinical Documentation), 1.4 (Results Reporting) and 2007 percent IT Capital Expense. As the value of the percent IT Capital Expense increases, so does the value of the indicated subsections (for example, Subsection 1.2; p-value = .001).

Overall, the findings above indicate that investment in IT is correlated with usage of IT. Essentially, hospitals that invest in IT are actually using the functionality associated with the IT (Refer to Chapter 4 for more information).

2) Increased IT investment and implementation associated with greater evidence-based decision making

There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Use of Data for Decision-Making indicator (Based on Acute Care Hospital Report). This indicates that higher adoption of IT is associated with greater usage of data for decision-making purposes (for example, the 2008 adoption score; p-value = .001).

There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Use of Data for Decision-Making indicator (Based on Acute Care Hospital Report). This indicates that higher investment in IT Capital is associated with greater usage of data for decision-making purposes (for example, the 2007 percent IT Capital Expense; p-value = .014).

3) Increased IT implementation associated with improved patient safety outcomes

There are significant positive correlations between OHA adoption scores (for 2006 and 2008) and the Patient Safety Reporting and Analysis indicator (Based on Acute Care Hospital Report). This indicates that higher adoption of IT is associated with greater Patient Safety Reporting and Analysis (for example, the 2008 adoption score; p-value =.038). For example, hospitals that implement IT have better monitoring and reporting of patient safety incidents.

There are significant negative correlations between 2007 Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.3 (Clinical Documentation), and 1.4 (Results Reporting) with the Adverse Events indicator (related to Labour and Delivery) (Based on Acute Care Hospital Report). This indicates that higher adoption of IT (with those particular subsections) is associated with a lower score for Adverse Events related to Labour and Delivery (for example, Subsection 1.1; p-value = .014).

4) Increased IT implementation associated with lower Length of Stay

There are significant negative correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and the Average Active Rehabilitation Length of Stay (LOS) indicator for all Rehabilitation Care Groups (RCGs) (Based on Rehabilitation Care Hospital Report). This indicates that higher adoption of IT is associated with a lower LOS (for example, the 2008 Adoption Score; p-value = .006).

There are significant negative correlations between 2007 Subsections 1.3 (Clinical Documentation), 1.4 (Results Reporting) and the Average Active Rehabilitation Length of Stay (LOS) indicator for all Rehabilitation Care Groups (RCGs) (Based on Rehabilitation Care Hospital Report). This indicates that higher adoption of IT (with respect to the indicated subsections) is associated with a lower LOS (for example, Subsection 1.3; p-value = .006).

There are significant negative correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and the Average Active Rehabilitation Length of Stay (LOS) indicator for Stroke (Based on Rehabilitation Care Hospital Report). This indicates that higher adoption of IT is associated with a lower LOS (for example, the 2008 Adoption Score; p-value = .027).

There are significant negative correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and the Average Active Rehabilitation Length of Stay (LOS) indicator for Ortho (Based on Rehabilitation Care Hospital Report). This indicates that higher adoption of IT is associated with a lower LOS (for example, the 2008 Adoption Score; p-value = .003).

There are significant negative correlations between 2007 Subsections 1.2 (Point-Of-Care Order Entry), 1.3 (Clinical Documentation), 1.4 (Results Reporting) and the Average Active Rehabilitation Length of Stay (LOS) indicator for Ortho (Based on Rehabilitation Care Hospital Report). This indicates that higher adoption of IT (with respect to the indicated subsections) is associated with a lower LOS (for example, Subsection 1.2; p-value = .045).

5) Increased IT investment and implementation associated with greater coordinated care and/or greater level of appropriate care

There are significant positive correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and the Internal Coordination of Care indicator (Based on Emergency Care Hospital Report). This indicates that higher adoption of IT is associated with greater internal coordination of care (for the 2008 Adoption Score; p-value = .001). For example, this indicates that hospitals with greater adoption of IT have better coordination of patient care.

There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Internal Coordination of Care indicator (Based on Emergency Care Hospital Report). This indicates that higher investment in IT Capital is associated with greater internal coordination of care (for the 2008 Adoption Score; p-value = .008).

There are significant negative correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and Readmission Rate for specific medical conditions (Based on Acute Care Hospital Report). This indicates that higher adoption of IT is associated with a lower Readmission rate for specific medical conditions (for example, the 2008 Adoption Score; p-value = .008).

There are significant negative correlations between OHA Adoption Scores (for 2006 and 2008) and Readmission Rate for Labour and Delivery (Based on Acute Care Hospital Report). This indicates that higher adoption of IT is associated with a lower Readmission rate (for example, the 2008 Adoption Score; p-value = .002).

There are significant positive correlations between OHA Adoption Scores (for 2006, 2007, and 2008) and the Use of Standardized Protocols indicator (Based on Emergency Care Hospital Report). This indicates that higher adoption of IT is associated with greater usage of standardized protocols (for example, the 2008 Adoption Score; p-value = .032). As an example, this may indicate that hospitals with greater adoption of IT are more likely to use common guidelines for diagnosis and treatment of clinical conditions.

There are significant negative correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Return X-Ray Rate for Ankle or Foot Injury Patients indicator (<=7days). As the adoption scores increase for all three years, the Return X-Ray Rate for Ankle or Foot Injury Patients indicator decreases (for example, the 2008 Adoption Score; p-value = .001).

6) <u>Increased IT investment and implementation associated with a higher number of medical nurse-sensitive adverse events</u>

There are significant positive correlations between OHA Adoption Scores (for 2007 and 2008) and the Medical Nurse-Sensitive Adverse Events indicator (Based on Acute Care Hospital Report). This indicates that higher adoption of IT is associated with a higher score for Medical Nurse-Sensitive Adverse Events (for example, the 2008 Adoption Score; p-value = .019). This result suggests that higher implementation of IT may lead to more errors. A regression test was also performed using Subsection scores to understand what aspect(s) of IT adoption are associated with an increase in the Medical Nurse-Sensitive Adverse events indicator. The only subsection significantly related to Medical Nurse-Sensitive Adverse Events was Subsection 1.3

(Clinical Documentation). The significance values included (t = 3.464; p-value = .001). This result suggests that increased IT functionality around Clinical Documentation is associated with a higher score for Medical Nurse-Sensitive Adverse events. Perhaps this suggests that by using IT for clinical documentation, hospitals are actually increasing their level of reporting on adverse events. As a result, this could explain why there is an increase in the number of adverse events.

There are significant positive correlations between percent IT Operating Expense (for 2006 and 2007) and the Medical Nurse-Sensitive Adverse Events indicator (Based on Acute Care Hospital Report). This indicates that higher investment in IT Operating Expense is associated with a higher score for Medical Nurse-Sensitive Adverse Events (for example, 2007 percent IT Operating Expense; p-value = .001).

The findings above suggest that increased investment and implementation of IT results in a higher value for the medical adverse events indicator. Whether IT usage increases or decreases the number of adverse events, one benefit of IT is that it provides a means by which to report or measure the number of adverse events.

7) Barriers and Resources Associated with e-Health Adoption

While studies have shown benefits of IT implementation in healthcare, hospitals are at varying stages of adoption. A secondary objective of this research study is to understand what the organizational barriers to IT implementation are within hospitals and to understand what resources (in relation to staffing and/or program areas) are necessary for successful IT adoption. Specifically, the study correlates the number of barriers and resources faced by hospitals to e-Health adoption.

In addition, specific barriers and resources were tabulated for two groups: hospitals with adoption scores that were above the mean adoption score and hospitals with adoption scores that were below the mean adoption score. For the two groups of hospitals, the following three barriers were identified (in order from most to least common):

- Lack of adequate financial support;
- Lack of qualified staff or access to qualified staff; and
- Difficulty in achieving end-user acceptance.

This suggests that regardless of the amount of IT adoption, these three barriers were the most common amongst all hospitals.

For the groups of hospitals with adoption scores below the mean, the following four resources were identified (in order from most to least common):

- IS Support in End User Departments;
- Project Management;
- Decision Support; and
- Clinical Systems Training.

For the groups of hospitals with adoption scores above the mean, the following three resources were identified (in order from most to least common):

- Clinical Systems training;
- IS Support in End User Departments; and
- Decision Support.

The findings indicate that there are common barriers amongst hospitals that may impede IT adoption and that there are also common resources amongst hospitals that may facilitate successful IT adoption.

# CHAPTER 1: INTRODUCTION

In order to sustain a healthcare system which emphasizes high quality, it is important to be able to manage healthcare. In healthcare, problems related to quality are not often caused by inadequate knowledge, but by failure of the system to accurately and consistently apply that knowledge (Kuperman & Gibson, 2003). A key part of successful management is the ability to access and use appropriate data or information (Leonard, 2000). The use of Information Technology (IT) or e-Health allows for better access to data and information, which in turn may increase the quality of healthcare delivery. Electronic communication has been described as a factor in successful growth of the healthcare industry (Guerriere, 1999).

There is no single, agreed upon meaning of the term e-Health. Various definitions include:

- "…a revolutionary new paradigm for health care that has evolved as a result of advances in information, telecommunication, network technologies and information management." (Urowitz et al., 2008);
- "…the integration of the internet into health care…" (Watson, 2004, p. 1155);
- "…new business models using technology to assist healthcare providers in caring for patients and providing services." (Sternberg, 2004, p.46); and
- "…an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology." (Eysenbach, 2001).

For this research project, e-Health will be defined broadly as the use of information technology in the healthcare sector.

In all industries, most decisions to implement any new form of technology require a business-case valuation approach, whereby potential benefits or gains are evaluated against current and future costs (Leonard, 1998). In healthcare, there is an increasing demand for this valuation to justify expenditure on e-Health applications. This process of evaluating benefits and costs may also be referred to as Return On Investment (ROI). To calculate ROI, it is necessary to understand what the benefits and costs are and to establish an association between these variables. Quantifying the benefits and costs would allow for the actual calculation of a ROI value.

In healthcare, there is a challenge in understanding and quantifying the benefits of e-Health adoption because the benefits from investment in such technologies are poorly defined (Garrett et al., 2006; Leonard, 2000). This may be due to some of the following reasons:

- Some benefits from use of IT in healthcare are difficult to quantify as they cannot be translated into monetary terms. For example, it may be difficult to financially assess improved quality of care (Menachemi & Brooks, 2006; Kuperman & Gibson, 2003);
- The use of IT in healthcare may not generate a billable service, such as with use of other medical technology such as a Magnetic Resonance Imaging (MRI)[2] scan (Menachemi & Brooks, 2006). Most IT used in healthcare is meant to improve a process and not to create a billable function. This makes it challenging to measure the economic impact of IT in healthcare (Menachemi & Brooks, 2006);
- Many organizations do not measure benefits related to investment of IT in healthcare (such as rates of medication errors) (Kuperman & Gibson, 2003); and
- There is a lack of consensus on the definitions and measures of performance related to IT in healthcare (Leonard, 2000).

Various literature has identified the need to measure value associated with IT (Leonard, 2004; Leonard, 1998). To measure value associated with IT, there is a need to develop methods for tracking utilization and spending on IT (Leonard & Sittig, 2007). As of 2007, there is no detailed study which analyzes the relationship between investment in IT and improvement in health outcomes and financial efficiencies, whereby the benefits and results may be observed (Leonard & Sittig, 2007).

There are studies which have investigated the benefits of e-Health applications, though most have not focused on financial benefits. For example, some studies have shown that Computer Physician Order Entry (CPOE)[3] systems reduce the number of medical errors (Bates et al., 1999; Bates et al., 1998). However, there are also studies that have shown that CPOE may increase the risk of errors (Koppel et al, 2005). Another study links IT implementation in healthcare with improvements in efficiency and quality of care (Chaudhry et al., 2006). Despite research showing differing results of IT implementation, the majority of studies show a positive impact of e-Health implementation.

The benefits of e-Health have been recognized in Canada and the United States. In 2009, The Canadian federal government invested $500 million into Canada Health Infoway[4], an organization dedicated to accelerating e-Health implementation in Canada. In 2009, The Obama administration in the United States committed to spending $19.2 billion on IT investment in healthcare (Steinbrook, 2009).

[2] An MRI scan is a technology that uses magnetic signals to produce images of the human body.
[3] CPOE involves the electronic ordering of tests and medications related to patient care. CPOE is an example of an e-Health application.
[4] Canada Health Infoway is a non-profit organization created to develop and implement electronic health records in Canada

Despite government commitment and research showing the benefits of IT usage in healthcare, implementation rates of e-Health applications have still been relatively low. For example, one study reveals that only 4% of United States physicians use a fully functional Electronic Health Record (EHR)[5] system (DesRoches et al., 2008).

Adoption of IT has been slower in the healthcare industry relative to other industries (Middleton, 2005). As discussed previously, this lack of e-Health implementation may be due to a lack of information surrounding ROI. However, there are other factors impeding IT implementation in healthcare. One report identified some of the following barriers[6] with respect to EHR implementation that were based on the 2004 annual American College of Medical Informatics (ACMI)[7] conference (Middleton et al., 2005):

- Lack of evidence surrounding ROI;
- Lack of standards adoption;
- Lack of definitions with respect to product or application features; and
- Lack of viable e-Health vendors.

Understanding other barriers to e-Health implementation will help explain why implementation rates are low. In understanding these obstacles, perhaps strategies to mitigate barriers may be developed; thereby increasing the implementation rate.

In addition to understanding the barriers to implementation, various research has studied the resources necessary to successfully implement e-Health solutions. At the 2004 American College of Medical Informatics (ACMI) conference, recommendations to stimulate EHR implementation was suggested (Middleton et al., 2005). Some of these recommendations included:

- increasing resources devoted to evaluation of the impact of IT in healthcare, with emphasis on economic outcomes, benefits and costs;
- increasing the use of standards for the EHR with respect to messaging, functionality, and data representation; and
- creating an educational campaign for healthcare providers and managers.

Understanding the resources related to successful e-Health implementation will help improve the usage of e-Health applications and help explain what is necessary to make IT implementation successful.

[5] An EHR is an electronic record of a patient's medical information. EHR is an example of an e-Health application.
[6] A barrier is any condition that hinders the achievement of an objective
[7] ACMI is a college consisting of individuals who have made contributions to the study of medical informatics

## RESEARCH OBJECTIVES:

The overall goal of this research study is to determine if there is a correlation between e-Health adoption, e-Health investment and better health outcomes in a hospital setting. For this research project, adoption[8] is defined as self-reported usage or functionality. To carry out this research, data with respect to e-Health spending, e-Health adoption and relevant health outcome indicators for Ontario hospitals will be analyzed to determine if there is a correlation between the variables.

This research project attempts to provide a foundation for calculation of ROI by establishing whether there is an association between cost (e-Health investment or spending) and benefits (better health outcomes). To calculate a specific ROI value, it would be necessary to quantify the benefits, which is outside the scope of this research project.

A second objective of this research study is to determine the impact of organizational barriers on e-Health adoption in a hospital setting. Specifically, it will be determined if there is a correlation between the number of barriers reported by hospitals and e-Health adoption. The specific types of barriers will also be determined. Analyzing the barriers to e-Health adoption may help explain adoption rates.

A final objective of this research study is to understand the organizational resources necessary for successful adoption of e-Health in healthcare. These resources may be related to staffing and/or program areas. Specifically, it will be determined if there is a correlation between the number of resources exhibited by hospitals and e-Health adoption. The specific types of resources will also be determined.

[8] This definition of Adoption is not commonly used; however the Ontario Hospital Association (OHA) defined the term in this context. For practical reasons, the OHA definition was selected for inclusion in this research study.

# CHAPTER 2: LITERATURE REVIEW

The overall goal of this research study is to determine if there is a correlation between e-Health adoption, e-Health investment and better health outcomes in a hospital setting. In order to test this, it is important to understand how e-Health can impact health outcomes.

In addition, two other objectives of this research study involve understanding the organizational barriers to e-Health adoption and organizational resources necessary for successful e-Health adoption. Understanding the barriers and resources for successful e-Health adoption faced by other organizations is important to understanding the role of these two factors in e-Health implementation.

## 2.1 E-HEALTH ADOPTION AND IMPACT ON HEALTH OUTCOMES

A health outcome may be defined as a change in health status resulting from the care of a healthcare provider. Various indicators may be used to measure health outcomes.

A systematic review conducted by Chaudhry et al. (2006) showed that information technology used in healthcare resulted in improved quality and efficiency. This study analyzed 257 studies, composed of descriptive, comparative, and systematic reviews of IT used in a healthcare setting. Most of these studies were focused on decision-support systems or electronic health records. The main benefits included (Chaudhry et al., 2006):

- increased adherence to guideline-based care;
- enhanced surveillance and monitoring;
- decreased medication errors; and
- decreased utilization of care.

A number of studies have investigated the impact of specific e-Health applications on health outcome measures. Table 2-1 below provides a summary of specific e-Health applications and impact on health outcome measures. The various studies are discussed further below, separated by the type of e-Health application.

**Table 2-1: Summary of Literature Review**

| Application | Study/Author(s) | Healthcare Setting | Design | Health Outcome Measure(s) |
|---|---|---|---|---|
| Computerized Physician Order Entry (CPOE)[9] with Clinical Decision Support (CDS)[10] | Wolfstadt et al. (2008) | Hospital and Ambulatory Care | Systematic Review | * reduction in number of adverse drug events (in 5 out of 10 studies; (P<.05)<br>* four out of 10 studies showed non-statistically significant reduction in number of adverse drug events<br>* 1 study showed no change in number of adverse drug events |
| CPOE with CDS | Kaushal et al. (2003) | Hospital inpatient care | Systematic Review | * reduction in medication error rate (2 out of 5 studies)<br>* improvement in corollary orders[11] (1 out of 5 studies)<br>* improvement in prescribing behaviors (1 out of 5 studies)<br>* improvement in dosing and frequency of nephrotoxic drug[12] (1 out of 5 studies)<br>* improvement in medication errors or adverse drug events related to antibiotics (3 out of 7 studies)<br>* improvement in medication errors related to theophylline[13] (1 out of 7 studies) |

[9] CPOE is also referred to as Computerized Provider Order Entry (CPOE)
[10] CDS is also referred to as Computerized Clinical Decision Support (CDSS) or Decision Support System (DSS)
[11] Tests or treatments ordered by healthcare providers in response to effects cause by previously ordered tests or treatments
[12] Nephrotoxic drugs are drugs that are damaging to the kidneys in some way
[13] Theophylline is a drug used to treat medical conditions such as asthma and bronchitis

| Application | Study/Author(s) | Healthcare Setting | Design | Health Outcome Measure(s) |
|---|---|---|---|---|
| CPOE with CDS | Chertow et al. (2001) | Medical / Surgical Services at academic hospital | Time-Series | * Mean length of stay reduced from 4.5 days to 4.3 days (P=.009)<br><br>* increase in number of appropriate prescriptions from 54% to 67% (P<.001)<br><br>*No significant difference in number of patients that experienced a change in renal function during hospitalization (between intervention and control periods) |
| CPOE with CDS | Dexter et al. (2001) | General medicine inpatients at academic hospital | Randomized Controlled Trial | * increased ordering rate (and subsequent delivery rate) of appropriate preventive therapies |
| CPOE with CDS | Teich et al. (2000) | Medical and surgical services at academic hospital | Time-Series | *improved physician prescribing – i.e. use of one particular drug increased from 24% to 47% (P<.001). |
| CPOE | Jayawardena et al. (2007) | Community-based academic hospital | Retrospective study | *reduction in prescription errors |
| CPOE | Koppel et al. (2005) | Tertiary-care academic hospital | Qualitative and quantitative study | * CPOE increased risk of medication errors (specifically, 22 type of errors) |
| CPOE | Bates et al. (1998) | Selected units at academic hospital | Time-Series | * decreased rate of non-intercepted medication errors by 55%<br><br>* preventable adverse drug events declined 17%<br><br>*non-intercepted potential adverse drug events declined 84% |
| CPOE | Tierney et al. (1993) | Internal Medicine department at a Public hospital | Randomized Controlled Trial | * Reduction in length of stay by .89 days (10.5%) (P = .11) |

| Application | Study/Author(s) | Healthcare Setting | Design | Health Outcome Measure(s) |
|---|---|---|---|---|
| CDS | Hicks et al. (2008) | Primary Care Practices (Hospital based and community-based) | Cluster Randomized Controlled Trial | * improved medication prescribing in terms of adherence to guidelines<br><br>(7% for group using CDS and 5% for group not using CDS, P < .001)<br><br>* No improvement in blood pressure control |
| CDS | Garg et al. (2005) | All types of care in various countries (United States, United Kingdom, Canada, Australia, Italy, Austria, France, Germany, Israel, Norway and Switzerland) | Systematic Review | * improved practitioner performance (in 62 of 97 studies) with respect to:<br><br>-improved diagnosis (in 4 out of 10 systems);<br><br>-improvements with respect to use of preventive care in 16 of 21 systems (i.e. counseling, testing, medication use, etc.);<br><br>-improved disease management in 23 of 37 systems (i.e. with respect to diabetes care, cardiovascular prevention, etc.); and<br><br>-improvement in drug dosing or drug prescribing in 19 of 29 systems<br><br>* effects on patient health outcomes inconsistent: lack of adequate statistical power to detect differences in clinical care |
| CDS | Sintchenko et al. (2005) | Tertiary[14] Hospital Intensive Care Unit providing medical/surgical services (in Australia) | Cohort Trial | * reduction in length of stay (7.15 to 6.22 (P=.02) between the control and intervention groups respectively<br><br>* reduction in antibiotic prescribing |

[14] Tertiary hospitals usually refer to hospitals offering a broad range of services and specialties

| Application | Study/Author(s) | Healthcare Setting | Design | Health Outcome Measure(s) |
|---|---|---|---|---|
| CDS | Hunt et al. (1998) | Not specific to any care type | Systematic Review | * 43 of 66 studies found benefit with respect to physician performance:<br>-drug dosing system (9 of 15 studies);<br>-diagnostic aids (1 of 5 studies); and<br>-preventive care systems (14 of 19 studies).<br>* Effect of CDS on patient outcomes not conclusive. |
| CDS | Lobach & Hammond (1997) | Primary care clinic | Controlled Trial | * A two-fold increase in physician compliance to guidelines for diabetes (P=.01) |
| CDS | Shea et al. (1995) | Academic Medical Center | Randomized Controlled Trial | * reduced length of stay by 3.2% |
| Electronic Health Record (EHR)[15] with functionality related to CDS | Davis et al. (2009) | Primary care (responses from physicians in 7 countries: Australia, Canada, Germany, the Netherlands, New Zealand, United Kingdom, and United States) | Multivariate analysis | * Physicians reported being better prepared to manage patients with chronic diseases (Odds Ratio[16] (OR) = 1.94)<br>*Physicians more likely to use medical practice guidelines (OR = 1.58)<br>*Strong IT usage associated with patient safety (follow-up/analysis of adverse events) |

[15] EHR is also referred to as an EMR (Electronic Medical Record)
[16] Odds Ratio is a statistic that describes the strength of association between binary data values

| Application | Study/Author(s) | Healthcare Setting | Design | Health Outcome Measure(s) |
|---|---|---|---|---|
| EHR with CDS | Amarasingham et al. (2009) | 72 acute care hospitals in Texas, United States (academic and community hospitals) | Cross-Sectional Study | * lower mortality rates (increase in use of automated notes / records associated with 15% decrease in likelihood of patient mortality)<br><br>* fewer medical complications [hospitals with higher amount of CDS associated with 16% decrease in likelihood of complications (across all medical conditions)]<br><br>*higher usage of Order Entry associated with 9% decrease in likelihood of death related to myocardial infarction<br><br>*higher usage of Order Entry associated with 55% decrease in likelihood of death related to coronary artery bypass graft |
| EHR | Linder et al. (2007) | Ambulatory care | Retrospective, Cross-Sectional analysis | *EHRs not associated with better quality ambulatory care<br><br>-for 14 out of 17 quality indicators – no significant difference related to performance with use of EHR |

### 2.1.1 CPOE WITH CDS

Some health outcome indicators related to CPOE and CDS that have been researched include length of stay, number of adverse drug events, and appropriate physician prescribing.

CPOE allows physicians to directly enter medical orders into an information system through a computer without having to handwrite them (Kuperman & Gibson, 2003). CPOE has been shown to decrease medication errors (Cordero et al., 2004; Kaushal et al., 2003; King et al., 2003). Clinical Decision Support (CDS) may be defined as an application or clinical system that helps healthcare providers make clinical decisions that enhance patient care.

A systematic review conducted by Wolfstadt et al. (2008) showed that five out of ten studies demonstrated a significant reduction in the number of adverse drug events by using CPOE coupled with CDS. Adverse drug events may be defined as injuries to patients that are drug-related. Additionally, four other studies showed a non-significant reduction in adverse drug events. One study showed no change in rate of adverse drug events. The ten studies used in this research were within the hospital and ambulatory care settings. Of the studies, 9 were performed in the hospital setting and consisted of care related to older patients, pediatric patients, Intensive Care Unit patients, and overall hospital-wide care. One study was carried out in the ambulatory care setting (Wolfstadt et al., 2008).

A systematic review conducted by Kaushal et al. (2003) showed a decrease in serious medication error rates with use of CPOE and isolated CDS. This study involved the analysis of studies that evaluated impact of CPOE and CDS on medication safety. There were a total of 12 trials evaluated in this study (5 related to CPOE and 7 related to CDS). Only CDS studies that focused on guiding physicians in the order-writing process were included in this systematic review. Studies were only included in the systematic review if they were controlled trials (randomized and nonrandomized) or observational studies (with controls).

Of the five CPOE studies:

- 2 showed a decrease in medication error rate;
- 1 showed an improvement in 5 prescribing behaviours;
- 1 showed an improvement in corollary orders; and
- 1 showed an improvement in dosing and frequency of nephrotoxic drugs.

Of the 7 CDS studies:

- 3 showed improvement in medication errors or adverse drug events related to antibiotics;
- 1 showed improvement in medication errors related to theophylline; and
- 3 studies showed non-significant results.

A study by Chertow et al. (2001) showed that usage of CDS incorporated with CPOE reduced the mean length of stay from 4.5 days (control group) to 4.3 days (intervention group) ($P = .009$). In addition, there was an increase in the number of appropriate prescriptions from 54% (control group) to 67% (intervention group) ($P < .001$). This study was aimed at patients with renal insuffiency[17]. This study was carried out using a control (CPOE) with an intervention (CPOE plus CDS) over a period of four 2-month intervals. This study consisted of a sample of 17,828 inpatients admitted to a 720-bed tertiary care teaching hospital in Boston, United States and was conducted in 1997-1998. The intervention involved use of real-time CDS for prescribing medications to patients with renal insufficiency. For the intervention, the default

[17] Renal insufficiency is a condition that affects the ability of the kidney to function normally

dose amount, adjusted dose listing, and default frequency were shown to the system user. For the control period, the recommended parameters were not shown to the system user. The total number of inpatients with renal insufficiency was 7,490. There was no significant difference in number of patients that experienced a change in renal function during hospitalization (between intervention and control periods).

A randomized controlled trial conducted by Dexter et al. (2001) determined that computerized reminders (CDS) increased the rate of ordering and subsequent delivery of four specific preventive therapies for inpatients. This study occurred during an 18-month period for a total sample of 6,371 patients that were admitted for a general medicine condition. Reminders for preventive care measures were generated as appropriate. Physicians in the intervention group viewed the reminders when using CPOE for inpatients. In total, the computerized reminders identified 3,416 patients that were eligible for preventive measures, which were not ordered by the physician. The computerized reminders involved higher ordering rates for the following conditions:

- pneumococcal vaccination[18] (35.8% of patients in intervention group versus 0.8% of patients in control group, P<.001);
- influenza vaccination[19] (51.4% of patients in intervention group versus 1.0% of patients in control group, P<.001;
- prophylactic heparin[20] (32.2% of patients in intervention group versus 18.9% of patients in control group, P<.001; and
- prophylactic aspirin[21] (36.4% of patients in intervention group versus 27.6% of patients in control group, P<.001.

This study occurred at a teaching hospital in Indianapolis, US, between 1997 and 1998.

Teich et al. (2000) showed that CPOE with CDS resulted in improved prescribing practices by physicians. When drug orders were entered, the computer would display guidelines for drug use and suggest appropriate doses. For example, to prevent thrombosis,[22] the use of a drug (subcutaneous heparin sodium[23]) in patients increased from 24% to 47% (P<.001) when the computer suggested use of the drug. This study was carried out at a 720-bed academic medical center in Boston, United States using time series analysis. This study used CPOE coupled with CDS. All adult inpatient orders were entered through CPOE.

[18] Pneumococcal vaccination is a vaccine to prevent pneumonia
[19] influenza vaccination is a vaccine to prevent influenza
[20] Prophylactic heparin is used to prevent any medical conditions that might result from blood clotting
[21] Prophylactic aspirin is used to prevent any medical conditions that might result from blood clotting
[22] Thrombosis is a condition caused by formation of a blood clot
[23] Subcutaneous heparin sodium is used to prevent any medical conditions that might result from blood clotting

Overall, these studies suggest that CPOE paired with CDS has the potential to reduce the number of adverse drug events, to reduce length of stay, and to increase the number of appropriate prescriptions.

### 2.1.2 CPOE

Some health outcome indicators related to CPOE that have been researched include length of stay and adverse drug events.

A study by Jayawardena et al. (2007) demonstrates that CPOE is successful in reducing prescription errors. This research was carried out as a retrospective study in a New York community-based academic hospital over a one-year period between 2004 and 2005. A total of 3,321 actual errors were identified through CPOE and the hospital pharmacist. These errors were errors in duplications, incorrect orders, allergy violations, incomplete orders or dosage adjustments. This study involved retrospectively evaluating adverse drug events during the one-year period.

A study by Koppel et al. (2005) determined that CPOE increased the risk of 22 types of medication errors. This study was conducted at an academic hospital between 2002 and 2004 and consisted of quantitative and qualitative study. This study involved:

- surveying medical staff in the hospital;
- conducting focus groups and one-on-one interviews with medical staff, IT leaders, pharmacy leaders, etc.;
- shadowing medical staff; and
- observing medical staff using CPOE.

These errors were caused in different ways including inadequate displaying of patients' medications on CPOE screen, formats for ordering that created incorrect orders, and CPOE functions that resulted in double dosing.

Bates et al. (1998) demonstrated that CPOE decreased the rate of non-intercepted medication errors by fifty-five percent. Non-intercepted errors are errors that were not intercepted before reaching the patient. Preventable adverse drug events declined seventeen percent. Non-intercepted potential adverse drug events declined eighty-four percent. Adverse drug events may be defined as injuries to patients that are drug-related. This study was conducted within a large tertiary care hospital in the United States. This study involved conducting a before and after comparison of baseline measures of adverse events (without CPOE) to measures of adverse events using CPOE.

A study by Tierney et al. (1993) showed a reduction in length of stay by 10.5% through use of a network of microcomputer workstations to enter inpatient orders (CPOE). Hospital length of stay for the intervention group was .89 days shorter than for controls (P = .11). The microcomputer workstations

were linked to an electronic medical record system. This study was carried out as a randomized controlled clinical trial at a public hospital in the United States, involving 5,219 internal medicine patients and 68 teams of staff caring for them (including medical students and internists).

Overall, these studies suggest that there are mixed findings with regard to the benefits of CPOE. One study indicates that CPOE may reduce length of stay and rate of prescription errors, while another study indicates that CPOE actually increases the rate of errors.

### 2.1.3 CDS

Some health outcome indicators related to CDS that have been researched include length of stay, disease management and compliance to clinical guidelines.

A randomized control trial conducted by Hicks et al. (2008) showed that CDS increased adherence to recommended guidelines in terms of medication prescribing. This study involved randomly assigning 2, 027 adult patients receiving hypertension care to either physicians using CDS for each patient or to care without use of CDS for the control group. This study was carried out over an 18-month period across 14 primary care practices in the U.S. The use of guideline recommended medication prescribing was higher with CDS than for the control group not using CDS (7% and 5% respectively, $P < .001$). The sample of practices in this study included 8 community practices and 6 hospital-based primary care practices, which were partnered with an academic medical center. There was no improvement in blood pressure control.

A systematic review conducted by Garg et al. (2005) showed that CDS improved performance of healthcare practitioners in 64% (62 of 97) of studies used to assess this outcome. Specifically, this included:

- Improved diagnosis (evaluating systems for diagnosis);
- Evaluating reminder systems for preventive care (including testing, medication use, counseling, vaccination, rates of screening, etc.);
- disease management (evaluating management of conditions such as diabetes); and
- studies evaluating drug dosing or prescribing.

This study reviewed controlled trials assessing effects of CDS. Randomized and non-randomized controlled trials were included in this study which evaluated care provided with CDS versus care provided without CDS. The effect on patient outcomes in this study was not conclusive. This study also showed that improved practitioner performance was associated with CDS when users were automatically prompted by the CDS as opposed to users having to activate the system (73% success rate for trials with automatic prompt versus 47% for users having to activate system; $P = .02$).

The study by Sintchenko et al. (2005) showed that use of CDS reduced length of stay and amount of antibiotic prescribing in an intensive care unit in an 800-bed tertiary hospital in Australia. The CDS was used on a handheld computer. The effect of CDS was determined through a cohort trial lasting for 12 months. The intensive care unit provides medical and surgical services. Outcome measures were related to antibiotic usage, mortality, and length of stay. The control period was for 6 months in 2002, with no CDS available to staff in the unit. The intervention group lasted 6 months (2002-2003) with CDS available to staff in the unit. Patient length of stay reduced from 7.15 to 6.22 (P=.02) between the control and intervention groups respectively. Two specific antibiotics were prescribed less during the intervention period as compared to the control period.

A systematic review conducted by Hunt et al. (1998) showed that CDS systems enhance clinical performance for drug dosing and preventive care. This study analyzed a total of 68 randomized controlled trials. Nine out of fifteen studies showed a benefit with regard to use of CDS and drug dosing. Fourteen out of nineteen studies showed a benefit with regard to use of CDS and preventive care systems (i.e. computerized reminders regarding tests, vaccinations, etc). This systematic review only included studies that assessed the effects of CDS with a concurrent control. Effect of CDS on patient outcomes was inconclusive.

A study by Lobach & Hammond (1997) showed an increase (two-fold) in compliance to guidelines for diabetes by primary care physicians through use of CDS. This study took place during a 6-month period at a primary care clinic. 30 primary care physicians were involved in the study. Even though the guidelines were electronically generated, they were delivered on paper as an attachment to the patient chart.

A randomized clinical trial conducted by Shea et al. (1995) showed that the mean length of stay for patients in the intervention group was 3.2% shorter than that of the control group (P = .022). This study involved the random assignment of 7,109 patient admissions to an intervention group (consisting of a computerized informational message which was directed to physicians) and 6,990 patient admissions to a control group (with no computerized informational message directed to physicians). This study occurred at a medical center in New York City, U.S. between the time periods of June 1991 and April 1993. The message that was communicated to physicians electronically was a message providing the average length of stay for a patient's admission (as assigned by the Diagnosis-related Group (DRG)) and the current length of stay (in days). This information was provided in the main menu for review of test results in the hospital's clinical information system and was available at all nursing stations in the hospital.

Overall, these studies suggest that CDS has the potential to increase adherence to clinical guidelines, to reduce length of stay, and to enhance performance related to drug dosing and preventive care.

### 2.1.4 EHR

Some health outcome indicators related to the EHR that have been researched include use of clinical guidelines, rate of adverse drug events, and mortality rates.

Health Canada (2007) defines the EHR as "a health record of an individual that is accessible online from many separate interoperable automated systems within an electronic network."

A study conducted by Davis et al. (2009) showed that primary care physicians that had greater implementation of IT (i.e. functionality related to EHR and CDS), reported being better able to manage patients with chronic diseases. 78% of primary care physicians with higher IT usage felt better able to manage patients with chronic diseases as opposed to 66% of physicians with lower IT usage. This study was conducted as a survey and included the responses of 6,536 physicians in seven countries (Australia, Canada, Germany, the Netherlands, New Zealand, United Kingdom, and United States). Data collected in this survey was collected via phone, mail, and fax in 2006. The measures used to determine the amount of IT capacity included:

- ordering of tests;
- systems to prompt patient reminders; and
- use of EHRs.

The outcome measures in this study included patient safety, management of patients with chronic conditions, and responsiveness to patients. Physicians reported being better prepared to manage patients with chronic diseases (Odds Ratio[24] = 1.94). Physicians reported being more likely to use medical practice guidelines (Odds Ratio = 1.58). There was a strong relationship between IT usage and patient safety: the greater the usage (with respect to ordering of tests, use of EHRs and systems to prompt patient reminders), the more likely a practice has a patient safety system in place. 43% of physicians with higher IT implementation had a process for dealing with adverse events compared with 27% of practices with lower IT implementation.

The study by Amarasingham et al. (2009) was a cross-sectional study of 72 acute-care hospitals in Texas, United States. The results of the study indicated that EHR implementation (with CDS) was associated with lower mortality rates and fewer complications. Specifically, functionality related to automation of test results, order entry, decision support, and medical records was analyzed to determine impact on outcomes such as mortality and complications. This study examined clinical data for 167,233 patients that were older than 50 years. The study occurred between 2005 and 2006. The following results were obtained from this study:

[24] Odds Ratio is a statistic that describes the strength of association between binary data values

- higher usage of automated notes / records associated with 15% decrease in likelihood of patient mortality;
- hospitals with higher amount of CDS associated with 16% decrease in likelihood of complications (across all medical conditions);
- higher usage of Order Entry associated with 9% decrease in likelihood of death related to myocardial infarction; and
- higher usage of Order Entry associated with 55% decrease in likelihood of death related to coronary artery bypass graft.

A study by Linder et al. (2007) did not find better quality of Ambulatory care associated with implementation of EHRs. The study noted that perhaps the EHRs referred to in the study may have lacked specific functionality, such as Clinical Decision Support, which impacted the results related to quality of care. This study was conducted as a retrospective cross-sectional study whereby visits to ambulatory care practices in the United States were analyzed. Using ambulatory care quality indicators, performance in 14 of 17 indicators showed no significant difference in performance. Performance on indicators was determined by the percent of visits in which patients received appropriate, recommended care. EHR was used in 18% of 1.8 billion visits related to ambulatory care in the United States in 2003 and 2004. The indicators were related to:

- antibiotic prescribing;
- screening tests;
- preventive counseling; and
- management of diseases.

In addition to the above studies, a study by Hillestad et al. (2005) mentions benefits of the EHR:

- Ability of the EHR to remind healthcare providers to provide certain services during visits with patients and also in reminding patients to schedule care;
- Ability to track frequency of diagnostic or preventive tests, reminding physicians to offer needed tests during visits with patients; and
- Condition-specific templates employed in EHR may ensure consistent recording of clinical results.

This study matched data from several databases, including the Medical Expenditure Panel Survey Inpatient File, the American Hospital Association Hospital Survey, and the Healthcare Cost and Utilization Project National Inpatient Sample. To estimate the potential effects enabled by EHRs, several years of data from the Medical Expenditure Panel Survey Inpatient File was used to develop a representative patient sample, with associated information on diagnosis and health care use.

Overall, these studies suggest that there are mixed findings with respect to the benefits of the EHR. On one hand, studies suggest that the EHR has the potential to improve patient care management and

decrease mortality rates. However, another study found no increase in quality of care with implementation of EHRs.

### 2.1.5 SUMMARY

As reported in the research above, numerous studies have investigated the impact of specific e-Health applications on health outcome measures and found an association. Some potential benefits include reduction in the number of adverse drug events, improved medication prescribing, and reduction in length of stay. However, some studies have also shown that e-Health applications may increase the risk of medication errors or not improve quality of care at all.

## 2.2 E-HEALTH ADOPTION AND RETURN ON INVESTMENT (ROI)

Relating e-Health adoption to ROI allows the benefits of e-Health investment to be quantified in some form. Some studies have attempted to quantify cost savings of e-Health in relation to health outcomes. Only research studies relating e-Health adoption, ROI and health outcomes will be discussed.

One of the reasons for the lack of adoption of IT in healthcare is the challenge in measuring ROI or conducting cost-benefit analyses of e-Health applications (Leonard, 2007; Menachemi & Brooks, 2006; Leonard, 1998). Costs associated with IT usually include costs related to hardware, software, implementation, personnel salaries, etc. However, benefits are usually more difficult to identify. Some examples of benefits may include reduction in length of stay, reduction in personnel, reduction of adverse events, etc. (Leonard, 1998).

There is a lack of rigorous studies of health IT ROI in peer-reviewed academic publications, which has slowed the adoption of IT in the healthcare setting (Menachemi & Brooks, 2006). One of the reasons for the problem in measuring the benefits of IT in health care is that such benefits are difficult to measure in financial terms. For example, it is difficult to measure in financial terms improved quality of care (Menachemi & Brooks, 2006).

There are few studies that have attempted to measure ROI with respect to health outcomes for e-Health applications. Table 2-2 below provides a summary of studies measuring ROI for health outcomes. The various studies are discussed further below.

**Table 2-2: Summary of ROI Studies**

| Application | Study/Author(s) | Savings (in dollars) (in relation to health outcomes) |
|---|---|---|
| CPOE | Kaushal et al. (2006) | *renal dosing guidance = $6.3 million<br>*specific or expensive drug guidance = $4.9 million<br>*Adverse Event prevention = $3.7 million |
| CPOE with CDS | Teich et al. (2000) | * savings approximated to be between $5 and $10 million[25] annually based on:<br><br>-appropriate use of laboratory and diagnostic tests<br>-prevention of adverse events<br>-reduction in drug costs |
| CPOE | Tierney et al. (1993) | * Intervention groups generated charges that were $887 (12.7%) less per admission than the control groups (P=.02).<br><br>*Differences in charges for the intervention group in relation to the following:<br><br>• bed charges (10.5% lower; p-value = .04);<br>• diagnostic test charges (12.4% lower; p-value =.005); and<br>• drug charges (15.1% lower; p-value = .008). |
| EHR with CDS | Wang et al. (2003) | *34% estimated savings by using CDS to prevent adverse events<br><br>*15% estimated savings due to better drug utilization<br>*8.8% estimated savings due to better laboratory test utilization<br>*14% estimated savings due to better radiology test utilization |
| EHR with CDS | Amarasingham et al. (2009) | Savings related to admission Cost breakdown included:<br><br>• electronic test results = savings of $110 per admission (p-value < .05);<br>• electronic order entry = $132 per admission (p-value < .05);<br>• electronic decision support = $538 per admission (p-value < .05). |

[25] No information provided on how savings were calculated

### 2.2.1 CPOE

Studies that have investigated ROI with respect to CDS have focused on measures relating to adverse drug prevention, appropriate use of laboratory and diagnostic tests, and bed charges.

A study by Kaushal et al. (2006) assessed the benefits and costs of CPOE at a hospital over a 10-year period. This hospital was a tertiary care, 720-bed, academic hospital located in Boston, Massachusetts. The benefits of CPOE were discovered through published studies of the CPOE system, various internal documents and through interviews with hospital staff. CDS was shown to reduce adverse drug events. For example, there was the ability to check for drug-drug interactions. Cost savings for these alerts was calculated by multiplying the number of ADEs by the average cost of an ADE[26]. Savings in drug costs were mainly through decreased use. For example, CDS was able to decrease the frequency of a particular drug being administered. Cost savings of this were calculated by multiplying the number of saved doses by the cost of each dose.

Teich et al. (2000) estimated overall savings from CPOE and CDS to be between $5 and $10 million annually. These savings were due to reduction of drug costs, prevention of adverse events, and proper use of diagnostic studies and laboratory tests. This study was carried out at a 720-bed academic medical center in Boston, United States using time series analysis. This study used CPOE coupled with CDS. All adult inpatient orders were entered through CPOE. When drug orders were entered, the computer would display guidelines for drug use and suggest appropriate doses. This study was carried out at a 720-bed academic medical center in Boston, United States using time series analysis. This study used CPOE coupled with CDS. No information was provided on how estimated savings were calculated.

A study by Tierney et al. (1993) demonstrated estimated savings of more than $3 million annually through use of a network of microcomputer workstations to enter inpatient orders. The microcomputer workstations were linked to an electronic medical record system. This study was carried out as a randomized controlled trial at a public hospital in the United States, involving 5,219 patients and 68 teams of staff caring for them (including medical students and internists). Intervention groups generated charges that were $887 (12.7%) less per admission than the control groups (P=.02). There were also significant differences in charges for the intervention group in relation to the following:

- bed charges (10.5% lower; p-value = .04);
- diagnostic test charges (12.4% lower; p-value = .005); and
- drug charges (15.1% lower; p-value = .008).

[26] Calculated in 1997 dollars

Overall, CPOE has been shown to increase savings by reducing the number of adverse drug events, by promoting usage of clinical guidelines, and by promoting the appropriate use of laboratory and diagnostic tests.

### 2.2.2 EHR

Studies that have investigated ROI with respect to the EHR have focused on measures relating to adverse drug prevention and appropriate use of laboratory and radiology tests.

Wang et al. (2003) performed a cost-benefit analysis by aggregating data from an installed EHR system, other published studies, and from expert opinion. This study showed that there was a positive Return on Investment with reductions in drug expenditure, adverse events, and improved utilization of radiology tests. This study occurred in an ambulatory primary care setting. The expert panel determined the savings from each of the items listed, based on prior research and discussion.

The study by Amarasingham et al. (2009) was a cross-sectional study of 72 acute-care hospitals in Texas, United States. The results of the study indicated that EHR implementation (specifically functionality related to electronic test results, order entry and decision support) was associated with lower hospital costs. This study examined clinical data for 167,233 patients that were older than 50 years.

Overall, the EHR has been shown to increase savings by preventing the number of adverse drug events and by promoting the appropriate use of laboratory and radiology testing.

### 2.2.3 SUMMARY

In reviewing the research studies presented in the literature review, it is evident that few studies provide an actual dollar value for costs or expenditures related to e-Health. However, many studies have determined the impact of e-Health adoption in relation to certain health outcomes. The actual dollar amount of spending on e-Health has not been provided in most research studies, which is partly why costs cannot be related to benefits.

Also, while some studies have established an association between e-Health adoption and health outcomes, few studies have tempted to quantify those benefits.

Without information surrounding costs and benefits, it is not possible to calculate ROI.

This study differs from other research in that data on e-Health spending or investment is being related to e-Health adoption and health outcomes. This research study is an attempt to create a foundation upon which to calculate ROI by investigating if there is an association between increased investment in IT and increased e-Health adoption and better health outcomes.

## 2.3 BARRIERS TO E-HEALTH ADOPTION

The level of implementation of e-Health applications varies across practices and hospitals depending on the type of technology (Sequist et al., 2008). One study reveals that only 9.6% of United States hospitals have CPOE available completely (Ash et al., 2004). According to the Canadian National Physician Survey of 2007[27]:

- 9.7% of physicians use computerized reminder systems for suggested patient care;
- 25.7% of physicians use electronic records to input and access clinical notes related to patient care; and
- 10.1% of physicians use computerized warning systems to caution drug interactions and/or adverse prescribing.

One of the barriers to implementation, as discussed previously, is a lack of information surrounding ROI. Chief Financial Officers (CFOs) in healthcare require strong evidence that investment in e-Health is cost-effective (Taylor et al., 2002). However, there are other barriers to implementation of IT in healthcare.

A number of studies have investigated the barriers to implementation of e-Health applications. Various methodologies have been used to conduct research in this area, mostly consisting of quantitative surveys, observations and focus groups (Vishwanath & Scamurra, 2007).

Table 2-3 below provides a summary of barriers to adoption of e-Health applications. The various studies are discussed further below.

[27] Source: 2007 National Physician Survey. The College of Family Physicians of Canada, Canadian Medical Association, The Royal College of Physicians and Surgeons of Canada. (http://www.nationalphysiciansurvey.ca/nps/2007_Survey/2007nps-e.asp)

**Table 2-3: Summary of Studies Relating Barriers to e-Health Adoption**

| Study | Application | Setting | Barriers |
|---|---|---|---|
| DesRoches et al. (2008) | EHR | Ambulatory care | Amongst physicians without access to an EHR, the following barriers were cited with the percentage of respondents that selected the barrier:<br><br>▪ Costs related to capital (66%);<br>▪ Not finding a suitable system (54%);<br>▪ Lack of information on Return on Investment (50%);<br>▪ Concern that system would become outdated (44%);<br>▪ Concern over productivity loss during implementation (41%);<br>▪ Ability to select, install and implement system (39%);<br>▪ Concern over illegal tampering of records (18%);<br>▪ Concern over legal liability for physicians (14%); and<br>▪ Legal concerns over accepting electronic records from a hospital (11%). |
| Houser & Johnson (2008) | EHR | Hospitals in Alabama, United States (academic and non-academic hospitals) | Barriers to Implementing EHRs for hospitals at all levels of EHR implementation with corresponding percentage of respondents that selected that barrier:<br><br>▪ Lack of funding/resources (75%);<br>▪ Lack of knowledge of EHRs (35%);<br>▪ Lack of medical staff support (33%);<br>▪ Lack of necessary technology (28%);<br>▪ Lack of employee training (28%);<br>▪ Issues related to privacy and privacy legislation (17%); and<br>▪ Inadequate/Incomplete code sets or standards (14%). |
| Shields et al. (2007) | EHR | Community Health Centers (CHCs)[28] (in United States) | Perceived barriers for CHCs that did not have an EHR in place with corresponding percentage that ranks importance of the barrier:<br><br>▪ Lack of capital (91%);<br>▪ Inability to integrate EHR with existing systems (81%);<br>▪ Concern over loss of productivity during transition to EHR (76%);<br>▪ Currently available products do not meet needs of CHC (56%);<br>▪ Inability to evaluate and select appropriate EHR system (56%);<br>▪ Lack of Return on Investment information (50%);<br>▪ Lack of physician support (50%); and<br>▪ Lack of support from non-physician staff (43%). |

[28] Community Health Centers (CHCs) provide primary healthcare typically to poorer populations

| Study | Application | Setting | Barriers |
|---|---|---|---|
| Garrett et al. (2006) | Medication Error Reporting System | 8 rural hospitals | Barriers discovered during implementation of the Medication Error Reporting System:<br><br>▪ Cost (initial costs and maintenance costs);<br>▪ Legal and regulatory (i.e. adhering to privacy and security legislation, lack of national standards);<br>▪ time (i.e. having to invest additional time to learn and use the system);<br>▪ fear (i.e. fear of change to workflow, fear of learning technology);<br>▪ usefulness (i.e. the perceived benefit of the technology);<br>▪ complexity (i.e. if technology is viewed as complicated or hard to learn);<br>▪ Personnel (needed to ensure system was easy for personnel to learn and easy to use, etc);<br>▪ Physical space (lack of space to house the technology); and<br>▪ Internet Access (lack of internet access for healthcare providers). |
| Kemper et al. (2006) | EHR | Pediatric Care | Perceived Barriers to implementing EHRs among those without an EHR with percentage of respondents selecting the barrier:<br><br>▪ Expense of implementation (93.5%);<br>▪ Lack of return on investment information (71.2%);<br>▪ Inability to find a suitable EHR solution to meet pediatric-specific requirements (80.5%);<br>▪ Inability to interface with existing systems (75.1%);<br>▪ Lack of research showing that EHR results in improved quality of care (58.1%);<br>▪ Physician resistance (77.1%);<br>▪ System downtime (71.5%);<br>▪ Increase in Physician workload (63.7%);<br>▪ Inadequate computer resources (for providers) (59.8%);<br>▪ Increased workload for staff (55.3%);<br>▪ Inadequate computer resources (for staff) (53.4%);<br>▪ Patient privacy / confidentiality (34.9%);<br>▪ Intrusion on relationship between doctor and patient (37.3%); and<br>▪ Negative experience previously with an EHR (22.5%) |
| Poon et al. (2004) | CPOE | 26 hospitals (varying types of hospitals, i.e. community, teaching, etc.) | Barriers to implementing CPOE among hospitals with varying levels of CPOE implementation:<br><br>▪ Organizational and physician resistance (negative impact on workflow);<br>▪ High cost of CPOE; and<br>▪ Product / Vendor immaturity. |

| Study | Application | Setting | Barriers |
|---|---|---|---|
| Miller & Sim (2004) | EHR | Ambulatory Care | Barriers to implementing EHRs among ambulatory physician practices with an EHR:<br><br>▪ High cost;<br>▪ Lack of return on investment information;<br>▪ High initial start-up physician time costs;<br>▪ Difficulty using technology;<br>▪ Physician attitudes; and<br>▪ Issues with electronic data exchange with other clinical systems.<br><br>It was noted that these barriers were more common for smaller practices than larger ones. |

There were various types of barriers identified in the studies, including barriers related to cost, ROI, and issues with the technology itself (such as with data exchange).

The study by DesRoches et al. (2008) identified cost and inability to find a suitable system as the top two barriers to EHR implementation (DesRoches et al., 2008). This study was conducted as a quantitative survey, which was administered to United States physicians via mail. The data on barriers was supplied by approximately 2,289 physicians. This survey was conducted between 2007 and 2008 and focused on use of EHRs in ambulatory care or an outpatient setting. Data on barriers was not compared to adoption rate.

The study by Houser & Johnson (2008) identified barriers to EHR adoption through a survey that was mailed to hospitals in Alabama, United States. 91 hospitals responded to the survey, consisting of academic and non-academic hospitals. The barriers presented represent responses from hospitals with varying levels of EHR implementation. Respondents included directors of Health Information Management, administrative staff, etc.

Shields et al. (2007) performed a national survey of federally-funded Community Health Centers (CHCs) in the United States to determine barriers to EHR implementation. Surveys were mailed and e-mailed and completed by CHC executive directors or designated staff. The survey was conducted in 2006. Specifically, 633 CHCs without an EHR rated the importance of potential pre-defined barriers.

Garrett et al. (2006) were involved in the actual implementation of a medication error reporting system and reported on their findings with respect to barriers during the implementation process. Data on barriers was gathered qualitatively based on interaction with various hospital staff. This study did not compare the data on barriers to adoption rate, but rather reported on the most common barriers discovered during implementation. The medication error reporting system was implemented in eight rural hospitals in the United States. It was noted that three of the barriers (personnel, physical space, and internet access) may be more specific to rural areas as opposed to urban areas or large hospitals.

Kemper et al. (2006) identified the barriers through a quantitative survey that was administered to randomly selected United States pediatricians via mail between August to November 2005. There was a total of 415 pediatricians that responded to the survey that did not have an EHR. The barriers presented are based on perceived barriers to EHR implementation among pediatricians without an EHR. Data on barriers was not compared to adoption rate.

Poon et al. (2004) identified barriers to CPOE implementation through interviews with senior management at 26 hospitals. 52 Interviews with staff were conducted via telephone in 2002. The individuals participating in the survey consisted of Chief Information Officers (CIOs), Chief Financial Offices (CFOs), Chief Medical Officers (CMOs) and other management staff. The hospitals involved in the survey were at different stages of CPOE implementation.

Miller & Sim (2004) conducted a qualitative study through interviews with approximately 90 physicians and EHR managers between 2000 and 2002. Barriers to EHR adoption included high costs, uncertain return on investments, and high initial cost for physicians. For example, some physicians indicated that start-up costs would range from $16,000 to $36,000 per physician (Miller & Sim, 2004). Additional costs stemmed from seeing fewer patients during the transition to the EHR. This study was targeted towards physician practices that had already implemented an EHR. 30 physician organizations participated. It was noted that these barriers were more common for smaller practices than larger ones. Data on barriers was not compared to adoption rate.

As found in the studies above and through other literature, cost is identified as the most important or common barrier to impact e-Health adoption (Garrett et al., 2006; Kemper et al., 2006; Sengstack & Gugerty, 2004; Anderson, 2006). Tied to this concept of cost is concern over ROI. One of the reasons for the uncertain ROI is the difficulty in calculating the cost-benefit savings of e-Health applications in patient care (Leonard, 2000).

Other literature has reported on barriers specific to certain specialties, for example pediatric care. A technical report by Kim et al. (2008) identifies the lack of IT standards related to pediatric care as a barrier. There is a need for dictionaries, terminology, and electronic standards to accurately capture and describe medical events related to pediatric care.

In addition to the studies above, a report by Ash & Bates (2005) based on the 2004 American College of Medical Informatics (ACMI)[29] discussion identified the following barriers to adoption of EHRs with CPOE (within both inpatient and outpatient settings) in the United States:

[29] ACMI is a college consisting of individuals who have made contributions to the study of medical informatics

**Misalignment of Incentives:**

- For payers, purchasers, and physicians. In outpatient practices, for example, most of the financial benefit of an EHR or CPOE goes towards payers and purchasers, and not the physician. However, the physician is making the initial investment. As incentives are not necessarily aligned towards the physician, implementation of e-Health applications is especially low in outpatient practices in the United States.

**Organizational Barriers:**

- Lack of information surrounding return-on-investment
- Fear of implementation failure (i.e. many publicized examples of IT failures in healthcare)

**Personal Barriers:**

- Impact on workflow

**Technical Barriers:**

- Inability for EHR to integrate with other clinical systems
- Privacy issues / legal liability with respect to physicians having access to EHR remotely (outside the hospital)

In analyzing the results of the studies presented above, it is important to keep in mind some key differences that will impact the results. Some of the studies involved physician participants, whereas others involved managers of EHR systems or other healthcare staff. As a result, depending on what position or title the participant of the study holds, the type of barriers could differ greatly.

In addition, the healthcare system in the US differs from that of other countries, such as Canada. As the US has a privatized healthcare system and Canada has a public healthcare system, the barriers identified may differ as the obstacles faced by organizations in different healthcare systems may differ.

In the United States, physicians in hospitals are not particularly worried about system costs (initial and ongoing) as initial and ongoing costs of e-Health applications are at the expense of hospitals (and not physicians) (Ash & Bates, 2005). There is better alignment of incentives in inpatient settings, in comparison to outpatient settings. Thus, this would potentially make the barriers for physicians different (depending on whether the physician is working in an inpatient or outpatient setting).

In addition, other differences with respect to the samples in the study that may impact results and not necessarily make the results generalizable include:

- Characteristics of population served by the particular hospitals or practices (socio-economic status, gender, race, age, etc.);
- Type of care (inpatient, ambulatory, pediatric, etc.); and
- Type of hospital (academic, community, etc);

Other research indicates that barriers to e-Health adoption may vary by size of a practice or organization (Menachemi & Brooks, 2006). For example, a study conducted in the US showed that physicians working in larger practices were more likely to use EHRs than those working in smaller practices. This was thought to be the case because greater financial resources are available to larger practices versus smaller ones (Menachemi & Brooks, 2006). In addition, primary care physicians were less likely than specialists or other type of doctors to use an EHR (Menachemi & Brooks, 2006). In analyzing the above studies, it is important to keep in mind differences such as specialty and size of practice, as the barriers could differ greatly.

### 2.3.1 SUMMARY

As described in the studies above, healthcare organizations are faced with different barriers with respect to e-Health adoption. Cost has been identified in the literature as one of the most common barriers. Identifying barriers to e-Health adoption helps explain why implementation may be a challenge for healthcare organizations.

## 2.4 RESOURCES AND E-HEALTH ADOPTION

Various literature has discussed resources necessary for successful implementation of IT in healthcare. These resources may be related to time, personnel, equipment, etc. As discussed above, resources may differ depending on different characteristics (i.e. type of care, hospital type, etc).

Table 2-4 below provides a summary of resources related to successful implementation of e-Health applications. The various literature is discussed further below.

**Table 2-4: Summary of Resources Necessary for Successful e-Health Adoption**

| Author(s) | Application | Necessary Resources |
|---|---|---|
| DesRoches et al. (2008) | EHR | Factors to successfully implement EHRs (among all respondents with varying levels of EHR implementation):<br>▪ Financial incentives for purchase;<br>▪ Payment for the use of an EHR; and<br>▪ Protecting physicians from personal liability for record tampering by third parties. |
| Terry et al. (2008) | EHR | ▪ Management of expectations concerning the EHR;<br>▪ Investment of appropriate time and training to implement the EHR;<br>▪ The establishment of an EHR champion[30]; and<br>▪ health providers' willingness to accept the system. |
| Kim et al. (2008) | e-Health technology (not application-specific) | This report identifies the following need for personnel to make implementation of Information Technology in pediatric care successful:<br>▪ pediatric health care providers (including nurses, physicians, etc.) with IT experience in implementation, analysis, etc.;<br>▪ Organizational change managers that are able to manage the transition; and<br>▪ Leaders (including institutional and pediatric) that understand how IT can result in improved quality and may relate this to the health needs of children. |
| Simon et al. (2007) | CPOE with CDS | ▪ External incentives (such as financial incentives) |
| Garg et al. (2005) | CDS | ▪ Automatic prompting to use CDS had better results than CDS that required initiation by the user;<br>▪ Champions to assist with implementation;<br>▪ User Acceptance;<br>▪ Seamless workflow integration;<br>▪ Interoperability with legacy systems; and<br>▪ Ability to upgrade system. |
| Leonard (2004) | General e-Health implementation (not application specific) | ▪ Change management (focus on process of change management, user acceptance to change, etc);<br>▪ Training (before and after transition); and<br>▪ Stakeholder buy-in and contribution (involve relevant stakeholders in design and development of IT systems). |

[30] A champion may be defined as someone within an organization who takes a leadership role in promoting change within that organization.

| Author(s) | Application | Necessary Resources |
|---|---|---|
| Ash et al. (2003) | CPOE | ▪ Motivation for implementation (i.e. Funding sources, political support, etc);<br>▪ Leadership, vision, personnel for implementing CPOE;<br>▪ Cost;<br>▪ Integration of CPOE into existing workflow and health care processes;<br>▪ Value to users (i.e. Users must understand benefit of CPOE);<br>▪ Project management;<br>▪ Technology (i.e. User/strategic considerations, user friendliness of application, customizability, etc);<br>▪ Training / Support (24 hours a day/ 7 days a week); and<br>▪ Continuous improvement. |
| Kuperman & Gibson (2003) | CPOE | ▪ CPOE should not be the first computerized system to be implemented in an organization (CPOE has greater likelihood of being accepted if existing computerized systems are well received - such as online access to medical literature and guidelines) ;<br>▪ Address workflow issues and prepare for unintended consequences of system implementation - Organization should be cautious of having other major clinical or administrative system projects at the same time;<br>▪ CPOE should be viewed as technology to support quality improvement, patient safety, etc. CPOE should be seen as part of an organizational strategy as opposed to an isolated IT initiative;<br>▪ Consider implementing features of CPOE that may reduce time burden to physicians (e.g. remote access to CPOE, adequate training, etc); and<br>▪ Decide whether to make CPOE use optional or mandatory – consider magnitude of quality-related problems, etc. |

Various resources or success factors to e-Health adoption were identified in the literature. Some of these resources were related to training, project management, change management, etc.

The study by DesRoches et al. (2008) was conducted as a quantitative survey, which was administered to United States physicians via mail. 2,758 physicians provided responses on factors related to successful implementation of an EHR and respondents included physicians with all levels of EHR implementation in their practice. This survey was conducted between 2007 and 2008 and focused on use of EHRs in ambulatory care or an outpatient setting.

The study by Terry et al. (2008) identified four common themes that emerged from the analysis of findings related to three qualitative studies. The studies reflected the experiences of primary healthcare providers and individuals who implement EHRs in Ontario, Canada. In the three studies, one-on-one interviews and focus groups were conducted.

A technical report by Kim et al. (2008) discusses considerations specific to pediatric care for implementation of IT related to inpatient care. This report was created based on findings from previous studies.

The study by Simon et al. (2007) was conducted as a quantitative national survey of primary care physician practices consisting of 20 or more physicians. 1,104 medical practices participated in the survey. The goal of this study was to understand adoption of chronic care guidelines in order entry systems for physician practices. External incentives was the only factor significant correlated with adoption of CDS in CPOE.

A systematic review conducted by Garg et al. (2005) reviewed controlled trials assessing effects of CDS. Randomized and non-randomized controlled trials were included in this study which evaluated care provided with CDS versus care provided without CDS. This study showed that improved practitioner performance was associated with CDS when users were automatically prompted by the CDS as opposed to users having to activate the system (73% success rate for trials with automatic prompt versus 47% for users having to activate system; p-value = .02).

Leonard (2004) uses various case studies to describe how change management, training, and stakeholder buy-in are key issues related to successful IT implementation.

Ash et al. (2003) reported on the results of a 2-day conference held to create a consensus set of recommendations for implementation of CPOE. Experts shared their perspectives on CPOE implementation, which was captured and later analyzed qualitatively. This conference occurred in 2001 and included 13 CPOE experts from around the world.

An article by Kuperman & Gibson (2003) identified various factors related to successful implementation of a CPOE system. This article analyzed various different studies showing the effect of CPOE in healthcare.

### 2.4.1 SUMMARY

The studies above describe various resources or factors necessary for successful e-Health adoption. User acceptance or buy-in has been identified in the literature as one of the most common areas that needs to be addressed for successful e-Health adoption. Having in place resources devoted to change management and training were also commonly identified as important to successful e-Health implementation.

The next chapter investigates the correlation between e-Health adoption with barriers and resources. Where applicable, the specific barriers and resources are also identified.

# CHAPTER 3: BARRIERS, DEDICATED RESOURCES AND E-HEALTH ADOPTION

This chapter explains the approach used in conducting this research. Specifically, the research design, data sources, background information, study participants, key variables, statistical methods, and statistical software will be described.

## 3.1 RESEARCH DESIGN

This study uses secondary data to determine the impact of organizational barriers and specific resources (related to staffing / program areas) on e-Health adoption in a hospital setting. The data used in this study was initially collected from Ontario hospitals by the Ontario Hospital Association (OHA).

## 3.2 DATA SOURCES

The e-Health adoption data used in this study has been provided by the OHA. The OHA provided access to the data via a copy of a database which was provided to the researcher on March 31, 2008. Queries were performed in Microsoft Excel to retrieve the data through Pivot Tables (See Appendix 3-1 for Sample Screenshot). The definitions of all fields used in the database are provided in Appendix 3-2.

The data with respect to barriers and dedicated resources (or resources) was provided separately to the researcher as a Microsoft Excel spreadsheet. This data was e-mailed to the researcher by OHA on May 1, 2008.

## 3.3 BACKGROUND

### 3.3.1 OHA SURVEY

The data used in this study was collected by OHA via a questionnaire that was distributed electronically and completed online. The OHA conducted a survey of all Ontario hospitals with respect to technology adoption in May 2006 and July 2007 (See Appendix 3-3 and 3-4 for copies of questionnaires for 2006 and 2007 respectively)[31]. Each participant received an email containing a unique link to access the online survey. Participants than completed the survey online. Once all sections were complete, participants signed off on the survey and submitted the survey electronically.

The individual(s) within each hospital that completed the survey varied and included:

[31] For this chapter of the research study, OHA adoption data for 2008 was not analyzed because this data was unavailable at the time this portion of the study was performed.

- Chief Information Officers (CIOs);
- Chief Executive Officers (CEOs);
- Chief Financial Officers (CFOs);
- Health Records staff;
- Directors of e-Health;
- Staff working in IT, Information Systems (IS) and /or Information Management (IM); and
- Managers of IT, IS, and/or IM.

The response rate for the survey was 94% in 2007 and 95% in 2006.

Various data with respect to e-Health adoption was collected in three specific areas, including:

- Level of e-Health capability and use (i.e., ability to electronically register patients, ability to electronically order laboratory tests, electronically create various clinical reports, etc.);
- Level of e-Health organizational and human capacity (i.e., number of resources dedicated to e-Health leadership and planning, definition of each hospital's e-Health priorities, etc.); and
- Level of regional/inter-organizational e-Health (i.e., ability for hospitals to electronically share data with other hospitals).

OHA used the data obtained from the questionnaires to create reports in 2006 and 2007. The name of the 2006 OHA report is "2006 e-Health Readiness Survey" and the name of the 2007 OHA report is "Ontario Hospital e-Health Adoption 2007 Survey Top Line Report". The reports are available online at http://www.oha.com/Client/OHA/OHA_LP4W_LND_WebStation.nsf/page/Ontario+Hospital+e-Health+Adoption+Survey.

These reports contain information including:

- Names of the participating Ontario hospitals;
- Calculated scores for sections and subsections of the questionnaire; and
- An overall calculated e-Health adoption score for each hospital.

There were some changes in the OHA survey between 2006 and 2007. This research will only focus on core questions, which are defined as questions that were asked in both years. Only analysis of responses to questions that were asked in both years will be conducted in this study. This will allow for year-to-year comparison of the various scores. Please refer to Appendix 3-5 for a list of core questions for 2006 and 2007 that will be used in this research study.

Of the questions asked in both 2006 and 2007, there were a total of 94 core questions (See Appendix 3-5). Of this total, there were 3 corresponding sections and 8 corresponding subsections as listed below:

SECTION 1 (LEVEL of e-Health CAPABILITY AND USE)

*Subsection 1.1 (Patient Registration, Records Management and Registry Services)*

*Subsection 1.2 (Point-of-Care Order Entry)*

*Subsection 1.3 (Clinical Documentation)*

*Subsection 1.4 (Results Reporting)*

*Subsection 1.5 (Information Infrastructure)*

SECTION 2 (LEVEL OF e-Health ORGANIZATIONAL AND HUMAN CAPACITY)

*Subsection 2.1 (e-Health Leadership and Planning)*

SECTION 3 (LEVEL OF REGIONAL/INTER-ORGANIZATIONAL e-Health)

*Subsection 3.2 (Inter-Organizational EMPI)*

*Subsection 3.3 (Interoperability Between Organizations)*

The subsections above are also referred to as "indicators" for this research study. Definitions of these indicators are provided in Appendix 3-6. The indicators used in the OHA survey are based on the Health Level Seven (HL7) functional model[32] and the Integrated Health Enterprise (IHE) profile[33].

The OHA created a scoring system based on responses to each of the questions, which applied to all indicators except for 2.1 (e-Health Leadership and Planning). The options which respondents had to choose from are shown in Table 3-1 below under 'Response' along with the corresponding 'Score'.

**Table 3-1: OHA Scoring Systems**

| 2007 Scoring System | | 2006 Scoring System | |
|---|---|---|---|
| ***Response*** | ***Score*** | ***Response*** | ***Score*** |
| Not Considered | 0 | Not Considered | 1 |
| Identified | 1 | Identified | 2 |
| Acquired | 2 | Acquired | 3 |
| In progress | 3 | In progress | 4 |
| Pilot/Implemented | 4 | Pilot/Implemented | 5 |
| Mostly Implemented | 5 | Mostly Implemented | 6 |
| Fully Implemented | 6 | Fully Implemented | 7 |
| N/A | - | N/A | - |

[32] The HL7 functional model is based on a set of functionality-related criteria that have been considered necessary to document healthcare delivery across care settings

[33] The IHE profile is a framework for implementation of multiple IT standards across healthcare settings

The scoring systems were slightly varied in 2006 and 2007. The 2007 Scoring System is the most recently used scoring system. To allow for year-to-year comparisons of the data, the scoring system in 2006 was mapped to the scoring system in 2007 by the OHA. Data for this research was extracted from a database that mapped scores and questions for both years, which allowed for the comparisons from year-to-year.

The OHA used this scoring system to create a normalized overall score for each indicator (except 2.1: e-Health Leadership and Planning). Highlights of the scoring system include:

- Questions answered with N/A were removed from overall score calculations;
- Scale value of 0 to 6 was used to calculate the overall score;
- The lowest possible score for an indicator is 0 (Not Considered); and
- The maximum possible score is 6 (Fully Implemented).

A normalized score was calculated for all indicators except for 2.1[34] (e-Health Leadership and Planning) based on the following calculation.

**NORMALIZED OVERALL SCORE CALCULATION FOR ALL INDICATORS (EXCEPT 2.1):**

$$\frac{\sum (C) \times 100}{Q \times 6}$$

Note:

- C = raw score for each question;
- Q = total number of questions (value for Q adjusted every time N/A responses are used); and
- Maximum possible score is 6.

**NORMALIZED OVERALL SCORE CALCULATION FOR INDICATOR 2.1 (E-HEALTH LEADERSHIP AND PLANNING):**

The calculation for indicator 2.1 is different from the other indicators because responses were either "Yes" or "No" and did not use the 0 to 6 scoring system defined above. For indicator 2.1, the scoring system is defined in Table 3-2:

**Table 3-2: OHA Scoring System (Indicator 2.1)**

| 2007 Scoring System | | 2006 Scoring System | |
|---|---|---|---|
| ***Response*** | ***Score*** | ***Response*** | ***Score*** |
| No | 0 | No | 0 |
| Yes | 1 | Yes | 1 |

[34] This indicator was calculated differently than the other indicators and is described below.

This scoring system for this indicator was the same in both years so no mapping of the scoring system was required.

The OHA used this scoring system to create a normalized overall score for indicator 2.1. Highlights of the scoring system include:

- Questions answered with N/A responses were removed from overall score calculations;
- The lowest possible score for the indicator is 0; and
- The maximum possible score is 1.

The normalized calculation for indicator 2.1:

$$\frac{\sum (Y) \text{ X } 100}{Q \text{ x } 1}$$

- Y is score for each question;
- Q is total number of questions; and
- 1 is maximum possible score.

### CALCULATION OF E-HEALTH ADOPTION SCORE FOR EACH HOSPITAL

The e-Health adoption score for each hospital was calculated by taking the average of all 8 subsections (or indicators). Essentially, a normalized value was calculated for each indicator as defined above, than the values of the 8 indicators were summed and divided by 8. This was done for 2006 and 2007. The same weighting was used for all 8 indicators.

Note: The data with respect to barriers and resources (or dedicated resources) was not included in calculation of the e-Health adoption score.

### PEER GROUPS AND LHINS

The e-Health adoption reports also divided the hospitals into two categories: Peer Group and Local Health Integration Network (LHIN). Aggregate results were provided for hospitals by Peer Group and LHIN by providing the subsection averages and overall adoption score, corresponding to hospitals that fall under the category of the relevant peer group or LHIN. There are four peer groups and fourteen LHINs.

The four peer groups are defined below:

a) Teaching hospitals: All acute general and pediatric hospitals that are members of the Council of Academic Hospitals of Ontario (CAHO).
b) Community Hospitals: Any acute care hospital that does not fit the definition of Small or Teaching hospital.

c) Small Hospitals: Provides less than 3,500 weighted cases, have a referral population less than 20,000 and are the only hospital in the community.
d) CCC, Rehab and Mental Health: Have stand-alone Complex Continuing Care (CCC) or Rehabilitation beds. They may or may not be members of CAHO.

All hospitals fall within one particular peer group.

There are fourteen LHINs, which were established to regionalize the province based on hospital referral patterns. They are listed below:

1) Central
2) Central East
3) Central West
4) Champlain
5) Erie St.Clair
6) Hamilton Niagara Haldimand Brant
7) Mississauga Halton
8) North East
9) North Simcoe Muskoka
10) North West
11) South East
12) South West
13) Toronto Central
14) Waterloo Wellington

All hospitals fall under one particular LHIN, based on location of the particular hospital. A LHIN is an advisory body that oversees the particular hospitals within that LHIN.

## 3.4 STUDY PARTICIPANTS

All Ontario hospitals were invited to participate in this survey in both 2006 and 2007. In 2007, 138 hospitals participated. In 2006, 139 hospitals participated. Since some hospitals participated in 2006 that did not participate in 2007, and vice versa, only core hospitals (hospitals that participated in both 2006 and 2007) were included in this research study. This results in a total of 131 hospitals that were included in the analysis. Please see Appendix 3-7 for the list of participating hospitals.

As discussed previously, hospitals were also divided by peer group and LHIN. Please see Appendix 3-8 and 3-9 for hospitals divided by Peer Group and LHIN respectively.

## 3.5 KEY VARIABLES

The key variables to be analyzed in this research are defined in Table 3-3 below. These variables are specifically related to the association between e-Health adoption and organizational barriers and resources (or dedicated resources).

**Table 3-3: Definition of Variables Relating Barriers, Resources, and E-Health Adoption**

| Variable | Definition | Independent / Dependent[35] | How to Measure |
|---|---|---|---|
| OHA e-Health adoption score | The amount of e-Health adoption within hospitals for 2007. A score calculated by OHA that takes the average of core subsection scores (Please refer to Section 3.3.1 above). | Dependent | Retrieved directly from data source |
| Improve-IT e-Health adoption score | The amount of e-Health adoption within hospitals for 2007. A score calculated by the researcher that takes the average of all core questions. | Dependent | Calculated by taking the average of core questions (as opposed to averaging the subsection averages) |
| Percent change in e-Health Adoption Score (from 2006 to 2007) | The percent change in the Improve-IT e-Health adoption score (from 2006 to 2007) | Dependent | Adoption Score in later year **MINUS** Adoption Score in former year, **DIVIDED BY** Adoption Score in former year, all **MULTIPLIED BY** 100 (i.e. 2007 Improve-IT e-Health adoption Score **MINUS** 2006 Improve-IT e-Health adoption Score, **DIVIDED BY** 2006 Improve-IT e-Health Adoption Score, all **MULTIPLIED BY** 100) |
| Change in e-Health Adoption Score (from 2006 to 2007) | The amount of raw change in the Improve-IT e-Health adoption score (from 2006 to 2007) | Dependent | Adoption Score in later year **MINUS** Adoption Score in former year (i.e. 2007 Improve-IT e-Health adoption Score **MINUS** 2006 Improve-IT e-Health adoption Score) |
| OHA Subsection Averages | A score calculated by OHA that takes average of response scores pertaining to core questions within specific subsections (Please refer to Section 3.3.1). Subsection scores were used for 2007. | Dependent | Retrieved directly from data source |
| Barriers[36] | A barrier may be defined as anything that impedes the adoption of e-Health technology. The 2006 OHA survey provided a list of organizational barriers to which hospitals were asked to select up to three in ranked order (i.e. 1, 2, 3). See Appendix 3-10 for the specific wording and list of available options. | Independent | Barriers were coded and the total number of barriers was summed |
| Dedicated Resources[37] | Dedicated resources are specific to staffing and/or program areas within each hospital. The 2006 OHA survey provided a list of dedicated resources (to which hospitals could select as many as were applicable). See Appendix 3-11 for the specific wording and list of available options. | Independent | Resources were coded and the total number of resources was summed |

[35] An Independent variable is a variable that may be manipulated and a dependent variable is a response that is measured; dependent variables are assumed or hypothesized to be dependent on independent variables.
[36] The list of barriers used in the survey was based on prior research and focus group testing.
[37] The list of resources (or dedicated resources) used in the survey was based on prior research and focus group testing.

As indicated above, the e-Health adoption score for each hospital was calculated in two different ways. The OHA method, as described in section 3.3.1 above, involved taking an average of all subsection values. Another method, termed the "Improve-IT e-Health adoption score," was developed by the researcher. This method involved taking an average of all core questions (not including any null response scores in the calculation). This method was thought to be a more accurate way to calculate the adoption score as it eliminated the effects of rounding (from using the subsection averages in calculating the adoption score) as used in the OHA method. However, in viewing the adoption score results using both calculations, the scores were similar and it was determined that there was not a substantial difference in adoption score using either method. Usage of the Improve-IT e-Health adoption score was only used in this portion of the research study and for the remaining sections of this research, the OHA e-Health adoption score was used. Please refer to Appendix 3-12 for a hospital summary sheet showing the e-Health adoption score results using the OHA method and the Improve-IT method.

As an additional test to confirm similarity between the OHA and the Improve-IT e-Health adoption scores, a Paired-Sample *t*-test[38] based on the correlation statistic (r), was performed using the 2007 adoption scores. The observed values were p-value = .000; t = -3.667; with r = .974. This result suggests a very high correlation between the two values, thus confirming the similarity between the two sets of adoption scores.

The percent and raw change in e-Health Adoption Score were also variables used in the analysis. As indicated above, the Improve-IT e-Health Adoption Score was used in the calculations of these two variables.

## 3.6 STATISTICAL METHODS

As indicated previously, only core hospitals or hospitals that participated in the survey in both 2006 and 2007 were included in the survey. To identify which hospitals did not participate in either year, an email was sent from OHA to the researcher identifying which hospitals should be removed from the analysis. These hospitals were than manually removed from the analysis. (Please see Appendix 3-13 for correspondence between OHA and the researcher).

As indicated previously, the data on barriers and resources (or dedicated resources) was provided separately from the e-Health adoption data. To match the information with respect to barriers and resources to the e-Health adoption data, hospitals were matched by hospital name.

The OHA data mentioned above was used to perform further analysis. Analysis of variables is broken down into three key groups:

[38] A Paired-Sample t-test is used to compare the means of two variables

1) ALL – This includes all 131 Core Hospitals
2) Peer Groups – There are 4 Peer Groups (Teaching Hospitals, Community Hospitals, Small Hospitals, CCC Rehab and Mental Health Hospitals)
3) LHINs (Local Health Integration Networks) – There are 14 LHINs (Central, Central East, Central West, Champlain, Erie St.Clair, Hamilton Niagara Haldimand Brant, Mississauga Halton, North East, North Simcoe Muskoka, North West, South East, South West, Toronto Central, Waterloo Wellington).

Analysis pertaining to all variables falls under one of three groups identified above.

### 3.6.1 BARRIERS

Pearson's correlations were conducted to determine if there is any relationship between the number of barriers (for 2006) and:

- 2007 Improve-IT e-Health adoption score;
- 2007 OHA Subsection Averages;
- Percent change in Improve-IT e-Health adoption score (from 2006 to 2007); and
- Raw change in Improve-IT e-Health adoption score (from 2006 to 2007).

For the barriers, hospitals were asked to select up to three barriers from a list and rank these barriers in order (i.e. "1", "2", "3"). The responses were interpreted in the following way by OHA (Table 3-4):

**Table 3-4: Definition of Ranked Barriers**

| | |
|---|---|
| 1.00 | 1st Choice (most significant) |
| 2.00 | 2nd Choice |
| 3.00 | 3rd Choice (least significant) |
| 0.00 | Did not select |

For each hospital, there could have been anywhere from 0 to 3 barriers selected. To allow Pearson's correlations to be computed on this data, coding was performed on the barriers. For example, if there was a barrier selected (regardless of ranking), this was coded as "1". If there was no barrier selected, this was coded as "0". The total number of barriers was summed for each hospital. Thus, the sum of the barriers for hospitals may range from 0 to 3.

All Pearson's correlations were performed in SPSS. Correlations with a p value <.05 were considered significant.

If there was a significant correlation between adoption score / subsection average and barriers, the specific barriers were identified by tabulating the amount of times each barrier was selected by a hospital. This involved accessing each relevant hospital's individual responses and tabulating how many times a hospital selected a particular barrier.

In addition to the tests performed above, barriers were tabulated for all 131 hospitals, separated by those hospitals with adoption scores higher than the 2007 adoption score mean and those hospitals with adoption scores lower than the 2007 adoption score mean. This was carried out by first calculating the mean of the 2007 Improve-IT e-Health adoption score. The mean was calculated by adding all the adoption scores together for all 131 hospitals (using the 2007 Improve-IT adoption score) and dividing by 131. Please refer to Appendix 3-12 for a list of all 131 hospitals with corresponding 2007 Improve-IT e-Health adoption score. The calculation and result of the mean included:

8068.12 (sum of adoption scores for all 131 hospitals) / 131 = 61.59

Next, hospitals were sorted by lowest to highest 2007 Improve-IT e-Health adoption score and grouped. Please refer to Appendix 3-14 for a list of the hospitals sorted by adoption score and separated according to whether adoption scores were above or below the mean.

For these two groups, specific barriers were identified by tabulating the amount of times each barrier was selected by a hospital. This involved accessing each relevant hospital's individual responses and tabulating how many times a hospital selected a particular barrier.

### 3.6.2 DEDICATED RESOURCES

Pearson's correlations were conducted to determine if there is any relationship between the number of resources (for 2006) and:

- 2007 Improve-IT e-Health adoption score;
- 2007 OHA Subsection Averages;
- Percent change in Improve-IT e-Health adoption score (from 2006 to 2007); and
- Raw change in Improve-IT e-Health adoption score (from 2006 to 2007).

For the resources, hospitals were asked to select as many resources or dedicated resources as applicable from a list by selecting "Yes", "No" or "NA". The responses were interpreted in the following way by OHA (Table 3-5):

**Table 3-5: Definition of Resource Selections**

| | |
|---|---|
| 1.00 | No |
| 2.00 | Yes |
| 3.00 | N/A |

To allow Pearson's correlations to be computed on this information, coding was performed on this data. If a resource was selected (i.e. "Yes", this was coded as "1" and if no resource was selected (i.e. "No" or "NA"), this was coded as "0". The total number of resources was summed up for each hospital. Thus, the sum of the resources for hospitals may range from 0 to 9.

All Pearson's correlations were performed in SPSS. Correlations with a p value <.05 were considered significant.

If there was a significant correlation between adoption score / subsection averages and resources, the specific resources were identified by tabulating the amount of times the resource was selected by a hospital. This involved accessing each hospital's individual responses and tabulating how many times a hospital selected a particular resource.

In addition to the tests performed above, specific resources were tabulated for all 131 hospitals, separated by those hospitals with adoption scores higher than the 2007 adoption score mean and those hospitals with adoption scores lower than the 2007 adoption score mean. This was carried out by first calculating the mean of the of the 2007 Improve-IT e-Health adoption score. The mean was calculated by adding all the adoption scores together for all 131 hospitals (using the 2007 Improve-IT adoption score) and dividing by 131. Please refer to Appendix 3-12 for a list of all 131 hospitals with corresponding 2007 Improve-IT e-Health adoption score. The calculation and result of the mean included:

8068.12 (sum of adoption scores for all 131 hospitals) / 131 = 61.59

Next, hospitals were sorted by lowest to highest 2007 Improve-IT e-Health adoption score and grouped. Please refer to Appendix 3-14 for a list of the hospitals sorted by adoption score and separated according to whether adoption scores were above or below the mean.

For these two groups, the specific resources were identified by tabulating the amount of times each resource was selected by a hospital. This involved accessing each relevant hospital's individual responses and tabulating how many times a hospital selected a particular resource.

## 3.7 STATISTICAL SOFTWARE

Correlations were performed using SPSS (Version 16.0) for Windows (SPSS Incorporated, Chicago, Ill).

## 3.8 ANALYSIS

As indicated previously, Pearson's correlations were performed for core hospitals (hospitals that participated in the survey in both 2006 and 2007) in three different ways:

- By All Hospitals;
- By Peer Groups; and
- By LHINs.

Correlations were performed using 2007 OHA core subsection averages (Subsections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 3.2, 3.3), 2007 Improve-IT e-Health adoption score, the number of barriers and resources, and lastly change and percent change in Improve-IT e-Health adoption score from 2006 to 2007. Please refer to Section 3.3.1 for definition of the subsection averages. If there were significant correlations between barriers/resources and e-Health adoption score, the specific barriers and resources were identified.

The results divided by each group will be presented.

In addition (as described previously), barriers and resources were tabulated for the group of hospitals with adoption scores below the mean and for hospitals with adoption scores above the mean. Results are presented below.

### 3.8.1 ALL HOSPITALS

Pearson's correlations were performed using all 131 core hospitals. Results are presented below.

1) Barriers were negatively correlated with Subsection 3.3 (Interoperability between organizations), indicating that the more interoperability between organizations for a particular hospital, the less the number of barriers (Table 3-6). The significance value is (p-value[39] = .036; r[40] = -.184).

2) There was a significant positive correlation between the number of resources and the 2007 Improve-IT e-Health adoption score. This indicates that the higher the number of resources (or dedicated resources), the higher the e-Health adoption score (Table 3-7). The significance value is (p-value = .000; r = .389). The top three resources associated with the 2007 e-Health adoption score included (Table 3-8):

    - Project Management (123);
    - Process Re-engineering (123); and
    - IS Support in End User Departments (100).[41]

[39] p-value is a measure of probability that may range from zero to one.
[40] 'r' represents the linear correlation coefficient; measuring the strength and direction of a linear relationship between two variables

3) There were significant positive correlations between the number of resources and all subsection averages except for subsection 3.3 (Interoperability between organizations). This indicates that the number of resources does not impact Interoperability between organizations (Table 3-6). Table 3-6 lists all significance values based on correlations between subsection averages and the number of resources.

4) The tabulated barriers for the group of hospitals with e-Health adoption scores below the 2007 Improve-IT e-Health adoption score mean are shown in Table 3-12:

**Table 3-12: Barriers related to Hospitals with Adoption Scores Below the Mean**

| BARRIER | TOTAL |
|---|---|
| Lack of adequate financial support | 43 |
| Lack of qualified staff or access to qualified staff | 27 |
| Difficulty in achieving end-user acceptance or use | 16 |
| Lack of strategic Information & Communication Technology (ICT) plan | 12 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 11 |
| Solution not yet scheduled | 11 |
| Lack of infrastructural or prerequisite technology | 9 |
| Lack of clinician support | 8 |
| Need to establish and adopt data standards | 7 |
| Lack of change management strategies and re-engineering processes | 4 |
| Hospital has not defined need | 4 |
| Lack of top management support | 0 |
| None | 0 |

5) The tabulated barriers for the group of hospitals with e-Health adoption scores above the 2007 Improve-IT e-Health adoption score mean are shown in Table 3-13:

[41] The numbers in brackets indicate the number of hospitals that selected that particular resource.

**Table 3-13: Barriers related to Hospitals with Adoption Scores Above the Mean**

| BARRIER | TOTAL |
|---|---|
| Lack of adequate financial support | 62 |
| Lack of qualified staff or access to qualified staff | 34 |
| Difficulty in achieving end-user acceptance or use | 24 |
| Lack of infrastructural or prerequisite technology | 20 |
| Lack of change management strategies and re-engineering processes | 18 |
| Need to establish and adopt data standards | 15 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 14 |
| Solution not yet scheduled | 13 |
| Lack of clinician support | 12 |
| Lack of strategic Information & Communication Technology (ICT) plan | 4 |
| Hospital has not defined need | 4 |
| Lack of top management support | 4 |
| None | 0 |

6) The tabulated resources for the group of hospitals with e-Health adoption scores below the 2007 Improve-IT e-Health adoption score mean are shown in Table 3-14:

**Table 3-14: Resources related to Hospitals with Adoption Scores Below the Mean**

| DEDICATED RESOURCES | TOTAL |
|---|---|
| IS Support in End User Departments | 38 |
| Project Management | 28 |
| Decision Support | 28 |
| Clinical Systems Training | 28 |
| Regional Infrastructure | 21 |
| Change Management | 16 |
| Nursing Informatics | 15 |
| Interface Development | 14 |
| Process Re-engineering | 13 |

7) The tabulated resources for the group of hospitals with e-Health adoption scores above the 2007 Improve-IT e-Health adoption score mean are shown in Table 3-15:

**Table 3-15: Resources related to Hospitals with Adoption Scores Above the Mean**

| DEDICATED RESOURCES | TOTAL |
|---|---|
| Clinical Systems Training | 67 |
| IS Support in End User Departments | 62 |
| Decision Support | 56 |
| Project Management | 54 |
| Interface Development | 51 |
| Nursing Informatics | 44 |
| Regional Infrastructure | 44 |
| Change Management | 30 |
| Process Re-engineering | 27 |

### 3.8.2 PEER GROUPS

Correlations were performed on all hospitals related to each peer group. The peer groups are identified below along with the corresponding number of hospitals in brackets.

**CCC, Rehab & Mental Health Hospitals (18)**

1) There is a significant positive correlation between the number of resources and the raw change in e-Health adoption score (from 2006 to 2007). This indicates that the higher the number of resources (or dedicated resources), the higher the raw change in e-Health adoption score from 2006 to 2007 (Table 3-9). The significance value is (p-value = .021; r = .540). The top three resources associated with the change in e-Health adoption score include (Table 3-10):

   - IS Support in End User Departments (14);
   - Project Management (12); and
   - Clinical Systems Training (12).

2) There are significant positive correlations between the number of resources and subsections 2.1 and 3.2 (Table 3-6). This indicates that the greater the values for ehealth leadership and planning and inter-organizational EMPI, the greater the number of resources. See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**Community Hospitals (50)**

1) The raw change in e-Health adoption score from 2006 to 2007 is significantly and negatively correlated with the number of barriers (Table 3-9). This indicates that the higher the change in e-

Health adoption score from 2006 to 2007, the lower the number of barriers. The significance value is (p-value = .001; r = -.442). The top three barriers associated with change in e-Health adoption score include (Table 3-11):

- Lack of adequate financial support (45);
- Lack of qualified staff or access to qualified staff (28); and
- Difficulty in achieving end-user acceptance or use (15).

2) The number of resources were positively and significantly correlated with subsections 1.4 and 2.1 (Table 3-6). This indicates that the higher the values of results reporting and ehealth leadership and planning, the greater the number of resources. See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**Teaching Hospitals (15)**

1) The number of resources was positively and significantly correlated with the 2007 e-Health adoption score (Table 3-7). This indicates that the higher the e-Health adoption score, the higher the number of resources. The significance value is (p-value = .026; r = .572). The top four resources associated with the 2007 e-Health adoption score include (Table 3-8):

- Clinical systems training (15);
- Project management (14);
- Interface Development (14); and
- Decision Support (14).

2) The number of resources was positively and significantly correlated with subsections 1.1 and 1.2 (Table 3-6). This indicates that the higher the values for Patient Registration, Records Management and Registry Services and for Point-of-Care order entry, the greater the number of resources. See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**Small Hospitals (48)**

1) The change in e-Health adoption score from 2006 to 2007 is positively correlated with the number of barriers (Table 3-9). This indicates that the greater the change in adoption score, the greater the number of barriers. The significance value is (p-value = .040; r = .298). The top three barriers associated with the change in e-Health adoption score from 2006 to 2007 (Table 3-11):

- Lack of adequate financial support (36);
- Lack of qualified staff or access to qualified staff (15); and
- Lack of infrastructural or prerequisite technology (15).

2) The number of barriers is negatively and significantly correlated with subsection 3.3 (Table 3-6). This indicates that the lower the interoperability between organizations, the higher the number of barriers. The significance value is (p-value = .047; r = -.288).

### 3.8.3 LHINS

Correlations were performed on all hospitals related to each LHIN. The LHINs are identified below along with the corresponding number of hospitals in brackets.

**Central (8)**

1) The change in adoption score between 2006 and 2007 is significantly and negatively correlated with the number of resources (Table 3-9). This indicates that the lower the change in adoption score, the greater the number of resources. The significance value is (p-value = .029; r = -.759). The top four resources associated with the change in e-Health adoption score from 2006 to 2007 (Table 3-10):
   - Clinical Systems Training (7);
   - Project Management (6);
   - IS Support in End User Departments (6); and
   - Decision Support (6).

**Central East (8)**

1) The number of resources is significantly and positively correlated with subsection 2.1 (Table 3-6). This indicates that the greater the value for ehealth leadership and planning, the higher the number of resources. The significance value is (p-value = .033; r = .747).

**Central West (2)**

*This LHIN consisted of only two hospitals, thus analysis using correlations was not possible.

**Champlain (17)**

1) The number of resources is significantly and positively correlated with the 2007 e-Health adoption score (Table 3-7). This indicates that the higher the adoption score, the greater the number of resources. The significance value is (p-value = .036; r = .511). The top three resources associated with the 2007 e-Health adoption score include (Table 3-8):

- IS Support in End User Departments (14);
- Project Management (13); and
- Clinical Systems Training (13).

2) Resources are positively and significantly correlated with subsections 1.2 (Point-of-Care Order Entry) and 2.1 (ehealth leadership and planning). The larger the value of those subsections, the greater the number of resources (Table 3-6). See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**North East (19)**

1) The number of barriers is significantly and positively correlated with the change in e-Health adoption score from 2006 to 2007 (Table 3-9). As the change in e-Health adoption score increases, the number of barriers also increases. The significance value is (p-value = .036; r = .483). The top four barriers associated with the change in e-Health adoption score from 2006 to 2007 (Table 3-11):

   - Lack of adequate financial support (16);
   - Lack of qualified staff or access to qualified staff (9);
   - Need to establish and adopt data standards (4); and
   - Lack of infrastructural or prerequisite technology (4).

2) The number of resources is positively and significantly correlated with subsections 1.1 (Patient Registration, Records Management and Registry Services) and 2.1 (e-Health Leadership and Planning) (Table 3-6). As the value of these subsections increases, so do the number of resources. See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**North Simcoe Muskoka (6)**

1) The number of resources is positively and significantly correlated with the 2007 e-Health adoption score (Table 3-7). As the e-Health adoption score for 2007 increases, so does the number of resources. The significance value is (p-value = .044; r = .823). The top four resources associated with the 2007 e-Health adoption score include (Table 3-8):

   - Nursing Informatics (5);
   - Clinical Systems Training (5);
   - IS Support in End User Departments (4); and
   - Decision Support (4).

2) The number of resources is positively and significantly correlated with subsection 3.2 (Inter-Organizational EMPI). As the value of inter-organizational EMPI increases, so does the number of resources (Table 3-6). The significance value is (p-value = .004; r = .946)

**South West (15)**

1) The number of barriers is significantly and negatively correlated with the change in adoption score from 2006 to 2007 (Table 3-9). As the change in e-Health adoption score increases, the number of barriers decreases. The significance value is (p-value = .036; r = -.544). The top three barriers associated with the change in e-Health adoption score from 2006 to 2007 include (Table 3-11):

   - Lack of adequate financial support (11);
   - Lack of change management strategies and re-engineering processes (7); and
   - Difficulty in achieving end-user acceptance or use (6).

**Toronto Central (14)**

1) The number of resources is positively and significantly correlated with the 2007 e-Health adoption score (Table 3-7). This indicates that as the adoption score increases, so does the number of resources. The significance value is (p-value = .016; r = .627). The top four resources associated with the 2007 e-Health adoption score include (Table 3-8):

   - IS Support in End User Departments (14);
   - Clinical Systems Training (13);
   - Project Management (12); and
   - Decision Support (12).

2) The number of resources are positively and significantly correlated with subsections 1.4 (Results Reporting), 2.1 (e-Health Leadership and Planning), 3.2 (Inter-Organizational EMPI), and 3.3 (Interoperability between organizations) (Table 3-6). As value of these subsections increases, so does the number of resources. See Table 3-6 for the significance values relating the correlations between the subsection averages and the number of resources.

**Waterloo Wellington (8)**

1) The number of resources is negatively and significantly correlated with change in e-Health adoption score from 2006 to 2007 (Table 3-9). As the change in adoption score increases, the number of resources decreases. The significance value is (p-value = .004; r = -.875). The top four resources associated with the change in e-Health adoption score include (Table 3-10):

- Project Management (7);
- Decision Support (6);
- Nursing Informatics (5); and
- Clinical Systems Training (5).

## 3.9 DISCUSSION OF FINDINGS

The findings will be discussed below, divided by dedicated resources and barriers.

### 3.9.1 FINDINGS RELATED TO BARRIERS

There were no significant correlations associated with the 2007 Improve-IT e-Health adoption score and the number of barriers. However, there were four significant correlations associated with the change in e-Health adoption score from 2006 to 2007 and the number of barriers (based on hospitals grouped within the Community peer group, Small peer group, North East LHIN and South West LHIN).

Of the four significant correlations associated with the number of barriers (Table 3-9), the top barrier that was identified in all cases was "Lack of adequate financial support." In many studies, cost has been identified as a top barrier to implementation of e-Health applications. For example, studies by DesRoches et al. (2008), Houser & Johnson (2008), Shields et al. (2007),and Kemper et al. (2006) all identify cost as the most common barrier. These included costs related to implementation and capital. Other studies have also identified cost as a barrier, though not specifically the primary barrier (Garrett et al., 2006; Poon et al., 2004; Miller & Sim, 2004).

Another common barrier that was identified for significant correlations in this research study was "lack of qualified staff or access to qualified staff." This barrier was identified as the second most common barrier for three out of the four significant correlations. Some studies have not specifically identified this barrier (DesRoches et al., 2008; Shields et al, 2007; Houser & Johnson, 2008). It is important to note that these studies provided a pre-defined list of barriers for respondents to choose from and the lack of qualified staff or access to qualified staff was not provided as an option. Perhaps if this option was available, this barrier may have been selected. A study by Kemper et al. (2006) identified inadequate computer resources for providers (59.8%) and inadequate computer resources for staff (53.4%) as barriers to implementation of an EHR in a pediatric setting. These barriers are related to lack of qualified staff as the providers and other personnel lacked resources necessary for implementation of the EHR. This was a quantitative study where respondents selected relevant barriers from a pre-defined list of barriers. In a qualitative study conducted by Garrett et al. (2006), personnel was identified as a barrier during the implementation of a Medication Error Reporting System in eight rural hospitals. Specifically related to personnel was the issue of ensuring that the system was easy for personnel to learn and easy to use. This ties into the barrier associated with lack of qualified staff or access to qualified staff because staff did

not have the necessary resources to work with the Medication Error Reporting system, which was a barrier to implementation.

The “lack of infrastructural or prerequisite technology” was also identified as a common barrier to implementation of e-Health applications in this research study. One significant correlation identified this barrier as the second most common barrier and two of the significant correlations identified this barrier as the third most common barrier. This barrier has also been identified as a common one in prior research. For example, Houser & Johnson (2008) identified “lack of necessary technology” as the fourth most common barrier (28%) to implementation of an EHR for hospitals in Alabama. Respondents were able to choose barriers from a list of pre-defined ones. Shields et al. (2007) identified “Inability to integrate EHR with existing systems” as the second most common barrier (81%) to implementation of an EHR in Community Health Centers in the United States. This relates to lack of infrastructural or prerequisite technology because these hospitals lacked the necessary technology to allow the EHR to function within their respective hospitals. Kemper et al. (2006) identified the “Inability to interface with existing systems” as the fourth most common barrier with respect to implementation of an EHR with 75.1% of respondents selecting this barrier. The practices within this study lacked the technology to allow the EHR to interface with existing systems. A qualitative study by Miller & Sim (2004) identified “Issues with electronic data exchange with other clinical systems” as a barrier to implementation of EHRs within ambulatory care practices in the United States.

Another common barrier identified in this research study was “Difficulty in achieving end-user acceptance or use.” This barrier was identified as the third most common barrier in two out of the four significant correlations. Other studies have also identified this barrier. Houser & Johnson (2008) identified “lack of medical staff support” as the third most common barrier (33%) to implementation of an EHR in hospitals in Alabama. Shields et al. (2007) identified lack of physician support (50%) and lack of support from non-physician staff (43%) as the fifth and sixth most common barrier to implementation of an EHR in Community Health Centers, respectively. Kemper et al. (2006) identified physician resistance (77.1%) as the third most common barrier to implementation of EHRs in pediatric care. Poon et al. (2004) identified organizational and physician resistance as a barrier to implementation of CPOE amongst hospitals in the United States.

A barrier that was commonly identified in this research study was “Lack of change management strategies and re-engineering processes.” This barrier was identified as the second most common barrier for one significant correlation. This barrier was identified as the fourth and fifth most common barrier with respect to two of the significant correlations. There are few studies that have specifically identified this barrier. Perhaps this is because this barrier was specifically provided as an option for respondents to choose from in this research study but not in others (DesRoches et al., 2008; Houser & Johnson, 2008; Shields et al., 2007; Kemper et al., 2006).

A barrier that was not commonly selected was “Hospital has not defined need.” In two out of the four significant correlations, this barrier was not selected at all. In one of the significant correlations, this barrier was only selected once and ranked sixth in comparison to the other barriers. There are few studies that have specifically identified this barrier in implementation of e-Health solutions.

Another barrier that was not commonly selected in relation to the other barriers was “Lack of top management support.” In two out of the four significant correlations, this barrier was not selected at all. In one of the correlations it was ranked fourth and with the other significant correlation it was ranked tenth in relation to other barriers. There are few studies that have specifically identified this barrier in implementation of e-Health solutions.

In viewing the actual correlation results with respect to the number of barriers, it was noted that two of the correlations were negative and two were positive. Specifically, the Community hospitals and the South West LHIN showed a negative correlation with the number of barriers, indicating that the higher the number of barriers, the lower the change in e-Health adoption score from 2006 to 2007. This seems logical as it would be expected that the greater the number of barriers faced by a hospital, the less likely implementation of e-Health applications would occur. However, two of the correlations were positive, specifically the Small hospitals and the North East LHIN groups. With positive correlations, this shows that the higher the number of barriers, the higher the change in adoption score from 2006 to 2007. This would not seem logical, as we would expect a higher number of barriers to decrease the amount of e-Health adoption in hospitals. In interpreting these results, perhaps these positive correlations occurred because the hospitals involved did not necessarily identify three barriers they were facing, but one or two barriers instead. Perhaps the individuals within the specific hospitals that completed the survey did not understand the question and answered inappropriately. Another issue that may have caused this result is inaccuracy with the actual e-Health adoption scores in either or both years. As discussed in this section, it is evident that there are various types of barriers that impact adoption of e-Health applications in healthcare.

The results pertaining to the tabulation of specific barriers related to all hospitals with e-Health adoption scores above and below the mean show some similarities and differences. For example, the top three barriers identified were the same for both groups (lack of adequate financial support, lack of qualified staff or access to qualified staff, and difficulty in achieving end-user acceptance or use) (Tables 3-12 and 3-13). This suggests that regardless of whether one hospital has implemented more IT than another, these three barriers are the most common. The lack of a strategic Information & Communication Technology (ICT) plan was a barrier that was more commonly selected for hospitals with e-Health adoption scores below the mean than for hospitals with e-Health adoption scores above the mean. This suggests that the lack of an Information & Communication Technology (ICT) plan is a barrier faced more by hospitals with lower e-Health adoption than by hospitals with greater e-Health adoption. The lack of change management strategies / re-engineering processes and the lack of infrastructural or prerequisite

technology were two barriers most selected by hospitals with higher e-Health adoption than by hospitals with lower e-Health adoption. This suggests that hospitals with higher e-Health adoption are faced with barriers related to the implementation stage of e-Health; whereas hospitals with lower e-Health adoption are faced with barriers related to the initial or planning stage of technology adoption.

In addition to the results above, the number of barriers was only significantly correlated with one subsection (3.3: Interoperability between Organizations) for 'All Hospitals' and Small hospitals. This correlation was negative, indicating that the higher the number of barriers, the lower the value of this particular subsection. This may suggest that the number of barriers strongly affects a hospital's capability to interoperate between organizations (using shared repositories, document registries, and secure email) in comparison to other areas. There is a lack of studies that specifically focus on the relationship between barriers and interoperability between organizations.

In interpreting prior studies on barriers, it is important to keep in mind the method by which the studies were conducted. Some of the barriers were identified by respondents through pre-defined lists, which may have resulted in respondents not being able to identify other barriers that were not included in the list. This research study also involved use of a pre-defined list of barriers, and perhaps other barriers could be added to this list as identified through previous research, for example:

- Lack of information on Return on Investment (DesRoches et al., 2008; Shields et al., 2007; Kemper et al., 2006, Miller & Sim, 2004);
- Lack of research showing that EHR results in improved quality of care (Kemper et al., 2006);
- Issues related to privacy and/or privacy legislation (Houser & Johnson, 2008; Garrett et al., 2006; Kemper et al., 2006); and
- Loss of productivity during implementation process (DesRoches et al., 2008; Shields et al., 2007).

Perhaps conducting qualitative research (i.e. through interviews) would be a more appropriate way to gather information with respect to all types of barriers, as opposed to providing a pre-defined list.

Lastly, in interpreting the results and relating the results to prior research, it is important to keep in mind some differences. This study was conducted in Ontario, Canada and most of the prior research that has studied barriers is focused in the United States. As a result, some of the differences in barriers could be due to differences between the two health systems. It is also important to keep in mind the types of care (i.e. inpatient versus outpatient). For example, in the United States, physicians in hospitals do not necessarily need to worry about e-Health system costs as these costs are incurred by hospitals and not the physicians. However, in ambulatory or outpatient care settings, the physicians are making the initial investment and the financial benefits of e-Health systems are not directed towards the physician. Thus, incentives are different and it is important to keep this in mind when interpreting results of this research and of prior studies. Other differences with respect to barriers faced by different organizations include:

- Characteristics of population served by the particular hospitals or practices (socio-economic status, gender, race, age, etc.);
- Type of care / Specialties (inpatient, ambulatory, pediatric, etc.); and
- Type of hospital (academic, community, etc.).

### 3.9.2 FINDINGS RELATED TO DEDICATED RESOURCES

Correlations between Number of Dedicated Resources and 2007 e-Health adoption score

There were five positive significant correlations between the number of dedicated resources and the 2007 e-Health adoption score. This indicates that the higher the number of dedicated resources, the higher the e-Health adoption score. This is a result that is to be expected, as the greater a hospital's resources, the greater would be the expected e-Health adoption than a hospital with less resources. These significant correlations were for the following groups:

- All hospitals;
- Teaching hospitals;
- Champlain LHIN;
- North Simcoe LHIN; and
- Toronto Central LHIN.

Out of the five significant correlations, Project Management was identified as a common resource to promote e-Health implementation. Specifically, one of the five correlations identified this as the most important resource; 2 of the correlations identified Project Management as the second most important resource; and one correlation identified Project Management as the third most important resource. Project management has been identified in some studies as important to e-Health implementation. Ash et al. (2003) specifically identified project management as a factor in successful implementation of e-Health solutions. This data was gathered qualitatively. Kim et al. (2008) identified "organizational change managers that are able to manage the transition" as a key factor in e-Health implementation. This ties to the concept of project management as managers are needed to manage the transition.

Information Systems (IS) Support in End User Departments was also a commonly identified resource in this research study. Two out of the five significant correlations identified this as the most important resource. Two out of five significant correlations identified this as the second most important resource. Ash et al. (2003) specifically identified training and support (24 hours a day; 7 days a week) as a key success factor in e-Health implementation. Leonard (2004) identified training (before and after the transition) as a key factor to successful implementation of e-Health applications. Training may be tied into the concept of support, as reported in the Ash et al. (2003) study.

It was interesting to note that Process Re-engineering was identified as one of the most important factors to successful e-Health implementation overall by All hospitals, but not for the other four groups. In two out of the five significant correlations, Process Re-engineering was one of the least most common factors to successful e-Health implementation in comparison to the other resources. Process re-engineering has been identified as a key factor in successful e-Health implementation in various research. For example, the ability to integrate e-Health applications into existing workflow has been identified as a key component to successful e-Health implementation (Garg et al., 2005; Ash et al., 2003; Kuperman & Gibson, 2003).

Clinical systems training was identified as a common factor to successful e-Health implementation. In two of the significant correlations, clinical systems training was identified as one of the most common factors to successful implementation. In two of the significant correlations, clinical systems training was identified as the second most common factor related to successful implementation. Clinical systems training may relate to IS Support in End User Departments, as discussed previously. Training has been specifically identified as a key factor in successful e-Health implementation (Leonard, 2004; Ash et al., 2003).

Change management was also identified as a resource for successful e-Health implementation in this research. In the overall breakdown of all hospitals, change management was identified as the least common resource necessary for successful e-Health implementation. In one of the significant correlations, it was ranked as the third most common resource. In two of the significant correlations, it was identified as the fourth most common resource. Prior research has also identified change management as a key factor in successful e-Health implementation. Kim et al. (2008) identified the need for organizational change managers to manage the transition or change to the new system. Leonard (2004) identifies change management, in relation to change management process and user acceptance to change, as a key factor in successful e-Health implementation. On a related topic of change management is the concept of a “champion” which has been identified in various research. A champion is someone within an organization who takes on a leadership role within that organization. While this research study did not specifically identify having a champion as an option for respondents to select as a factor in successful e-Health implementation, prior research has identified the establishment of a champion as a key factor in successful implementation (Terry et al., 2008; Kim et al., 2008; Garg et al., 2005).

Decision support was also commonly identified with respect to correlations between the number of resources and the 2007 e-Health adoption score. This resource was identified as the second most commonly selected resource in two of the significant correlations. Decision support was selected as the third most commonly selected resource for two of the significant correlations. Decision support may be viewed as feature of the technology itself, indicating that if the technology has this feature, there is a more likely chance of successful implementation. Ash et al. (2003) also mentions features of technology as a factor in successful e-Health implementation. Kuperman & Gibson (2003) also mention features of technology as important to successful e-Health implementation.

Correlations between Number of Resources and change in e-Health adoption score from 2006 to 2007

There were three significant correlations between the number of resources and change in adoption score for three different groups:

- CCC, Rehab and Mental Health;
- Central LHIN; and
- Waterloo LHIN.

The commonly identified resources were similar to the correlations between number of resources and 2007 e-Health adoption score. The most commonly identified barriers were:

- IS Support in End User Departments;
- Project Management;
- Clinical Systems Training; and
- Decision Support.

The results showed that out of the three significant correlations, two were negative and one was positive. For the CCC, Rehab & Mental Health peer group, the correlation between the number of resources and the change in adoption score was positive, that is as the number of resources went up, so did the change in adoption score for the particular hospitals falling under that peer group.

For the Central and Waterloo LHINs, the correlations were negative, indicating that as the number of resources increased, the change in adoption score decreased from 2006 to 2007. This result is not what would be expected, as it would be expected that an increase in resources would cause a higher amount of e-Health adoption. In interpreting these results, perhaps these negative correlations occurred because the hospitals involved did not identify all relevant resources. Perhaps the individuals within the specific hospitals that completed the survey did not understand the question and answered inappropriately. Another issue that may have caused this result is inaccuracy with the actual e-Health adoption scores in either or both years.

This research study allowed respondents to select the most relevant resources to successful implementation based on a pre-defined list. One of the disadvantages of a pre-defined list is that not all resources may have been captured. Prior research has defined some areas, not necessarily specific to staffing or program areas, that may be useful to capture results on with respect to successful e-Health implementation:

- Stakeholder buy-in and contribution (involving the relevant stakeholders in the design and development of IT systems) (Leonard, 2004);
- Having in place the appropriate leadership and vision for e-Health implementation (Ash et al., 2003) that views IT as part of an organizational strategy to support quality improvement, etc. (Kuperman & Gibson, 2003); and
- Characteristics of the technology itself: i.e. user friendliness, customizability (Ash et al., 2003), ability to upgrade the system (Garg et al., 2005).

Correlations between Number of Resources and subsection averages

The number of resources was correlated with all subsections except for subsection 3.3 (Interoperability between Organizations) for all hospitals. These included the following subsections:

- 1.1: Patient Registration, Records Management, and Registry Services;
- 1.2: Point-of-Care Order Entry;
- 1.3: Clinical Documentation;
- 1.4: Results Reporting;
- 1.5: Information Infrastructure;
- 2.1: e-Health Leadership and Planning; and
- 3.2: Inter-Organizational EMPI.

This indicates that overall for all hospitals, the larger the number of resources, the larger the value of the indicated subsections. It was noted that the number of resources was not correlated with subsection 3.3 (Interoperability between Organizations). Perhaps this suggests that the number of resources within hospitals do not have an effect on this indicator and that other external factors affect the value of this indicator.

The Toronto Central LHIN had the most amount of significant correlations between the number of resources and subsection scores. Specifically, the number of resources was correlated with the following subsections:

- 1.4: Results Reporting;
- 2.1: e-Health Leadership and Planning;
- 3.2: Inter-Organizational EMPI); and
- 3.3: Interoperability between Organizations.

Perhaps this suggests that in comparison to the other LHINs, the Toronto Central LHIN has a larger number of resources that promote e-Health adoption. It was noted that the Toronto Central LHIN consists or a larger number of teaching hospitals in comparison to other LHINs.

The results pertaining to the tabulation of specific resources related to all hospitals with e-Health adoption scores above and below the mean show varying results. For both groups of hospitals (with lower and higher e-Health adoption), resources dedicated to clinical systems training, decision support, project management and IS support in end user departments rank amongst the most common resources. For both groups of hospitals, resources dedicated to Process Re-engineering is least common. For hospitals with more e-Health adoption, resources for interface development and nursing informatics are more common than for hospitals with less e-Health adoption.

## 3.10 LIMITATIONS

There are some limitations with the research relating barriers and dedicated resources to e-Health adoption score:

- As discussed above, the OHA questionnaire provided respondents with a pre-defined list of barriers and dedicated resources; thus perhaps there were barriers and dedicated resources faced by hospitals that were not captured in the survey;
- When conducting analysis on peer groups and LHINs, some of the sample sizes were very small, affecting usefulness of the results. For example, there was one LHIN which only had a sample of two hospitals (Central West). As the sample sizes were so small, it was difficult to draw definitive conclusions between the different LHINs and peer groups;
- The respondents in the survey were not provided definitions of the actual barriers and dedicated resources indicated in the pre-defined lists. As a result, there could have been misinterpretation of the meanings of the actual terms; and
- Other issues that may have affected calculation of e-heath adoption score:
    - Variation in individuals completing the survey from year-to-year;
    - Variation in individuals in regard to actual job position;
    - No audit or verification of the calculated e-Health adoption scores (reliance on self-reported data); and
    - Misinterpretation of questions by respondents.

## 3.11 SUMMARY

With respect to barriers to e-Health adoption, cost was identified as the most common barrier by hospitals, which is consistent with the literature. For the resources necessary for successful adoption of e-Health applications, project management and end user support were identified as common resources necessary for successful e-Health adoption. Consistent with literature, clinical systems training was also identified as a common resource necessary for successful e-Health implementation.

The next chapter begins to relate e-Health adoption to e-Health investment.

# CHAPTER 4: E-HEALTH ADOPTION AND INVESTMENT

This chapter explains the approach used in conducting this research. Specifically, the research design, data sources, background information, study participants, key variables, statistical methods, and statistical software will be described.

## 4.1 RESEARCH DESIGN

This study uses secondary analysis to determine if there is a correlation between the dollar amount spent on e-Health and the e-Health adoption rate within a hospital setting. The data used in this study was provided by the Ontario Hospital Association (OHA).

## 4.2 DATA SOURCES

### 4.2.1 E-HEALTH ADOPTION DATA

The e-Health adoption data used in this study was provided by the OHA. The OHA provided access to the data via a copy of a database which was provided to the researcher on March 31, 2008. This included data for 2006 and 2007.

This database was subsequently updated and the researcher was provided access on December 18, 2008. This updated data included e-Health adoption data for 2008 in addition to the other years (2006 and 2007).

As indicated previously, queries were performed in Microsoft Excel to retrieve the data through Pivot tables. Updated definitions of fields in the database are provided in Appendix 4-1.

### 4.2.2 FINANCIAL DATA

The financial data used in this research focuses on the dollar amount of spending on IT within Ontario hospitals. The OHA provided access to this data via a secure online website (https://survey.oha.com/ohadownload/). OHA provided a username and password to access the secure online site. After entering the site, a link was used to download a Microsoft Excel document containing the financial data.

## 4.3 BACKGROUND

### 4.3.1 OHA SURVEY

The background information with respect to the OHA Survey was discussed previously in regard to the 2006/2007 data (see Section 3.3.1). The change in this section of the research is the addition of the 2008 data. The background information provided previously is the same except for the following additions:

- The OHA survey for 2008 was administered in July of 2008 (Please see Appendix 4-2 for copy of 2008 questionnaire);
- The response rate was 97% for the 2008 OHA survey;
- OHA used the data obtained from the 2008 OHA Survey to create a report in 2008 called "2008 Ontario Hospital e-Health Adoption Survey: Clinical Capabilities." This report is available online at http://www.oha.com/client/OHA/OHA_LP4W_LND_WebStation.nsf/resources/Ehealth/$file/2008+e-Health+Adoption+Survey+Clinical+Capabilities+Key+Findings+Report.pdf;
- There were various changes to the OHA survey between 2006, 2007, and 2008. This aspect of the research will only focus on core questions, which are defined as questions that were asked in all three years. Only analysis of responses to questions that were asked in all three years was conducted in this study. This allowed for year-to-year comparisons of the various scores. Please refer to Appendix 4-3 for a list of core questions for 2006, 2007, and 2008;
- Of the questions asked in all three years (2006, 2007 and 2008), there was a total of 91 core questions (See Appendix 4-3). Of this total, there were 3 corresponding sections[42] and 7 corresponding subsections[43] as listed below:

  SECTION 1 (LEVEL of e-Health FUNCTIONAL CAPABILITY AND USE)

  *Subsection 1.1 (Patient Registration, Records Management and Registry Services)*

  *Subsection 1.2 (Point-of-Care Order Entry)*

  *Subsection 1.3 (Clinical Documentation)*

  *Subsection 1.4 (Results Reporting)*

  *Subsection 1.5 (Information Infrastructure)*

  SECTION 2 (LEVEL OF e-Health ORGANIZATIONAL CAPACITY)

  *Subsection 2.1 (e-Health Leadership and Planning)*

  SECTION 3 (LEVEL OF REGIONAL/INTER-ORGANIZATIONAL e-Health)

  *Subsection 3.2 (Interoperability for a Shared EHR)*

[42] Section names vary slightly between the three years.
[43] Subsection names vary slightly between the three years.

- The OHA created a scoring system based on responses to each of the questions, which applied to all indicators except for 2.1 (e-Health Leadership and Planning). The options which respondents had to choose from are shown in the Table below under 'Response'. The corresponding 'Score' associated with each response is also shown in the table. The scoring systems were slightly varied in 2006, 2007, and 2008 and are shown in Table 4.1:

**Table 4-1: OHA Scoring System over 2006, 2007, and 2008**

| 2008 Scoring System | | 2007 Scoring System | | 2006 Scoring System | |
|---|---|---|---|---|---|
| ***Response*** | ***Score*** | ***Response*** | ***Score*** | ***Response*** | ***Score*** |
| Not Considered | 0 | Not Considered | 0 | Not Considered | 1 |
| Identified | 1 | Identified | 1 | Identified | 2 |
| Acquired | 2 | Acquired | 2 | Acquired | 3 |
| In progress | 3 | In progress | 3 | In progress | 4 |
| Pilot/Implemented | 4 | Pilot/Implemented | 4 | Pilot/Implemented | 5 |
| Mostly Implemented | 5 | Mostly Implemented | 5 | Mostly Implemented | 6 |
| Fully Implemented | 6 | Fully Implemented | 6 | Fully Implemented | 7 |
| N/A | - | N/A | - | N/A | - |

The 2008 Scoring System is the most recently used scoring system and is the same as the 2007 scoring system. Refer to Appendix 4-4 for definitions of the scoring system. To allow for year-to-year comparisons of the data, the scoring system in 2006 was mapped to the scoring system in 2007 and 2008 by the OHA. Data for this research was extracted from a database that mapped scores and questions for all three years, which allowed for the comparisons from year-to-year.

The OHA used this scoring system to create a normalized overall score for each indicator (except 2.1: e-Health Leadership and Planning). Highlights of the scoring system include:

- Questions answered with N/A were removed from overall score calculations;
- Scale value of 0 to 6 was used to calculate the overall score;
- The lowest possible score for an indicator is 0 (Not Considered); and
- The maximum possible score is 6 (Fully Implemented).

A normalized score was calculated for all indicators except for 2.1 (e-Health Leadership and Planning) based on the following calculation.

**NORMALIZED OVERALL SCORE CALCULATION FOR ALL INDICATORS (EXCEPT 2.1):**

$$\frac{\sum (C) \text{ X } 100}{Q \text{ x } 6}$$

Note:

- C = raw score for each question;
- Q = total number of questions (value for Q adjusted every time N/A responses are used); and
- Maximum possible score is 6.

**NORMALIZED OVERALL SCORE CALCULATION FOR INDICATOR 2.1 (E-HEALTH LEADERSHIP AND PLANNING):**

The calculation for indicator 2.1 is different from the other indicators because responses were either "Yes" or "No" and did not use the 0 to 6 scoring system defined above. For indicator 2.1, the scoring system is defined in Table 4.2:

**Table 4-2: Scoring System for Indicator 2.1**

| 2008 Scoring System | | 2007 Scoring System | | 2006 Scoring System | |
|---|---|---|---|---|---|
| ***Response*** | ***Score*** | ***Response*** | ***Score*** | ***Response*** | ***Score*** |
| No | 0 | No | 0 | No | 0 |
| Yes | 1 | Yes | 1 | Yes | 1 |

This scoring system for this indicator was the same in all three years so no mapping of the scoring system was required.

The OHA used this scoring system to create a normalized overall score for indicator 2.1. Highlights of the scoring system include:

- Questions answered with N/A responses were removed from overall score calculations;
- The lowest possible score for the indicator is 0; and
- The maximum possible score is 1.

The normalized calculation for indicator 2.1:

$$\frac{\sum (Y) \text{ X } 100}{Q \text{ x } 1}$$

- Y is score for each question;
- Q is total number of questions;
- 1 is maximum possible score; and

- The calculation of the core e-Health adoption score (for all three years) was calculated for each hospital by taking the average of all 7 core subsections. Essentially, a normalized value was calculated for each indicator as defined above, than the values of the 7 indicators were summed and divided by 7. The same weighting was used for all 7 indicators.

### 4.3.2 FINANCIAL DATA

The financial data used in this research study is also referred to as Management Information Systems (MIS) data. MIS data consists of financial and staffing data collected from hospitals that adhere to specific reporting standards or guidelines, referred to as the MIS Standards. Please refer to Appendix 4-5 for general information on the MIS Standards and data. The MIS data was provided via Compact Disc (CD) to the OHA by the Ontario Ministry of Health[44].

The Ontario Ministry of Health received this data directly from all Ontario hospitals. On a quarterly basis, hospitals provide this data to the Ministry of Health through an online tool. This data is than reconciled by the Ministry for the fiscal year (April 1 – March 31).

The MIS data for this research consists of two years of data that spans each fiscal year. Specifically, this research project uses MIS data for 2006/2007 (April 2006 – March 2007) and for 2005/2006 (April 2005 – March 2006). The MIS data contains information for 154 hospitals for 2006/2007 and information for 155 hospitals for 2005/2006.

MIS data is self-reported by hospitals. Specifically, the finance departments within the hospitals provide the information. From year-to-year, there may be slight changes in the methodology behind collection of the MIS data, in an effort to improve accuracy of the reporting. As a result, year-to-year comparison of the data is not possible for this research study.

The Ministry of Health also performs a variety of Quality Assurance checks on the MIS data received from the hospitals.

This MIS data received from the OHA contained various worksheets within a single Microsoft Excel file or document. Information was extracted from only one tab or sheet within this document called “Summary”. This sheet contained all reconciled MIS data for the two fiscal years and is the information used in this research project. For a complete list and corresponding definitions of all variables included on this worksheet, refer to Appendix 4-6.

This research project is specifically concerned with four variables extracted from the MIS data. These four variables are defined in general terms below:

[44] The Ministry of Health (of Ontario) is the government ministry responsible for managing the healthcare system and providing specific programs related to areas such as disease prevention and health promotion.

- Capital Expense: Expense related to fixed assets, such as buildings or equipment. Capital Expenses may be thought of expenditures that create future benefits;
- Operating Expense: Expenditure that a business acquires as a result of performing its normal business operations or on-going cost for running a business;
- IT Capital Expense: Same definition as Capital Expense above, but specific to IT; and
- IT Operating Expense: Same definition as Operating Expense above, but specific to IT.

Specific definitions of these four variables in relation to this research project are provided in Appendix 4-7.

## 4.4 STUDY PARTICIPANTS

All Ontario hospitals were invited to participate in this survey in 2006, 2007, and 2008. In 2008, 140 hospitals participated; in 2007, 138 hospitals participated; and in 2006, 139 hospitals participated. Only core hospitals (or hospitals that participated in all three years) were included in this section of the analysis. This resulted in a total of 129 hospitals. The core hospitals were determined by comparing the hospitals that participated (by name) and removing any hospitals from the analysis that did not participate in the OHA survey for all three years. The hospitals which were identified for removal from the analysis were confirmed with OHA to ensure accuracy.

In order to perform analysis relating the OHA adoption data to the MIS data, hospitals were matched based on hospital name. There were some hospital names in the OHA survey that were different from the hospital names in the MIS data. This could have been due to hospital name changes or hospital mergers, etc. Please refer to Appendix 4-8 for the core OHA hospital names matched to the hospital names in the MIS data. The matching of hospital names between the two data sources was provided by the OHA.

In addition, there were other exclusion criteria which reduced the number of participating hospitals in this research study:

- There was one hospital that participated in the OHA survey for all three years; but no MIS data with respect to this hospital could be retrieved (Chatham-Kent Health Alliance). This hospital was removed from the analysis;
- There were two hospitals whereby MIS data was available for 2006/07 but no MIS data was available for 2005/06 (Muskoka Algonquin Healthcare and Whitby Mental Health Centre). These two hospitals were removed from the analysis;
- For the MIS data, any hospitals that had null values (which was represented by a dashed [-] line) or a value of zero for any of the following variables were removed from the analysis:

- Total Operating Expense;
- Total Capital Expense;
- Total IT Operating Expense; and
- Total IT Capital Expense.

As a result:

- 2 hospitals were removed because of lack of data for Total Capital Expense (Chapleau Health Services / Services De Santé De Chapleau and Hamilton Health Sciences Corporation);
- 1 hospital was removed because of lack of data for Total IT Operating Expense (Haliburton Highlands Health Services Corporation); and
- 14 hospitals were removed because of lack of data for Total IT Capital Expense (Almonte General Hospital, Homewood Health Centre, Brant Community Healthcare System, Leamington District Memorial Hospital, Peterborough Regional Health Centre, Renfrew Victoria Hospital, Religious Hospitallers of Saint Joseph of the Hotel Dieu of St. Catharines, Tillsonburg District Memorial Hospital, Baycrest Centre for Geriatric Care, Thunder Bay Regional Health Sciences Centre, Rouge Valley Health System, The Ottawa Hospital, Groves Memorial Community Hospital, Riverside Health Care Facilities Inc.).

Any hospital that had no reported value or a value of zero[45] for any of the above variables for one or both years was removed; and

- Any hospitals that had negative values for any of the four variables (Total Operating Expense, Total Capital Expense, Total IT Operating Expense, and Total IT Capital Expense) were removed from the analysis. This data is assumed to have been entered in error. There were 3 hospitals that had negative values for some of the financial data:

    - Deep River and District Hospital (negative value for 2007 Total IT Capital Expense) (-2887);
    - Red Lake Margaret Cochenour Memorial Hospital (negative value for 2007 Total IT Capital Expense) (-34826); and
    - St. Joseph's Health Centre (Toronto) (negative values for 2006 Total IT Capital Expense [-68797842] and negative for 2007 Total IT Capital Expense [-62688545]).

[45] A value of zero was treated as an unknown value

Due to the above exclusion criteria, a total of 106 hospitals were included in this part of the research study. Please refer to Appendix 4-9 for a list of the participating hospitals.

## 4.5 KEY VARIABLES

The key variables to be analyzed in this research are defined in Table 4-3. These variables are specifically related to the association between e-Health adoption and the MIS variables identified previously.

**Table 4-3: Key Variables**

| Variable | Definition | Independent / Dependent[46] | How to Measure |
|---|---|---|---|
| OHA e-Health adoption score[47] | The amount of e-Health adoption within hospitals. A score calculated by OHA that takes the average of core subsection scores. | Dependent | Retrieved directly from data source |
| Percent change in e-Health Adoption Score[48] | The percent change in the OHA e-Health adoption score from year-to-year | Dependent | Adoption Score in later year **MINUS** Adoption Score in former year, **DIVIDED BY** Adoption Score in former year, all **MULTIPLIED BY** 100 (i.e. 2007 OHA e-Health adoption Score **MINUS** 2006 OHA e-Health adoption Score, **DIVIDED BY** 2006 OHA e-Health Adoption Score, all **MULTIPLIED BY** 100) |
| Change in e-Health Adoption Score[49] | The amount of raw change in the OHA e-Health adoption score from year-to-year | Dependent | Adoption Score in later year **MINUS** Adoption Score in former year (i.e. 2007 OHA e-Health adoption Score **MINUS** 2006 OHA e-Health adoption Score) |
| Percent IT Capital Expense | A calculated percent of spending on IT Capital | Independent | Total IT Capital Expense **DIVIDED BY** Total Capital Expense |
| Percent IT Operating Expense | A calculated percent of spending on IT Operating costs | Independent | Total IT Operating Expense **DIVIDED BY** Total Operating Expense |
| Total IT Operating Expense | Raw value of spending on IT Operating costs | Independent | Retrieved directly from data source |
| Total IT Capital Expense | Raw value of spending on IT Capital expenses | Independent | Retrieved directly from data source |

[46] An Independent variable is a variable that may be manipulated and a dependent variable is a response that is measured; dependent variables are assumed or hypothesized to be dependent on independent variables.
[47] OHA e-Health adoption scores for all three years (2006, 2007 and 2008) included only core adoption scores (i.e. only questions that were asked in all three years were used to calculate the adoption score)
[48] The percent change in e-Health adoption score includes percent changes between 2006 – 2007; 2007 – 2008; and 2006-2008
[49] The change in e-Health adoption score includes raw change between 2006 – 2007; 2007 – 2008; and 2006-2008

| | | | |
|---|---|---|---|
| Total Capital Expense | Raw value of spending on Capital expenses | Independent | Retrieved directly from data source |
| Total Operating Expense | Raw value of spending on Operating costs | Independent | Retrieved directly from data source |
| OHA Subsection Averages[50] | A score calculated by OHA that takes average of response scores pertaining to core questions within specific subsections. Core Subsection scores were used for 2007. | Dependent | Retrieved directly from data source |
| Barriers | A barrier may be defined as anything that impedes the adoption of e-Health technology.<br>The 2006 OHA survey provided a list of organizational barriers to which hospitals were asked to select up to three in ranked order (i.e. 1, 2, 3). See Appendix 3-10 for the specific wording and list of available options. | Independent | Barriers were coded and the total number of barriers was summed |
| Dedicated Resources | Dedicated resources are specific to staffing and/or program areas within each hospital.<br>The 2006 OHA survey provided a list of dedicated resources (to which hospitals could select as many as were applicable). See Appendix 3-11 for the specific wording and list of available options. | Independent | Resources were coded and the total number of resources was summed |

In a previous section of this research, another method was used to calculate the e-Health adoption score. As the e-Health adoption scores were quite similar calculated via either method (OHA's method or Improve-IT's method), only the OHA method to calculate e-Health adoption scores was used in this section of the research.

To allow for statistical comparisons between hospitals, percentages were calculated for IT Capital Expense and IT Operating Expense as described above.

For further information on the MIS variables used in this research, refer to Appendix 4- 7.

## 4.6 STATISTICAL METHODS

As indicated previously, only core hospitals or hospitals that participated in the OHA survey in 2006, 2007, and 2008 were included in this section of the research. Hospitals that did not participate in all three years were removed from the analysis.

As described previously, the financial MIS data was downloaded as a Microsoft Excel document. To match this information to the OHA survey information, hospitals were matched by hospital name.

The data above was used to perform analysis by:

- ALL – This includes all 106 hospitals
- Peer Groups – There are 4 Peer Groups (Teaching Hospitals, Community Hospitals, Small Hospitals, CCC Rehab and Mental Health Hospitals).

[50] Subsection averages are based on 2007 core data only, and include subsections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, and 3.2

Analysis of hospitals was not conducted by LHIN (as in prior research) because the sample of hospitals was reduced in this section of the research. In addition, the actual number of hospitals falling within certain LHINs would be very small, not allowing for sufficient statistical analysis for purposes of this research.

Pearson's correlations were conducted to determine if there is any relationship between the spending on IT Capital expense, IT Operating expense, Total Capital Expense, and Total Operating expense (for 2006 and 2007) and:

- OHA e-Health adoption score (for 2006, 2007, and 2008);
- Raw Change in OHA e-Health adoption score (from 2006 to 2007; from 2007 to 2008; and from 2006 to 2008);
- Percent change in OHA e-Health adoption score (from 2006 to 2007; from 2007 to 2008; and from 2006 to 2008); and
- 2007 OHA core Subsection averages.

To allow for comparison of the MIS financial data from hospital-to-hospital, percentage IT Capital and percentage IT Operating Expense were calculated as described above.

All Pearson's correlations were performed in SPSS. Correlations with a p value <.05 were considered significant.

If there were significant correlations between any of the variables and the percentage IT Capital and/or percentage IT Operating expense variables, the significance value (p -value) and strength of the correlation (r value) were obtained.

In addition to performing Pearson's correlations, the Spearman's (non-parametric) correlation test was performed on some of the tests as a supplementary test. This is because some of the data used in this research may have violated parametric assumptions. Spearman's correlation test was used as a supplementary test to validate the findings.

## 4.7 STATISTICAL SOFTWARE

Correlations were performed using SPSS (Version 16.0) for Windows (SPSS Incorporated, Chicago, Ill).

## 4.8 ANALYSIS

As indicated previously, Pearson's correlations were performed for All hospitals (106 hospitals) and by the four peer groups.

Findings from the correlations will be discussed below.

Note: While Total Capital Expense, Total Operating Expense, Total IT Operating Expense, and Total IT Capital Expense were included as variables in the analysis, the significance values are not reported because these raw values do not allow for comparison across hospitals. Results associated with these variables were reported in the appropriate tables as "X"s for informational purposes only and are not discussed in the Findings. The significance values associated with percentage IT Capital Expense and percentage IT Operating Expense are reported and discussed.

The results divided by each group of analysis will be presented.

### 4.8.1 ALL HOSPITALS (106 HOSPITALS)

A Pearson's correlation was performed on all 106 hospitals. The correlation results are shown in Table 4-5. Table 4-4 provides an explanation of acronyms used in the table. Findings are discussed below.

1) There were significant positive correlations between 2007 percent IT Capital Expense and OHA adoption scores for all three years (2006, 2007 and 2008). As the value of the 2007 percent IT Capital Expense increases, so does the value of the adoption scores for all three years. The significance values include:

   - ✓ p-value[51] = .005; r[52] = .273 (2008 adoption score)
   - ✓ p-value = .003; r = .283 (2007 adoption score)
   - ✓ p-value = .004; r = .276 (2006 adoption score)

   This same test was performed using the Spearman's Rank Correlation. Results of the test using Spearman's rank are shown below:

   - ✓ p-value = .024; r = .219 (2008 adoption score)
   - ✓ p-value = .014; r = .239 (2007 adoption score)
   - ✓ p-value = .002; r = .292 (2006 adoption score)

2) There were significant positive correlations between 2006 percent IT Capital Expense and OHA adoption scores for all three years (2006, 2007 and 2008). As the value of the 2006 percent IT Capital Expense increases, so does the value of the adoption scores for all three years. The significance values include:

   - ✓ p-value = .011; r = .245 (2008 adoption score)
   - ✓ p-value = .007; r = .262 (2007 adoption score)
   - ✓ p-value = .013; r = .240 (2006 adoption score)

[51] p-value is a measure of probability that may range from zero to one
[52] 'r' represents the linear correlation coefficient; measuring the strength and direction of a linear relationship between two variables

This same test was performed using the Spearman's Rank Correlation. Results of the test using Spearman's rank are shown below:

- ✓ p-value = .035; r = .205 (2008 adoption score)
- ✓ p-value = .011; r = .246 (2007 adoption score)
- ✓ p-value = .014; r = .238 (2006 adoption score)

3) There was a significant positive correlation between 2006 percent IT Operating Expense and 2007 OHA adoption score. As the value of the 2006 percent IT Operating Expense increases, so does the value of the 2007 OHA adoption score. The significance value is (p = .043; r = .197).

4) There were significant positive correlations between 2007 percent IT Capital Expense and Subsections 1.2 (Point-of-Care Order Entry), 1.3 (Clinical Documentation), and 1.4 (Results Reporting). As the value of the 2007 percent IT Capital Expense increases, so does the value of the indicated subsection averages. The significance values include:

   - ✓ p-value = .001; r = .314 (Point-of-Care Order Entry)
   - ✓ p-value = .033; r = .207 (Clinical Documentation)
   - ✓ p-value = .013; r = .240 (Results Reporting)

5) There was a significant positive correlation between 2007 percent IT Operating expense and Subsection 2.1 (e-Health Leadership and Planning). As the value of the 2007 percent IT Operating expense increases, so does the value of that subsection. The significance value is (p-value = .024; r = .219).

6) There were significant positive correlations between 2006 percent IT Capital Expense and Subsections 1.2 (Point-of-Care Order Entry), 1.4 (Results Reporting), and 2.1 (e-Health Leadership and Planning). As the value of the 2006 percent IT Capital Expense increases, so does the value of the indicated subsection averages. The significance values include:

   - ✓ p-value = .012; r = .248 (Point-of-Care Order Entry)
   - ✓ p-value = .030; r = .211 (Results Reporting)
   - ✓ p-value = .035; r = .205 (e-Health Leadership and Planning)

7) There was a significant positive correlation between 2006 percent IT Operating expense and Subsection 2.1 (e-Health Leadership and Planning). As the value of the 2006 percent IT Operating Expense increases, so does the value of the indicated subsection average. The significance value is (p-value = .005; r = .274).

### 4.8.2 PEER GROUPS

*Community Hospitals (43)*

The correlation results are shown in Table 4-6. Table 4-4 provides an explanation of acronyms used in the table.

Please Refer to Appendix 4-10 for list of all Community Hospitals.

1) There are significant positive correlations between 2007 percent IT Capital Expense and OHA adoption scores for all three years (2006, 2007 and 2008). As the 2007 percent IT Capital Expense increases, so does the OHA adoption scores for all three years. The significance values include:
    - ✓ p-value = .001; r = .487 (2008 adoption score)
    - ✓ p-value = .019; r = .357 (2007 adoption score)
    - ✓ p-value = .009; r = .395 (2006 adoption score)

2) There is a significant positive correlation between 2007 percent IT Operating Expense and 2008 OHA adoption score. As the 2007 percent IT Operating Expense increases, so does the 2008 OHA adoption score. The significance value is (p-value = .011; r = .386).

3) There are significant positive correlations between 2006 percent IT Capital Expense and OHA adoption scores for all three years (2006, 2007 and 2008). As the 2006 percent IT Capital Expense increases, so does the OHA adoption scores for all three years. The significance values include:
    - ✓ p-value = .000; r = .527 (2008 adoption score)
    - ✓ p-value = .002; r = .456 (2007 adoption score)
    - ✓ p-value = .021; r = .351 (2006 adoption score)

4) There is a significant positive correlation between 2006 percent IT Operating Expense and 2008 OHA adoption score. As the 2006 percent IT Operating Expense increases, so does the 2008 OHA adoption score. The significance value is (p-value = .002; r = .454).

5) There is a significant positive correlation between 2007 percent IT Operating Expense and Subsection 2.1 (e-Health Leadership and Planning). As the value of the 2007 percent IT Operating Expense increases, so does the value of the indicated subsection. The significance values includes (p-value = .021; r = .352).

6) There is a significant positive correlation between 2006 percent IT Capital Expense and Subsection 1.3 (Clinical Documentation). As the value of 2006 percent IT Capital Expense increases, so does the value of the indicated subsection. The significance values includes (p-value = .028; r = .334).

*Small Hospitals (37)*

The correlation results are shown in Table 4-7. Table 4-4 provides an explanation of acronyms used in the table

Please Refer to Appendix 4-11 for list of all Hospitals within Small Hospital Peer Group.

1) There is a significant positive correlation between 2007 percent IT Capital Expense and 2006 OHA Adoption score. As the 2007 percent IT Capital Expense increases, so does the 2006 adoption score. The significance value is (p-value = .034; r = .350).

2) There is a significant positive correlation between 2007 percent IT Operating Expense and OHA adoption scores (for 2006 and 2007). As the 2007 percent IT Operating Expense increases, so does the OHA adoption scores for 2006 and 2007. The significance values include:

   - ✓ p-value = .050; r = .325 (2007 adoption score)
   - ✓ p-value = .007; r = .433 (2006 adoption score)

3) There is a significant positive correlation between 2006 percent IT Capital Expense and 2006 OHA Adoption score. As the 2006 percent IT Capital Expense increases, so does the 2006 OHA adoption score. The significance value is (p-value = .038; r = .342).

4) There is a significant positive correlation between 2006 percent IT Operating Expense and OHA adoption scores (for 2006 and 2007). As the 2006 percent IT Operating Expense increases, so does the OHA adoption scores for 2006 and 2007. The significance values include:

   - ✓ p-value = .038; r = .342 (2007 adoption score)
   - ✓ p-value = .033; r = .352 (2006 adoption score)

5) There are significant positive correlations between 2007 percent IT Capital Expense and Subsections 1.2 (Point-Of-Care Order Entry) and 1.4 (Results Reporting). As the value of the 2007 percent IT Capital Expense increases, so does the value of the indicated subsections. The significance values include:

- ✓ p-value = .028; r = .377 (Point-Of-Care Order Entry)
- ✓ p-value = .035; r = .347 (Results Reporting)

6) There is a significant positive correlation between 2006 percent IT Operating Expense and Subsection 1.5 (Information Infrastructure). As the value of the 2006 percent IT Operating Expense increases, so does the value of the indicated subsection. The significance value includes (p-value = .039; r = .341).

*Teaching Hospitals (12)*

The correlation results are shown in Table 4-8. Table 4-4 provides an explanation of acronyms used in the table.

Please Refer to Appendix 4-12 for list of all Hospitals within Teaching Peer Group.

*CCC, Rehab & Mental Health (14)*

The correlation results are shown in Table 4-9. Table 4-4 provides an explanation of acronyms used in the table

Please Refer to Appendix 4-13 for list of all Hospitals within CCC, Rehab & Mental Health Peer Group.

1) There are significant positive correlations between 2007 percent IT Capital Expense and Subsections 1.1 (Patient Registration, Records Management, and Registry Services), 1.2 (Point-Of-Care Order Entry), and 1.3 (Clinical Documentation). As the 2007 percent IT Capital Expense increases, so does the value of the indicated subsections. The significance values include:

   - ✓ p-value = .040; r = .555 (Patient Registration, Records Management, and Registry Services)
   - ✓ p-value = .025; r = .595 (Point-Of-Care Order Entry)
   - ✓ p-value = .036; r = .562 (Clinical Documentation)

2) There is a significant positive correlation between 2007 percent IT Operating Expense and Subsection 1.2 (Point-Of-Care Order Entry). As the 2007 percent IT Operating Expense increases, so does the value of the indicated subsection. The significance value includes (p-value = .028; r = .586).

3) There is a significant positive correlation between 2006 percent IT Capital Expense and Subsection 1.3 (Clinical Documentation). As the 2006 percent IT Capital Expense increases, so does the value of the indicated subsection. The significance value includes (p-value = .042; r = .550).

## 4.9 DISCUSSION OF FINDINGS

Findings are discussed below divided by correlation using All hospitals and by Peer Group.

### 4.9.1 CORRELATION INVOLVING ALL 106 HOSPITALS

For the correlation with all 106 hospitals (Table 4-5), the percentage IT Capital Expense (for 2006 and 2007) was correlated with the e-Health adoption scores for all three years. This indicates that expenditure on IT Capital contributes to a higher amount of e-Health adoption within hospitals. It was interesting to note that percent IT Capital Expense in 2006 was positively and significantly correlated with the 2008 adoption score. This indicates that investment in IT Capital expense two years before impacted the adoption score two years later. There is a lack of research studies investigating the relationship between IT spending and e-Health adoption. However, this aspect of the research indicates that investment in IT capital affects e-Health adoption in a hospital setting.

The raw values for Total IT Operating Expense (for 2006 and 2007), Total IT Capital Expense (for 2006 and 2007), Total Capital Expense (for 2006 and 2007), and Total Operating Expense (for 2006 and 2007) were also correlated with the Adoption Scores for all three years. While the raw values do not provide a means by which to compare spending from hospital-to-hospital, it does indicate that increased investment in those financial indicators increases e-Health adoption.

The correlations between subsections and financial indicators (Table 4-5) showed that Subsections 1.2 (Point-Of-Care Order Entry), 1.4 (Results Reporting), and 2.1 (e-Health Leadership and Planning) had the most amount of correlations with the financial indicators (percent IT Capital Expense (2006 and 2007), percent IT Operating Expense (2006 and 2007), Total IT Operating Expense (2006 and 2007), Total IT Capital Expense (2006 and 2007), Total Capital Expense (2006 and 2007), and Total Operating Expense (2006 and 2007). This indicates that hospitals are focusing on IT spending or investment in the subsections or areas identified above. Put another way, investment in the financial indicators above are being used to pay for functionality associated with the subsections identified above. There is a lack of research to support the above results as few studies actually relate IT spending to e-heath adoption.

The Spearman's rank was performed for two of the tests and also showed significant correlations with the same variables as did Pearson's. The p-values and r values were slightly different. This validates the findings obtained from the Pearson's test.

### 4.9.2 CORRELATIONS INVOLVING PEER GROUPS

For the Community Hospitals, all of the financial indicators (percent IT Capital Expense (2006 and 2007), percent IT Operating Expense (2006 and 2007), Total IT Operating Expense (both 2006 and 2007), Total IT Capital Expense (both 2006 and 2007), Total Capital Expense (both 2006 and 2007), and Total

Operating Expense (both 2006 and 2007) were correlated with the 2008 OHA adoption score, as opposed to any other year. For Small hospitals, most financial indicators are correlated with the 2006 OHA adoption score as opposed to any other year. This would seem to indicate that most investment in IT impacted Community hospitals most in 2008 and most investment in IT impacted Small hospitals in 2006.

For Community hospitals, percent IT Capital Expense (in 2006 and 2007) is positively and significantly correlated with e-Health adoption scores (for all three years). This indicates that hospitals' spending on IT Capital increases e-Health adoption rate. Subsection 2.1 (e-Health Leadership and Planning) is the subsection that is most correlated with the financial indicators. This indicates that IT spending within community hospitals is most focused in this area.

For Small hospitals, Subsections 1.2 (Point-Of-Care Order Entry) and 1.4 (Results Reporting) are most correlated with the financial indicators. This indicates that spending within those areas is most associated with increased e-Health adoption as opposed to other areas. Put another way, hospitals belonging to the Small Peer Group are investing more in IT in relation to the areas or subsections identified above.

For the Teaching Hospitals, there does not appear to be any correlations with percentage IT Capital Expense and percentage IT Operating Expense. However, there are correlations with some of the raw financial indicators (i.e. Total Operating Expense, Total Capital Expense, etc.).

As mentioned previously, there is a lack of research to support the above results because many studies do not relate IT spending or investment to e-Health adoption. Rather, some studies attempt to calculate some type of ROI and relate spending on IT to some type of quantifiable savings or to health outcomes. For example, some studies have shown that investment in IT may save dollars by reducing the number of adverse events (Kaushal et al., 2006; Teich et al., 2000).

One of the benefits of this aspect of the research study is that the actual functionality associated with technologies (such as the EHR or CPOE) is compared to IT spending. This allows for an idea as to where hospital spending on IT is focused and how this potentially impacts e-Health adoption rate.

## 4.10 LIMITATIONS

There were some limitations to this research:

- As indicated previously, the OHA data used in this research is based on self-reported data; this data was not verified or confirmed for accuracy;
- The MIS Data used in this research was also self-reported and there was no verification of the data;
- For the MIS data, it is possible that some hospitals may have categorized certain types of expenses differently (i.e. one hospital may categorize one type of expense as a capital expense whereby another hospital may categorize that same type of expense as an Operating Expense). Thus, results may vary across the MIS data according to the individual or hospital reporting the financial data;
- IT Capital Expense includes both IT and Telecom; and
- In analyzing the Peer Group results, the Teaching and CCC Rehab and Mental Health Peer Groups in particular had small sample sizes. This made it difficult to draw definitive conclusions amongst the peer groups.

## 4.11 SUMMARY

Overall, the findings suggest that increased investment in IT (both in terms of Capital and Operating Expense) is correlated with increased adoption of IT. Thus, hospitals that invest in IT are actually using the functionality associated with investment of that IT.

The next chapter relates adoption and investment of IT to health outcome indicators.

# CHAPTER 5: E-HEALTH ADOPTION, INVESTMENT, AND HEALTH OUTCOMES

This chapter explains the approach used in conducting this research. Specifically, the research design, data sources, background information, study participants, key variables, statistical methods, and statistical software will be described.

## 5.1 RESEARCH DESIGN

This study uses secondary analysis to determine if there is a correlation between health outcome indicators and:

- e-Health spending or investment; and
- e-Health adoption score

The above variables are analyzed with respect to Ontario hospitals. The data on hospital IT spending and e-Health adoption was provided by the Ontario Hospital Association (OHA). The health outcomes data was downloaded from a public internet web site.

## 5.2 DATA SOURCES

### 5.2.1 E-HEALTH ADOPTION DATA

The e-Health adoption data used in this section of the research study has been described previously. The data used includes core data for 2006, 2007, and 2008. See Section 4.3.1 for more information.

### 5.2.2 FINANCIAL DATA

The financial data used in this section of the research study has been described previously. The data used includes data for 2005-2006 and for 2006-2007. See section 4.3.2 for more information.

### 5.2.3 HEALTH OUTCOMES DATA

The health outcomes data used in this research was downloaded from a public internet web site (http://www.hospitalreport.ca/downloads/year.html ). The specific reports used in this section were downloaded by year (2008 only).

## 5.3 BACKGROUND

Previously, background information surrounding methodology behind the e-Health adoption data and the financial data was provided in detail. This portion of the research study will focus on providing background information on the health outcomes data.

### 5.3.1 HOSPITAL REPORT SERIES

The health outcomes data used within this research project is contained within a series of Reports known as the Hospital Report Series, which is produced by the Hospital Report Research Collaborative (HRRC). The HRRC is an independent research collaborative dedicated to performing research related to performance measurement within Ontario hospitals. This research collaborative works with various organizations to produce the Hospital Reports. Refer to Appendix 5-1 for a list of these organizations and their role.

These reports may be downloaded from the following web site: http://www.hospitalreport.ca/downloads/annual.html. This information may be downloaded by year (between 1998 and 2008) or by sector (i.e. Acute Care, Emergency Department Care, etc.).

For this research project, the hospital report data was downloaded by year for the most current year (2008). As the methodology behind calculation of the various health indicators differs from year-to-year, comparison over multiple years was not possible.

For the 2008 year, four reports within the Hospital Report series were available:

- Acute Care: Focuses on data for hospitals that provide acute care in Ontario;
- Complex Continuing Care: Focuses on data for hospitals that provide Complex Continuing Care in Ontario;
- Emergency Department Care: Focuses on data for hospitals that provide Emergency Department Care in Ontario; and
- Rehabilitation: Focuses on data for hospitals that provide Rehabilitation Care in Ontario.

The data contained within the 2008 Hospital Report Series is primarily based on data collected between 2006 and 2007.

The Hospital Report Series uses a Balanced Scorecard[53] Approach to reporting on hospital performance in Ontario. Specifically, the balanced scorecard approach used in the Hospital Report Series focuses on performance within four key areas:

[53] The Balanced Scorecard is a method of conducting performance measurement using key performance indicators

1) System Integration and Change
2) Patient Satisfaction
3) Clinical Utilizations and Outcomes
4) Financial Performance and Condition

The above areas will be discussed in further detail based on each type of report.

Note: In viewing the data contained within each of the four reports, the decision was made to exclude the Complex Continuing Care report from the analysis. Much of the data within this report was 'Non-Reportable' (NR), indicating that there was insufficient data or data quality issues. This data would have resulted in very small sample sizes for the indicators, which would have been insufficient for purposes of this research.

As some hospitals provide multiple types of care (i.e. acute care, emergency care), data on some hospitals is reported multiple times in the different reports.

For all reports, data collection and analysis was completed by the Canadian Institute for Health Information (CIHI)[54].

Each of the three reports within the Hospital Report Series that will be used in this research project will be described in further detail below.

### 5.3.2 ACUTE CARE 2008

For this report, 44 indicators were used to examine the four areas or quadrants mentioned previously: Clinical Utilization and Outcomes, Financial Performance and Condition, Patient Satisfaction, and System Integration and Change. Performance indicator results are available for 114 out of 123 hospitals (114 hospitals participated in at least one quadrant of the balanced scorecard). 79 out of 123 hospitals participated in all four areas of the balanced scorecard, representing 64% of hospitals.

For this report, results are summarized by hospital type or peer group (i.e. small, community, etc.) and LHIN.

As described above, each report is divided into four main sections, under which corresponding indicators are used to measure performance in each of the four areas. These four main areas and corresponding indicators are described in Table 5-1 below for the Acute Care 2008 report:

[54] CIHI is an independent, non-profit organization that provides data and analysis on Canada's healthcare system.

**Table 5-1: Acute Care Indicators**

| **Clinical Utilization and Outcomes: Clinical indicators that are used to explain the amount of care that hospitals provide and quality of care. Where possible, clinical indicators are adjusted to remove effect of age, illness type, and other factors to promote comparability.** | |
|---|---|
| **Indicator** | **Definition** |
| Nurse-Sensitive Adverse Events - Medical | Proportion of medical patients who experienced an adverse event after admission such as a fracture caused by a fall, or a pressure ulcer. |
| Nurse-Sensitive Adverse Events – Surgical | Proportion of surgical patients who experienced an adverse event after admission such as a fracture caused by a fall or a pressure ulcer. |
| Adverse Events – Labour and Delivery | The proportion of labour / delivery patients who experienced an adverse event after admission such as a cardiac event or a wound infection. |
| Readmissions[55] – Specific Medical Conditions | The proportion of medical patients who needed to return expectedly to the hospital for reasons that might be related to the care provided during their initial hospital stay. |
| Readmissions[62] – Specific Surgical Procedures | The proportion of surgical patients who needed to return unexpectedly to the hospital for reasons that might be related to the care provided during their initial hospital stay. |
| Readmissions[62] – Labour and Delivery | The proportion of labour / delivery patients who needed to return unexpectedly to the hospital for reasons that might be related to the care provided during their initial hospital stay. |
| Access to Angiography | The proportion of patients who received appropriate heart related services following a heart attack while in hospital. |
| **Financial Performance and Condition: Financial indicators provide information that can be helpful in making informed decisions for management of finances and resources.** | |
| **Indicator** | **Definition** |
| Total Margin % | Measures whether hospitals are spending more money than their revenue. Hospitals require positive margin to help pay for new technology, growth in services, and new programs. |
| Current Ratio | Measures whether hospitals have enough money on hand to pay for their upcoming bills within the next year. Hospitals with an indicator value greater than 1.0 have enough cash to meet these expenses and those with a value less than 1.0 do not have enough cash. |
| Debt Service Coverage | When hospitals borrow money, they must make loan payments. Hospitals with an indicator value greater than 1.0 generate enough cash each year to make these loan payments. Indicator values less than 1.0 mean that the hospital does not have enough cash to make loan payments. |
| % Equipment Expense | Quality care requires resourced providers and modern equipment. The greater the value for this indicator, the larger the portion of a hospital's spending that is directed toward equipment purchases and/or equipment maintenance. |

[55] Readmissions do not include transfer from one hospital to another

| | |
|---|---|
| % Corporate Services | Hospitals are complex organizations and must be carefully managed. The greater the value for this indicator, the larger the portion of a hospital's spending that is directed toward administrative functions such as finance, personnel, and system support. Hospitals with multiple sites (often in different cities) can find this adds to their administrative costs. |
| % Sick Time | Measures the proportion of full-time personnel hours that were paid sick hours. Health care staff should not come to work if they are ill, but sick time may also indicate poor staff safety procedures or staff discontentment with the workplace. |
| Unit Cost Performance | Measures the extent to which a hospital's actual cost per comparable cases differ from its expected cost. |
| % Registered Nurse Hours | Measures the proportion of nursing care hours provided by registered nurses (RNs). Higher proportion of RNs has been linked to better patient outcomes. |

**Patient Satisfaction: Indicators help to describe a patient's perception of quality of services provided in hospitals by reporting on their experiences, evaluation of the services, and their interaction with hospital staff.**

| Indicator | Definition |
|---|---|
| Overall Impressions | A patient's view of the overall hospital experience, including the quality of care and services they received at the hospital. |
| Communication | A patient's view of how well information was communicated to them or their family during their hospital stay |
| Consideration | A patient's view of whether they were treated with respect, dignity, and courtesy during their hospital stay |
| Responsiveness | A patient's view of the extent to which they got the care they needed and how coordinated and integrated that care was when it was delivered |

**System Integration and Change: Indicators help to assess efforts and investments made by hospitals to improve access to information for external/internal partners. These indicators also help in considering approaches to improve system management practices within hospitals.**

| Indicator | Definition |
|---|---|
| Use of Clinical Information Technology | The degree to which clinical information is available electronically to care providers inside and outside the hospital. |
| Use of Data for Decision-Making | The degree to which organizations use clinical and administrative data to evaluate and plan for service delivery. |
| Healthy Work Environment | The extent to which hospitals have mechanisms in place to support and promote a healthy work environment such as smoking cessation and employee assistance programs. |
| Patient Safety Reporting and Analysis | The degree to which hospitals are reporting, monitoring, and analyzing patient safety incidents. |
| Performance Management in Ambulatory Care | The extent to which hospitals use and monitor clinic performance indicators, as well as how hospitals incorporate quality improvement plans in walk-in clinics. |
| Medication Documentation and Reconciliation | The extent to which hospital staff document, reconcile and discuss complete lists of patient medications. |
| Formalized Audit of Hand Hygiene Practices | The extent to which hand hygiene practices are audited, the frequency in which they are monitored and whether they are used as criteria for performance appraisal for all staff in the organization. |

For the Acute Care report, the clinical utilization indicators were selected based on results of a literature review and advice of expert panels.

### 5.3.3 EMERGENCY DEPARTMENT CARE 2008

For this report, 32 indicators were used to examine the four areas or quadrants mentioned previously: Clinical Utilization and Outcomes, Financial Performance and Condition, Patient Satisfaction, and System Integration and Change. Performance indicator results are available for 116 out of 125 hospitals (116 hospitals participated in at least one quadrant of the balanced scorecard). 86 out of 125 hospitals participated in all four areas of the balanced scorecard, representing 69% of hospitals.

For this report, results are summarized by hospital type and LHIN.

As described above, each report is divided into four main sections, under which corresponding indicators are used to measure performance in each of the four areas. These areas and corresponding indicators are described in Table 5-2 below for the Emergency Department Care 2008 report:

**Table 5-2: Emergency Department Care indicators**

| **Clinical Utilization and Outcomes: Clinical indicators that are used to explain the amount and quality of care that emergency departments provide. Where possible, clinical indicators are adjusted to remove effect of age, illness type, and other factors to promote comparability.** | |
|---|---|
| **Indicator** | **Definition** |
| Chest or Neck X-Ray Rate for Croup – Pediatric (3 months – 3 years) | A measure of the extent to which x-rays are being used in the diagnosis and management of croup. Croup is a relatively common pediatric condition treated in most emergency departments. |
| Chest X-Ray Rate for Asthma – Pediatric (1 – 19 years) | A measure of the extent to which chest x-rays are being used in the diagnosis and management of asthma |
| Chest X-Ray Rate for Bronchiolitis – Pediatric (3 – 24 months) | A measure of the extent to which chest x-rays are being used in the diagnosis and management of bronchiolitis |
| Proportion of pneumonia patients that have an Inpatient Length of Stay (LOS) of less than or equal to 2 days – Adult (20-84 years) | A measure of the proportion of patients seen in the emergency department with pneumonia who could potentially be safely treated in the community rather than being admitted to hospital. |
| Return X-Ray Rate for Ankle or Foot Injury less than or equal to 7 days – Patients (5-84 years) | A measure of how frequently hospitals chose not to use x-rays when diagnosing possible ankle or foot injury, where it was later determined that an x-ray would have been helpful |
| Return Visit Rate for Asthma less than or equal to 24 hours – Adult (20 – 64 years) | A measure of the emergency department's ability to manage severe attacks of asthma among adult patients |
| Return Visit Rate for Asthma 24 – 72 hours – Adult (20 – 64 years) | A measure of an emergency department's ability to manage severe asthma attacks in adults during the patient's first emergency department visit |
| Return Visit Rate for Asthma 0 – 72 hours – Pediatric (1 – 19 years) | A measure of an emergency department's ability to manage severe asthma attacks in children during the patient's first emergency department visit. |

| | |
|---|---|
| X-Ray Rate for Ankle or Foot Injury Patients – Adult (20 – 84 years) | The proportion of adult patients with an ankle or foot injury who receive an x-ray of the ankle or foot |
| X-Ray Rate for Ankle or Foot Injury Patients – Pediatric (5 - 19 years) | The proportion of child patients with an ankle or foot injury who receive an x-ray of the ankle or foot |
| **Financial Performance and Condition: Financial indicators provide information that can be helpful in making informed decisions for management of finances and resources.** | |
| **Indicator** | **Definition** |
| % Management and Operational Support Staff Hours | Measures the proportion of all staff time for management of the emergency department. |
| % Registered Nurse Hours | Measures the proportion of nursing care hours provided by registered nurses (RNs). Higher proportion of RNs has been linked to better patient outcomes. |
| % Nursing Worked Hours | Measures the proportion of nursing staff time for patient care and continuing education (excludes time for management) |
| % Total Worked Hours | Measures the proportion of staff hours spent engaged in activities related to operation of the emergency department. Sick time and educational time are examples of staff hours (nursing and non-nursing) that are not spent engaged in activities directly related to the operation of the emergency department. |
| **Patient Satisfaction: Indicators help to describe a patient's perception of quality of services provided by emergency departments by reporting on their experiences, evaluation of the services, and their interaction with hospital staff.** | |
| **Indicator** | **Definition** |
| Overall Impressions | A patient's view of the overall hospital experience, including the quality of care and services they received at the hospital. |
| Communication | A patient's view of how well information was communicated to them or their family during their hospital stay |
| Consideration | A patient's view of whether they were treated with respect, dignity, and courtesy during their hospital stay |
| Responsiveness | A patient's view of the extent to which they got the care they needed and how coordinated and integrated that care was when it was delivered |
| **System Integration and Change: Indicators help to describe an emergency department's ability to manage change.** | |
| **Indicator** | **Definition** |
| Use of Clinical Information Technology | A measure of the extent to which clinical information is available electronically to care providers inside and outside the hospital. |
| Clinical Data Collection and Dissemination | A measure of the extent to which the Emergency Department is collecting and sharing information on clinical activities. |
| Healthy Work Environment | The extent to which hospitals have mechanisms in place to support and promote a healthy work environment such as smoking cessation and employee assistance programs. |
| Internal Coordination of Care | A measure of the extent to which the Emergency Department helps coordinate patient care both internally, and with other parts of the hospital. |
| Use of Standardized Protocols | A measure of the extent to which hospitals develop and use a set of rules for the diagnosis and treatment of a broad range of relatively common clinical conditions and procedures. |

### 5.3.4 REHABILITATION 2008

For this report, 21 indicators were used to examine the four areas or quadrants mentioned previously: Clinical Utilization and Outcomes, Financial Performance and Condition, Patient Satisfaction, and System Integration and Change. Performance indicator results are available for 59 hospitals (100%) of hospitals with designated rehabilitation beds. 36 out of 59 hospitals participated in all four areas of the balanced scorecard, representing 61% of hospitals.

For this report, results are summarized by LHIN and by individual hospital (in alphabetical order).

As described above, each report is divided into four main sections, under which corresponding indicators are used to measure performance in each of the four areas. These four main areas and corresponding indicators are described in Table 5-3 below for the Rehabilitation 2008 report:

**Table 5-3: Rehabilitation Care Indicators**

| **Clinical Utilization and Outcomes: Clinical indicators that are used to explain the amount and quality of care that hospitals with rehabilitation services provide. Where possible, clinical indicators are adjusted to remove effect of age, illness type, and other factors to promote comparability.** | |
|---|---|
| **Indicator** | **Definition** |
| Average Total Function Change | Measures a patient's improvement in function from admission to discharge while in inpatient rehabilitation |
| Average Active Rehabilitation Length of Stay | The average number of days patients required rehab therapy before being ready for discharge |
| Length of Stay Efficiency | A measure of how quickly patients respond to rehabilitation therapies |
| Average Total Function Change (Stroke) | Measures a stroke patient's improvement in function from admission to discharge while in inpatient rehabilitation |
| Average Active Rehabilitation LOS (Stroke) | The average number of days stroke patients required rehab therapy before being ready for discharge |
| Length of Stay Efficiency (Stroke) | A measure of how quickly stroke patients respond to rehabilitation therapies |
| Average Total Function Change (Ortho) | Measures orthopaedic patients improvement in function from admission to discharge while in inpatient rehabilitation |
| Average Active Rehabilitation LOS (Ortho) | The average number of days orthopaedic patients required rehab therapy before being ready for discharge |
| Length of Stay Efficiency (Ortho) | A measure of how quickly patients respond to rehabilitation therapies |
| **Financial Performance and Condition: Financial indicators provide information that can be helpful in making informed decisions for management of finances and resources.** | |
| **Indicator** | **Definition** |
| % Nursing and Therapy Hours | Measures the proportion of time staff spent for patient's in rehabilitation units |
| % Direct Rehabilitation Cost | Measures costs of providing nursing, diagnostic and therapeutic services, and food services to rehabilitation patients |

| | |
|---|---|
| % Nursing Worked Hours (Rehab) | Measures nursing staff time for patient care as a proportion of the total hours worked in the Rehabilitation unit (excludes time for management) |

**Patient Satisfaction: Indicators help to describe a patient's perception of quality of services provided in hospitals with rehabilitation services by reporting on their experiences, evaluation of the services, and their interaction with hospital staff.**

| Indicator | Definition |
|---|---|
| Family Involvement | A patient's view of whether families were involved in the rehabilitation process |
| Overall Quality of Care | A patient's view of the overall hospital experience including the quality of rehabilitation care and services they received at the hospital |
| Evaluation of Outcomes | A patient's view of their involvement in evaluating the outcomes of treatment. |
| Continuity and Transition | A patient's view of whether they received the help, information, and support they needed following discharge. |
| Physical Comfort | A patient's view of whether they felt that they received relief and support for their discomfort and pain during their hospital stay |
| Emotional Support | A patient's view of whether they felt that their emotional needs were met during their hospital stay. |
| Participation in Decision-Making and Goal-Setting | A patient's view of whether they were involved in decision-making and goal-setting. |
| Client Education | A patient's view of whether they received the education and information about community and other services. |

**System Integration and Change: Indicators help to assess efforts and investments made by hospitals to improve delivery of adult inpatient rehabilitation services. These indicators also help in considering approaches to improve system management practices within hospitals.**

| Indicator | Definition |
|---|---|
| Cross Continuum Care | The extent of coordination and continuity of care for patients who are discharged from rehabilitation settings |
| Best Practices | The extent of the best practices in making decisions about the care of patients. |
| Evidence of Client-Centred Care | Measures the extent to which hospitals are providing patient care in a client-centred manner |
| Healthy Work Environment | The extent to which hospitals have mechanisms in place to support and promote a healthy work environment such as smoking cessation and employee assistance programs. |
| CrossContinuum Care (Stroke) | The extent of coordination and continuity of care for stroke patients who are discharged from rehabilitation settings |
| CrossContinuum Care (HipKnee) | The extent of coordination and continuity of care for patients who had hip and knee replacement who are discharged from rehabilitation settings |
| CrossContinuum Care (Hip) | The extent of coordination and continuity of care for patients who had hip replacement who are discharged from rehabilitation settings |
| CrossContinuum Care (Ortho) | The extent of coordination and continuity of care for orthopaedic patients who are discharged from rehabilitation settings |

### 5.3.4 HEALTH OUTCOME INDICATORS SELECTED FOR THIS STUDY

Specific indicators from all three reports identified above were selected for this study. In selecting indicators to analyze for this study, focus was on indicators whereby usage of IT could potentially impact the particular indicator. The following table highlights the indicators selected for the study. A total of 21 indicators were selected for analysis. Information surrounding methodology of these indicators is provided in Appendices as indicated in Table 5-4.

**Table 5-4: Indicators Selected for Study**

| Indicator | Report | Data Collection Period | Information on Methodology |
|---|---|---|---|
| Use of Clinical IT | Acute Care 2008 | 2007 | Appendix 5-2 |
| Use of Data for Decision-Making | Acute Care 2008 | 2007 | Appendix 5-2 |
| Patient Safety Reporting and Analysis | Acute Care 2008 | 2007 | Appendix 5-2 |
| Performance Management in Ambulatory Care | Acute Care 2008 | 2007 | Appendix 5-2 |
| Medication Documentation and Reconciliation | Acute Care 2008 | 2007 | Appendix 5-2 |
| Nurse-Sensitive Adverse Events (Medical) | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Nurse-Sensitive Adverse Events (Surgical) | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Adverse Events (Labour and Delivery) | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Readmissions – Specific Medical Conditions | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Readmissions – Specific Surgical Procedures | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Readmissions – Labour & Delivery | Acute Care 2008 | 2006-07 | Appendix 5-2 |
| Average Active Rehabilitation LOS (All RCG) | Rehabilitation 2008 | 2006-07 | Appendix 5-3 |
| Average Active Rehabilitation LOS (Stroke) | Rehabilitation 2008 | 2006-07 | Appendix 5-3 |
| Average Active Rehabilitation LOS (Ortho) | Rehabilitation 2008 | 2006-07 | Appendix 5-3 |
| Clinical Data Collection and Dissemination | Emergency Department Care 2008 | 2007 | Appendix 5-4 |

| | | | |
|---|---|---|---|
| Internal Coordination of Care | Emergency Department Care 2008 | 2007 | Appendix 5-4 |
| Use of Clinical Information Technology | Emergency Department Care 2008 | 2007 | Appendix 5-4 |
| Use of Standardized Protocols | Emergency Department Care 2008 | 2007 | Appendix 5-4 |
| Chest X-Ray Rate for Asthma – Pediatric | Emergency Department Care 2008 | 2006-07 | Appendix 5-4 |
| Return X-Ray Rate for Ankle or Foot Injury Patients (less than or equal to 7 days) | Emergency Department Care 2008 | 2006-07 | Appendix 5-4 |
| Return Visit Rate for Asthma (less than or equal to 24 hours) – Adult | Emergency Department Care 2008 | 2006-07 | Appendix 5-4 |

The indicators selected for inclusion in the Hospital Report series was determined through literature review, expert panel consensus, and consultations with other staff (such as physicians, nurses, etc.). This research project does not verify the methodology or defend the indicators selected by the Hospital Report Research Collaborative.

## 5.4 STUDY PARTICIPANTS

All Ontario hospitals that could be matched between the e-Health adoption data, the financial data, and the health outcomes data were included in this study. Matching was done by hospital name. As matching had been done previously between the e-Health adoption data and the MIS financial data (which resulted in a total of 106 hospitals), focus was on matching the health outcomes data to this list of hospitals. The number of hospitals that were included for the analysis varied because there were different numbers of hospitals that reported results for the health indicators or outcomes. Table 5-5 provides the breakdown of the number of hospitals that participated in the analysis by indicator:

**Table 5-5: Number of Participating Hospitals**

| Indicator | Number of Participating Hospitals |
|---|---|
| Use of Clinical IT | 76 |
| Use of Data for Decision-Making | 76 |
| Patient Safety Reporting and Analysis | 76 |
| Performance Management in Ambulatory Care | 76 |
| Medication Documentation and Reconciliation | 76 |
| Nurse-Sensitive Adverse Events (Medical) | 80 |
| Nurse-Sensitive Adverse Events (Surgical) | 60 |
| Adverse Events (Labour and Delivery) | 62 |
| Readmissions – Specific Medical Conditions | 79 |
| Readmissions – Specific Surgical Procedures | 60 |
| Readmissions – Labour & Delivery | 62 |
| Average Active Rehabilitation LOS (All RCG) | 44 |
| Average Active Rehabilitation LOS (Stroke) | 40 |
| Average Active Rehabilitation LOS (Ortho) | 43 |
| Clinical Data Collection and Dissemination | 75 |
| Internal Coordination of Care | 75 |
| Use of Clinical Information Technology | 75 |
| Use of Standardized Protocols | 75 |
| Chest X-Ray Rate for Asthma – Pediatric | 80 |
| Return X-Ray Rate for Ankle or Foot Injury Patients (less than or equal to 7 days) | 81 |
| Return Visit Rate for Asthma (less than or equal to 24 hours) – Adult | 78 |

No hospitals were excluded for any reason for this portion of the research project.

The list of participating hospitals (that participated in at least one indicator above) is provided in Appendix 5-5.

## 5.5 KEY VARIABLES

The key variables to be analyzed in this research are defined in Table 5-6. These variables are specifically related to the association between health indicators and:

- e-Health adoption
- e-Health spending

**Table 5-6: Key Variables**

| Variable | Definition | Independent / Dependent | How to Measure |
|---|---|---|---|
| OHA Score[56] | Amount of e-Health adoption within a hospital | Independent | Retrieved directly from data source |
| Change in OHA Adoption Score[57] | Amount of raw change in adoption from year-to-year | Independent | OHA Adoption score in later year minus adoption score in former year (i.e. adoption score in 2007 **minus** adoption score in 2006) |
| Percent Change in OHA Adoption Score[58] | Percent change in adoption from year-to-year | Independent | Adoption score in later year minus adoption score in former year, divided by adoption score in former year, all multiplied by 100, (i.e. adoption score in 2007 **minus** adoption score in 2006, **divided by** adoption score in 2006 **multiplied by** 100) |
| Percent IT Capital Expense | A calculated percent of spending on IT Capital | Independent | Total IT Capital Expense **divided by** Total Capital Expense |
| Percent IT Operating Expense | A calculated percent of spending on IT Operating costs | Independent | Total IT Operating Expense **divided by** Total Operating Expense |
| Total IT Operating Expenses (Raw) | Raw value of spending on IT Operating costs | Independent | Retrieved directly from data source |
| Total IT Capital Expenses (Raw) | Raw value of spending on IT Capital expenses | Independent | Retrieved directly from data source |
| Total Capital Expenses (Raw) | Raw value of spending on Capital expenses | Independent | Retrieved directly from data source |
| Total Operating Expenses (Raw) | Raw value of spending on Operating expenses | Independent | Retrieved directly from data source |
| Subsection Averages[59] | Average of questions pertaining to each subsection | Independent | Retrieved directly from data source |
| Health Indicators (from Hospital Report series) | Specific indicators (defined in Section 5.3.4) obtained from Hospital Reports | Dependent | Retrieved directly from data source |

[56] OHA adoption scores for all three years (2006, 2007, and 2008) included only Core adoption scores (i.e. only questions that were asked in all three years were used to calculate the adoption score)

[57] The change in e-Health adoption score includes raw score changes between 2006 – 2007; 2007 – 2008; and 2006 - 2008

[58] The percent change in e-Health adoption score includes percent changes between 2006 – 2007; 2007 – 2008; and 2006 - 2008

[59] Subsection averages are based on 2007 core data only and include subsections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, and 3.2

For further information on the indicators used in this research, refer to Appendices 5-2, 5-3 and 5-4.

## 5.6 STATISTICAL METHODS

The data that was matched previously between the e-Health adoption data and the MIS data was the data set used initially for this portion of the research study. This data was matched, using hospital name, to the hospitals within the Hospital Report Series. 21 indicators were selected for inclusion in this research study.

To access the Hospital Report data, a public web site[60] was accessed. In viewing the "2008 reports", each report was downloaded. For example, the "Acute Care" report could be downloaded by selecting the appropriate link. Upon selecting this link, a screen appeared describing general contents of the report. Towards the bottom of this screen were web links. The link called "Hospital Performance Results 2008 Online" was used to download the specific indicator information. A button called "Start" was selected to open the online tool used to display the results of the report. Upon selecting this, there was a choice of options to display the results by type, region, etc. By selecting "type", hospitals were grouped into specific categories (i.e. community peer group, small peer group). Each individual hospital's data was manually entered into SPSS and matched to the e-Health adoption and financial data obtained previously.

As described previously, only core hospitals or hospitals that participated in all three years of the OHA survey were included in the analysis.

The data above was used to perform analysis by all hospitals that had information for each indicator. As each indicator contained data on different hospitals, separate analyses were performed for each indicator.

In this portion of the research, analysis of hospitals was not conducted by LHIN or peer group (as in prior research). This was because the sample size of the hospitals varied considerably across the different indicators and would have proved difficult to perform analysis using the LHIN or peer group dimension. Analysis was performed for each indicator using all hospitals that contained data for that particular indicator.

Pearson's correlations were conducted to determine if there is any relationship between specific health indicators and:

- e-Health adoption (e-Health adoption score, change in e-Health adoption score, percent change in e-Health adoption score, subsection averages)
- e-Health spending (percent IT Capital Expense, percent IT Operating Expense, Total IT Operating Expense, Total IT Capital Expense, Total Capital Expense, Total Operating Expense)

[60] http://www.hospitalreport.ca/downloads/year.html

All Pearson's correlations were performed in SPSS. Correlations with a p value <.05 were considered significant.

If there was a significant correlation between the health indicator variables and any of the other variables, the significance value (p-value) and strength of the correlation (r value) were noted. In addition, the coefficient of determination ($r^2$) was calculated by squaring the r value.

In addition to performing Pearson's correlations, the Spearman's (non-parametric) correlation test was performed on some of the tests as a supplementary test. This is because some of the data used in this research may have violated parametric assumptions. Spearman's correlation test was used as a supplementary test to validate the findings.

## 5.7 STATISTICAL SOFTWARE

Correlations were performed using SPSS (Version 16.0) for Windows (SPSS Incorporated, Chicago, Ill).

## 5.8 ANALYSIS

As indicated previously, Pearson's correlations were performed for All hospitals for each particular Hospital Report indicator.

Findings from the correlations will be presented below.

Note: While Total Capital Expense, Total Operating Expense, Total IT Operating Expense, and Total IT Capital Expense were included as variables in the analysis, the significance values are not reported because these raw values do not allow for comparison across hospitals. Results associated with these variables were reported in the appropriate tables as "X"s for informational purposes only and are not discussed in the Findings. The significance values associated with percentage IT Capital Expense and percentage IT Operating Expense are reported and discussed.

The results are divided by type of Hospital report (i.e. Acute Care, Rehabilitation Care, Emergency Department Care).

The number of hospitals analyzed for each indicator is provided in brackets after the indicator name.

### 5.8.1 ACUTE CARE (Refer to Table 5-7)

**Use of Clinical IT (76)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and Use of Clinical IT. As the Use of Clinical IT increases, so does the adoption scores for all three years. This finding confirms that adoption of IT score (as obtained from the OHA e-Health adoption report) is correlated to the Use of Clinical IT Indicator (As obtained from

the Acute Care Hospital Report). Both of these variables measure IT usage and this correlation confirms that the reported variables within the reports are similar. The significance values include:

- ✓ p-value[61] = .000; r[62] = .617; $(r^2)$[63] = .380 (2008 OHA Adoption Score)
- ✓ p-value = .000; r = .604; $r^2$ = .365 (2007 OHA Adoption Score)
- ✓ p-value = .000; r = .687; $r^2$ = .472 (2006 OHA Adoption Score)

This same test was performed using the Spearman's Rank Correlation. Results of the test using Spearman's rank are shown below:

- ✓ p-value = .000; r = .539 (2008 adoption score)
- ✓ p-value = .000; r = .519 (2007 adoption score)
- ✓ p-value = .000; r = .607 (2006 adoption score)

2) There are significant negative correlations between Use of Clinical IT and change / percentage change in OHA score between 2006 and 2007. As the Use of Clinical IT increases, the change and percentage change in OHA score between 2006 and 2007 decreases. The significance values include:

- ✓ p-value = .040; r = -.236; $r^2$ = .056 (Change in OHA Score between 2006 and 2007)
- ✓ p-value = .001; r = -.383; $r^2$ = .147 (Percent change in OHA Score between 2006 and 2007)

3) There is a significant negative correlation between Use of Clinical IT and percent change in OHA score between 2006 and 2008. As the Use of Clinical IT increases, the percentage change in OHA score between 2006 and 2007 decreases. The significance value includes:

- ✓ p-value = .002; r = -.357; $r^2$ = .128

4) There are significant positive correlations between Use of Clinical IT and percent IT Capital Expense (for 2006 and 2007). As the Use of Clinical IT increases, so does the percent IT Capital Expense for both years. The significance values include:

[61] p-value is a measure of probability that may range from zero to one

[62] 'r' represents the linear correlation coefficient; measuring the strength and direction of a linear relationship between two variables

[63] '$r^2$' represents the coefficient of determination; measuring the amount of variation of one variable that is predictable from the other variable

- ✓ p-value = .012; r = .286; $r^2$ = .082 (2007 Percent IT Capital Expense)
- ✓ p-value = .015; r = .278; $r^2$ = .078 (2006 Percent IT Capital Expense)

This same test was performed using the Spearman's Rank Correlation. Results of the test using Spearman's rank are shown below:

- ✓ p-value = .025; r = .257; $r^2$ = .066 (2007 Percent IT Capital Expense)
  (There was no significant correlation for the 2006 Percent IT Capital Expense)

5) There is a significant positive correlation between Use of Clinical IT and 2006 percent IT Operating Expense. As the Use of Clinical IT increases, so does the 2006 percent IT Operating Expense. The significance value includes:

- ✓ p-value = .034; r = .243; $r^2$ = .059

6) There are significant positive correlations between Use of Clinical IT and Subsections 1.1, 1.2, 1.3, 1.4, 1.5, and 2.1. As the Use of Clinical IT increases, so does the value of the indicated subsections. Hospitals are using IT functionality in relation to the identified subsections. The significance values include:

- ✓ p-value = .000; r = .395; $r^2$ = .156 (Subsection 1.1)
- ✓ p-value = .000; r = .563; $r^2$ = .317 (Subsection 1.2)
- ✓ p-value = .000; r = .461; $r^2$ = .213 (Subsection 1.3)
- ✓ p-value = .000; r = .557; $r^2$ = .310 (Subsection 1.4)
- ✓ p-value = .018; r = .271; $r^2$ = .073 (Subsection 1.5)
- ✓ p-value = .000; r = .421; $r^2$ = .177 (Subsection 2.1)

**Use of Data for Decision Making (76)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Use of Data for Decision Making indicator. As the value of the Use of Data for Decision Making indicator increases, so does the adoption scores for all three years. The significance values include:

- ✓ p-value = .001; r = .381; $r^2$ = .145 (2008 OHA Adoption Score)
- ✓ p-value = .000; r = .395; $r^2$ = .156 (2007 OHA Adoption Score)
- ✓ p-value = .000; r = .401; $r^2$ = .161 (2006 OHA Adoption Score)

2) There is a significant negative correlation between percent change in OHA Adoption Score (between 2006 and 2008) and the Use of Data for Decision Making indicator. As the value of the

Use of Data for Decision Making indicator increases, the percent change in OHA Adoption score from 2006 to 2008 decreases. The significance value includes:

- ✓ p-value = .041; r = -.235; $r^2$ = .056

3) There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Use of Data for Decision making indicator. As the value of the Use of Data for Decision Making indicator increases, so does the percent IT Capital Expense for both years. The significance values include:

- ✓ p-value = .014; r = .281; $r^2$ = .079 (2007 Percent IT Capital Expense)
- ✓ p-value = .011; r = .291; $r^2$ = .085 (2006 Percent IT Capital Expense)

4) There are significant positive correlations between the Use of Data for Decision-Making indicator and Subsections 1.1, 1.2, 1.3, 1.4, and 2.1. As the Use of Data for Decision-Making indicator increases, so does the value of the indicated subsections. The significance values include:

- ✓ p-value = .033; r = .244; $r^2$ = .060 (Subsection 1.1)
- ✓ p-value = .019; r = .270; $r^2$ = .073 (Subsection 1.2)
- ✓ p-value = .005; r = .321; $r^2$ = .103 (Subsection 1.3)
- ✓ p-value = .000; r = .390; $r^2$ = .152 (Subsection 1.4)
- ✓ p-value = .004; r = .328; $r^2$ = .108 (Subsection 2.1)

**Patient Safety Reporting and Analysis (76)**

1) There are significant positive correlations between OHA adoption scores for 2006 and 2008 and the Patient Safety Reporting and Analysis indicator. As the value of the Patient Safety Reporting and Analysis indicator increases, so does the adoption scores for 2006 and 2008. The significance values include:

- ✓ p-value = .038; r = .239; $r^2$ = .057 (2008 OHA Adoption Score)
- ✓ p-value = .008; r = .303; $r^2$ = .092 (2006 OHA Adoption Score)

2) There is a significant negative correlation between percent change in OHA score (between 2006 and 2007) and the Patient Safety Reporting and Analysis indicator. As the value of the Patient Safety Reporting and Analysis indicator increases, there is a decrease in the percent change in OHA score (from 2006 to 2007). The significance value includes:

- ✓ p-value = .017; r = -.274; $r^2$ = .075

3) There is a significant negative correlation between percent change in OHA score (between 2006 and 2008) and the Patient Safety Reporting and Analysis indicator. As the value of the Patient Safety Reporting and Analysis indicator increases, there is a decrease in the percent change in OHA score (from 2006 to 2008). The significance value includes:

   - ✓ p-value = .035; r = -.243; $r^2$ = .059

4) There is a significant positive correlation between the Patient Safety Reporting and Analysis indicator and Subsection 2.1. As the Patient Safety Reporting and Analysis indicator increases, so does the value of the indicated subsection. The significance values include:

   - ✓ p-value = .016; r = .274; $r^2$ = .075 (Subsection 2.1)

**Performance Management in Ambulatory Care (76)**

1) There is a significant positive correlation between the Performance Management in Ambulatory Care indicator and Subsection 2.1. As the Performance Management in Ambulatory Care indicator increases, so does the value of the indicated subsection. The significance values include:

   - ✓ p-value = .004; r = .325; $r^2$ = .106 (Subsection 2.1)

**Medication Documentation and Reconciliation (76)**

1) There is a significant negative correlation between the Medication Documentation and Reconciliation indicator and 2008 OHA Adoption Score. As the value of the Medication Documentation and Reconciliation indicator increases, the value of the 2008 OHA Adoption Score decreases. The significance value includes:

   - ✓ p-value = .043; r = -.232; $r^2$ = .054

2) There is a significant positive correlation between the Medication Documentation and Reconciliation indicator and Subsection 3.2. As the Medication Documentation and Reconciliation indicator increases, so does the value of the indicated subsection. The significance values include:

   - ✓ p-value = .004; r = .324; $r^2$ = .105 (Subsection 3.2)

**Nurse-Sensitive Adverse Events - Medical (80)**

1) There are significant positive correlations between OHA adoption scores for 2007 / 2008 and the Medical Nurse-Sensitive Adverse events indicator. As the adoption scores for 2007 and 2008

increase, so does the Medical Nurse-Sensitive Adverse events indicator. The significance values include:

- ✓ p-value = .019; r = .261; $r^2$ = .068 (2008 OHA Adoption Score)
- ✓ p-value = .043; r = .227; $r^2$ = .052 (2007 OHA Adoption Score)

2) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2007) and the Medical Nurse-Sensitive Adverse events indicator. As the change in adoption score increases from 2006 to 2007, the Medical Nurse-Sensitive Adverse events indicator also increases. The significance value includes:

- ✓ p-value = .028; r = .246; $r^2$ = .061

3) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2008) and the Medical Nurse-Sensitive Adverse events indicator. As the percent change in adoption score increases from 2006 to 2008, the Medical Nurse-Sensitive Adverse events indicator increases. The significance value includes:

- ✓ p-value = .039; r = .231; $r^2$ = .053

4) There are significant positive correlations between percent IT Operating Expense (for 2006 and 2007) and the Medical Nurse-Sensitive Adverse events indicator. As the percent IT Operating Expense increases for both years, so does the Medical Nurse-Sensitive Adverse events indicator. The significance values include:

- ✓ p-value = .001; r = .362; $r^2$ = .131 (2007 Percent IT Operating Expense)
- ✓ p-value = .000; r = .401; $r^2$ = .161 (2006 Percent IT Operating Expense)

5) There is a significant positive correlation between 2006 percent IT Capital Expense and the Medical Nurse-Sensitive Adverse events indicator. As the 2006 percent IT Capital Expense increases, so does the Medical Nurse-Sensitive Adverse events indicator. The significance values include:

- ✓ p-value = .021; r = .257; $r^2$ = .066

6) There is a significant positive correlation between the Medical Nurse-Sensitive Adverse events indicator and Subsection 1.3. As the Medical Nurse-Sensitive Adverse events indicator increases, so does the value of the indicated subsection. The significance values include:

- ✓ p-value = .001; r = .365; $r^2$ = .133 (Subsection 1.3)

In addition to correlation, a linear regression was performed using the Medical Nurse-Sensitive Adverse events indicator as the dependent variable and subsection 1.3 as the independent variable. The significance values included (t = 3.464; p-value = .001).

**Nurse-Sensitive Adverse Events - Surgical (60)**

1) There is a significant positive correlation between the Surgical Nurse-Sensitive Adverse events indicator and Subsection 3.2. As the Surgical Nurse-Sensitive Adverse events indicator increases, so does the value of the indicated subsection. The significance values include:

   - ✓ p-value = .030; r = .281; $r^2$ = .079 (Subsection 3.2)

**Adverse Events – Labor and Delivery (62)**

1) There are significant negative correlations between the Adverse events indicator (related to Labor and Delivery) and Subsections 1.1, 1.3 and 1.4. As the Adverse events indicator increases (related to Labor and Delivery), the value of the indicated subsections decreases. The significance values include:

   - ✓ p-value = .014; r = -.311; $r^2$ = .097 (Subsection 1.1)
   - ✓ p-value = .009; r = -.331; $r^2$ = .110 (Subsection 1.3)
   - ✓ p-value = .006; r = -.348; $r^2$ = .121 (Subsection 1.4)

**Readmissions – Specific Medical Conditions (79)**

1) There are significant negative correlations between OHA adoption scores (for 2006, 2007 and 2008) and Readmission rate for specific medical conditions. As the adoption scores increase for all three years, the Readmission rate for specific medical conditions decreases. The significance values include:

   - ✓ p-value = .008; r = -.297; $r^2$ = .088 (2008 OHA Adoption Score)
   - ✓ p-value = .049; r = -.222; $r^2$ = .049 (2007 OHA Adoption Score)
   - ✓ p-value = .002; r = -.345; $r^2$ = .119 (2006 OHA Adoption Score)

2) There is a significant positive correlation between change in OHA adoption score (from 2006 to 2007) and Readmission rate for specific medical conditions. As the change in adoption score increases from 2006 to 2007, so does the Readmission rate. The significance value includes:

   - ✓ p-value = .037; r = .236; $r^2$ = .056

3) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2007) and Readmission rate for specific medical conditions. As the percent change in

adoption score increases from 2006 to 2007, so does the Readmission rate. The significance value includes:

- ✓ p-value = .007; r = .300; $r^2$ = .090

4) There is a significant negative correlation between Readmission rate for specific medical conditions and Subsection 2.1. As the Readmission rate for specific medical conditions increases, the value of the indicated subsection decreases. The significance values include:

- ✓ p-value = .047; r = -.224; $r^2$ = .050 (Subsection 2.1)

**Readmissions – Labor and Delivery (62)**

1) There are significant negative correlations between OHA adoption scores (for 2006 and 2008) and Readmission rate (for Labor and Delivery). As the adoption scores increase for those two years, the Readmission rate (for Labor and Delivery) decreases. The significance values include:

- ✓ p-value = .002; r = -.393; $r^2$ = .154 (2008 OHA Adoption Score)
- ✓ p-value = .014; r = -.312; $r^2$ = .097 (2006 OHA Adoption Score)

2) There is a significant negative correlation between change in OHA adoption score (from 2007 to 2008) and Readmission rate (for Labour and Delivery). As the change in adoption score increases from 2007 to 2008, the Readmission rate (for Labour and Delivery) decreases. The significance value includes:

- ✓ p-value = .014; r = -.311; $r^2$ = .097

3) There is a significant negative correlation between percent change in OHA adoption score (from 2007 to 2008) and Readmission rate (for Labour and Delivery). As the percent change in adoption score increases from 2007 to 2008, the Readmission rate for Labour and Delivery decreases. The significance value includes:

- ✓ p-value = .013; r = -.314; $r^2$ = .099

### 5.8.2 REHABILITATION CARE

(Refer to Table 5-8)

**Average Active Rehabilitation LOS (All RCG) (44)**

1) There are significant negative correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Average Active Rehabilitation Length of Stay indicator (for all Rehabilitation Care Groups (RCGs)). As the adoption scores increase for all three years, the

Average Active Rehabilitation Length of Stay indicator (for all RCG) decreases. The significance values include:

- ✓ p-value = .006; r = -.409; $r^2$ = .167 (2008 OHA Adoption Score)
- ✓ p-value = .015; r = -.366; $r^2$ = .134 (2007 OHA Adoption Score)
- ✓ p-value = .003; r = -.443; $r^2$ = .196 (2006 OHA Adoption Score)

2) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2007) and the Average Active Rehabilitation Length of Stay indicator (for all RCG). As the percent change in OHA adoption score increases from 2006 to 2007, the Average Active Rehabilitation Length of Stay indicator (for all RCG) also increases. The significance value includes:

- ✓ p-value = .008; r = .397; $r^2$ = .158

3) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2008) and the Average Active Rehabilitation Length of Stay indicator (for all RCG). As the percent change in OHA adoption score increases from 2006 to 2008, the Average Active Rehabilitation Length of Stay indicator (for all RCG) also increases. The significance value includes:

- ✓ p-value = .004; r = .430; $r^2$ = .185

4) There are significant negative correlations between the Average Active Rehabilitation LOS indicator (for all RCGs) and Subsections 1.3 and 1.4. As the value of this indicator increases, the value of the indicated subsections decreases. The significance values include:

- ✓ p-value = .006; r = -.412 (Subsection 1.3) ; $r^2$ = .170
- ✓ p-value = .026 ; r =-.335 (Subsection 1.4) ; $r^2$ = .112

**Average Active Rehabilitation LOS (Stroke) (40)**

1) There are significant negative correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Average Active Rehabilitation LOS indicator (for stroke). As the adoption scores increase for all three years, the Average Active Rehabilitation LOS indicator (for stroke) decreases. The significance values include:

- ✓ p-value = .027; r = -.349; $r^2$ = .122 (2008 OHA Adoption Score)
- ✓ p-value = .033; r = -.338; $r^2$ = .114 (2007 OHA Adoption Score)
- ✓ p-value = .039; r = -.328; $r^2$ = .108 (2006 OHA Adoption Score)

2) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2008) and the Average Active Rehabilitation LOS indicator (for stroke). As the percent change in OHA adoption score increases from 2006 to 2008, the Average Active Rehabilitation LOS indicator (for stroke) increases as well. The significance value includes:

- ✓ p-value = .045; r = .318; $r^2$ = .101

**Average Active Rehabilitation LOS (Ortho) (43)**

1) There are significant negative correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the adoption scores increase for all three years, the Average Active Rehabilitation Length of Stay indicator (for Ortho) decreases. The significance values include:

- ✓ p-value = .003; r = -.446; $r^2$ = .199 (2008 OHA Adoption Score)
- ✓ p-value = .006; r = -.410; $r^2$ = .168 (2007 OHA Adoption Score)
- ✓ p-value = .000; r = -.522; $r^2$ = .272 (2006 OHA Adoption Score)

2) There is a significant positive correlation between change in OHA adoption score (from 2006 to 2007) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the change in OHA adoption score increases from 2006 to 2007, the Average Active Rehabilitation Length of Stay indicator (for Ortho) also increases. The significance value includes:

- ✓ p-value = .020; r = .353; $r^2$ = .125

3) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2007) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the percent change in OHA adoption score increases from 2006 to 2007, the Average Active Rehabilitation Length of Stay indicator (for Ortho) also increases. The significance value includes:

- ✓ p-value = .001; r = .471; $r^2$ = .222

4) There is a significant positive correlation between percent change in OHA adoption score (from 2007 to 2008) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the percent change in OHA adoption score increases from 2007 to 2008, the Average Active Rehabilitation Length of Stay indicator (for Ortho) also increases. The significance value includes:

- ✓ p-value = .014; r = .373; $r^2$ = .139

5) There is a significant positive correlation between change in OHA adoption score (from 2006 to 2008) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the change in OHA adoption score increases from 2006 to 2008, the Average Active Rehabilitation Length of Stay indicator (for Ortho) also increases. The significance value includes:

   - ✓ p-value = .033; r = .326; $r^2$ = .106

6) There is a significant positive correlation between percent change in OHA adoption score (from 2006 to 2008) and the Average Active Rehabilitation Length of Stay indicator (for Ortho). As the percent change in OHA adoption score increases from 2006 to 2008, the Average Active Rehabilitation Length of Stay indicator (for Ortho) also increases. The significance value includes:

   - ✓ p-value = .000; r = .553; $r^2$ = .306

7) There are significant negative correlations between the Average Active Rehabilitation LOS indicator (for Ortho) and Subsections 1.2, 1.3 and 1.4. As the value of this indicator increases, the value of the indicated subsections decreases. The significance values include:

   - ✓ p-value = .045; r = -.307; $r^2$ = .094 (Subsection 1.2)
   - ✓ p-value = .002; r = -.453; $r^2$ = .205 (Subsection 1.3)
   - ✓ p-value = .005 ; r =-.417; $r^2$ = .174 (Subsection 1.4)

### 5.8.3 EMERGENCY DEPARTMENT CARE

(Refer to Table 5-9)

**Clinical Data Collection and Dissemination (75)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Clinical Data Collection and Dissemination indicator. As the adoption scores increase for all three years, so does the Clinical Data Collection and Dissemination indicator. The significance values include:

   - ✓ p-value = .016; r = .277; $r^2$ = .077 (2008 OHA Adoption Score)
   - ✓ p-value = .005; r = .322; $r^2$ = .104 (2007 OHA Adoption Score)
   - ✓ p-value = .000; r = .399; $r^2$ = .159 (2006 OHA Adoption Score)

2) There is a significant negative correlation between percent change in OHA adoption score (from 2006 to 2007) and the Clinical Data Collection and Dissemination indicator. As the percent

change in OHA adoption score increases from 2006 to 2007, the Clinical Data Collection and Dissemination indicator decreases. The significance value includes:

- ✓ p-value = .018; r = -.274; $r^2$ = .075

3) There is a significant negative correlation between percent change in OHA adoption score (from 2006 to 2008) and the Clinical Data Collection and Dissemination indicator. As the percent change in OHA adoption score increases from 2006 to 2008, the Clinical Data Collection and Dissemination indicator decreases. The significance value includes:

- ✓ p-value = .010; r = -.296; $r^2$ = .088

4) There are significant positive correlations between the Clinical Data Collection and Dissemination indicator and Subsections 1.1, 1.2, 1.3, 1.4 and 2.1. As the value of this indicator increases, so does the value of the indicated subsections. The significance values include:

- ✓ p-value = .003; r = .335; $r^2$ = .112 (Subsection 1.1)
- ✓ p-value = .008; r = .304; $r^2$ = .092 (Subsection 1.2)
- ✓ p-value = .009; r =.299; $r^2$ = .089 (Subsection 1.3)
- ✓ p-value = .024; r =.261; $r^2$ = .068 (Subsection 1.4)
- ✓ p-value = .004; r =.333; $r^2$ = .111 (Subsection 2.1)

**Internal Coordination of Care (75)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Internal Coordination of Care indicator. As the adoption scores increase for all three years, so does the Internal Coordination of Care indicator. The significance values include:

- ✓ p-value = .001; r = .370; $r^2$ = .137 (2008 OHA Adoption Score)
- ✓ p-value = .003; r = .342; $r^2$ = .117 (2007 OHA Adoption Score)
- ✓ p-value = .000; r = .412; $r^2$ = .170 (2006 OHA Adoption Score)

2) There is a significant negative correlation between percent change in OHA adoption score (from 2006 to 2007) and the Internal Coordination of Care indicator. As the percent change in OHA adoption score increases from 2006 to 2007, the Internal Coordination of Care indicator decreases. The significance value includes:

- ✓ p-value = .034; r = -.245; $r^2$ = .060

3) There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Internal Coordination of Care indicator. As the percent IT Capital Expense increases for both years, the Internal Coordination of Care indicator also increases. The significance values include:

   - ✓ p-value = .008; r = .306; $r^2$ = .094 (2007 percent IT Capital Expense)
   - ✓ p-value = .012; r = .289; $r^2$ = .084 (2006 percent IT Capital Expense)

4) There are significant positive correlations between the Internal Coordination of Care indicator and Subsections 1.1, 1.2, 1.3, 1.4 and 2.1. As the value of this indicator increases, so does the value of the indicated subsections. The significance values include:

   - ✓ p-value = .020; r = .269; $r^2$ = .072 (Subsection 1.1)
   - ✓ p-value = .030; r = .253; $r^2$ = .064 (Subsection 1.2)
   - ✓ p-value = .032; r =.248; $r^2$ = .062 (Subsection 1.3)
   - ✓ p-value = .005; r =.318; $r^2$ = .101 (Subsection 1.4)
   - ✓ p-value = .000; r =.403; $r^2$ = .162 (Subsection 2.1)

**Use of Clinical Information Technology (75)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Use of Clinical Information Technology indicator. As the adoption scores increase for all three years, so does the Use of Clinical Information Technology indicator. The significance values include:

   - ✓ p-value = .000; r = .528; $r^2$ = .279 (2008 OHA Adoption Score)
   - ✓ p-value = .000; r = .514; $r^2$ = .264 (2007 OHA Adoption Score)
   - ✓ p-value = .000; r = .503; $r^2$ = .253 (2006 OHA Adoption Score)

2) There are significant positive correlations between percent IT Capital Expense (for 2006 and 2007) and the Use of Clinical Information Technology indicator. As the percent IT Capital Expense increases for both years, the Use of Clinical Information Technology indicator also increases. The significance values include:

   - ✓ p-value = .013; r = .286; $r^2$ = .082 (2007 percent IT Capital Expense)
   - ✓ p-value = .012; r = .289; $r^2$ = .084 (2006 percent IT Capital Expense)

3) There are significant positive correlations between the Use of Clinical Information Technology indicator and Subsections 1.1, 1.2, 1.3, 1.4 and 2.1. As the value of this indicator increases, so does the value of the indicated subsections. The significance values include:

- ✓ p-value = .000; r = .453; $r^2$ = .205 (Subsection 1.1)
- ✓ p-value = .000; r = .477; $r^2$ = .228 (Subsection 1.2)
- ✓ p-value = .001; r =.387; $r^2$ = .150 (Subsection 1.3)
- ✓ p-value = .000; r =.473; $r^2$ = .224 (Subsection 1.4)
- ✓ p-value = .001; r =.367; $r^2$ = .135 (Subsection 2.1)

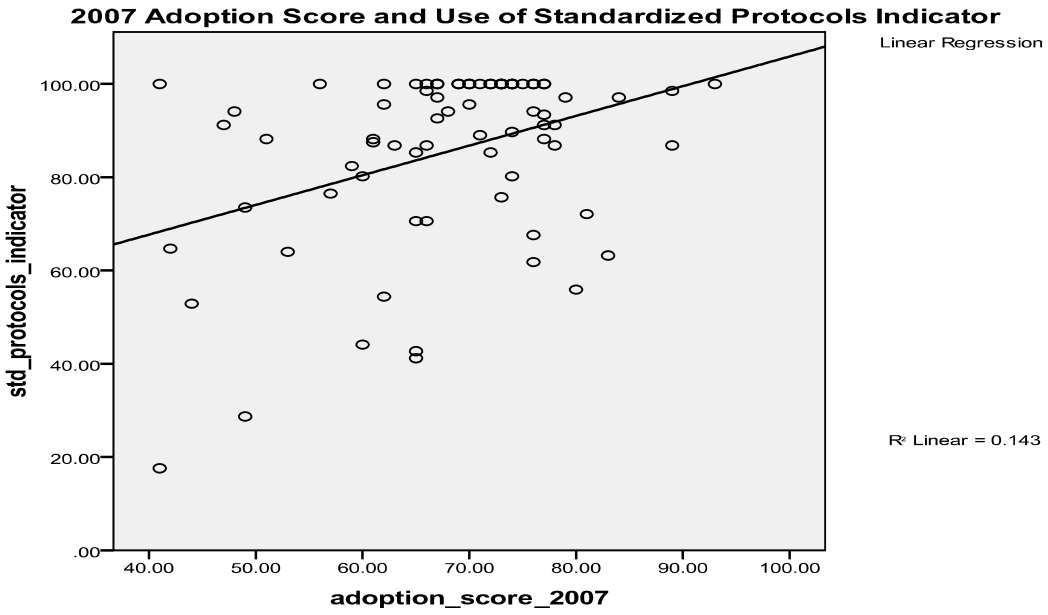
**Use of Standardized Protocols (75)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Use of Standardized Protocols indicator. As the adoption scores increase for all three years, so does the Use of Standardized Protocols indicator. The significance values include:

- ✓ p-value = .032; r = .247; $r^2$ = .061 (2008 OHA Adoption Score)
- ✓ p-value = .001; r = .378; $r^2$ = .143 (2007 OHA Adoption Score)
- ✓ p-value = .004; r = .326; $r^2$ = .106 (2006 OHA Adoption Score)

Figure 5-1 below is a graph depicting the relationship between 2007 OHA Adoption Score and the Use of Standardized Protocols Indicator.

**Figure 5-1: Graph of 2007 Adoption Score and Use of Standardized Protocols Indicator**



2) There is a significant negative correlation between change in OHA adoption score (from 2007 to 2008) and the Use of Standardized Protocols indicator. As the change in OHA adoption score increases from 2007 to 2008, the Use of Standardized Protocols indicator decreases. The significance values include:

   - ✓ p-value = .016; r = -.276; $r^2$ = .076

3) There is a significant negative correlation between percent change in OHA adoption score (from 2007 to 2008) and the Use of Standardized Protocols indicator. As the percent change in OHA adoption score increases from 2007 to 2008, the Use of Standardized Protocols indicator decreases. The significance values include:

   - ✓ p-value = .002; r = -.345; $r^2$ = .119

4) There are significant positive correlations between the Use of Standardized Protocols indicator and Subsections 1.1, 1.2, 1.3, and 1.4. As the value of this indicator increases, so does the value of the indicated subsections. The significance values include:

   - ✓ p-value = .002; r = .357; $r^2$ = .127 (Subsection 1.1)
   - ✓ p-value = .000; r = .421; $r^2$ = .177 (Subsection 1.2)
   - ✓ p-value = .011; r =.291; $r^2$ = .085 (Subsection 1.3)
   - ✓ p-value = .002; r =.356; $r^2$ = .127 (Subsection 1.4)

**Chest X-Ray Rate for Asthma - Pediatric (80)**

1) There are significant positive correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Chest X-Ray Rate for Asthma (Pediatric) indicator. As the adoption scores increase for all three years, so does the Chest X-Ray Rate for Asthma (Pediatric) indicator. The significance values include:

   - ✓ p-value = .003; r = .323; $r^2$ = .104 (2008 OHA Adoption Score)
   - ✓ p-value = .001; r = .354; $r^2$ = .125 (2007 OHA Adoption Score)
   - ✓ p-value = .000; r = .382; $r^2$ = .146 (2006 OHA Adoption Score)

2) There are significant positive correlations between Chest X-Ray Rate for Asthma (Pediatric) and Subsections 1.1, 1.3, and 2.1. As the value of this indicator increases, so does the value of the indicated subsections. The significance values include:

- ✓ p-value = .000; r = .484; $r^2$ = .234 (Subsection 1.1)
- ✓ p-value = .002; r = .334; $r^2$ = .112 (Subsection 1.3)
- ✓ p-value = .000; r =.407; $r^2$ = .166 (Subsection 2.1)

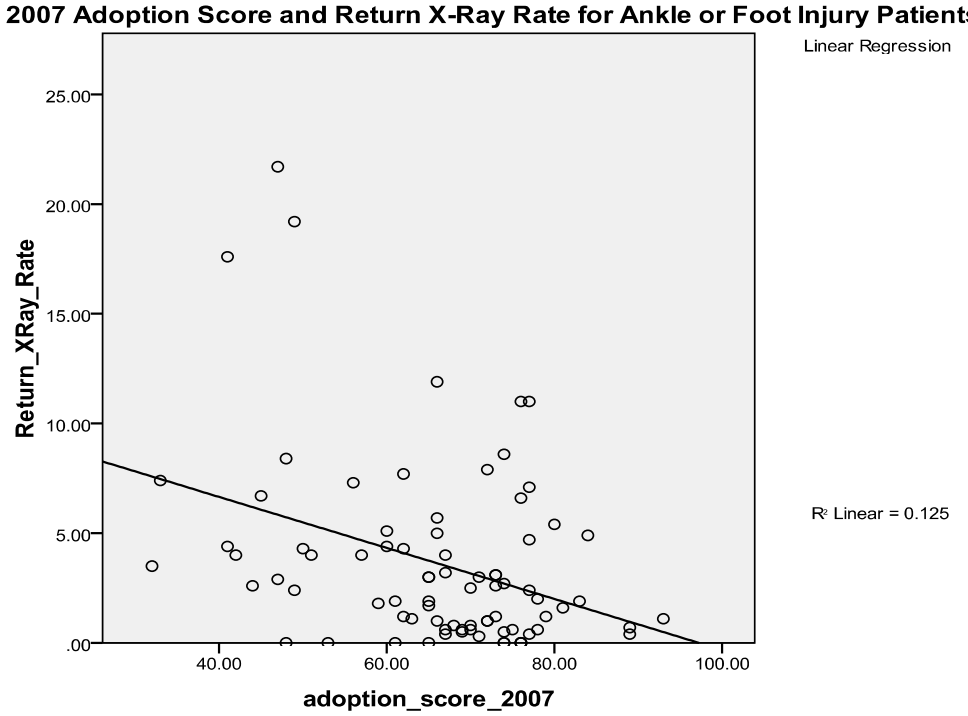
**Return X-Ray Rate for Ankle or Foot Injury Patients (<= 7days) (81)**

1) There are significant negative correlations between OHA adoption scores for all three years (2006, 2007, and 2008) and the Return X-Ray Rate for Ankle or Foot Injury Patients indicator (<=7days). As the adoption scores increase for all three years, the Return X-Ray Rate for Ankle or Foot Injury Patients (<=7 days) indicator decreases. The significance values include:

   - ✓ p-value = .001; r = -.367; $r^2$ = .135 (2008 OHA Adoption Score)
   - ✓ p-value = .001; r = -.353; $r^2$ = .125 (2007 OHA Adoption Score)
   - ✓ p-value = .002; r = -.341; $r^2$ = .116 (2006 OHA Adoption Score)

   Figure 5-2 below is a graph depicting the relationship between 2007 OHA Adoption Score and Return X-Ray Rate (for Ankle or Foot Injury Patients).

   **Figure 5-2: Graph of 2007 Adoption Score and Return X-Ray Rate Indicator**




2) There is a significant negative correlation between 2006 percent IT Operating Expense and the Return X-Ray Rate for Ankle or Foot Injury Patients indicator (<=7days). As the 2006 percent IT

Operating Expense increases, the Return X-Ray Rate for Ankle or Foot Injury Patients (<=7 days) indicator decreases. The significance values include:

- ✓ p-value = .042; r = -.226; $r^2$ = .051

3) There are significant negative correlations between Return X-Ray Rate for ankle or foot injury patients and Subsections 1.1, 1.2, 1.3, 1.5 and 2.1. As the value of this indicator increases, the value of the indicated subsections decreases. The significance values include:

- ✓ p-value = .011; r = -.282; $r^2$ = .080 (Subsection 1.1)
- ✓ p-value = .031; r = -.243; $r^2$ = .059 (Subsection 1.2)
- ✓ p-value = .028; r = -.245; $r^2$ = .060 (Subsection 1.3)
- ✓ p-value = .032; r = -.238; $r^2$ = .057 (Subsection 1.5)
- ✓ p-value = .002; r =-.340; $r^2$ = .116 (Subsection 2.1)

**Return Visit Rate for Asthma (<=24 hours) - Adult (78)**

1) There is a significant negative correlation between 2006 OHA adoption score and the Return Visit Rate for Asthma indicator (<=24 hours, Adult). As the 2006 adoption score increases, the Return Visit Rate for Asthma indicator (<=24 hours, Adult) decreases. The significance value includes:

- ✓ p-value = .042; r = -.231; $r^2$ = .053

2) There are significant negative correlations between Return Visit Rate for Asthma (<= 24 hours, Adults) and Subsections 1.1 and 1.3. As the value of this indicator increases, the value of the indicated subsections decreases. The significance values include:

- ✓ p-value = .013; r = -.279; $r^2$ = .078 (Subsection 1.1)
- ✓ p-value = .017; r = -.269; $r^2$ = .072 (Subsection 1.3)

## 5.9 DISCUSSION OF FINDINGS

Findings are discussed below divided by Hospital Report Indicator Type.

### 5.9.1 ACUTE CARE

The Use of Clinical IT indicator was positively and significantly correlated with e-Health adoption rate for all three years. Both the Use of Clinical IT indicator and e-Health adoption score measure self-reported functionality or use of IT. Thus, this correlation confirms the similarity between the data, which was obtained from two different data sources (Hospital Report Card Series and OHA e-Health technology adoption survey). All financial indicators (except for 2007 percent IT Capital Expense) were associated with use of clinical IT. This indicates that increased investment in IT leads to higher use of IT. This

shows that there is a relationship between IT investment and IT usage within a hospital. There is a lack of research that has investigated the relationship between actual use of clinical IT and e-Health adoption, whereby use of IT is compared to an actual overall e-Health adoption rate. All subsections were correlated with Use of Clinical IT except for subsection 3.2 (Interoperability for a shared EHR). This suggests that functions related to interoperability or sharing of data is not used as much as other IT-related functions in hospitals.

The Use of Data for Decision-Making indicator was positively and significant correlated with e-Health adoption rate for all three years. For this indicator, decision-making is mostly in reference to benchmarking activities within hospitals (Appendix 5-2). This correlation may show that IT helps to facilitate the benchmarking process, by providing a medium to collect and analyze data. Another component of this indicator is Safety and Utilization Management, which includes reporting for adverse events, patient safety-related analysis, etc. (Appendix 5-2). Davis et al. (2009) showed a strong relationship between IT implementation and patient safety. This study showed that the greater the IT functionality, the more likely a healthcare practice had a patient safety system in place. 43% of physicians with higher IT implementation had a process for dealing with adverse events compared to 27% of practices with lower IT implementation. Usage of IT requires standardization of processes in most instances, and may be viewed as a supporting factor. This indicator was also correlated with all financial indicators (except for percent IT Operating Expense for 2006 and 2007). Thus, investment in IT results in a higher value for this indicator.

The Patient Safety Reporting and Analysis indicator was positively and significantly correlated with e-Health adoption score (for 2006 and 2008). This indicator measures if hospitals maintain a registry of sentinel events and if hospitals have a reporting system to collect information from employees that may lead to near misses or adverse events (Appendix 5-2). As described previously with the study by Davis et al. (2009), greater IT implementation resulted in a process for dealing with adverse events compared to healthcare practices with lower IT implementation. Thus, IT may provide the means of infrastructure necessary to facilitate the processes associated with this indicator.

The Performance Management in Ambulatory Care indicator was not correlated with e-Health adoption score. This indicator is associated with use and monitoring of performance indicators for Ambulatory Care (both internally and externally). Perhaps, this indicates that in Ambulatory care, there is a lack of performance measurement in general, or perhaps this indicates that IT is not a factor in facilitating the performance measurement process.

The Medication Documentation and Reconciliation indicator was negatively correlated with the 2008 e-Health adoption score. This indicates that the greater the 2008 e-Health adoption score, the lower the value for this indicator. This indicator looks at whether organizations document a complete list of each patient's medications upon admission and whether a complete list of a patient's medication is

communicated to the next provider of healthcare services when transferred or referred to another setting (Appendix 5-2). The negative correlation associated with this indicator may suggest that IT is not used to communicate patient medication information externally to other care providers. Perhaps the infrastructure is not in place to allow for communication of this type between organizations. There is a lack of research relating e-Health adoption to this aspect of this indicator. In addition, there were significant negative correlations between this indicator and spending on Total IT Operating Expense (for 2006 and 2007), Total Capital Expense (for 2006 and 2007), and Total Operating Expense (for 2006 and 2007). This indicates the higher the investment in those specific areas, the lower the e-Health adoption rate. There is a positive correlation between subsection 3.2 (Interoperability for a Shared EHR) and this indicator. This indicates that the greater the ability to interoperate with other organizations, the greater the value of this indicator. The results of this indicator may suggest that investment in IT needs to be focused on interoperability between organizations as opposed to other functionality to increase the value of this indicator.

For the three types of adverse events, there was only a correlation between e-Health adoption score (for 2007 and 2008) and nurse-sensitive adverse events (for medical only). This suggests that the higher the e-Health adoption, the higher the number of reported nurse-sensitive adverse events. This indicator is described in detail in Appendix 5-2. The results of a linear regression indicated that only subsection 1.3 (Clinical Documentation) (out of all subsections) was associated with the number of Medical Nurse-Sensitive Adverse events. Thus, it is increased usage of IT functionality related to Clinical Documentation that is associated with the higher number of Medical Nurse-Sensitive Adverse events. Perhaps this suggests that by using IT for clinical documentation, hospitals are increasing the amount of reporting on adverse events, which is showing an increase in the rate of adverse events. Despite this result, and whether IT increases or decreases the number of adverse events, IT use does allow for monitoring or reporting of adverse events. Some studies contradict this result and show that IT usage causes a lower rate of adverse events and medical errors (Wolfstadt et al., 2008; Kaushal et al., 2003; Bates et al., 1998). Also, investment in many of the financial indicators was also associated with a higher number of nurse-sensitive adverse events (medical). Again, this could indicate that investment in functionality related to Clinical Documentation is causing a higher number of adverse events due to an increase in the amount of reporting. There was no correlation between e-Health adoption score and nurse-sensitive adverse events (surgical). Some studies have indicated no correlation between e-Health adoption and rate of adverse events (Wolfstadt et al., 2008). For adverse events related to labour and delivery, there were negative correlations with subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.3 (Clinical Documentation), and 1.4 (Results Reporting). This suggests that increased functionality associated with those subsections is related to reduction of adverse events (related to labour and delivery).

For the three types of indicators related to Readmissions, there were significant negative correlations between e-Health adoption rate and readmissions (for specific medical conditions and labour and delivery). This indicates the higher the investment in IT, the lower the readmission rates in the indicated areas. Readmission rate is something hospitals aim to reduce, in order to improve overall quality of care. There are a lack of studies specifically relating readmission rate to IT usage. However, in comparing results of different studies and tying the results to together, a potential mechanism to explain the result may be:

- A study by Dexter et al. (2001) showed that use of CDS increased the ordering rate of specific preventive measures, such as pneumococcal and influenza vaccinations. Use of both of these vaccinations has been associated with a reduced risk of hospitalization and length of stay in the elderly (Christenson et al., 2008). Influenza vaccination has been associated with reductions in hospitalization for the elderly (Nichol et al, 2003). Pneumonia and influenza have been cited as major causes of hospitalization and death (Fedson et al., 2000). Many cases of pneumonia and influenza could be prevented if delivery of vaccines were more effectively targets to those individuals who are otherwise destined to be hospitalized or die due to one of the diseases. One study by (Fedson et al., 1990) showed that patients who were discharged had a 6 to 9 % chance of being readmitted with pneumonia within 5 years. Each readmission could be prevented by immunizing approximately 100 discharged patients with pneumococcal vaccine. 1 future readmission may be avoided by administration of pneumococcal vaccine to 100 appropriate hospitalized patients. Tying the information from these studies is an example of how e-Health can reduce readmissions: Use of CDS promotes appropriate ordering of preventive measures at discharge. These preventive measures reduce the possibility of readmission

For the Readmissions for specific medical conditions, greater investment in most of the financial indicators also correlated with lower readmission rates.

The Spearman's rank was performed for two of the tests and also showed significant correlations. The p-values and r values were slightly different. This validates the findings obtained from the Pearson's test.

### 5.9.2 REHABILITATION CARE

The three indicators related to Length of Stay (LOS) for stroke, orthopaedic and all Rehabilitation Client Groups (RCGs) showed that the greater the e-Health adoption rate, the lower the value of these variables. A lower LOS is a favorable result desired by hospitals in an effort to increase quality of care. Various studies across care settings have shown that IT usage may reduce LOS (Sintchenko et al., 2005; Chertow et al., 2001; Shea et al., 1995; Tierney et al., 1993). Perhaps implementation of IT creates standardized processes (such as adherence to guidelines by healthcare providers), which increases

overall quality of care and reduces LOS. Chertow et al (2001) also offers a possible explanation as to why CPOE (with CDS) reduced LOS in their particular study:

- Perhaps LOS is reduced through avoidance of overdosing of selected drugs in elderly patients, which may have led to fewer central nervous system or gastrointestinal tract adverse events or other complications

For two of the Rehabilitation LOS indicators, subsections 1.3 and 1.4 are negatively correlated with LOS. This suggests that increased investment in functionality related to Clinical Documentation and Results Reporting is related to a lower LOS. Literature has associated functionality related to CPOE, which includes clinical documentation, with lower LOS (Chertow et al., 2001; Tierney et al., 1993).

### 5.9.3 EMERGENCY DEPARTMENT CARE

The Clinical Data Collection and Dissemination indicator is significantly correlated with e-Health adoption rate (for all three years) indicating that the higher the amount of IT use, the greater the value for this indicator. This indicator is composed of various areas including clinical data collection and how data is shared with other groups (Appendix 5-4). This correlation suggests that usage of IT may facilitate the process of data sharing internally within a hospital. Many of the financial indicators are correlated with this indicator, suggesting that investment in IT creates a higher value for this variable for hospitals providing emergency care.

The Internal Coordination of Care indicator is significantly correlated with e-Health adoption rate (for all three years) indicating that the higher the amount of IT use, the greater the value for this indicator. This indicator looks at patient flow strategy development and use, internal coordination communication, etc. (Appendix 5-4). These correlations suggest that IT is a supporting factor in facilitating processes that are associated with this indicator. Many of the financial indicators are correlated with this indicator, suggesting that investment in IT creates a higher value for this variable and is something which hospitals that provide emergency care are focused on.

The Use of Clinical IT indicator was positively and significantly correlated with e-Health adoption rate for all three years. Both the Use of Clinical IT indicator and e-Health adoption score measure self-reported functionality or use of IT. Thus, this correlation confirms the similarity between the data, which was obtained from two different data sources (Hospital Report Card Series and OHA e-Health technology adoption survey). All financial indicators (except for 2006 and 2007 percent IT Operating Expense) were associated with use of clinical IT. This indicates that increased investment in IT leads to higher use of IT. There is a lack of research that has investigated the relationship between use of clinical IT and e-Health adoption, whereby use of IT is compared to an actual overall e-Health adoption rate. As with this indicator in the Acute Care group, subsection 3.2 (Interoperability for a shared EHR) was not correlated

with this indicator. This suggests that functions related to interoperability or sharing of data is not used as much as other IT-related functions.

The Use of Standardized protocols indicator is positively and significantly correlated with e-Health adoption rate for all three years. Figure 5-1 depicts a graph showing the relationship between the 2007 e-Health adoption score and the Use of Standardized protocols indicator. This indicator is related to standardized protocols for clinical practice guidelines and medical directives (Appendix 5-4). Prior research confirms a relationship between IT usage and adherence to guidelines (Davis et al., 2009; Hicks et al., 2008; Lobach & Hammond, 1997). These guidelines are commonly implemented as a form of Clinical Decision Support, where a practitioner uses this information during an episode of care. Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.2 (Point-of-Care Order Entry), 1.3 (Clinical Documentation), and 1.4 (Results Reporting) are positively correlated with use of standardized protocols. This indicates that the functionality associated with those particular subsections is related to a higher use of standardized protocols.

The Chest X-Ray Rate for Asthma (Pediatric) is positively and significantly correlated with e-Health adoption rate (for all three years). A lower value for this indicator is desirable (Appendix 5-4). Investment in IT is correlated with higher value for this indicator. This may suggest that use of IT is increasing the over-utilization of X-Rays. However, this result may also be viewed in a positive light. This result may suggest that as a result of IT usage, further X-Rays are being performed which could potentially identify health care issues or problems, which increases quality of care. There is a lack of studies that focus on comparing X-Ray rate to e-Health adoption.

The Return X-Ray rate for ankle or foot injury patients is negatively correlated to e-Health adoption rate for all three years. This indicates that IT usage lowers the rate of return X-Rays. For this indicator, a lower return rate is desirable and is related to the concept of readmission rate described previously. Figure 5-2 depicts a graph showing the relationship between the 2007 e-Health adoption score and the Return X-Ray Rate for Ankle or Foot Injury Patients indicator. A possible explanation for why return X-Ray rate is lowered is that IT usage allows for more appropriate decisions to be made during an episode of care. Overall, this increases quality of care and results in more appropriate care, thereby reducing return X-Ray rate. There is a lack of research specifically relating return X-Ray rate to e-Health adoption. However, in referring to the discussion of Readmission rates under the “Acute Care” section, the concepts and discussion can be related. Many of the financial indicators are negatively correlated with this indicator, suggesting that greater IT investment results in lower return X-Ray rates. Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.2 (Point-of-Care Order Entry), 1.3 (Clinical Documentation), 1.5 (Information Infrastructure), and 2.1 (e-Health Leadership and Planning) are negative correlated with this indicator, suggesting that the functionality associated with the identified areas reduces the return X-Ray rate.

The Return visit rate for asthma is negatively correlated with the e-Health adoption score for 2006. This indicates that IT usage lowers the rate of return visit rates for asthma. For this indicator, a lower return visit rate is desirable and is related to the concept of readmission rate described previously. A possible explanation for why return visit rate for asthma is lowered is that IT usage allows for more appropriate decisions to be made during an episode of care. Overall, this increases quality of care and results in more appropriate care, thereby reducing return visit rate. There is a lack of research specifically relating return visit rate for asthma to e-Health adoption. However, in referring to the discussion of Readmission rates under the "Acute Care" section, the concepts and discussion can be related.

## 5.10 SUMMARY OF FINDINGS

For most of the health outcome indicators, IT investment and IT adoption was associated with favorable results.

Subsection 3.2 (Interoperability for a shared EHR) is the subsection least correlated with any of the health outcome indicators. This may suggest that hospitals are not focusing on investment or implementation of this functionality in relation to others.

Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.2 (Point-of-Care Order Entry), and 1.3 (Clinical Documentation) are most correlated with the selected health outcome indicators. Perhaps this suggests that hospitals are focusing on functionality related to these areas.

## 5.11 LIMITATIONS

There were various limitations with this aspect of the research study. All data used in this research project was self-reported (i.e. e-Health adoption data, MIS financial data, and hospital report series data). Thus, there is reliance on the hospitals reporting this data. There was no audit or verification of any of the results.

The Hospital Report Series data contained null or non-reportable data. This reduced the sample sizes of the indicators. The scoring for each of the components in the hospital report data involved weighting of different areas. However, there may have been some areas within each actual component that would have been of interest to the researcher. Only the overall score for the indicator was provided for this study.

The next chapter identifies the key findings of this research study.

# CHAPTER 6: KEY FINDINGS

This chapter highlights the key findings for the entire research study.

## 6.1 BARRIERS AND E-HEALTH ADOPTION

For all hospitals, barriers were negatively correlated with subsection 3.3 (Interoperability between organizations) indicating that more interoperability between organizations for a particular hospital, the less the number of barriers (p-value = .036; r = -.184).

Of the significant correlations associated with the number of barriers, the top barrier that was indentified was "lack of adequate financial support." Other common barriers included:

- Lack of qualified staff or access to qualified staff;
- Lack of infrastructural or prerequisite technology; and
- Difficulty in achieving end-user acceptance or use.

## 6.2 RESOURCES AND E-HEALTH ADOPTION

For all hospitals, there was a significant positive correlation between number of resources and the 2007 e-Health adoption score. This indicates that the higher the number of resources, the higher the e-Health adoption score. The significance values are (p-value = .000; r = .389). The top three resources associated with 2007 e-Health adoption score are:

- Project Management;
- Process Re-engineering; and
- IS Support in End User Departments.

The number of resources was correlated with all subsections except for subsection 3.2 (Inter-Organizational EMPI) for all hospitals. Perhaps this suggests that the number of resources within hospitals do not have an effect on this indicator and that perhaps other external factors affect value of this indicator.

## 6.3 E-HEALTH ADOPTION AND INVESTMENT

For the correlation with all 106 hospitals, the percentage IT Capital Expense (for 2006 and 2007) was correlated with the e-health adoption scores for all three years. This indicates that expenditure on IT Capital contributes to a higher amount of e-health adoption within hospitals. It was interesting to note that percent IT Capital Expense in 2006 was positively and significantly correlated with the 2008 adoption

score. This indicates that investment in IT Capital expense two years before impacted the adoption score two years later. This indicates that investment in IT capital affects e-health adoption in a hospital setting.

The raw values for Total IT Operating Expense (for 2006 and 2007), Total IT Capital Expense (for 2006 and 2007), Total Capital Expense (for 2006 and 2007), and Total Operating Expense (for 2006 and 2007) were also correlated with the Adoption Scores for all three years. While the raw values do not provide a means by which to compare spending from hospital-to-hospital, it does indicate that increased investment in those financial indicators increases e-health adoption.

The correlations between subsections and financial indicators showed that Subsections 1.2 (Point-Of-Care Order Entry), 1.4 (Results Reporting), and 2.1 (e-Health Leadership and Planning) had the most amount of correlations with the financial indicators (Total IT Operating Expense (2006 and 2007), Total IT Capital Expense (2006 and 2007), Total Capital Expense (2006 and 2007), and Total Operating Expense (2006 and 2007)). This indicates that hospitals are focusing on IT spending or investment in the subsections or areas identified above. Put another way, investment in the financial indicators above are being used to pay for functionality associated with the subsections identified above.

Subsection 1.3 (Clinical Documentation) was also correlated with many of the financial indicators (Total IT Operating Expense (both 2006 and 2007), Total Capital Expense (both 2006 and 2007), and Total Operating Expense (both 2006 and 2007). This indicates that this is another area where spending on IT is focused within hospitals.

## 6.4 E-HEALTH ADOPTION, INVESTMENT, AND HEALTH OUTCOMES

The Patient Safety Reporting and Analysis indicator was positively and significantly correlated with e-health adoption score (for 2006 and 2008). This indicator includes if hospitals maintain a registry of sentinel events and if hospitals have a reporting system to collect information from employees that may lead to near misses or adverse events (Appendix 5-2). IT may provide the means of infrastructure necessary to facilitate the processes associated with this indicator.

For the three types of adverse events, there was only a correlation between e-health adoption rate (for 2007 and 2008) and nurse-sensitive adverse events (for medical only). This indicates the higher the e-health adoption, the higher the number of nurse-sensitive adverse events. This indicator is described in detail in Appendix 5-2. Despite this result, IT use does allow for monitoring of adverse events to begin with. Also, investment in many of the financial indicators was also associated with a higher number of nurse-sensitive adverse events (medical). There was no correlation between e-Health adoption score and nurse-sensitive adverse events (surgical). For adverse events related to labour and delivery, there were negative correlations with subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.3 (Clinical Documentation), and 1.4 (Results Reporting). This suggests that increased

functionality associated with those subsections is related to reduction of adverse events (related to labour and delivery).

For the three types of indicators related to Readmissions, there were significant negative correlations between e-health adoption rate and readmissions (for specific medical conditions and labour and delivery). This indicates the higher the investment in IT, the lower the readmission rates in the indicated areas. Readmission rate is something hospitals aim to reduce, in order to improve overall quality of care.

The three indicators related to Rehabilitation Length of Stay (LOS) for stroke, orthopaedic and all Rehabilitation Client Groups (RCGs) showed that the greater the e-health adoption rate, the lower the value of these variables.

The Use of Standardized protocols indicator is positively and significantly correlated with e-health adoption rate for all three years. This indicator is related to standardized protocols for clinical practice guidelines and medical directives (Appendix 5-2). Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.2 (Point-of-Care Order Entry), 1.3 (Clinical Documentation), and 1.4 (Results Reporting) are positively correlated with use of standardized protocols. This indicates that the functionality associated with those particular subsections is related to a higher use of standardized protocols.

The Chest X-Ray Rate for Asthma (Pediatric) is positively and significantly correlated with e-health adoption rate (for all three years). A lower value for this indicator is desirable (Appendix 5-4). Investment in IT creates a higher value for this indicator. This may suggest that use of IT is increasing the over-utilization of X-Rays. However, this result may also be viewed in a positive light. This result may suggest that as a result of IT usage, further X-Rays are being performed which could potentially identify health care issues or problems, which increases quality of care.

The Return X-Ray rate for ankle or foot injury patients is negatively correlated to e-health adoption rate for all three years. This indicates that IT usage lowers the rate of return X-Rays. For this indicator, a lower return rate is desirable and is related to the concept of readmission rate described previously. Many of the financial indicators are negatively correlated with this indicator, suggesting that greater IT investment results in lower return X-Ray rates. Subsections 1.1 (Patient Registration, Records Management and Registry Services), 1.2 (Point-of-Care Order Entry), 1.3 (Clinical Documentation), 1.5 (Information Infrastructure), and 2.1 (e-Health Leadership and Planning) are negative correlated with this indicator, suggesting that the functionality associated with the identified areas reduces the return X-Ray rate.

The Return visit rate for asthma is negatively correlated with the e-health adoption score for 2006. This indicates that IT usage lowers the rate of return visit rates for asthma. For this indicator, a lower return visit rate is desirable and is related to the concept of readmission rate described previously.

# FURTHER RESEARCH

The methodology and outcomes of this study has created a foundation for the potential investigation of other research questions and inquiries.

1) As this research project relied heavily on data that was self-reported by hospitals, further research could be conducted to determine if there are differences in the way that the data was reported by respondents. For example, with the OHA e-Health adoption survey, were characteristics of respondents, such as job title, a factor in how the questions were answered?

2) Data used in this study was all self-reported by the participating organizations, with no audit or verification of the results. Further research could involve conducting an audit on a sample of hospitals to determine if the reported data were accurate. In addition, differences in the way that hospitals responded could be studied. For example, were hospitals consistent in reporting certain financial expenses as capital or operating expenses? Was the coding performed by hospitals, with respect to clinical indicators (diagnoses and procedures), consistent for all hospitals?

3) This research project involved analyzing indicators specific to the Hospital Report Series. However, there are other health indicators that could be analyzed in future research that were not contained in the Hospital Report Series. For example, indicators related to mortality, morbidity, wait times, etc. These indicator values could be obtained through other data sources, such as Statistics Canada or the Canadian Institute for Health Information (CIHI). Analyzing other indicators will provide more data on the impact of e-Health adoption and investment on health outcomes.

4) The indicators provided within the Hospital Report Series contained data for many hospitals that was either null or non-reportable. If data for other indicators is obtained and is available for more hospitals, further research could be conducted by peer group (i.e. Community, Small, Teaching hospitals) to provide further analysis on hospitals with some similar characteristics.

5) There is a lack of studies showing the impact of e-Health on health outcomes, particularly in Canada. Therefore, many of the studies used in the literature review for this research are United States (US) based. In comparing the results of US studies to the results of this research, perhaps there were differences attributed to the different health care systems. More research in Canada is needed to facilitate comparability between Canadian hospitals.

6) An interesting result of this study was the difference in correlation results between e-Health adoption and nurse-sensitive adverse events (for medical, surgical, and labour and delivery). To understand these differences between the types of care, a qualitative study could be performed to understand how e-Health impacts care related to medicine, surgery, and labour and delivery. The study could focus on where e-Health is implemented and used within these respective areas, in an attempt to understand why there are differences in correlations between e-Health adoption and medical errors based on type of care.

7) This study focused on analysis of e-Health adoption at the overall score level and the subsection level. Further research could involve analyzing individual questions in relation to health outcome indicators. For example, is there a specific component of a subsection correlated with a health outcome? This would provide more specific information with respect to functionality associated with health outcomes.

8) While the main type of statistical test used in this study was Pearson's Correlation, a Regression model could be created using the Outcome indicators as the dependent variable(s), and the e-Health adoption and investment variables as the predictor variable(s). Ultimately, a Regression model could be used as a forecasting tool to predict the relationship between investment, adoption and health outcomes. For example, the question of how much e-Health adoption is required to achieve a certain improvement in Length of Stay indicators (in days) could be determined through use of a Regression model.

9) The barriers and dedicated resources data in this study was collected quantitatively. As an alternative, this data could be collected qualitatively. In collecting this data qualitatively, there could be potentially less of a chance of certain barriers and resources not being selected because they were not present within pre-defined lists.

10) This research study did not distinguish between the types of systems implemented within the hospitals (i.e. EHRs, CPOE, etc.), as this data was not collected. Knowing the types of e-Health applications implemented within hospitals would be useful in future studies to understand the types of applications that are having an impact on health outcomes. This data could be collected through the OHA e-Health adoption survey.

11) The literature review described some e-Health applications as being commercially sold or homegrown. Many studies do not discuss whether the indicated system was a commercial or homegrown application. This information may be useful as it would help describe the nature of the applications being implemented within hospitals that are having an impact on health outcomes. This information could be collected through the OHA e-Health adoption survey.

12) The e-Health adoption score calculated in this study was more focused on organization and provider use of e-Health technology. As hospitals choose to adopt patient portals and other types of applications that promote patient empowerment, perhaps OHA's e-Health technology adoption survey can incorporate this functionality into calculation of the e-Health adoption score (i.e. ability for patient's to share information with other healthcare providers).

13) Most research studies, such as this one, have studied e-Health implementation or adoption in relation to health outcome indicators and not actual health outcomes. For example, few studies have been able to associate e-Health implementation with healthier patients. A retrospective study using randomized patients would be an insightful study to provide more evidence in this area. For example, patient charts could be pulled for a random number of patients and their health outcomes could be observed over a period of time starting from admission. The technology that is available within the particular hospital that the patient was admitted to could be used as a variable with the overall intention to understand the impact of specific functions of technologies to patient care. While this type of study would be desirable, it is also noted that such a study would require a great deal of time and resources, making the feasibility of this type of study questionable.

# OVERALL CONCLUSIONS

This study provided answers to the stated research objectives.

Specifically, the results of the study showed that there is an association between increased investment in e-Health and increased adoption of e-Health. E-Health adoption and investment have also shown to be associated with certain health outcome indicators, such as Length of Stay (LOS), readmission rates, and adverse events. The majority of the correlations related to health outcome indicators showed favorable results. This study creates a foundation for calculation of ROI by establishing an association between e-Health adoption, investment, and health outcomes. The challenge still lies in being able to quantify benefits in some form so that ROI can be accurately calculated.

This research project is one of the few that studies the relationship between investment in IT, e-Health adoption, and health outcome performance.

With respect to barriers and resources, there were correlations with e-Health adoption and the specific barriers and resources were determined.

High cost has been identified as the most common barrier with respect to e-Health implementation, a barrier that is common across other research studies. Other common barriers included lack of qualified staff or access to qualified staff and lack of infrastructural or prerequisite technology. Understanding barriers to e-Health implementation will help explain why implementation rates are low. In understanding these obstacles, perhaps strategies to mitigate barriers may be developed.

Project management and Information Systems (IS) Support in End User Departments were identified as common resources for successful e-Health implementation. Understanding resources related to successful e-Health implementation will help improve the usage of e-Health applications and help explain what is necessary to make IT implementation successful.

There is little research which compares the number of barriers and resources to a quantitative adoption score as was performed in this study.

While investment and adoption of e-Health applications have shown to be associated with certain health indicators, there is a lack of research that relates the health indicators to actual health status. For example, Length of Stay is an indicator widely used as a measure of performance in hospitals, but does a lower length of stay necessarily result in better health outcomes for patients in the long run? Further in-depth studies are necessary to truly understand the impact of e-Health on patient care.

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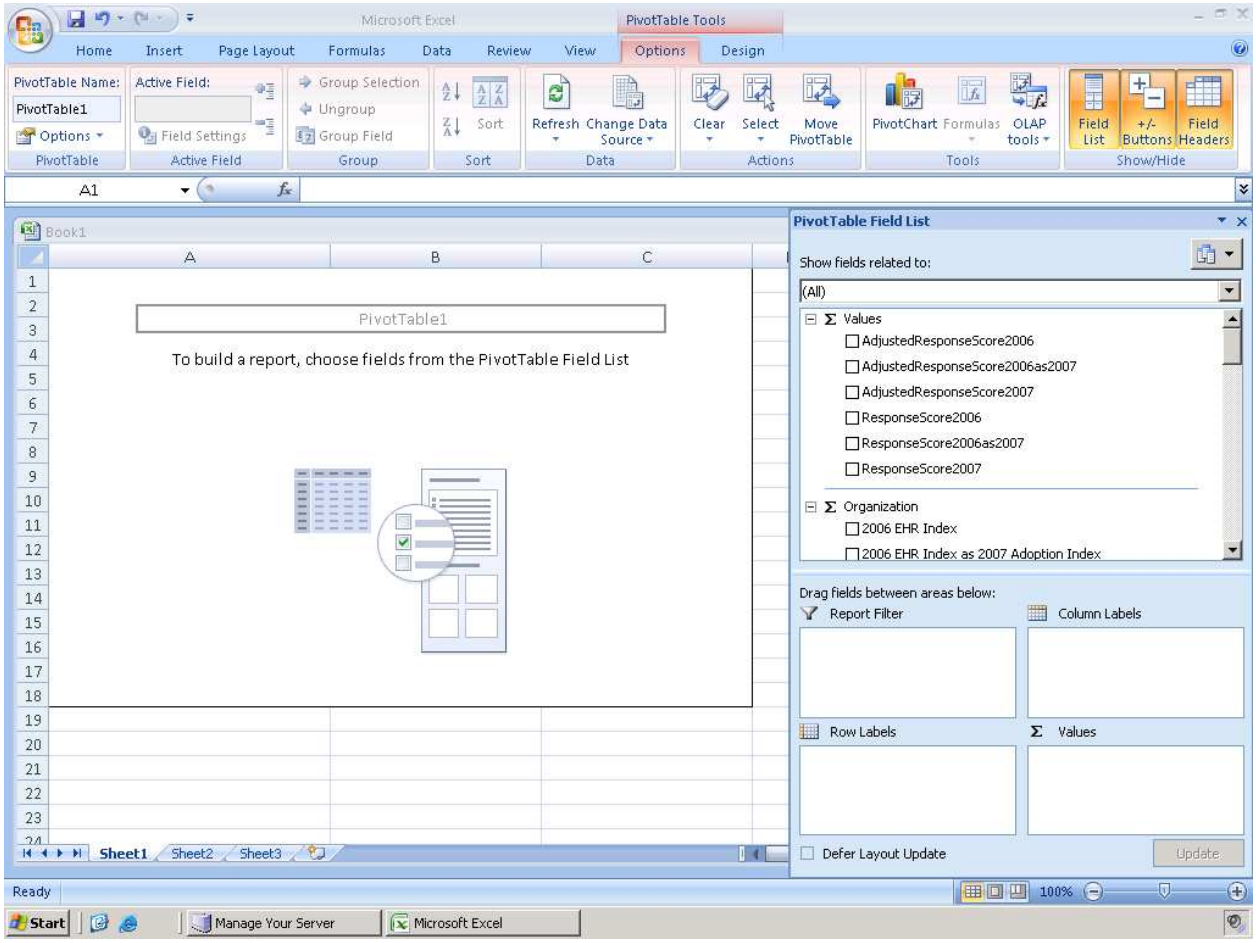
**APPENDIX 3-1: SAMPLE SCREENSHOT OF DATABASE WITH PIVOT TABLES**

(Source: OHA internal data cube)



**APPENDIX 3-2: DEFINITIONS OF ALL FIELDS USED IN DATABASE**

(Source: OHA internal documents)

**Survey Responses**

- ResponseScore (2006, 2006As2007, 2007) = Response Score for an individual question (If Response Included in Response Score = 0; it is set to an empty value; otherwise it shows the value)
- AdjustedResponseScore (2006, 2006As2007, 2007) = Adjusted Response Score for an individual question (If Question Included in Adjusted Score = 0; it is set to an empty value; otherwise it shows the value)

**Organization**

- 2006 EHR Index / 2006 EHR Index as 2007 Adoption Index / 2007 Adoption Index = a value that was calculated based on technical report calculations.
- 2006 EHR Index as 2007 Adoption Index Core / 2007 Adoption Index Core = a value that was calculated based on technical report calculations. **Includes only the Core Questions.**

**Survey Responses**

- Question Included In Adjusted Score (2006, 2006As2007, 2007) = These values signify if the question is included in the score. If included it will display as 1 otherwise an empty value will be displayed.
- Response Included In Response Score (2006, 2006As2007, 2007) = These values signify if the response is included in the score. If included it will display as 1 otherwise an empty value will be displayed.

**Survey Section Scores**

- Adjusted Section Score (2006, 2006As2007, 2007) (calculated by averaging Adjusted Sub Section Scores). Uses the sub-section scores to calculate the section scores.
- Adjusted Section Score (2006As2007 Core, 2007 Core) (calculated by averaging Adjusted Sub Section Scores). Uses the sub-section scores to calculate the section scores. **Includes only the Core Questions.**

**Survey Sub Section Scores**

- Adjusted Sub Section Score (2006, 2006As2007, 2007) (calculated by averaging Adjusted Response Scores). These values were added to calculate the section scores, because the cube calculates section scores by averaging all of the questions in that particular section instead the average of the sub-sections were needed to calculate the section scores.
- Adjusted Sub Section Score (2006As2007 Core, 2007 Core) (calculated by averaging Adjusted Response Scores). These values were added to calculate the section scores, because the cube calculates section scores by averaging all of the questions in that particular section instead the average of the sub-sections were needed to calculate the section scores. **Includes only the Core Questions.**

**APPENDIX 3-3: 2006 SURVEY QUESTIONS**

(Source: OHA internal documents)

1 SECTION 1: LEVEL OF e-Health FUNCTIONAL READINESS

1.1 Patient Registration, Records Management and Registry Services

1.1.1 Electronically register all patients in your primary hospital information system in the **inpatient** setting

1.1.2 Electronically register all patients in your primary hospital information system in the **emergency** setting

1.1.3 Electronically register all patients in your primary hospital information system in the hospital **outpatient clinic** setting

1.1.4 Electronically maintain an up-to-date provider directory that is available from your primary hospital information system, including full name, addresses, physical location and telecommunications address

1.1.5 Electronically create and update relationships in your primary hospital information system of care providers treating a single patient using care provider directory services

1.1.6 Electronically generate different lists of patients sorted by variables, such as active patients by in hospital unit location, most responsible care provider, discharge patient, etc.

1.1.7 Electronically capture patient and family preferences regarding issues important to the delivery of care (e.g. language or emergency contact information)

1.1.8 Electronically merge duplicate patient records and unmerge erroneously combined records in your primary hospital information system

1.2 Results Reporting

1.2.1 Electronically capture and present patient general laboratory and microbiology test results in an easily accessible manner to the appropriate care providers in the **inpatient** setting

1.2.2 Electronically capture and present patient general laboratory and microbiology test results in an easily accessible manner to the appropriate care providers in the **emergency** setting

1.2.3 Electronically capture and present patient general laboratory and microbiology test results in an easily accessible manner to the appropriate care providers in the hospital **outpatient clinic** setting

1.2.4 Electronically provide laboratory result interpretations

1.2.5 Electronically provide notification/alerts of abnormal laboratory results

1.2.6 Electronically present patient pathology reports in an easily accessible manner to the appropriate care providers

1.2.7 Electronically present diagnostic imaging reports in an easily accessible manner to the appropriate care providers in the **inpatient** setting

1.2.8 Electronically present diagnostic imaging reports in an easily accessible manner to the appropriate care providers in the **emergency** setting

1.2.9 Electronically present diagnostic imaging reports in an easily accessible manner to the appropriate care providers in the hospital **outpatient clinic** setting

1.2.10 Store most diagnostic images in a PACS

1.2.11 Provide access to images stored in a PACS at the appropriate points of care

1.2.12 Electronically provide structured data (e.g. blood pressure, heart rate) in flowsheets or graphs to appropriate care providers to view or uncover trends in the critical care, and general inpatient settings

1.2.13 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in an easily accessible manner to the appropriate care providers in the **inpatient** setting

1.2.14 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in an easily accessible manner to the appropriate care provider in the hospital **emergency** setting
1.2.15 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in an easily accessible manner to the appropriate care provider in the hospital **outpatient clinic** setting
1.2.16 Electronically present results information in an easily accessible manner to patients via a patient portal
1.2.17 Is your Hospital currently participating as an identified site for wait time information?
1.2.18 Electronically capture procedure start times for provincial priority procedures including selected cancer services, hip and knee total joint replacements, selected cardiac services, cataract surgery, and MRI/CT procedures
1.2.19 Electronically capture procedure close times for provincial priority procedures including selected cancer services, hip and knee total joint replacements, selected cardiac services, cataract surgery, and MRI/CT procedures
1.2.20 Electronically capture procedure start times procedures other than those identified as provincial priorities
1.2.21 Electronically capture procedure close times procedures other than those identified as provincial priorities

1.3 Point-of-Care Order Entry

1.3.1 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the **inpatient** setting
1.3.2 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the **emergency** setting
1.3.3 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the hospital **outpatient clinic** setting
1.3.4 Electronically order pathology exams at bedside or at nursing station
1.3.5 Electronically order ECGs at bedside or at nursing station in the **inpatient** setting
1.3.6 Electronically order ECGs at bedside or at nursing station in the **emergency** setting
1.3.7 Electronically order ECGs at bedside or at nursing station in the hospital **outpatient clinic** setting
1.3.8 Electronically order diagnostic imaging examinations at bedside or at nursing station in the **inpatient** setting
1.3.9 Electronically order diagnostic imaging examinations at bedside or at nursing station in the **emergency** setting
1.3.10 Electronically order diagnostic imaging examinations at bedside or at nursing station in the hospital **outpatient clinic** setting
1.3.11 Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew orders in the **inpatient** setting
1.3.12 Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the **emergency** setting
1.3.13 Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the **outpatient** setting
1.3.14 Electronically provide generic and brand name drug information to the provider at the time of ordering (e.g. alternate drug names, prescribing guidelines or contraindications)
1.3.15 Electronically order chemotherapy medications based on standard chemotherapy treatment protocols
1.3.16 Electronically sign orders at bedside or nursing station in the **inpatient** setting
1.3.17 Electronically sign orders at bedside or nursing station in the **emergency** setting
1.3.18 Electronically sign orders at bedside or nursing station in the **outpatient clinic** setting
1.3.19 Electronically provide order sets at bedside or nursing station (e.g. diagnosis-specific, care-plan specific or standing orders)

1.3.20 Electronically provide clinical decision support at time of ordering (e.g. real-time alerts, suggested corollary orders, notification of duplicate orders, institution-specific orders)
1.3.21 Electronically document and track consults between care providers in the organization

1.4 Clinical Documentation

1.4.1 Electronically capture, review, and maintain record of current illness and patient data related to medical diagnoses, surgeries and other procedures scoreed on the patient

1.4.2 Electronically capture relevant health conditions of family members, including pertinent positive and negative histories

1.4.3 Electronically capture patient-reported clinical information

1.4.4 Electronically capture, review, and maintain a medication profile

1.4.5 Electronically capture, review, and maintain a summary of allergies and adverse reactions

1.4.6 Electronically capture, review, and maintain a summary of patient problems maintained by nursing and allied health.

1.4.7 Electronically create, append, and correct transcribed or directly entered patient pathology reports

1.4.8 Electronically create, append, and correct transcribed or directly entered diagnostic imaging reports

1.4.9 Electronically create, append, and correct transcribed or directly entered discharge summaries

1.4.10 Electronically create, append, and correct transcribed or directly entered surgical reports

1.4.11 Electronically create, append, and correct transcribed or directly entered consultant notes or reports (excluding nursing and multi-disciplinary assessments)

1.4.12 Electronically sign DI reports, discharge summaries, surgical reports and/ or consultant reports

1.4.13 Provide access to a comprehensive medication profile from the Ontario Drug Benefit database (ODB) in the **emergency** setting

1.4.14 Integrate data from the ODB into the hospital system medication profile

1.4.15 Electronically capture and send discharge medication instructions to other providers (non-acute facilities, teaching physicians, etc.)

1.4.16 Electronically capture relevant structured data (e.g. blood pressure, heart rate) from monitors at the point of care in the **inpatient** setting to the EPR

1.4.17 Electronically capture relevant structured data (e.g., blood pressure, heart rate) from monitors at the point of care in the hospital **outpatient clinic** setting to the EPR/ EMR

1.4.18 Electronically document medication administration record (MAR) in the **inpatient** setting

1.4.19 Electronically document medication administration record (MAR) in the **emergency** setting

1.4.20 Electronically capture structured clinical data using the SNOMED or other clinical vocabulary

1.5 Information Infrastructure

1.5.1 Authenticate authorized users when they attempt to access the EPR/ EMR

1.5.2 Enable EPR security administrators to grant role-based authorization based on the responsibility or function of the user (e.g. nurse, dietician, administrator, or auditor)

1.5.3 Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives

1.5.4 Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives

1.5.5 Electronically provide indicators or flags to indicate that certain data has been 'masked' or hidden from view (e.g. lockbox)

1.5.6 Electronically allow 'break the glass' provision to allow authorized care providers emergency access to all data, including masked data

1.5.7 Electronically enable authorized care providers to manage a patient's access to the patient's personal health information by restricting access to information that is potentially harmful to the patient

1.5.8 Archive EPR data and clinical documents for the time period designated by policy or legal requirement in a format retrievable across iterations of technology changes

1.5.9 Electronically provide security audit, that logs access attempts and if any actual or attempted security violations occurred
1.5.10 Electronically provide data audit, that records who, when and by which system an EPR record was created, updated, viewed, extracted, or archived/deleted
1.5.11 Electronically verify patient treatment decisions and advance directives when required against electronically maintained consents and authorizations
1.5.12 Use secure email for sharing clinical information between care providers within the same organization
1.5.13 Use secure electronic document management system for sharing clinical information between care providers within the same organization
1.5.14 Provide high speed (at least 100MBit/sec) network connection to every clinical desktop
1.5.15 Extract EPR data for the purposes of analyzing and planning patient care or outcomes for administrative management purposes
1.5.16 Provide secure remote access for physicians
1.5.17 Electronically provide sufficient redundancy that guarantees 24/7 access to patient information
1.5.18 What best describes your organization's approach to e-Health systems
1.5.19 What vendor and product are your organization's primary patient management system/clinical information system/health information system

2 SECTION 2: LEVEL OF e-Health ORGANIZATIONAL AND HUMAN CAPACITY

2.1 e-Health Leadership and Planning
2.1.1 A Chief Information Officer or equivalent
2.1.2 If yes to the previous question, is the Chief Information Officer considered part of the executive team at your organization
2.1.3 A board-approved e-Health strategic plan
2.1.4 A completed readiness assessment to support your e-Health strategy
2.1.5 An approved change management methodology to encourage end-user adoption of e-Health
2.1.6 An approved project management methodology and resources to support large scale IT initiatives
2.1.7 Is e-Health part of your organizational plan

2.2 e-Health Priorities
2.2.1 Replace/ upgrade ambulatory care clinical systems
2.2.2 Replace/ upgrade inpatient clinical systems
2.2.3 Implement a computer-based Electronic Patient Record System (EPR)
2.2.4 Integrate systems in a multi-vendor environment
2.2.5 Portal technology to present disparate data via CPR
2.2.6 Patient portal for patient education/ support/ monitoring etc.
2.2.7 Upgrade Network Infrastructure (LANs, WANs)
2.2.8 Improve IS departmental services, cost effectiveness, efficiencies
2.2.9 Implement wireless systems (e.g. wireless LANs)
2.2.10 Implement technology to reduce medical errors/ promote patient safety
2.2.11 Upgrade security on IT systems to meet PIPEDA requirements
2.2.12 Upgrade security on IT systems to meet SSHA requirements
2.2.13 Adopt provincially approved Ontario health information standards
2.2.14 Train and support personnel to use existing and newly installed systems
2.2.15 Outsource (e.g. ASPs, infrastructure, other services)
2.2.16 Other (Please specify)

2.3 Barriers to Implementation

2.3.1 Lack of adequate financial support
2.3.2 Lack of qualified staff or access to qualified staff
2.3.3 Lack of clinician support
2.3.4 Difficulty in achieving end-user acceptance or use
2.3.5 Lack of top management support
2.3.6 Lack of strategic Information & Communication Technology (ICT) plan
2.3.7 Lack of change management strategies and re-engineering processes
2.3.8 Hospital has not defined need
2.3.9 Vendor's inability to effectively deliver product/ solution does not meet needs
2.3.10 Need to establish and adopt data standards
2.3.11 Solution not yet scheduled
2.3.12 Lack of infrastructural or prerequisite technology
2.3.13 None

2.4 e-Health Resources Complement

2.4.1 Does your hospital have qualified resources dedicated to the following
2.4.2 What e-Health resources are insufficiently resourced and most needed at your hospital?
2.4.3 What best describes your IT operations? If a portion of your IT operations is shared or outsourced, please specify in comments section below.

3 SECTION 3: LEVEL OF REGIONAL/INTER-ORGANIZATIONAL e-Health READINESS

3.1 Inter-Organizational Data Sharing

3.1.1 Electronically share admission histories and physical exams
3.1.2 Electronically share discharge summaries
3.1.3 Electronically share patient referrals
3.1.4 Electronically share drug profiles
3.1.5 Electronically share lab results
3.1.6 Electronically share diagnostic images
3.1.7 Electronically share reports (imaging, surgical/procedural)
3.1.8 Electronically share ER / ED visit encounter summaries

3.2 Inter-Organizational EMPI

3.2.1 Electronically cross-reference local patient identifiers (e.g., matching chart numbers across different organizations)
3.2.2 Electronically cross-reference local patient identifiers with an Enterprise Master Patient Index (EMPI) that serves most organizations in your Local Health Integration Network (LHIN) (e.g., matching chart numbers across different organizations with a centralized EMPI)
3.2.3 Send HL7 version 2.3 compliant Admission, Discharge, Transfer (ADT) messages externally
3.2.4 Electronically exchange clinical information with another organization using SNOMED or other standard

3.3 Interoperability Between Organizations

3.3.1 Electronically send *laboratory results* to OLIS or other shared repositories for retrieval by other organizations / providers
3.3.2 Electronically send *diagnostic images* to a shared repository for retrieval by other organizations / providers
3.3.3 Electronically Send *other clinical documents* (e.g., discharge summaries or surgical reports or clinical notes) to a shared repository for retrieval by other organizations / providers
3.3.4 Participate in a document registry that allows other organizations/ providers to electronically retrieve documents from your EPR on demand
3.3.5 Provide secure email for sharing clinical information with other organizations

3.3.6 Electronically interface with Family Health Team EMR
3.3.7 Have secure email between Family Health Teams and hospital

3.4 Regional Governance

3.4.1 A CIO or senior executive responsible for e-Health across hospital entities
3.4.2 e-Health Steering Committee or IT Steering Committee with e-Health responsibility
3.4.3 A strategic e-Health plan
3.4.4 A strategic e-Health plan that encompasses all the organizations in your LHIN

3.5 Main reasons for lack of readiness

**Financial** – Lack of adequate financial support;
**Staffing** – Lack of qualified staff or access to qualified staff;
**Clinician Support** – Lack of clinician support;
**End User Acceptance** – Difficulty in achieving end-user acceptance or use;
**Management Support** – Lack of top management support;
**Strategic ICT Plan** – Lack of strategic Information & Communication Technology plan;
**Change Management** – Lack of change management and re-engineering processes;
**No Need** – Hospital has not defined need;
**Vendor** – Vendor's inability to effectively deliver product/solution does not meet needs;
**Standards Adoption** – Need to establish and adopt data standards;
**Not Scheduled** – Solution not yet scheduled;
**Infrastructure/Pre-Reqs** – Lack of infrastructural or pre-requisite technology; or
**None** – None of the above

**APPENDIX 3-4: 2007 SURVEY QUESTIONS**

(Source: OHA internal documents)

SECTION 1: LEVEL OF e-Health CAPABILITY AND USE

1.1 Patient Registration, Records Management and Registry Services

1 Electronically register all patients in your primary hospital information system in the inpatient setting.
2 Electronically register all patients in your primary hospital information system in the emergency setting.
3 Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting.
4 Electronically maintain an up-to-date care provider directory that includes full name, addresses, physical location and contact information within your primary hospital information system.
5 Electronically track different care providers treating a single patient in your primary hospital information system.
6 Electronically generate different lists of patients sorted by variables, such as active patients by in-hospital unit location, most responsible care provider, discharge patient, etc.
7 Electronically capture patient and family preferences regarding issues important to the delivery of care (e.g. language or emergency contact information).
8 Electronically capture a record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient.
9 Electronically capture relevant health conditions of family members, including pertinent positive and negative histories.
10 Electronically capture patient-reported clinical information.
11 Electronically capture a medication profile.
12 Electronically capture a summary of allergies and adverse reactions.
13 Electronically capture a summary of patient problems maintained by nursing and allied health.
14 Provide access to a comprehensive medication profile from the Ontario Drug Benefit database (ODB) in the emergency setting.

1.2 Point-of-Care Order Entry

1 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the inpatient setting.
2 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the emergency setting.
3 Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the hospital outpatient clinic setting.
4 Electronically order pathology exams at bedside or at nursing station.
5 Electronically order ECGs at bedside or at nursing station in the inpatient setting.
6 Electronically order ECGs at bedside or at nursing station in the emergency setting.
7 Electronically order ECGs at bedside or at nursing station in the hospital outpatient clinic setting.
8 Electronically order diagnostic imaging examinations at bedside or at nursing station in the inpatient setting.
9 Electronically order diagnostic imaging examinations at bedside or at nursing station in the emergency setting.
10 Electronically order diagnostic imaging examinations at bedside or at nursing station in the hospital outpatient clinic setting.
11 Electronically order medications with instructions (excluding chemotherapy, IVs), including

new, change, stop and renew orders in the inpatient setting.
12 Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the emergency setting.
13 Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the outpatient setting.
14 Electronically order chemotherapy medications supported by standard chemotherapy treatment protocols.
15 Electronically provide generic and brand name drug information to the provider at the time of ordering (e.g. alternate drug names, prescribing guidelines or contraindications).
16 Electronically provide clinical decision support at time of ordering medications (e.g. real-time alerts, suggested corollary orders, notification of duplicate orders, institution-specific orders).
17 Electronically provide clinical decision support at time of ordering diagnostic tests (e.g. realtime alerts, suggested corollary order, notification of duplicate orders, institution-specific orders).
18 Identify and present appropriate dose recommendations based on patient-specific conditions and characteristics at the time of medication ordering (e.g. drug-condition interactions) and patient specific contraindications and warnings (e.g. pregnancy, breast-feeding or occupational risks, preferences of the patient such as reluctance to use an antibiotic).
19 Electronically sign orders at bedside or nursing station in the inpatient setting.
20 Electronically sign orders at bedside or nursing station in the emergency setting.
21 Electronically sign orders at bedside or nursing station in the outpatient clinic setting.
22 Electronically provide order sets at bedside or nursing station (e.g. diagnosis-specific, care-plan specific or standing orders).
23 Electronically document and track consults between care providers in the organization.

1.3 Clinical Documentation

1 Electronically create and modify transcribed or directly entered patient pathology reports.
2 Electronically create and modify transcribed or directly entered diagnostic imaging reports.
3 Electronically create and modify transcribed or directly entered discharge summaries.
4 Electronically create and modify transcribed or directly entered surgical reports.
5 Electronically create and modify transcribed or directly entered consultant notes or reports (excluding nursing and multi-disciplinary assessments).
6 Electronically capture and send discharge medication instructions to other providers outside your hospital (non-acute facilities, community physicians, etc.).
7 Electronically capture relevant structured data (e.g. blood pressure, heart rate) from monitors at the point of care in the inpatient setting to the EPR.
8 Electronically capture relevant structured data (e.g., blood pressure, heart rate) from monitors at the point-of-care in the hospital outpatient clinic setting to the EPR/ EMR.
9 Electronically document medication administration record (MAR) in the inpatient setting.
10 Electronically document MAR in the emergency setting.
11 Electronically capture patient related incidents or adverse events in an incident reporting/risk management system or database.
12 Electronically integrate captured record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient to the EPR/ EMR.
13 Electronically integrate relevant health conditions of family members, including pertinent positive and negative histories to the EPR/ EMR.
14 Electronically integrate patient-reported clinical information to the EPR/ EMR.
15 Electronically integrate a medication profile to the EPR/ EMR.
16 Electronically integrate a summary of allergies and adverse reactions to the EPR/ EMR.
17 Electronically integrate a summary of patient problems maintained by nursing and allied health to the EPR/EMR.
18 Electronically capture structured clinical data using standard clinical vocabulary (e.g. SNOMED).

1.4 Results Reporting

1 Electronically capture and present patient general laboratory and microbiology test results in the inpatient setting.
2 Electronically capture and present patient general laboratory and microbiology test results in the emergency setting.
3 Electronically capture and present patient general laboratory and microbiology test results to the appropriate care providers in the hospital outpatient clinic setting.
4 Electronically provide laboratory result interpretations.
5 Electronically provide notification/alerts of abnormal laboratory results.
6 Electronically present patient pathology reports.
7 Electronically present diagnostic imaging reports in the inpatient setting.
8 Electronically present diagnostic imaging reports in the emergency setting.
9 Electronically present diagnostic imaging reports in the hospital outpatient clinic setting.
10 Electronically store most diagnostic images in a PACS.
11 Electronically provide access to images stored in a PACS at the appropriate points of care.
12 Electronically provide structured patient data (e.g. blood pressure, heart rate) in flowsheets or graphs to view or uncover trends in critical care, and general inpatient settings.
13 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the inpatient setting.
14 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital emergency setting.
15 Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital outpatient clinic setting.
16 Electronically present results information to patients via a patient portal.

1.5 Information Infrastructure

1 Authenticate authorized users when they attempt to access the EPR/ EMR.
2 Enable EPR security administrators to grant role-based authorization based on the responsibility or function of the user (e.g. nurse, dietician, administrator, or auditor).
3 Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives.
4 Electronically provide indicators or flags to indicate that certain data has been 'masked' or hidden from view (e.g. lockbox).
5 Electronically allow 'break the glass' provision to allow authorized care providers emergency access to all data, including masked data.
6 Electronically enable authorized care providers to restrict access to a patient's personal health information that is potentially harmful to the patient.
7 Archive EPR data and clinical documents for the time period designated by policy or legal requirement in a format retrievable across iterations of technology changes.
8 Secure Personal Health Information (PHI) that is electronically transmitted or accessed off-site using robust encryption technology.
9 Encrypt PHI stored on portable devices or media (e.g. laptop, PDA, USB key).
10 Complete a Threat/Risk Assessment (TRA) annually or following a significant infrastructure change to identify organizational strengths and weaknesses in data protection and data security practices through the evaluation of security protocols, policies, and procedures.
11 Electronically provide a security audit that logs access attempts and whether any actual or attempted security violations have occurred.
12 Electronically provide a data audit that records who, when and by which system an EPR record was created, updated, viewed, extracted, or archived/deleted.
13 Electronically verify patient treatment decisions and advance directives when required against electronically maintained consents and authorizations.

14 Use secure email for sharing clinical information between care providers within the same organization.
15 Use secure electronic document management system for sharing clinical information between care providers within the same organization.
16 Provide high speed (at least 100MBit/sec) network connection to every clinical desktop.
17 Extract EPR data for the purposes of analyzing and planning patient care or outcomes for administrative management purposes.
18 Provide secure remote access for physicians.
19 Electronically provide sufficient redundancy that guarantees access to patient information twenty-four hours a day, seven days a week.

SECTION 2: LEVEL OF e-Health ORGANIZATIONAL AND HUMAN CAPACITY

2.1 e-Health Leadership and Planning

1 Does your organization currently have an established Chief Information Officer or equivalent that is considered part of the executive team at your organization?
2 Does your organization currently have a Privacy and/or Security Officer or recognized individual with equivalent expertise and responsibility?
3 Does your organization currently have a board-approved e-Health strategic plan?
4 Does your organization currently have an Information Security policy?
5 Does your organization currently have an identified change management and reengineering leadership capacity to encourage end-user adoption of your e-Health?
6 Does your organization currently have an approved project management methodology and resources to support large scale IT initiatives?
7 Is e-Health part of your organizational plan?
8 Please identify the health care application areas that your hospital management has identified as important for your organization over the next two fiscal years (2007/08 and 2008/09). (Please select five).

2.2 e-Health Priorities

1 Please indicate your organization's top e-Health priorities today. (Please select five).

2.3 e-Health Resources Complement

1 Does your hospital have qualified resources dedicated to the following?
2 What are the three most needed and insufficiently resourced e-Health resources at your hospital? Please rank your answers on a scale of 1 to 3, with 1 being most significant and 3 being least significant.

SECTION 3: LEVEL OF REGIONAL/INTER-ORGANIZATIONAL e-Health

3.1 Inter-Organizational Data Sharing

1 Does your hospital corporation currently (or is in the process of developing the functionality to) electronically share data with other hospital corporations?
2 Does your hospital corporation currently (or is in the process of developing the functionality to) electronically share data with consulting physicians in the community (GP, FHT, etc.)?
3 Does your hospital corporation currently (or is in the process of developing the functionality to) electronically share data with other health care organizations (CCACs etc.)?
For questions 1, 2 and 3 above, please indicate whether your hospital corporation currently (or is in the process of developing the functionality to electronically share any of the following outside your hospital corporation :
a) admission histories and physical exams
b) discharge summaries
c) patient referrals

d) drug profiles
e) lab results
f) diagnostic images
g) reports (imaging, surgical/procedural)
h) ER / ED visit encounter summaries
If answering yes to questions a) to h) above, please indicate if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both

3.2 Inter-Organizational EMPI

1 Electronically cross-reference local patient identifiers (e.g., matching chart numbers across different organizations).
2 Electronically cross-reference local patient identifiers with an Enterprise Master Patient Index (EMPI) that serves most organizations in your Local Health Integration Network (LHIN) (e.g., matching chart numbers across different organizations with a centralized EMPI).
3 Send HL7 version 2.3 compliant Admission, Discharge, Transfer (ADT) messages externally.
4 Electronically exchange clinical information with another organization using a standard clinical vocabulary (e.g. SNOMED).

3.3 Interoperability Between Organizations

1 Electronically send laboratory results to OLIS or other shared repositories for retrieval by other organizations/providers.
2 Electronically send diagnostic images to a shared repository for retrieval by other organizations/providers.
3 Electronically send other clinical documents (e.g., discharge summaries or surgical reports or clinical notes) to a shared repository for retrieval by other organizations/providers.
4 Participate in a document registry that allows other organizations/providers to electronically retrieve documents from your EPR on demand.
5 Provide secure email for sharing clinical information with other organizations.
6 Electronically interface with Family Health Team (FHT) EMR.
7 Have secure email between FHT and hospital.

**APPENDIX 3-5: CORE QUESTIONS FOR 2006/2007 (ONLY QUESTIONS THAT WERE ASKED IN BOTH 2006 AND 2007)**

(Source: OHA internal documents)

1.1.001. Electronically register all patients in your primary hospital information system in the inpatient setting

1.1.002. Electronically register all patients in your primary hospital information system in the emergency setting

1.1.003. Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting

1.1.004. Electronically maintain an up-to-date care provider directory that includes full name, addresses, physical location and contact information within your primary hospital information system

1.1.005. Electronically create and update relationships in your primary hospital information system of care providers treating a single patient using care provider directory services

1.1.006. Electronically generate different lists of patients sorted by variables, such as active patients by inhospital unit location, most responsible care provider, discharge patient, etc.

1.1.007. Electronically capture patient and family preferences regarding issues important to the delivery of care (e.g. language or emergency contact information)

1.1.008. Electronically capture a record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient

1.1.009. Electronically capture relevant health conditions of family members, including pertinent positive and negative histories

1.1.010. Electronically capture patient-reported clinical information

1.1.011. Electronically capture a medication profile

1.1.012. Electronically capture a summary of allergies and adverse reactions

1.1.013. Electronically capture a summary of patient problems maintained by nursing and allied health.

1.1.014. Provide access to a comprehensive medication profile from the Ontario Drug Benefit database (ODB) in the emergency setting

1.2.001. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the inpatient setting

1.2.002. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the emergency setting

1.2.003. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the hospital outpatient clinic setting

1.2.004. Electronically order pathology exams at bedside or at nursing station

1.2.005. Electronically order ECGs at bedside or at nursing station in the inpatient setting

1.2.006. Electronically order ECGs at bedside or at nursing station in the emergency setting

1.2.007. Electronically order ECGs at bedside or at nursing station in the hospital outpatient clinic setting

1.2.008. Electronically order diagnostic imaging examinations at bedside or at nursing station in the inpatient setting

1.2.009. Electronically order diagnostic imaging examinations at bedside or at nursing station in the emergency setting

1.2.010. Electronically order diagnostic imaging examinations at bedside or at nursing station in the hospital outpatient clinic setting

1.2.011. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew orders in the inpatient setting

1.2.012. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the emergency setting

1.2.013. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the outpatient clinic setting

1.2.014. Electronically order chemotherapy medications supported by standard chemotherapy treatment protocols

1.2.015. Electronically provide generic and brand name drug information to the provider at the time of ordering (e.g. alternate drug names, prescribing guidelines or contraindications)

1.2.016. Electronically provide clinical decision support at time of ordering medications (e.g. real-time alerts, suggested corollary orders, notification of duplicate orders, institution-specific orders)

1.2.019. Electronically sign orders at bedside or nursing station in the inpatient setting

1.2.020. Electronically sign orders at bedside or nursing station in the emergency setting

1.2.021. Electronically sign orders at bedside or nursing station in the outpatient clinic setting

1.2.022. Electronically provide order sets at bedside or nursing station (e.g. diagnosis-specific, care-plan specific or standing orders)

1.2.023. Electronically document and track consults between care providers in the organization

1.3.001. Electronically create and modify transcribed or directly entered patient pathology reports

1.3.002. Electronically create and modify transcribed or directly entered diagnostic imaging reports

1.3.003. Electronically create and modify transcribed or directly entered discharge summaries

1.3.004. Electronically create and modify transcribed or directly entered surgical reports

1.3.005. Electronically create and modify transcribed or directly entered consultant notes or reports (excluding nursing and multi-disciplinary assessments)

1.3.006. Electronically capture and send discharge medication instructions to other providers outside your hospital (non-acute facilities, community physicians, etc.)

1.3.007. Electronically capture relevant structured data (e.g. blood pressure, heart rate) from monitors at the point of care in the inpatient setting to the EPR

1.3.008. Electronically capture relevant structured data (e.g., blood pressure, heart rate) from monitors at the point-of-care in the hospital outpatient clinic setting to the EPR/ EMR

1.3.009. Electronically document medication administration record (MAR) in the inpatient setting

1.3.010. Electronically document medication administration record (MAR) in the emergency setting

1.3.018. Electronically capture structured clinical data using a standard clinical vocabulary (e.g. SNOMED)

1.4.001. Electronically capture and present patient general laboratory and microbiology test results in the inpatient setting

1.4.002. Electronically capture and present patient general laboratory and microbiology test results in the emergency setting

1.4.003. Electronically capture and present patient general laboratory and microbiology test results to the appropriate care providers in the hospital outpatient clinic setting

1.4.004. Electronically provide laboratory result interpretations

1.4.005. Electronically provide notification/alerts of abnormal laboratory results

1.4.006. Electronically present patient pathology reports

1.4.007. Electronically present diagnostic imaging reports in the inpatient setting

1.4.008. Electronically present diagnostic imaging reports in the emergency setting

1.4.009. Electronically present diagnostic imaging reports in the hospital outpatient clinic setting

1.4.010. Electronically store most diagnostic images in a PACS

1.4.011. Electronically provide access to images stored in a PACS at the appropriate points of care

1.4.012. Electronically provide structured patient data (e.g. blood pressure, heart rate) in flowsheets or graphs to view or uncover trends in critical care, and general inpatient settings

1.4.013. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the inpatient setting

1.4.014. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital emergency setting

1.4.015. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital outpatient clinic setting

1.4.016. Electronically present results information to patients via a patient portal

1.5.001. Authenticate authorized users when they attempt to access the EPR/ EMR

1.5.002. Enable EPR security administrators to grant role-based authorization based on the responsibility or function of the user (e.g. nurse, dietician, administrator, or auditor)

1.5.003. Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives

1.5.004. Electronically provide indicators or flags to indicate that certain data has been 'masked' or hidden from view (e.g. lockbox)

1.5.005. Electronically allow 'break the glass' provision to allow authorized care providers emergency access to all data, including masked data

1.5.006. Electronically enable authorized care providers to restrict access to a patient’s personal health information that is potentially harmful to the patient

1.5.007. Archive EPR data and clinical documents for the time period designated by policy or legal requirement in a format retrievable across iterations of technology changes

1.5.011. Electronically provide a security audit that logs access attempts and if any actual or attempted security violations occurred

1.5.012. Electronically provide a data audit that records who, when and by which system an EPR record was created, updated, viewed, extracted, or archived/deleted

1.5.013. Electronically verify patient treatment decisions and advance directives when required against electronically maintained consents and authorizations

1.5.014. Use secure email for sharing clinical information between care providers within the same organization

1.5.015. Use secure electronic document management system for sharing clinical information between care providers within the same organization

1.5.016. Provide high speed (at least 100MBit/sec) network connection to every clinical desktop

1.5.017. Extract EPR data for the purposes of analyzing and planning patient care or outcomes for administrative management purposes

1.5.018. Provide secure remote access for physicians

1.5.019. Electronically provide sufficient redundancy that guarantees 24/7 access to patient information

2.1.001. Does your organization currently have an established Chief Information Officer or equivalent that is considered part of the executive team at your organization?

2.1.003. Does your organization currently have an established board-approved e-Health strategic plan?

2.1.005. Does your organization currently have an established identified change management and reengineering leadership capacity to encourage end-user adoption of your e-Health?

2.1.006. Does your organization currently have an established and approved project management methodology and resources to support large scale IT initiatives?

2.1.007. Is e-Health part of your organizational plan?

3.2.001. Electronically cross-reference local patient identifiers (e.g., matching chart numbers across different organizations).

3.2.002. Electronically cross-reference local patient identifiers with an Enterprise Master Patient Index (EMPI) that serves most organizations in your Local Health Integration Network (LHIN) (e.g., matching chart numbers across different organizations with a centralized EMPI).

3.2.003. Send HL7 version 2.3 compliant Admission, Discharge, Transfer (ADT) messages externally.

3.2.004. Electronically exchange clinical information with another organization using a standard clinical vocabulary (e.g. SNOMED).

3.3.001. Electronically send laboratory results to OLIS or other shared repositories for retrieval by other organizations / providers

3.3.002. Electronically send diagnostic images to a shared repository for retrieval by other organizations / providers

3.3.003. Electronically send other clinical documents (e.g., discharge summaries or surgical reports or clinical notes) to a shared repository for retrieval by other organizations / providers

3.3.004. Participate in a document registry that allows other organizations/ providers to electronically retrieve documents from your EPR on demand

3.3.005. Provide secure email for sharing clinical information with other organizations

3.3.006. Electronically interface with Family Health Team (FHT) EMR

3.3.007. Have secure email between FHT and hospital

**APPENDIX 3-6: INDICATOR DEFINITIONS**

(Source: OHA internal documents)

| Indicator | Definition |
|---|---|
| Patient Registration, Records Management, and Registry Services (1.1) | Represents a hospital's capability to electronically register patients, capture patient-reported information and manage records, as well as maintain a functional directory of care provider information. |
| Point-of-Care Order Entry (1.2) | Represents a hospital's capability to electronically order test and medications at the bedside or nursing station. Ordering may be done by any care provider, but must be electronically signed by a qualified practitioner. It also reports on the availability of electronic decision support information at the time of ordering. |
| Clinical Documentation (1.3) | Represents a hospital's capability to capture clinical patient information, reports, and structured data, as well as a hospital's capability to integrate these features into an electronic patient record (EPR). |
| Results Reporting (1.4) | Represents a hospital's capability to electronically capture and present clinical results and reports. |
| Information Infrastructure (1.5) | Represents a hospital's adoption of technical capabilities that are essential to the smooth, safe and effective use of e-Health applications. |
| e-Health Leadership and Planning (2.1) | Represents the adoption of processes and people in an organization that contribute to the development and support of e-Health. |
| Inter-Organizational EMPI (3.2) | Represents a hospital's adoption of an Enterprise Master Patient Index (EMPI) and related standards. |
| Interoperability between Organizations (3.3) | Represents a hospital's capability to interoperate between organizations using shared repositories, document registries and secure email. |

**APPENDIX 3-7: CORE HOSPITALS (PARTICIPATED IN OHA SURVEY IN BOTH 2006 and 2007)**

(Source: OHA internal documents)

Alexandra Hospital
Alexandra Marine & General Hospital
Almonte General Hospital
Atikokan General Hospital
Baycrest Centre for Geriatric Care
Blind River District Health Centre
Bloorview Kids Rehab
Bluewater Health
Brant Community Healthcare System
Bridgepoint Hospital
Brockville General Hospital
Cambridge Memorial Hospital
Campbellford Memorial Hospital
Carleton Place & District Memorial Hospital
Centre for Addiction & Mental Health
Chapleau Health Services / Services De Santé De Chapleau
Chatham-Kent Health Alliance
Children's Hospital of Eastern Ontario
Collingwood General and Marine Hospital
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Deep River and District Hospital
Dryden Regional Health Centre
Englehart & District Hospital
Espanola General Hospital
Four Counties Health Services
Glengarry Memorial Hospital
Grand River Hospital Corporation
Grey Bruce Health Services
Groves Memorial Community Hospital
Guelph General Hospital
Haliburton Highlands Health Services Corporation
Halton Healthcare Services Corporation
Hamilton Health Sciences Corporation
Hanover and District Hospital
Hawkesbury & District General Hospital
Headwaters Health Care Centre
Homewood Health Centre
Hopital regional de Sudbury Regional Hospital Corporation

Hornepayne Community Hospital
Hospital for Sick Children
Hotel-Dieu Grace Hospital (Windsor)
Humber River Regional Hospital
Huron Perth Healthcare Alliance
Huronia District Hospital
Joseph Brant Memorial Hospital
Kemptville District Hospital
Kirkland and District Hospital
Lady Dunn Health Centre
Lake of the Woods District Hospital
Lakeridge Health Corporation
Leamington District Memorial Hospital
Lennox and Addington County General Hospital
Listowel Memorial Hospital
London Health Sciences Centre
Manitoulin Health Centre
Manitouwadge General Hospital
Markham Stouffville Hospital
Mattawa General Hospital
Montfort Hospital
Mount Sinai Hospital
Muskoka Algonquin Healthcare
Niagara Health System
Nipigon District Memorial Hospital
Norfolk General Hospital
North Bay General Hospital
North Wellington Health Care Corporation
North York General Hospital
Northeast Mental Health Centre
Northumberland Hills Hospital
Orillia Soldiers' Memorial Hospital
Pembroke Regional Hospital Inc.
Penetanguishene General Hospital
Perth & Smiths Falls District Hospital
Peterborough Regional Health Centre
Providence Continuing Care Centre
Providence Healthcare
Queensway Carleton Hospital
Quinte Healthcare Corporation
Red Lake Margaret Cochenour Memorial Hospital
Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston
Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Catharines

Renfrew Victoria Hospital
Riverside Health Care Facilities Inc.
Rouge Valley Health System
Royal Ottawa Health Care Group
Runnymede Healthcare Centre
Sault Area Hospital
SCO Health Service
Sensenbrenner Hospital
Sioux Lookout Meno-Ya-Win Health Centre
Smooth Rock Falls Hospital
South Bruce Grey Health Centre
Southlake Regional Health Centre
St. Francis Memorial Hospital
St. John's Rehabilitation Hospital
St. Joseph's Care Group (Thunder Bay)
St. Joseph's General Hospital Elliot Lake
St. Joseph's Health Care, London
St. Joseph's Health Centre (Toronto)
St. Joseph's Health Centre, Guelph
St. Joseph's Healthcare Hamilton
St. Mary's General Hospital
St. Michael's Hospital
St. Thomas Elgin General Hospital
Strathroy Middlesex General Hospital
Sunnybrook Health Sciences Centre
Temiskaming Hospital
The Arnprior and District Memorial Hospital
The Board of Governors of the Kingston Hospital
The Credit Valley Hospital
The Ottawa Hospital
The Royal Victoria Hospital of Barrie
The Scarborough Hospital
The Stevenson Memorial Hospital
The Toronto East General Hospital
The West Nipissing General Hospital
Thunder Bay Regional Health Sciences Centre
Tillsonburg District Memorial Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district
Toronto Rehabilitation Institute
Trillium Health Centre
University Health Network
West Lincoln Memorial Hospital
West Park Healthcare Centre

Whitby Mental Health Centre
William Osler Health Centre
Wilson Memorial General Hospital
Windsor Regional Hospital
Wingham and District Hospital
Woodstock General Hospital
York Central Hospital

**APPENDIX 3-8: CORE HOSPITALS (PARTICIPATED IN OHA SURVEY IN BOTH 2006 AND 2007) – DIVIDED BY PEER GROUP**

(Source: OHA internal documents)

**CCC Rehab and Mental Health**

Baycrest Centre for Geriatric Care
Bloorview Kids Rehab
Bridgepoint Hospital
Centre for Addiction & Mental Health
Homewood Health Centre
Northeast Mental Health Centre
Penetanguishene General Hospital
Providence Continuing Care Centre
Providence Healthcare
Royal Ottawa Health Care Group
Runnymede Healthcare Centre
SCO Health Service
St. John's Rehabilitation Hospital
St. Joseph's Care Group (Thunder Bay)
St. Joseph's Health Centre, Guelph
Toronto Rehabilitation Institute
West Park Healthcare Centre
Whitby Mental Health Centre

**Small**

Alexandra Hospital
Alexandra Marine & General Hospital
Almonte General Hospital
Atikokan General Hospital
Blind River District Health Centre
Campbellford Memorial Hospital
Carleton Place & District Memorial Hospital
Chapleau Health Services / Services De Santé De Chapleau
Deep River and District Hospital
Dryden Regional Health Centre
Englehart & District Hospital
Espanola General Hospital
Four Counties Health Services
Glengarry Memorial Hospital
Groves Memorial Community Hospital
Haliburton Highlands Health Services Corporation

Hanover and District Hospital
Hawkesbury & District General Hospital
Hornepayne Community Hospital
Kemptville District Hospital
Kirkland and District Hospital
Lady Dunn Health Centre
Lake of the Woods District Hospital
Leamington District Memorial Hospital
Lennox and Addington County General Hospital
Listowel Memorial Hospital
Manitoulin Health Centre
Manitouwadge General Hospital
Mattawa General Hospital
Nipigon District Memorial Hospital
North Wellington Health Care Corporation
Red Lake Margaret Cochenour Memorial Hospital
Renfrew Victoria Hospital
Riverside Health Care Facilities Inc.
Sensenbrenner Hospital
Sioux Lookout Meno-Ya-Win Health Centre
Smooth Rock Falls Hospital
South Bruce Grey Health Centre
St. Francis Memorial Hospital
St. Joseph's General Hospital Elliot Lake
Strathroy Middlesex General Hospital
The Arnprior and District Memorial Hospital
The Stevenson Memorial Hospital
The West Nipissing General Hospital
Tillsonburg District Memorial Hospital
West Lincoln Memorial Hospital
Wilson Memorial General Hospital
Wingham and District Hospital

**Community**

Bluewater Health
Brant Community Healthcare System
Brockville General Hospital
Cambridge Memorial Hospital
Chatham-Kent Health Alliance
Collingwood General and Marine Hospital
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Grand River Hospital Corporation

Grey Bruce Health Services
Guelph General Hospital
Halton Healthcare Services Corporation
Headwaters Health Care Centre
Hotel-Dieu Grace Hospital (Windsor)
Humber River Regional Hospital
Huron Perth Healthcare Alliance
Huronia District Hospital
Joseph Brant Memorial Hospital
Lakeridge Health Corporation
Markham Stouffville Hospital
Montfort Hospital
Muskoka Algonquin Healthcare
Niagara Health System
Norfolk General Hospital
North Bay General Hospital
North York General Hospital
Northumberland Hills Hospital
Orillia Soldiers' Memorial Hospital
Pembroke Regional Hospital Inc.
Perth & Smiths Falls District Hospital
Peterborough Regional Health Centre
Queensway Carleton Hospital
Quinte Healthcare Corporation
Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Catharines
Rouge Valley Health System
Sault Area Hospital
Southlake Regional Health Centre
St. Joseph's Health Centre (Toronto)
St. Mary's General Hospital
St. Thomas Elgin General Hospital
Temiskaming Hospital
The Credit Valley Hospital
The Royal Victoria Hospital of Barrie
The Scarborough Hospital
The Toronto East General Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district
Trillium Health Centre
William Osler Health Centre
Windsor Regional Hospital
Woodstock General Hospital
York Central Hospital

**Teaching**

Children's Hospital of Eastern Ontario
Hamilton Health Sciences Corporation
Hopital regional de Sudbury Regional Hospital Corporation
Hospital for Sick Children
London Health Sciences Centre
Mount Sinai Hospital
Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston
St. Joseph's Health Care, London
St. Joseph's Healthcare Hamilton
St. Michael's Hospital
Sunnybrook Health Sciences Centre
The Board of Governors of the Kingston Hospital
The Ottawa Hospital
Thunder Bay Regional Health Sciences Centre
University Health Network

**APPENDIX 3-9: CORE HOSPITALS (PARTICIPATED IN OHA SURVEY IN BOTH 2006 AND 2007) – DIVIDED BY LHIN**

(Source: OHA internal documents)

**CENTRAL**

Bloorview Kids Rehab
Humber River Regional Hospital
Markham Stouffville Hospital
North York General Hospital
Southlake Regional Health Centre
St. John's Rehabilitation Hospital
The Stevenson Memorial Hospital
York Central Hospital

**CENTRAL EAST**

Campbellford Memorial Hospital
Haliburton Highlands Health Services Corporation
Lakeridge Health Corporation
Northumberland Hills Hospital
Peterborough Regional Health Centre
Rouge Valley Health System
The Scarborough Hospital
Whitby Mental Health Centre

**CENTRAL WEST**

Headwaters Health Care Centre
William Osler Health Centre

**CHAMPLAIN**

Almonte General Hospital
Carleton Place & District Memorial Hospital
Children's Hospital of Eastern Ontario
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Deep River and District Hospital
Glengarry Memorial Hospital
Hawkesbury & District General Hospital
Kemptville District Hospital
Montfort Hospital
Pembroke Regional Hospital Inc.
Queensway Carleton Hospital
Renfrew Victoria Hospital
Royal Ottawa Health Care Group

SCO Health Service
St. Francis Memorial Hospital
The Arnprior and District Memorial Hospital
The Ottawa Hospital

**ERIE ST. CLAIR**

Bluewater Health
Chatham-Kent Health Alliance
Hotel-Dieu Grace Hospital (Windsor)
Leamington District Memorial Hospital
Windsor Regional Hospital

**HAMILTON NIAGARA HALDIMAND BRANT**

Brant Community Healthcare System
Hamilton Health Sciences Corporation
Joseph Brant Memorial Hospital
Niagara Health System
Norfolk General Hospital
Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Catharines
St. Joseph's Healthcare Hamilton
West Lincoln Memorial Hospital

**MISSISSAUGA HALTON**

Halton Healthcare Services Corporation
The Credit Valley Hospital
Trillium Health Centre

**NORTH EAST**

Blind River District Health Centre
Chapleau Health Services / Services De Santé De Chapleau
Englehart & District Hospital
Espanola General Hospital
Hopital regional de Sudbury Regional Hospital Corporation
Hornepayne Community Hospital
Kirkland and District Hospital
Lady Dunn Health Centre
Manitoulin Health Centre
Mattawa General Hospital
North Bay General Hospital
Northeast Mental Health Centre
Sault Area Hospital
Sensenbrenner Hospital

Smooth Rock Falls Hospital
St. Joseph's General Hospital Elliot Lake
Temiskaming Hospital
The West Nipissing General Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district

**NORTH SIMCOE MUSKOKA**

Collingwood General and Marine Hospital
Huronia District Hospital
Muskoka Algonquin Healthcare
Orillia Soldiers' Memorial Hospital
Penetanguishene General Hospital
The Royal Victoria Hospital of Barrie

**NORTH WEST**

Atikokan General Hospital
Dryden Regional Health Centre
Lake of the Woods District Hospital
Manitouwadge General Hospital
Nipigon District Memorial Hospital
Red Lake Margaret Cochenour Memorial Hospital
Riverside Health Care Facilities Inc.
Sioux Lookout Meno-Ya-Win Health Centre
St. Joseph's Care Group (Thunder Bay)
Thunder Bay Regional Health Sciences Centre
Wilson Memorial General Hospital

**SOUTH EAST**

Brockville General Hospital
Lennox and Addington County General Hospital
Perth & Smiths Falls District Hospital
Providence Continuing Care Centre
Quinte Healthcare Corporation
Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston
The Board of Governors of the Kingston Hospital

**SOUTH WEST**

Alexandra Hospital
Alexandra Marine & General Hospital
Four Counties Health Services
Grey Bruce Health Services
Hanover and District Hospital
Huron Perth Healthcare Alliance

Listowel Memorial Hospital
London Health Sciences Centre
South Bruce Grey Health Centre
St. Joseph's Health Care, London
St. Thomas Elgin General Hospital
Strathroy Middlesex General Hospital
Tillsonburg District Memorial Hospital
Wingham and District Hospital
Woodstock General Hospital

**TORONTO CENTRAL**

Baycrest Centre for Geriatric Care
Bridgepoint Hospital
Centre for Addiction & Mental Health
Hospital for Sick Children
Mount Sinai Hospital
Providence Healthcare
Runnymede Healthcare Centre
St. Joseph's Health Centre (Toronto)
St. Michael's Hospital
Sunnybrook Health Sciences Centre
The Toronto East General Hospital
Toronto Rehabilitation Institute
University Health Network
West Park Healthcare Centre

**WATERLOO WELLINGTON**

Cambridge Memorial Hospital
Grand River Hospital Corporation
Groves Memorial Community Hospital
Guelph General Hospital
Homewood Health Centre
North Wellington Health Care Corporation
St. Joseph's Health Centre, Guelph
St. Mary's General Hospital

**APPENDIX 3-10: QUESTION RELATED TO BARRIERS (2006 OHA SURVEY)**

(Source: OHA internal documents)

What are the ***most* significant** barriers to successfully implementing e-Health solutions that will improve the patient care process in your organization ***today***? (**Please select three**).

| | |
|---|---|
| Lack of adequate financial support | ○ |
| Lack of qualified staff or access to qualified staff | ○ |
| Lack of clinician support | ○ |
| Difficulty in achieving end-user acceptance or use | ○ |
| Lack of top management support | ○ |
| Lack of strategic Information & Communication Technology (ICT) plan | ○ |
| Lack of change management strategies and re-engineering processes | ○ |
| Hospital has not defined need | ○ |
| Vendor's inability to effectively deliver product/ solution does not meet needs | ○ |
| Need to establish and adopt data standards | ○ |
| Solution not yet scheduled | ○ |
| Lack of infrastructural or prerequisite technology | ○ |
| None | ○ |

**APPENDIX 3-11: QUESTION RELATED TO DEDICATED RESOURCES – 2006 OHA SURVEY**

(Source: OHA internal documents)

99. Does your hospital have qualified resources dedicated to the following?

| | N | Y | N/A |
|---|---|---|---|
| Project Management | ○ | ○ | ○ |
| Change Management | ○ | ○ | ○ |
| Process Reengineering | ○ | ○ | ○ |
| Interface Development | ○ | ○ | ○ |
| IS Support in End User Departments | ○ | ○ | ○ |
| Nursing Informatics | ○ | ○ | ○ |
| Decision Support | ○ | ○ | ○ |
| Clinical Systems Training | ○ | ○ | ○ |
| Regional Infrastructure | ○ | ○ | ○ |

**APPENDIX 3-12: HOSPITAL SUMMARY SHEET**

## ALL HOSPITALS

**(Sorted by Highest to Lowest Change in Percentage Score)**

| | 2006 Adoption Scores | | 2007 Adoption Scores | | | |
|---|---|---|---|---|---|---|
| | OHA | Improve-IT | OHA | Improve-IT | Change in Score (2007-06) | Percentage Change (2007-06) |
| North Wellington Health Care Corporation | 33.73 | 35.84 | 63.95 | 65.95 | **30.11** | **84.00** |
| West Park Healthcare Centre | 32.74 | 29.07 | 49.08 | 46.09 | **17.03** | **58.58** |
| Toronto Rehabilitation Institute | 31.11 | 30.83 | 51.98 | 48.77 | **17.93** | **58.16** |
| Blind River District Health Centre | 29.04 | 32.77 | 55.02 | 51.17 | **18.40** | **56.14** |
| Groves Memorial Community Hospital | 38.41 | 37.77 | 54.31 | 57.98 | **20.21** | **53.52** |
| St. Joseph's Healthcare Hamilton | 39.48 | 41.49 | 62.45 | 63.65 | **22.16** | **53.42** |
| Woodstock General Hospital | 45.60 | 52.72 | 81.07 | 79.57 | **26.85** | **50.94** |
| Windsor Regional Hospital | 47.56 | 51.24 | 74.33 | 74.11 | **22.87** | **44.64** |
| The Stevenson Memorial Hospital | 38.97 | 38.28 | 55.54 | 54.79 | **16.51** | **43.13** |
| Cornwall Community Hospital / Hôpital communautaire de Corı | 35.40 | 38.83 | 54.85 | 55.19 | **16.36** | **42.12** |
| Nipigon District Memorial Hospital | 57.15 | 51.69 | 73.51 | 71.68 | **20.00** | **38.69** |
| Mattawa General Hospital | 20.62 | 22.22 | 30.25 | 30.59 | **8.36** | **37.64** |
| Homewood Health Centre | 18.53 | 21.83 | 27.63 | 29.61 | **7.78** | **35.67** |
| Carleton Place & District Memorial Hospital | 25.30 | 28.99 | 40.67 | 39.01 | **10.03** | **34.59** |
| South Bruce Grey Health Centre | 59.28 | 60.57 | 75.19 | 78.49 | **17.92** | **29.59** |
| Hanover and District Hospital | 58.12 | 59.93 | 74.13 | 77.42 | **17.49** | **29.18** |
| Lennox and Addington County General Hospital | 41.75 | 48.15 | 60.83 | 61.72 | **13.57** | **28.19** |
| Lady Dunn Health Centre | 43.01 | 42.91 | 57.07 | 54.96 | **12.06** | **28.10** |
| St. John's Rehabilitation Hospital | 32.57 | 28.90 | 42.04 | 36.63 | **7.72** | **26.72** |
| Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Cat | 49.92 | 49.58 | 57.84 | 60.90 | **11.32** | **22.83** |
| Manitouwadge General Hospital | 45.51 | 41.47 | 47.94 | 50.54 | **9.07** | **21.87** |
| Kemptville District Hospital | 43.14 | 38.26 | 51.52 | 46.30 | **8.04** | **21.01** |
| Alexandra Marine & General Hospital | 50.60 | 55.73 | 70.97 | 66.85 | **11.11** | **19.94** |
| Joseph Brant Memorial Hospital | 45.75 | 54.26 | 62.24 | 64.72 | **10.46** | **19.28** |
| Northeast Mental Health Centre | 39.39 | 41.19 | 46.94 | 48.84 | **7.65** | **18.58** |
| Almonte General Hospital | 20.78 | 18.26 | 28.76 | 21.63 | **3.37** | **18.45** |
| The Scarborough Hospital | 59.33 | 66.67 | 70.14 | 78.90 | **12.23** | **18.35** |
| Bridgepoint Hospital | 57.17 | 55.98 | 65.38 | 66.25 | **10.27** | **18.34** |
| Homepayne Community Hospital | 28.83 | 27.90 | 30.22 | 32.98 | **5.08** | **18.21** |

| | 2006 Adoption Scores | | 2007 Adoption Scores | | | |
|---|---|---|---|---|---|---|
| | OHA | Improve-IT | OHA | Improve-IT | Change in Score (2007-06) | Percentage Change (2007-06) |
| Hawkesbury & District General Hospital | 59.42 | 50.74 | 60.29 | 59.14 | **8.40** | **16.55** |
| St. Joseph's Health Centre (Toronto) | 66.78 | 65.77 | 81.16 | 76.60 | **10.83** | **16.46** |
| Listowel Memorial Hospital | 70.71 | 76.16 | 78.79 | 88.48 | **12.31** | **16.16** |
| London Health Sciences Centre | 79.09 | 77.48 | 89.22 | 89.01 | **11.52** | **14.87** |
| Sunnybrook Health Sciences Centre | 77.06 | 80.67 | 93.66 | 91.84 | **11.17** | **13.85** |
| Red Lake Margaret Cochenour Memorial Hospital | 60.58 | 57.79 | 70.84 | 65.60 | **7.81** | **13.52** |
| St. Joseph's Health Care, London | 80.26 | 78.55 | 89.22 | 89.01 | **10.46** | **13.32** |
| Royal Ottawa Health Care Group | 29.42 | 29.70 | 34.55 | 33.55 | **3.85** | **12.95** |
| Atikokan General Hospital | 50.11 | 49.81 | 59.42 | 56.09 | **6.28** | **12.60** |
| Bluewater Health | 64.05 | 73.26 | 82.06 | 81.91 | **8.65** | **11.81** |
| Riverside Health Care Facilities Inc. | 37.08 | 34.95 | 38.52 | 39.01 | **4.06** | **11.62** |
| Chatham-Kent Health Alliance | 60.21 | 67.20 | 75.61 | 74.82 | **7.62** | **11.35** |
| Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingst | 53.31 | 57.80 | 63.68 | 63.59 | **5.79** | **10.01** |
| Timmins & District Hospital - L'Hopital de Timmins et du district | 59.75 | 62.06 | 68.82 | 68.26 | **6.21** | **10.00** |
| Thunder Bay Regional Health Sciences Centre | 58.52 | 54.61 | 60.33 | 59.93 | **5.32** | **9.74** |
| Headwaters Health Care Centre | 48.66 | 56.56 | 55.32 | 62.01 | **5.45** | **9.63** |
| Mount Sinai Hospital | 63.80 | 66.13 | 77.56 | 72.34 | **6.21** | **9.39** |
| Campbellford Memorial Hospital | 66.05 | 76.32 | 77.76 | 83.33 | **7.02** | **9.20** |
| Grand River Hospital Corporation | 62.14 | 66.84 | 67.07 | 72.87 | **6.03** | **9.02** |
| Grey Bruce Health Services | 73.31 | 73.05 | 76.93 | 79.61 | **6.56** | **8.98** |
| Centre for Addiction & Mental Health | 45.28 | 48.25 | 49.31 | 52.53 | **4.29** | **8.88** |
| Wilson Memorial General Hospital | 44.04 | 44.62 | 45.77 | 48.58 | **3.96** | **8.87** |
| Northumberland Hills Hospital | 53.71 | 65.56 | 67.96 | 71.20 | **5.64** | **8.60** |
| Norfolk General Hospital | 75.08 | 70.93 | 75.54 | 76.70 | **5.77** | **8.13** |
| Deep River and District Hospital | 56.44 | 46.38 | 47.50 | 50.00 | **3.62** | **7.81** |
| Rouge Valley Health System | 58.05 | 62.23 | 61.38 | 67.02 | **4.79** | **7.69** |
| Montfort Hospital | 59.99 | 61.11 | 67.22 | 65.78 | **4.67** | **7.64** |
| Humber River Regional Hospital | 68.21 | 69.50 | 74.37 | 74.29 | **4.79** | **6.89** |
| St. Michael's Hospital | 55.54 | 57.62 | 59.98 | 61.52 | **3.90** | **6.77** |
| York Central Hospital | 55.15 | 63.12 | 63.23 | 67.38 | **4.26** | **6.74** |

| | 2006 Adoption Scores | | 2007 Adoption Scores | | | |
|---|---|---|---|---|---|---|
| | OHA | Improve-IT | OHA | Improve-IT | Change in Score (2007-06) | Percentage Change (2007-06) |
| Quinte Healthcare Corporation | 65.38 | 67.74 | 70.47 | 72.16 | **4.42** | **6.53** |
| Cambridge Memorial Hospital | 65.36 | 69.78 | 69.10 | 74.29 | **4.51** | **6.46** |
| Tillsonburg District Memorial Hospital | 63.69 | 65.75 | 69.64 | 69.96 | **4.21** | **6.41** |
| Brant Community Healthcare System | 56.17 | 60.99 | 56.97 | 64.89 | **3.90** | **6.40** |
| Hotel-Dieu Grace Hospital (Windsor) | 64.96 | 67.73 | 68.60 | 71.81 | **4.08** | **6.02** |
| William Osler Health Centre | 65.49 | 75.38 | 77.74 | 79.61 | **4.23** | **5.61** |
| The Toronto East General Hospital | 61.97 | 62.06 | 63.28 | 65.43 | **3.37** | **5.43** |
| Hospital for Sick Children | 71.70 | 74.11 | 74.66 | 77.66 | **3.55** | **4.78** |
| Hamilton Health Sciences Corporation | 59.73 | 67.55 | 67.24 | 70.57 | **3.01** | **4.46** |
| Bloorview Kids Rehab | 63.54 | 68.46 | 66.54 | 71.46 | **3.00** | **4.38** |
| Haliburton Highlands Health Services Corporation | 27.76 | 29.57 | 28.37 | 30.85 | **1.28** | **4.33** |
| Markham Stouffville Hospital | 69.45 | 71.63 | 74.42 | 74.65 | **3.01** | **4.21** |
| Huronia District Hospital | 52.55 | 56.81 | 57.82 | 59.14 | **2.33** | **4.10** |
| Baycrest Centre for Geriatric Care | 71.40 | 75.32 | 72.91 | 78.33 | **3.02** | **4.01** |
| Pembroke Regional Hospital Inc. | 63.58 | 58.16 | 64.16 | 60.46 | **2.30** | **3.96** |
| Brockville General Hospital | 70.78 | 71.25 | 71.14 | 74.05 | **2.81** | **3.94** |
| St. Thomas Elgin General Hospital | 66.88 | 72.52 | 73.56 | 75.35 | **2.84** | **3.91** |
| Sault Area Hospital | 62.95 | 60.46 | 64.55 | 62.77 | **2.30** | **3.81** |
| St. Joseph's Care Group (Thunder Bay) | 58.71 | 56.10 | 60.34 | 58.14 | **2.05** | **3.65** |
| Chapleau Health Services / Services De Santé De Chapleau | 63.58 | 69.88 | 70.79 | 72.35 | **2.47** | **3.53** |
| Guelph General Hospital | 63.62 | 69.68 | 64.05 | 71.99 | **2.30** | **3.31** |
| Southlake Regional Health Centre | 60.95 | 67.55 | 65.78 | 69.68 | **2.13** | **3.15** |
| Halton Healthcare Services Corporation | 64.64 | 68.46 | 68.94 | 70.61 | **2.15** | **3.14** |
| Niagara Health System | 56.72 | 66.13 | 65.15 | 67.93 | **1.80** | **2.72** |
| Peterborough Regional Health Centre | 58.08 | 61.52 | 62.14 | 63.12 | **1.60** | **2.59** |
| Englehart & District Hospital | 69.14 | 71.08 | 70.91 | 72.64 | **1.56** | **2.20** |
| The Board of Governors of the Kingston Hospital | 62.53 | 61.70 | 63.95 | 63.04 | **1.34** | **2.17** |
| University Health Network | 74.57 | 76.77 | 76.81 | 78.37 | **1.60** | **2.08** |
| North Bay General Hospital | 60.37 | 68.09 | 62.54 | 69.33 | **1.24** | **1.82** |
| Penetanguishene General Hospital | 53.23 | 56.25 | 56.64 | 57.20 | **0.95** | **1.69** |

| | 2006 Adoption Scores | | 2007 Adoption Scores | | | |
|---|---|---|---|---|---|---|
| | OHA | Improve-IT | OHA | Improve-IT | Change in Score (2007-06) | Percentage Change (2007-06) |
| Queensway Carleton Hospital | 68.97 | 69.86 | 69.43 | 70.92 | **1.06** | **1.52** |
| Collingwood General and Marine Hospital | 48.78 | 61.05 | 57.51 | 61.83 | **0.78** | **1.27** |
| North York General Hospital | 65.78 | 69.35 | 68.29 | 69.68 | **0.33** | **0.47** |
| St. Joseph's General Hospital Elliot Lake | 70.77 | 64.87 | 63.06 | 64.36 | **-0.51** | **-0.79** |
| Glengarry Memorial Hospital | 51.46 | 48.67 | 51.16 | 47.99 | **-0.69** | **-1.42** |
| Providence Continuing Care Centre | 53.37 | 60.00 | 54.24 | 58.87 | **-1.13** | **-1.88** |
| The Royal Victoria Hospital of Barrie | 53.83 | 61.83 | 55.30 | 60.64 | **-1.19** | **-1.92** |
| Lake of the Woods District Hospital | 43.49 | 45.39 | 49.49 | 44.50 | **-0.89** | **-1.95** |
| Kirkland and District Hospital | 71.32 | 70.74 | 67.77 | 69.33 | **-1.42** | **-2.01** |
| Children's Hospital of Eastern Ontario | 57.50 | 58.51 | 60.77 | 57.27 | **-1.24** | **-2.12** |
| The Ottawa Hospital | 70.32 | 69.38 | 67.82 | 67.91 | **-1.48** | **-2.13** |
| West Lincoln Memorial Hospital | 43.36 | 41.88 | 39.16 | 40.94 | **-0.93** | **-2.23** |
| Hopital regional de Sudbury Regional Hospital Corporation | 69.91 | 69.93 | 64.72 | 67.57 | **-2.36** | **-3.37** |
| The Credit Valley Hospital | 70.47 | 79.61 | 72.22 | 76.70 | **-2.91** | **-3.65** |
| Perth & Smiths Falls District Hospital | 65.49 | 79.78 | 73.21 | 76.77 | **-3.00** | **-3.76** |
| Muskoka Algonquin Healthcare | 33.14 | 36.70 | 35.16 | 35.28 | **-1.42** | **-3.86** |
| St. Mary's General Hospital | 75.38 | 77.90 | 67.91 | 74.19 | **-3.71** | **-4.76** |
| Smooth Rock Falls Hospital | 59.07 | 53.79 | 54.52 | 50.98 | **-2.81** | **-5.22** |
| Dryden Regional Health Centre | 65.45 | 63.48 | 63.58 | 59.93 | **-3.55** | **-5.59** |
| Sensenbrenner Hospital | 36.80 | 41.29 | 40.45 | 38.77 | **-2.52** | **-6.10** |
| Huron Perth Healthcare Alliance | 65.08 | 71.74 | 61.02 | 67.03 | **-4.71** | **-6.57** |
| Wingham and District Hospital | 69.70 | 75.00 | 67.38 | 70.04 | **-4.96** | **-6.62** |
| Lakeridge Health Corporation | 68.25 | 77.78 | 65.18 | 72.58 | **-5.20** | **-6.68** |
| Leamington District Memorial Hospital | 73.45 | 73.40 | 71.77 | 68.09 | **-5.32** | **-7.25** |
| Alexandra Hospital | 75.65 | 76.74 | 70.52 | 71.15 | **-5.59** | **-7.29** |
| Trillium Health Centre | 68.66 | 71.99 | 67.55 | 65.96 | **-6.03** | **-8.37** |
| Runnymede Healthcare Centre | 26.38 | 28.45 | 24.48 | 25.52 | **-2.93** | **-10.29** |
| Strathroy Middlesex General Hospital | 72.98 | 72.29 | 63.30 | 64.54 | **-7.75** | **-10.72** |
| The West Nipissing General Hospital | 53.93 | 54.26 | 48.46 | 48.23 | **-6.03** | **-11.11** |
| Providence Healthcare | 28.09 | 33.59 | 30.38 | 29.72 | **-3.87** | **-11.51** |

| | 2006 Adoption Scores | | 2007 Adoption Scores | | | |
|---|---|---|---|---|---|---|
| | OHA | Improve-IT | OHA | Improve-IT | Change in Score (2007-06) | Percentage Change (2007-06) |
| Four Counties Health Services | 77.15 | 73.14 | 63.30 | 64.54 | **-8.60** | **-11.76** |
| St. Francis Memorial Hospital | 53.17 | 47.73 | 42.99 | 41.85 | **-5.88** | **-12.32** |
| Orillia Soldiers' Memorial Hospital | 65.57 | 66.49 | 59.68 | 57.98 | **-8.51** | **-12.79** |
| Whitby Mental Health Centre | 42.27 | 50.22 | 39.81 | 42.92 | **-7.30** | **-14.54** |
| Espanola General Hospital | 56.67 | 59.90 | 50.17 | 50.79 | **-9.10** | **-15.20** |
| Manitoulin Health Centre | 71.45 | 67.05 | 54.34 | 56.73 | **-10.33** | **-15.40** |
| Sioux Lookout Meno-Ya-Win Health Centre | 61.75 | 58.16 | 50.51 | 48.76 | **-9.40** | **-16.16** |
| The Amprior and District Memorial Hospital | 52.30 | 48.70 | 45.85 | 39.96 | **-8.74** | **-17.94** |
| St. Joseph's Health Centre, Guelph | 60.01 | 63.95 | 40.38 | 52.47 | **-11.48** | **-17.95** |
| Temiskaming Hospital | 74.85 | 78.37 | 55.51 | 62.37 | **-16.00** | **-20.42** |
| Renfrew Victoria Hospital | 66.50 | 69.26 | 52.46 | 53.76 | **-15.50** | **-22.37** |
| SCO Health Service | 21.92 | 22.22 | 14.60 | 13.58 | **-8.64** | **-38.89** |

**APPENDIX 3-13: EMAIL CONTAINING DISQUALIFIED PARTICIPATING HOSPITALS**
(Source: Correspondence with OHA)

# Participants not to include in 07 and 06

From: **Martha Murray** (mmurray@oha.com)
Sent: April 25, 2008 8:45:55 AM
To: nancyg74@hotmail.com

_____
Martha Murray
e-Health Analyst
Ontario Hospital Association
200 Front Street West, 28th Floor
Toronto, ON, M5V 3L1
416-205-1312
mmurray@oha.com



----- Forwarded by Martha Murray/OHA on 04/25/2008 11:46 AM -----
**Martha Murray/OHA**
10/22/2007 11:05 AM

To
cc
Subject

2007
138 participants
Make sure the following hospitals do not appear in 2007 data:
Geraldton
Haldimand War Memorial
Mental Health Centre
MICS
Ross Memorial
St. Peter's
The Willet
Winchester

2006
139 participants
Make sure the following hospitals do not appear in 2006 data:
Hopital Notre Dame Hearst
James Bay General
South Huron Hospital Association
Religious Hospitaliers of St. Joseph's Cornwall
The Salvation Army Toronto Grace
West Haldimand General
Women's College

**APPENDIX 3-14: HOSPITALS SEPARATED ACCORDING TO WHETHER ADOPTION SCORES FALL BELOW OR ABOVE THE MEAN**

*Hospitals without shading have adoption scores below the mean; hospitals shaded in grey have adoption scores above the mean

| HOSPITAL | 2007 IMPROVE IT ADOPTION SCORE |
|---|---|
| SCO Health Service | 13.58 |
| Almonte General Hospital | 21.63 |
| Runnymede Healthcare Centre | 25.52 |
| Homewood Health Centre | 29.61 |
| Providence Healthcare | 29.72 |
| Mattawa General Hospital | 30.59 |
| Haliburton Highlands Health Services Corporation | 30.85 |
| Hornepayne Community Hospital | 32.98 |
| Royal Ottawa Health Care Group | 33.55 |
| Muskoka Algonquin Healthcare | 35.28 |
| St. John's Rehabilitation Hospital | 36.63 |
| Sensenbrenner Hospital | 38.77 |
| Riverside Health Care Facilities Inc. | 39.01 |
| Carleton Place & District Memorial Hospital | 39.01 |
| The Arnprior and District Memorial Hospital | 39.96 |
| West Lincoln Memorial Hospital | 40.94 |
| St. Francis Memorial Hospital | 41.85 |
| Whitby Mental Health Centre | 42.92 |
| Lake of the Woods District Hospital | 44.50 |
| West Park Healthcare Centre | 46.09 |
| Kemptville District Hospital | 46.30 |
| Glengarry Memorial Hospital | 47.99 |
| The West Nipissing General Hospital | 48.23 |
| Wilson Memorial General Hospital | 48.58 |
| Sioux Lookout Meno-Ya-Win Health Centre | 48.76 |
| Toronto Rehabilitation Institute | 48.77 |
| Northeast Mental Health Centre | 48.84 |
| Deep River and District Hospital | 50.00 |
| Manitouwadge General Hospital | 50.54 |
| Espanola General Hospital | 50.79 |
| Smooth Rock Falls Hospital | 50.98 |
| Blind River District Health Centre | 51.17 |
| St. Joseph's Health Centre, Guelph | 52.47 |
| Centre for Addiction & Mental Health | 52.53 |
| Renfrew Victoria Hospital | 53.76 |
| The Stevenson Memorial Hospital | 54.79 |

| | |
|---|---|
| Lady Dunn Health Centre | 54.96 |
| Cornwall Community Hospital / Hôpital communautaire de Cornwall | 55.19 |
| Atikokan General Hospital | 56.09 |
| Manitoulin Health Centre | 56.73 |
| Penetanguishene General Hospital | 57.20 |
| Children's Hospital of Eastern Ontario | 57.27 |
| Orillia Soldiers' Memorial Hospital | 57.98 |
| Groves Memorial Community Hospital | 57.98 |
| St. Joseph's Care Group (Thunder Bay) | 58.14 |
| Providence Continuing Care Centre | 58.87 |
| Hawkesbury & District General Hospital | 59.14 |
| Huronia District Hospital | 59.14 |
| Dryden Regional Health Centre | 59.93 |
| Thunder Bay Regional Health Sciences Centre | 59.93 |
| Pembroke Regional Hospital Inc. | 60.46 |
| The Royal Victoria Hospital of Barrie | 60.64 |
| Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Catharines | 60.90 |
| St. Michael's Hospital | 61.52 |
| Lennox and Addington County General Hospital | 61.72 |
| Collingwood General and Marine Hospital | 61.83 |
| Headwaters Health Care Centre | 62.01 |
| Temiskaming Hospital | 62.37 |
| Sault Area Hospital | 62.77 |
| The Board of Governors of the Kingston Hospital | 63.04 |
| Peterborough Regional Health Centre | 63.12 |
| Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston | 63.59 |
| St. Joseph's Healthcare Hamilton | 63.65 |
| St. Joseph's General Hospital Elliot Lake | 64.36 |
| Strathroy Middlesex General Hospital | 64.54 |
| Four Counties Health Services | 64.54 |
| Joseph Brant Memorial Hospital | 64.72 |
| Brant Community Healthcare System | 64.89 |
| The Toronto East General Hospital | 65.43 |
| Red Lake Margaret Cochenour Memorial Hospital | 65.60 |
| Montfort Hospital | 65.78 |
| North Wellington Health Care Corporation | 65.95 |
| Trillium Health Centre | 65.96 |
| Bridgepoint Hospital | 66.25 |
| Alexandra Marine & General Hospital | 66.85 |
| Rouge Valley Health System | 67.02 |
| Huron Perth Healthcare Alliance | 67.03 |

| | |
|---|---|
| York Central Hospital | 67.38 |
| Hopital regional de Sudbury Regional Hospital Corporation | 67.57 |
| The Ottawa Hospital | 67.91 |
| Niagara Health System | 67.93 |
| Leamington District Memorial Hospital | 68.09 |
| Timmins & District Hospital - L'Hopital de Timmins et du district | 68.26 |
| Kirkland and District Hospital | 69.33 |
| North Bay General Hospital | 69.33 |
| Southlake Regional Health Centre | 69.68 |
| North York General Hospital | 69.68 |
| Tillsonburg District Memorial Hospital | 69.96 |
| Wingham and District Hospital | 70.04 |
| Hamilton Health Sciences Corporation | 70.57 |
| Halton Healthcare Services Corporation | 70.61 |
| Queensway Carleton Hospital | 70.92 |
| Alexandra Hospital | 71.15 |
| Northumberland Hills Hospital | 71.20 |
| Bloorview Kids Rehab | 71.46 |
| Nipigon District Memorial Hospital | 71.68 |
| Hotel-Dieu Grace Hospital (Windsor) | 71.81 |
| Guelph General Hospital | 71.99 |
| Quinte Healthcare Corporation | 72.16 |
| Mount Sinai Hospital | 72.34 |
| Chapleau Health Services / Services De Santé De Chapleau | 72.35 |
| Lakeridge Health Corporation | 72.58 |
| Englehart & District Hospital | 72.64 |
| Grand River Hospital Corporation | 72.87 |
| Brockville General Hospital | 74.05 |
| Windsor Regional Hospital | 74.11 |
| St. Mary's General Hospital | 74.19 |
| Humber River Regional Hospital | 74.29 |
| Cambridge Memorial Hospital | 74.29 |
| Markham Stouffville Hospital | 74.65 |
| Chatham-Kent Health Alliance | 74.82 |
| St. Thomas Elgin General Hospital | 75.35 |
| St. Joseph's Health Centre (Toronto) | 76.60 |
| The Credit Valley Hospital | 76.70 |
| Norfolk General Hospital | 76.70 |
| Perth & Smiths Falls District Hospital | 76.77 |
| Hanover and District Hospital | 77.42 |
| Hospital for Sick Children | 77.66 |
| Baycrest Centre for Geriatric Care | 78.33 |

| | |
|---|---|
| University Health Network | 78.37 |
| South Bruce Grey Health Centre | 78.49 |
| The Scarborough Hospital | 78.90 |
| Woodstock General Hospital | 79.57 |
| Grey Bruce Health Services | 79.61 |
| William Osler Health Centre | 79.61 |
| Bluewater Health | 81.91 |
| Campbellford Memorial Hospital | 83.33 |
| Listowel Memorial Hospital | 88.48 |
| London Health Sciences Centre | 89.01 |
| St. Joseph's Health Care, London | 89.01 |
| Sunnybrook Health Sciences Centre | 91.84 |

**APPENDIX 4-1: UPDATED DEFINITION OF FIELDS USED IN DATABASE**

(Source: OHA internal documents)

**Survey Responses**

- ResponseScore (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) = Response Score for an individual question (If Response Included in Response Score = 0; it is set to an empty value; otherwise it shows the value)
- AdjustedResponseScore (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) = Adjusted Response Score for an individual question (If Question Included in Adjusted Score = 0; it is set to an empty value; otherwise it shows the value)

**Organization**

- 2006 EHR Index / 2006 EHR Index as 2007 Adoption Index / 2006 EHR Index as 2008 Adoption Index / 2007 Adoption Index / 2007 Adoption Index as 2008 Adoption Index / 2008 Adoption Index = a value that was calculated based on technical report calculations.
- 2006 EHR Index as 2007 Adoption Index Core / 2006 EHR Index as 2008 Adoption Index Core / 2007 Adoption Index Core / 2007 Adoption Index as 2008 Adoption Index Core / 2008 Adoption Index Core = a value that was calculated based on technical report calculations. **Includes only the Core Questions.**

**Survey Responses**

- Question Included In Adjusted Score (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) = These values signify if the question is included in the score. If included it will display as 1 otherwise an empty value will be displayed.
- Response Included In Response Score (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) = These values signify if the response is included in the score. If included it will display as 1 otherwise an empty value will be displayed.

**Survey Section Scores**

- Adjusted Section Score (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) (calculated by averaging Adjusted Sub Section Scores). Uses the sub-section scores to calculate the section scores.
- Adjusted Section Score (2006As2007 Core, 2006As2008 Core, 2007 Core, 2007As2008 Core, 2008 Core) (calculated by averaging Adjusted Sub Section Scores). Uses the sub-section scores to calculate the section scores. **Includes only the Core Questions.**

**Survey Sub Section Scores**

- Adjusted Sub Section Score (2006, 2006As2007, 2006As2008, 2007, 2007As2008, 2008) (calculated by averaging Adjusted Response Scores). These values were added to calculate the section scores, because the cube calculates section scores by averaging all of the questions in that particular section instead the average of the sub-sections were needed to calculate the section scores.
- Adjusted Sub Section Score (2006As2007 Core, 2006As2008 Core, 2007 Core, 2007As2008 Core, 2008 Core) (calculated by averaging Adjusted Response Scores). These values were added to calculate the section scores, because the cube calculates section scores by averaging all of the questions in that particular section instead the average of the sub-sections were needed to calculate the section scores. **Includes only the Core Questions.**

**APPENDIX 4-2: 2008 E-HEALTH ADOPTION SURVEY QUESTIONS**

(Source: OHA internal documents)

Section 1: Level of e-Health Functional Capability and Use
1.1 Patient Registration, Records Management and Registry Services
Using the Capability and Use Legend, please indicate the level of electronic capability in your organization for each of the following questions.
If your answer falls between selections, please choose the selection that best fits your current situation.
Answer Main Reason
CORE 1
Electronically register all patients in your primary hospital information system in the inpatient setting
CORE 2
Electronically register all patients in your primary hospital information system in the emergency setting
CORE 3
Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting
CORE 4
Electronically maintain an up-to-date care provider directory that includes full name, addresses, physical location and contact information within your primary hospital information system
CORE 5
Electronically track different care providers treating a single patient in your primary hospital information system
CORE 6
Electronically generate different lists of patients sorted by variables, such as active patients by inhospital unit location, most responsible care provider, discharge patient, etc.
CORE 7
Electronically capture patient and family preferences regarding issues important to the delivery of care (e.g. language or emergency contact information)
CORE 8
Electronically capture a record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient
CORE 9
Electronically capture relevant health conditions of family members, including pertinent positive and negative histories
CORE 10
Electronically capture patient-reported clinical information
CORE 11
Electronically capture a medication profile
CORE 12
Electronically capture a summary of allergies and adverse reactions
CORE 13
Electronically capture a summary of patient problems maintained by nursing and allied health.

1.2 Order Entry
Electronic order entry requires that the capability exists to order diagnostic tests (such as labs, digital images, and/or other order sets) and medications in the inpatient, emergency or hospital outpatient clinic setting. Transcribing orders from paper requisitions in the ancillary department (e.g. laboratory orders electronically transcribed by a laboratory technician in the laboratory) is not electronic order entry.
Using the Capability and Use Legend, please indicate the level of electronic capability in your organization for each of the following questions.
If your answer falls between selections, please choose the selection that best fits your current situation.

Order Entry CPOE
Answer
CORE
Main Reason
CORE
Answer Main Reason
CORE 1
Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the inpatient setting
CORE 2
Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the emergency setting
CORE 3
Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the hospital outpatient clinic setting
CORE 4
Electronically order pathology exams at bedside or at nursing station
CORE 5
Electronically order ECGs at bedside or at nursing station in the inpatient setting
CORE 6
Electronically order ECGs at bedside or at nursing station in the emergency setting
CORE 7
Electronically order ECGs at bedside or at nursing station in the hospital outpatient clinic setting
CORE 8
Electronically order diagnostic imaging examinations at bedside or at nursing station in the inpatient setting
CORE 9
Electronically order diagnostic imaging examinations at bedside or at nursing station in the emergency setting
CORE 10
Electronically order diagnostic imaging examinations at bedside or at nursing station in the hospital outpatient clinic setting
CORE 11
Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew orders in the inpatient setting
CORE 12
Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the emergency setting
CORE 13
Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the outpatient setting
CORE 14
Electronically order chemotherapy medications supported by standard chemotherapy treatment protocols
CORE 15
Electronically provide generic and brand name drug information to the provider at the time of ordering (e.g. alternate drug names, prescribing guidelines or contraindications)
CORE 16
Electronically provide clinical decision support at time of ordering medications (e.g. real-time alerts, suggested corollary orders, notification of duplicate orders, institution-specific orders)
17
Electronically provide clinical decision support at time of ordering diagnostic tests (e.g. real-time alerts, suggested corollary order, notification of duplicate orders, institution-specific orders)
18
Identify and present appropriate dose recommendations based on patient-specific conditions and characteristics at the time of medication ordering (e.g. drug-condition interactions) and patient specific contraindications and

warnings (e.g. pregnancy, breast-feeding or occupational risks, preferences of the patient such as reluctance to use an antibiotic)
CORE 19
Electronically provide order sets at bedside or nursing station (e.g. diagnosis-specific, care-plan specific or standing orders)
CORE 20
Electronically document and track consults between care providers in the organization

1.3 Clinical Documentation
Using the Capability and Use Legend, please indicate the level of electronic capability and use in your organization for each of the following questions.
If your answer falls between selections, please choose the selection that best fits your current situation.
Answer Main Reason
CORE 1
Electronically create and modify transcribed or directly entered patient pathology reports
CORE 2
Electronically create and modify transcribed or directly entered diagnostic imaging reports
CORE 3
Electronically create and modify transcribed or directly entered discharge summaries
CORE 4
Electronically create and modify transcribed or directly entered surgical reports
CORE 5
Electronically create and modify transcribed or directly entered consultant notes or reports (excluding nursing and multi-disciplinary assessments)
CORE 6
Electronically capture and send discharge medication instructions to other providers outside your hospital (non-acute facilities, community physicians, etc.)
CORE 7
Electronically capture relevant structured data (e.g. blood pressure, heart rate) from monitors at the point of care in the inpatient setting to the EPR
CORE 8
Electronically capture relevant structured data (e.g., blood pressure, heart rate) from monitors at the point-of-care in the hospital outpatient clinic setting to the EPR/ EMR
CORE 9
Electronically document medication administration record (MAR) in the inpatient setting
CORE 10
Electronically document medication administration record (MAR) in the emergency setting
11
Electronically capture patient related incidents or adverse events in an incident reporting/risk management system or database
12
Electronically integrate captured record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient to the EPR/ EMR
13
Electronically integrate relevant health conditions of family members, including pertinent positive and negative histories to the EPR/ EMR
14
Electronically integrate patient-reported clinical information to the EPR/ EMR
15
Electronically integrate a medication profile to the EPR/ EMR
16
Electronically integrate a summary of allergies and adverse reactions to the EPR/ EMR
17

Electronically integrate a summary of patient problems maintained by nursing and allied health to the EPR/EMR

CORE 18
Provide access to a comprehensive medication profile from the Ontario Drug Benefit database (ODB) in the emergency setting

1.4 Results Reporting
Using the Capability and Use Legend, please indicate the level of electronic capability in your organization for each of the following questions.
If your answer falls between selections, please choose the selection that best fits your current situation.
Answer Main Reason
CORE 1
Electronically capture and present patient general laboratory and microbiology test results in the inpatient setting
CORE 2
Electronically capture and present patient general laboratory and microbiology test results in the emergency setting
CORE 3
Electronically capture and present patient general laboratory and microbiology test results to the appropriate care providers in the hospital outpatient clinic setting
CORE 4
Electronically provide laboratory result interpretations
CORE 5
Electronically provide notification/alerts of abnormal laboratory results
CORE 6
Electronically present patient pathology reports
CORE 7
Electronically present diagnostic imaging reports in the inpatient setting
CORE 8
Electronically present diagnostic imaging reports in the emergency setting
CORE 9
Electronically present diagnostic imaging reports in the hospital outpatient clinic setting
CORE 10
Electronically store most diagnostic images in a PACS
11
Electronically provide access to images stored in a PACS at the appropriate points of care
CORE 12
Electronically provide structured patient data (e.g. blood pressure, heart rate) in flowsheets or graphs to view or uncover trends in critical care, and general inpatient settings
CORE 13
Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the inpatient setting
CORE 14
Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital emergency setting
CORE 15
Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital outpatient clinic setting
CORE 16
Electronically present results information to patients via a patient portal

1.5 Information Infrastructure
Using the Capability and Use Legend, please indicate the level of electronic capability and use in your organization for each of the following questions.

If your answer falls between selections, please choose the selection that best fits your current situation.
Answer Main Reason
CORE 1
Authenticate authorized users when they attempt to access the EPR/ EMR
CORE 2
Enable EPR security administrators to grant role-based authorization based on the responsibility or function of the user (e.g. nurse, dietician, administrator, or auditor)
CORE 3
Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives
CORE 4
Electronically provide indicators or flags to indicate that certain data has been 'masked' or hidden from view (e.g. lockbox)
CORE 5
Electronically allow 'break the glass' provision to allow authorized care providers emergency access to all data, including masked data
CORE 6
Electronically enable authorized care providers to restrict access to a patient's personal health information that is potentially harmful to the patient
CORE 7
Archive EPR data and clinical documents for the time period designated by policy or legal requirement in a format retrievable across iterations of technology changes
8
Secure Personal Health Information (PHI) that is electronically transmitted or accessed off-site using robust encryption technology
9
Encrypt PHI stored on portable devices or media (e.g. laptop, PDA, USB key)
10
Complete a Threat/Risk Assessment (TRA) annually or following a significant infrastructure change to identify organizational strengths and weaknesses in data protection and data security practices through the evaluation of security protocols, policies, and procedures.
CORE 11
Electronically provide a security audit that logs access attempts and if any actual or attempted security violations occurred
CORE 12
Electronically provide a data audit that records who, when and by which system an EPR record was created, updated, viewed, extracted, or archived/deleted
CORE 13
Electronically verify patient treatment decisions and advance directives when required against electronically maintained consents and authorizations
CORE 14
Use secure email for sharing clinical information between care providers within the same organization
CORE 15
Use a secure electronic document management system for sharing clinical information between care providers within the same organization
CORE 16
Provide high speed (at least 100MBit/sec) network connection to every clinical desktop
CORE 17
Extract EPR data for the purposes of analyzing and planning patient care or outcomes for administrative management purposes
CORE 18
Provide secure remote access for physicians
CORE 19

Electronically provide sufficient redundancy that guarantees 24/7 access to patient information

Section 2: Level of e-Health Organizational Capacity
2.1 e-Health Leadership and Planning
Does your organization currently have the following?
Y N
CORE 1
A Chief Information Officer (CIO) or recognized equivalent with the delegated responsibility (it may not be their only responsibility) at your organization (not at the LHIN/Regional level)? ○ ○
If yes: Does the CIO or equivalent report to a: (please check all that apply)
Director
VP
Executive VP
COO (Chief Operating Officer)
CFO (Chief Financial Officer)
CEO (Chief Executive Officer)
Other, please specify:
2
A Privacy and/or Security Officer or recognized equivalent with the delegated responsibility (it may not be their only responsibility) at your organization (not at the LHIN/Regional level)? ○ ○
If yes: Does the Privacy and/or Security Officer or equivalent report to a: (please check all that apply)
Director
VP
Executive VP
COO (Chief Operating Officer)
CFO (Chief Financial Officer)
CEO (Chief Executive Officer)
Other, please specify:
CORE 3
A board-approved e-Health strategic plan? ○ ○
4
An Information Security policy ○ ○
CORE 5
Identified change management and reengineering leadership capacity to encourage end-user adoption of your e-Health? ○ ○
CORE 6
An approved project management methodology and resources to support large scale IT initiatives? ○ ○
CORE 7
Is e-Health part of your organizational plan? ○ ○

2.2 e-Health Priorities
1. Please indicate your organization's top e-Health priorities today. (Please select five).
Replace/Upgrade Ambulatory Care Clinical Systems ○
Replace/Upgrade Inpatient Clinical Systems ○
Implement a Computer-Based Electronic Patient Record System (EPR) ○
Implement Computer-Based Practitioner Order Entry (CPOE) ○
Integrate Business Intelligence/Decision Support Systems (e.g. data warehouse) ○
Integrate Point-of-Care Clinical Decision Support ○
Integrate Systems in Multi-Vendor Environment ○
Portal Technology to Present Disparate Data via CDR ○
Patient Portal for Patient Education/Support/Monitoring etc. ○
Upgrade Network Infrastructure (LANs, WANs) ○
Enterprise Scheduling for Patients ○

Improve IS Departmental Services, Cost Effectiveness and Efficiencies ○
Implement Wireless Systems (e.g. Wireless LANs) ○
Implement Technology to Reduce Medical Errors/Promote Patient Safety ○
Implement Bar Coded Medication Management ○
Implement Picture Archiving and Communications System (PACS) ○
Upgrade Security on IT Systems to Meet PHIPPA Requirements ○
Upgrade Security on IT Systems to Meet SSHA Requirements ○
Adopt provincially approved Ontario health information standards ○
Train and Support Personnel to Use Existing and Newly Installed Systems ○
Outsource (e.g. ASPs, Infrastructure, Other Services) ○
Other (please specify) ○
Other (Please specify) ○
Other (Please specify) ○

Section 3: Level of Regional/Inter-Organizational e-Health
These questions are focused on understanding the electronic sharing of documents for your EPR between two or more health care organizations. These organizations could belong to a group crossing the continuum of care (such as a hospital and homecare) or a network focusing on a specialized group of patients (such as children) or a group of organizations treating patients in the same geographic region (such as a LHIN).

3.1 Inter-Organizational Data Sharing for your EPR
The questions in this section refer to what your organization electronically shares, as defined by both the providing and receiving of information to and from various care delivery organizations or practitioners. For each type of information that your organization shares with various care delivery organizations or practitioners, please use the Data Sharing Legend to indicate how this information is electronically shared (remote access, interoperable systems or both) and how frequently it is shared.
Yes No
1. Does your hospital corporation currently (or is in the process of developing the functionality to) electronically share data outside your hospital corporation?
○ ○
If "Yes" please answer the following with reference to Outside your Hospital Corporation.
Yes No N/A
a) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share admission histories and physical exams outside your hospital corporation?
○ ○
If YES, indicate for admission histories and physical exams if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share admission histories and physical exams outside your hospital corporation
Yes No N/A
b) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share discharge summaries outside your hospital corporation?
○ ○
If YES, indicate for discharge summaries if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system

Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share discharge summaries outside your hospital corporation
Yes No N/A
c) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share patient referrals outside your hospital corporation?
○ ○
If YES, indicate for patient referrals if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share patient referrals outside your hospital corporation
Yes No N/A
d) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share drug profiles outside your hospital corporation?
If YES, indicate for drug profiles if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share drug profiles outside your hospital corporation
Yes No N/A
e) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share lab results outside your hospital corporation?
○ ○
If YES, indicate for lab results if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share lab results outside your hospital corporation
Yes No N/A
f) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share diagnostic images (PACS) outside your hospital corporation?
○ ○
If YES, indicate for diagnostic images if you electronically share outside your corporation using:

Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share diagnostic images outside your hospital corporation
Yes No N/A
g) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share reports (imaging, surgical/procedural) outside your hospital corporation?
○ ○
If YES, indicate for reports (imaging, surgical/procedural) if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share reports (imaging, surgical/procedural) outside your hospital corporation
Yes No N/A
h) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share ER/ED visit encounter summaries outside your hospital corporation?
○ ○
If YES, indicate for ER/ED visit encounter summaries if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share ER/ED visit encounter summaries outside your hospital corporation
Yes No
2. Does your hospital corporation currently (or is in the process of developing the functionality to) electronically share data with consulting physicians in the community (GP, FHT, etc.)?
○ ○
If "Yes" please answer the following with reference to Consulting Physicians in the Community.
Yes No N/A
a) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share admission histories and physical exams outside your hospital corporation?
○ ○
If YES, indicate for admission histories and physical exams if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○

Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share admission histories and physical exams outside your hospital corporation
Yes No N/A
b) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share discharge summaries outside your hospital corporation?
○ ○
If YES, indicate for discharge summaries if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share discharge summaries outside your hospital corporation
Yes No N/A
c) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share patient referrals outside your hospital corporation?
○ ○
If YES, indicate for patient referrals if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share patient referrals outside your hospital corporation
Yes No N/A
d) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share drug profiles outside your hospital corporation?
○ ○
If YES, indicate for drug profiles if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share drug profiles outside your hospital corporation
○ ○
Yes No N/A
e) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share lab results outside your hospital corporation?
If YES, indicate for lab results if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both

○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share lab results outside your hospital corporation
Yes No N/A
f) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share diagnostic images (PACS) outside your hospital corporation?
○ ○
If YES, indicate for diagnostic images if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share diagnostic images outside your hospital corporation
Yes No N/A
g) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share reports (imaging, surgical/procedural) outside your hospital corporation?
○ ○
If YES, indicate for reports (imaging, surgical/procedural) if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share reports (imaging, surgical/procedural) outside your hospital corporation
Yes No N/A
h) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share ER/ED
visit encounter summaries outside your hospital corporation?
○ ○
If YES, indicate for ER/ED visit encounter summaries if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share ER/ED visit encounter summaries outside your hospital corporation
Yes No
3. Does your hospital corporation currently (or is in the process of
developing the functionality to) electronically share data with other
healthcare organizations (CCACs etc.)?
○ ○

If "Yes" please answer the following with reference to Other
Healthcare Organizations.
Yes No N/A
a) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share admission histories and physical exams outside your hospital corporation?
○ ○
If YES, indicate for admission histories and physical exams if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share admission histories and physical exams outside your hospital corporation
Yes No N/A
b) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share discharge summaries outside your hospital corporation?
○ ○
If YES, indicate for discharge summaries if you electronically share outside
your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share discharge summaries outside your hospital corporation
Yes No N/A
c) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share patient referrals outside your hospital corporation?
○ ○
If YES, indicate for patient referrals if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share patient referrals outside your hospital corporation
Yes No N/A
d) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share drug profiles outside your hospital corporation?
○ ○
If YES, indicate for drug profiles if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both

○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share drug profiles outside your hospital corporation
Yes No N/A
e) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share lab results outside your hospital corporation?
○ ○
If YES, indicate for lab results if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share lab results outside your hospital corporation
Yes No N/A
f) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share diagnostic images (PACS) outside your hospital corporation?
○ ○
If YES, indicate for diagnostic images if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
Both
○
○
○
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share diagnostic images outside your hospital corporation
Yes No N/A
g) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share reports (imaging, surgical/procedural) outside your hospital corporation?
○ ○
If YES, indicate for reports (imaging, surgical/procedural) if you electronically share outside your corporation using:
Remote access, portal, or similar tool
An interoperable electronic system
○
○
○
Both
Answer Main Reason
Using the Data Sharing Legend, please indicate the level of electronic capability to share reports (imaging, surgical/procedural) outside your hospital corporation
Yes No N/A
h) Indicate whether your hospital corporation currently (or is in the process of developing the functionality to) electronically share ER/ED visit encounter summaries outside your hospital corporation?
○ ○
If YES, indicate for ER/ED visit encounter summaries if you electronically share outside your corporation using:
Remote access, portal, or similar tool

An interoperable electronic system
Both
○
○
○

Section 3: Level of Regional/Inter-Organizational e-Health
3.2 Interoperability for a Shared EHR
This section focuses on the interoperability between organizations to enable a shareable EHR. Some organizations share information by electronically submitting documents to an EHR or shared document repository. Others share information by maintaining a registry of available documents and allowing other organizations to electronically retrieve documents.
Using the Capability and Use Legend, please indicate the level of electronic capability and use in your organization for each of the following.
Answer Main Reason
CORE 1
Electronically cross-reference local patient identifiers (e.g., matching chart numbers across different organizations)
CORE 2
Electronically cross-reference local patient identifiers with an Enterprise Master Patient Index (EMPI) that serves most organizations in your Local Health Integration Network (LHIN) (e.g., matching chart numbers across different organizations with a centralized EMPI)
CORE 3
Electronically send laboratory results to a shared repository for retrieval by other organizations/providers
CORE 4
Electronically send diagnostic images to a shared repository for retrieval by other organizations/providers
CORE 5
Electronically send other clinical documents (e.g., discharge summaries or surgical reports or clinical notes) to a shared repository for retrieval by other organizations/providers
CORE 6
Participate in a document registry that allows other organizations/providers to electronically retrieve documents from your EPR on demand
CORE 7
Provide secure email for sharing clinical information with other organizations
CORE 8
Electronically interface with Family Health Team (FHT) EMR
CORE 9
Have secure email between FHT and hospital

**APPENDIX 4-3: CORE QUESTIONS FOR 2006/2007/2008 (ONLY QUESTIONS THAT WERE ASKED IN ALL THREE YEARS)**

(Source: OHA internal documents)

| |
|---|
| 1.1.001. Electronically register all patients in your primary hospital information system in the inpatient setting |
| 1.1.002. Electronically register all patients in your primary hospital information system in the emergency setting |
| 1.1.003. Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting |
| 1.1.003. Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting |
| 1.1.003. Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting |
| 1.1.003. Electronically register all patients in your primary hospital information system in the hospital outpatient clinic setting |
| 1.1.004. Electronically maintain an up-to-date care provider directory that includes full name, addresses, physical location and contact information within your primary hospital information system |
| 1.1.005. Electronically track different care providers treating a single patient in your primary hospital information system |
| 1.1.006. Electronically generate different lists of patients sorted by variables, such as active patients by inhospital unit location, most responsible care provider, discharge patient, etc. |
| 1.1.007. Electronically capture patient and family preferences regarding issues important to the delivery of care (e.g. language or emergency contact information) |
| 1.1.008. Electronically capture a record of current illness and patient data related to medical diagnoses, surgeries and other procedures performed on the patient |
| 1.1.009. Electronically capture relevant health conditions of family members, including pertinent positive and negative histories |
| 1.1.010. Electronically capture patient-reported clinical information |
| 1.1.011. Electronically capture a medication profile |
| 1.1.012. Electronically capture a summary of allergies and adverse reactions |
| 1.1.013. Electronically capture a summary of patient problems maintained by nursing and allied health. |
| 1.2.001. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the inpatient setting-OE |
| 1.2.002. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the emergency setting OE |
| 1.2.003. Electronically order laboratory tests (general lab and microbiology) at bedside or at nursing station in the hospital outpatient clinic setting-OE |
| 1.2.004. Electronically order pathology exams at bedside or at nursing station-OE |
| 1.2.005. Electronically order ECGs at bedside or at nursing station in the inpatient setting-OE |
| 1.2.006. Electronically order ECGs at bedside or at nursing station in the emergency setting-OE |
| 1.2.007. Electronically order ECGs at bedside or at nursing station in the hospital outpatient clinic setting-OE |
| 1.2.008. Electronically order diagnostic imaging examinations at bedside or at nursing station in the inpatient setting-OE |
| 1.2.009. Electronically order diagnostic imaging examinations at bedside or at nursing station in the emergency setting-OE |

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|---|
| 1.2.010. Electronically order diagnostic imaging examinations at bedside or at nursing station in the hospital outpatient clinic setting-OE |
| 1.2.011. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew orders in the inpatient setting-OE |
| 1.2.012. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the emergency setting-OE |
| 1.2.013. Electronically order medications with instructions (excluding chemotherapy, IVs), including new, change, stop and renew in the outpatient clinic setting-OE |
| 1.2.014. Electronically order chemotherapy medications supported by standard chemotherapy treatment protocols-OE |
| 1.2.015. Electronically provide generic and brand name drug information to the provider at the time of ordering (e.g. alternate drug names, prescribing guidelines or contraindications)-OE |
| 1.2.016. Electronically provide clinical decision support at time of ordering medications (e.g. real-time alerts, suggested corollary orders, notification of duplicate orders, institution-specific orders)-OE |
| 1.2.019. Electronically provide order sets at bedside or nursing station (e.g. diagnosis-specific, care-plan specific or standing orders)-OE |
| 1.2.020. Electronically document and track consults between care providers in the organization-OE |
| 1.3.001. Electronically create and modify transcribed or directly entered patient pathology reports |
| 1.3.002. Electronically create and modify transcribed or directly entered diagnostic imaging reports |
| 1.3.003. Electronically create and modify transcribed or directly entered discharge summaries |
| 1.3.004. Electronically create and modify transcribed or directly entered surgical reports |
| 1.3.005. Electronically create and modify transcribed or directly entered consultant notes or reports (excluding nursing and multi-disciplinary assessments) |
| 1.3.006. Electronically capture and send discharge medication instructions to other providers outside your hospital (non-acute facilities, community physicians, etc.) |
| 1.3.007. Electronically capture relevant structured data (e.g. blood pressure, heart rate) from monitors at the point of care in the inpatient setting to the EPR |
| 1.3.008. Electronically capture relevant structured data (e.g., blood pressure, heart rate) from monitors at the point-of-care in the hospital outpatient clinic setting to the EPR/ EMR |
| 1.3.009. Electronically document medication administration record (MAR) in the inpatient setting |
| 1.3.010. Electronically document medication administration record (MAR) in the emergency setting |
| 1.3.018. Provide access to a comprehensive medication profile from the Ontario Drug Benefit database (ODB) in the emergency setting. |
| 1.4.001. Electronically capture and present patient general laboratory and microbiology test results in the inpatient setting |
| 1.4.002. Electronically capture and present patient general laboratory and microbiology test results in the emergency setting |
| 1.4.003. Electronically capture and present patient general laboratory and microbiology test results to the appropriate care providers in the hospital outpatient clinic setting |
| 1.4.004. Electronically provide laboratory result interpretations |
| 1.4.005. Electronically provide notification/alerts of abnormal laboratory results |
| 1.4.006. Electronically present patient pathology reports |
| 1.4.007. Electronically present diagnostic imaging reports in the inpatient setting |
| 1.4.008. Electronically present diagnostic imaging reports in the emergency setting |
| 1.4.009. Electronically present diagnostic imaging reports in the hospital outpatient clinic setting |

| |
|---|
| 1.4.010. Electronically store most diagnostic images in a PACS |
| 1.4.011. Electronically provide access to images stored in a PACS at the appropriate points of care |
| 1.4.012. Electronically provide structured patient data (e.g. blood pressure, heart rate) in flowsheets or graphs to view or uncover trends in critical care, and general inpatient settings |
| 1.4.013. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the inpatient setting |
| 1.4.014. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital emergency setting |
| 1.4.015. Electronically capture and present ECG results (including clinician and computer-generated interpretations) in the hospital outpatient clinic setting |
| 1.4.016. Electronically present results information to patients via a patient portal |
| 1.5.001. Authenticate authorized users when they attempt to access the EPR/ EMR |
| 1.5.002. Enable EPR security administrators to grant role-based authorization based on the responsibility or function of the user (e.g. nurse, dietician, administrator, or auditor) |
| 1.5.003. Enable EPR security administrators to deny access to all or part of a record to authorized users for reasons such as privacy based on patient directives |
| 1.5.004. Electronically provide indicators or flags to indicate that certain data has been 'masked' or hidden from view (e.g. lockbox) |
| 1.5.005. Electronically allow 'break the glass' provision to allow authorized care providers emergency access to all data, including masked data |
| 1.5.006. Electronically enable authorized care providers to restrict access to a patient's personal health information that is potentially harmful to the patient |
| 1.5.007. Archive EPR data and clinical documents for the time period designated by policy or legal requirement in a format retrievable across iterations of technology changes |
| 1.5.011. Electronically provide a security audit that logs access attempts and if any actual or attempted security violations occurred |
| 1.5.012. Electronically provide a data audit that records who, when and by which system an EPR record was created, updated, viewed, extracted, or archived/deleted |
| 1.5.013. Electronically verify patient treatment decisions and advance directives when required against electronically maintained consents and authorizations |
| 1.5.014. Use secure email for sharing clinical information between care providers within the same organization |
| 1.5.015. Use secure electronic document management system for sharing clinical information between care providers within the same organization |
| 1.5.016. Provide high speed (at least 100MBit/sec) network connection to every clinical desktop |
| 1.5.017. Extract EPR data for the purposes of analyzing and planning patient care or outcomes for administrative management purposes |
| 1.5.018. Provide secure remote access for physicians |
| 1.5.019. Electronically provide sufficient redundancy that guarantees 24/7 access to patient information |
| 2.1.001. Does your organization currently have a Chief Information Officer (CIO) or recognized equivalent with the delegated responsibility (it may not be their only responsibility) at your organization (not at the LHIN/Regional level). |
| 2.1.003. Does your organization currently have an established board-approved e-Health strategic plan? |
| 2.1.005. Does your organization currently have an identified change management and reengineering leadership capacity to encourage end-user adoption of your e-Health |
| 2.1.006. Does your organization currently have an established and approved project management methodology and resources to support large scale IT initiatives? |

| |
|---|
| 2.1.007. Is e-Health part of your organizational plan? |
| 3.2.001. Electronically cross-reference local patient identifiers (e.g., matching chart numbers across different organizations). |
| 3.2.002. Electronically cross-reference local patient identifiers with an Enterprise Master Patient Index (EMPI) that serves most organizations in your Local Health Integration Network (LHIN) (e.g., matching chart numbers across different organizations with a |
| 3.2.003. Electronically send laboratory results to a shared repository for retrieval by other organizations / providers |
| 3.2.004. Electronically send diagnostic images to a shared repository for retrieval by other organizations / providers |
| 3.2.005. Electronically send other clinical documents (e.g., discharge summaries or surgical reports or clinical notes) to a shared repository for retrieval by other organizations / providers |
| 3.2.006. Participate in a document registry that allows other organizations/ providers to electronically retrieve documents from your EPR on demand |
| 3.2.007. Provide secure email for sharing clinical information with other organizations |
| 3.2.008. Electronically interface with Family Health Team (FHT) EMR |
| 3.2.009. Have secure email between FHT and hospital |

**APPENDIX 4-4: DESCRIPTION OF SCORING SYSTEM**

(Source: OHA internal documents)

| RESPONSE | DEFINITION | SCORE |
|---|---|---|
| Not Considered | Functional requirement has not been considered. | 0 |
| Identified | Functional requirement has been identified and discussed but minimal progress has been made towards planning, procurement or implementation. | 1 |
| Acquired | A commitment has been made towards implementing the functional requirement. Procurement process has been initiated or the functionality has been acquired. | 2 |
| In progress | Functionality is currently being implemented. | 3 |
| Pilot / Implemented | Functionality is either in pilot or production and used by a few intended users. | 4 |
| Mostly Implemented | Functionality is mostly implemented and commonly used by some of intended users. | 5 |
| Fully Implemented | Functionality is fully implemented and is used by most or all intended users. There is no other usual way to perform this function. | 6 |
| N/A | Functionality is not applicable to your facility (e.g., if your facility does not have a cancer centre or an emergency department, you would answer "N/A" for a question such as #2 "Register all patients in your primary hospital information system in the emergency setting".) | - |

**APPENDIX 4-5: DESCRIPTION OF MANAGEMENT INFORMATION SYSTEMS (MIS) STANDARDS (GENERAL INFORMATION)**

(Source: http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=mis_e)

The MIS Standards consist of national standards for the collection and processing of data providing a standardized framework for reporting and collection of financial and statistical data on the day-to-day operations of healthcare institutions.

Elements of the MIS Standards include:

- chart of accounts[64] for reporting of financial position;
- accounting guidelines and procedures;
- workload measurement systems[65];
- indicators; and
- management reporting applications.

MIS standards are used to:

- promote more accurate resource allocation;
- allow for better informed decision-making by management;
- promote budget development based on meaningful data related to workload activity; and
- promote accountability reporting for resource use.

The MIS Standards data is used by:

- front-line managers of healthcare institutions;
- senior management of healthcare institutions;
- board of directors of healthcare institutions;
- Statistics Canada;
- Researchers; and
- Ministries of Health (provincial and territorial).

Various types of healthcare institutions use the MIS Standards data (i.e. acute care, mental health, long-term care, etc).

[64] A list of accounts by an identification number and name; defines financial structure of an organization
[65] A workload measurement system is designed to record the volume of activity associated with a particular department or service in relation to staff productivity

**APPENDIX 4-6: DEFINITION OF ALL FIELDS INCLUDED IN "SUMMARY TAB" OF MIS DATA**

(Source: OHA internal documents)

| Variable | Definition |
|---|---|
| Year | Fiscal Year (April 1 – March 31) |
| Institution # | Identification number assigned to healthcare institution by Ministry of Health of Ontario |
| Institution Name | Name of healthcare institution |
| Total Expense (All fund types) | Calculation of Total Amount of Expense that is offset by Recoveries and Amortization |
| Total Expense – Fund Type 1 Only (Operating Expense) | Overall Operating Expense (does not include specifically funded mental health, veterans, research funding, or federal health funding); Expenditure that a business acquires as a result of performing its normal business operations or on-going cost for running a business |
| HIT Value | A value calculated based on the Healthcare Indicator Tool (HIT)[66] for Total Expense (all fund types and fund type 1) |
| Variance | Difference between expense calculated using MIS method versus expense calculated using HIT tool |
| Total Capital Expenses | Expense related to fixed assets, such as buildings or equipment. Capital Expenses may be thought of expenditures that create future benefits |
| Total IT Operating Expense | Same definition as (Total Expense – Fund Type 1) but specific to IT. |
| Total IT Capital Expense | Same definition as Total Capital Expenses, but specific to IT. Includes both IT and Telecom Capital Expense |
| Total Telecom Op. Ex | Operating Expense related to Telecom[67] |
| Total FTEs | Total number of Full-Time Equivalents (FTEs[68]) across the whole hospital |
| Total # of Nurses (FTEs) | Total number of Full-Time Equivalents (for nurses) |
| Total IT FTEs – MOS | Total IT Full-Time Equivalents (for management positions) |
| Total IT FTEs – UPP | Total IT Full-Time Equivalents (for non-management positions) |
| Acute beds | Number of acute care beds |
| Rehab beds | Number of Rehabilitation care beds |
| MH beds | Number of Mental Health Care beds |
| CC beds | Number of Chronic Care beds |
| ELDCAP beds | Number of elderly or long-term care beds |
| Acute Inpatient Days | Number of inpatient days[69] specific to Acute Care |
| Chronic Care Inpatient Days | Number of inpatient days specific to Chronic Care |
| ELDCAP | Number of inpatient days specific to elderly or long-term care |

[66] The HIT is an online tool that may be used to calculate total expense
[67] Telecom is also known as telecommunication
[68] A measurement of staff size
[69] Inpatient days refer to days spent in hospital

| | |
|---|---|
| Inpatient Days | |
| Mental Health Inpatient Days | Number of inpatient days specific to mental health care |
| Rehabilitation Inpatient Days | Number of inpatient days specific to rehabilitation care |
| OP Visits | Number of outpatient visits |
| Total Payroll Expense | Total Payroll Expense across the hospital |
| IT Salary Exp – UPP | IT Salary Expense for Unit Producing Staff (Non-management positions) |
| IT Salary Exp MOS | IT Salary Expense for Management and Administrative Support Staff (Management positions) |

**APPENDIX 4-7: DESCRIPTION OF MIS VARIABLES USED IN THIS RESEARCH STUDY**

(Source: OHA internal documents)

| Variable | Definition | Source | Measurement |
|---|---|---|---|
| IT Capital Expense[70] | Same definition as Capital Expense below, but specific to IT / Telecom | OHRS V6.0 – Glossary of Terms – Balance Sheet Accounts[71] | IT Capital Expense includes the following components:<br>➢ Information Systems Major Equipment includes computer installations and related costs for management information system applications, such as: Accounts Receivable, Central Patient Index, Capital Assets, Admission Discharge and Transfer, Accounts Payable, Patient Scheduling, Material Management, Workload Measurement Systems, Order Entry/Results Reporting, Personnel Health Record Management, Compensation, Diagnostic Imaging Department, Cost Allocation, Clinical Laboratory Department Management, Financial General Ledger, Pharmacy Department Management, Statistical General Ledger Food Services Department Management, Budget/Forecasting, Personal Computers, Financial/Statistical;<br>➢ Total amount of amortization[72] charged to Operations in useful life of Information Systems Major Equipment; and<br>➢ Any Major Information Systems equipment distributed and acquired during current fiscal year (holding account used to record cost of information systems major equipment acquired during current year). |
| Capital Expense | Expense related to fixed assets, such as buildings or equipment. Capital Expenses may be | OHRS V6.0 – Glossary of Terms – Balance Sheet Accounts | Includes all components identified above with "IT Capital Expense", in addition to the following:<br>➢ Major Equipment (excluding Information Systems Major Equipment) identified with operations of a functional center, whereby a related amortization expense will be charged;<br>➢ Total amount of amortization in useful life of Major |

[70] IT Capital Expense includes Capital Expense for IT and Telecom

[71] This document was created by the Ministry of Health and Long-Term Care of Ontario to provide definitions of various financial accounts. This document was provided by OHA.

[72] Amortization involves deduction of capital expenses over a specific amount of time (usually related to life of an asset).

| | | | |
|---|---|---|---|
| | thought of expenditures that create future benefits | | Equipment (excluding Information Systems); and<br><br>➢ Any Major Equipment (excluding Information Systems major equipment) distributed and acquired during current fiscal year (holding account used to record cost of major equipment [excluding Information Systems Major Equipment] acquired during current year). |
| IT Operating Expense | Same definition as Operating Expense below, but specific to IT | OHRS Version 7.0 Full Provincial Functional / Accounting Centre List[73] | IT Operating Expenses related to Administration and Support Services Information Systems Support, including:<br><br>➢ Data processing;<br>➢ Systems Engineering;<br>➢ System Development;<br>➢ Operations Research;<br>➢ Technical Support; and<br>➢ Implementation and Maintenance.<br><br>Total IT Operating expenses offset by recoveries, amortization, and interdepartmental expenses. |
| Operating Expense | Expenditure that a business acquires as a result of performing its normal business operations or on-going cost for running a business | Healthcare Indicator Tool (HIT) document[74] | This is calculated as total operating expenses offset by internal/external recoveries, and excludes interdepartmental expenses, amortization of land improvement, buildings, building service equipment and leasehold improvement. |

[73] This document was created by the Ministry of Health and Long-Term Care of Ontario to provide a list of financial accounts. This document was provided by OHA.
[74] The OHA provided one page of an HIT document which explained the calculation of Operating Expense

## APPENDIX 4-8: CORE HOSPITALS (PARTICIPATED IN OHA SURVEY IN 2006, 2007 AND 2008) MATCHED TO MIS HOSPITAL NAMES

| OHA Hospital Name | MIS Hospital Name |
|---|---|
| Alexandra Hospital | ALEXANDRA HOSPITAL |
| Alexandra Marine & General Hospital | ALEXANDRA MARINE AND GENERAL HOSPITAL |
| Almonte General Hospital | ALMONTE GENERAL HOSPITAL |
| Atikokan General Hospital | ATIKOKAN GENERAL HOSPITAL |
| Baycrest Centre for Geriatric Care | BAYCREST HOSPITAL (NORTH YORK) |
| Blind River District Health Centre | BLIND RIVER DIST HLTH CTR/PAVILLON SANTE |
| Bloorview Kids Rehab | BLOORVIEW KIDS REHAB |
| Bluewater Health | BLUEWATER HEALTH-PETROLIA SITE |
| Brant Community Healthcare System | BRANTFORD GENERAL HOSPITAL (THE), WILLETT HOSPITAL (THE) |
| Bridgepoint Hospital | BRIDGEPOINT HOSPITAL |
| Brockville General Hospital | BROCKVILLE GENERAL HOSPITAL |
| Cambridge Memorial Hospital | CAMBRIDGE MEMORIAL HOSPITAL |
| Campbellford Memorial Hospital | CAMPBELLFORD MEMORIAL HOSPITAL |
| Carleton Place & District Memorial Hospital | CARLETON PLACE AND DISTRICT MEM HOSPITAL |
| Centre for Addiction & Mental Health | CENTRE FOR ADDICTION&MENTAL HLTH |
| Chapleau Health Services / Services De Santé De Chapleau | SERVICES DE SANTE DE CHAPLEAU HLTH SERV |
| Chatham-Kent Health Alliance | ST JOSEPH'S HLTH SERV ASSOC OF CHATHAM, SYDENHAM DISTRICT HOSPITAL, PUBLIC GENERAL HOSP SOCIETY OF CHATHAM |
| Children's Hospital of Eastern Ontario | CHILDRENS HOSPITAL OF EASTERN ONTARIO |
| Collingwood General and Marine Hospital | COLLINGWOOD GENERAL AND MARINE HOSPITAL |
| Cornwall Community Hospital / Hôpital communautaire de Cornwall | CORNWALL COMMUNITY HOSP-GENERAL SITE |
| Deep River and District Hospital | DEEP RIVER AND DISTRICT HOSPITAL |
| Dryden Regional Health Centre | DRYDEN REGIONAL HEALTH CENTRE |
| Englehart & District Hospital | ENGLEHART AND DISTRICT HOSPITAL |
| Espanola General Hospital | ESPANOLA GENERAL HOSPITAL |
| Four Counties Health Services | FOUR COUNTIES HEALTH SERVICES CORP |

| | |
|---|---|
| Glengarry Memorial Hospital | GLENGARRY MEMORIAL HOSPITAL |
| Grand River Hospital Corporation | GRAND RIVER HOSPITAL CORP-FREEPORT SITE |
| Grey Bruce Health Services | GREY BRUCE HEALTH SERV |
| Groves Memorial Community Hospital | GROVES MEMORIAL COMMUNITY HOSPITAL |
| Guelph General Hospital | GUELPH GENERAL HOSPITAL |
| Haliburton Highlands Health Services Corporation | HALIBURTON HIGHLANDS HLTH SERV CORP-HALI |
| Halton Healthcare Services Corporation | HALTON HEALTHCARE SERVICES CORP |
| Hamilton Health Sciences Corporation | HAMILTON HEALTH SCIENCES CORP-CHEDOKE |
| Hanover and District Hospital | HANOVER AND DISTRICT HOSPITAL |
| Hawkesbury & District General Hospital | HAWKESBURY AND DISTRICT GENERAL HOSPITAL |
| Headwaters Health Care Centre | HEADWATERS HEALTH CARE CENTRE-DUFFERIN |
| Homewood Health Centre | HOMEWOOD HEALTH CENTRE INC |
| Hopital regional de Sudbury Regional Hospital Corporation | HOPITAL REGIONAL DE SUDBURY-LAURENTIAN |
| Hornepayne Community Hospital | HORNEPAYNE COMMUNITY HOSPITAL |
| Hospital for Sick Children | HOSPITAL FOR SICK CHILDREN (THE) |
| Hotel-Dieu Grace Hospital (Windsor) | HOTEL-DIEU GRACE HOSPITAL-ST JOSEPH'S |
| Humber River Regional Hospital | HUMBER RIVER REGIONAL HOSP- |
| Huron Perth Healthcare Alliance | CLINTON PUBLIC HOSPITAL, SEAFORTH COMMUNITY HOSPITAL, ST MARYS MEMORIAL HOSPITAL, STRATFORD GENERAL HOSPITAL |
| Huronia District Hospital | HURONIA DISTRICT HOSPITAL |
| Joseph Brant Memorial Hospital | JOSEPH BRANT MEMORIAL HOSPITAL |
| Kemptville District Hospital | KEMPTVILLE DISTRICT HOSPITAL |
| Kirkland and District Hospital | KIRKLAND AND DISTRICT HOSPITAL |
| Lake of the Woods District Hospital | LAKE-OF-THE-WOODS DISTRICT HOSPITAL |
| Lakeridge Health Corporation | LAKERIDGE HEALTH CORPORATION |
| Leamington District Memorial Hospital | LEAMINGTON DISTRICT MEMORIAL HOSPITAL |
| Lennox and Addington County General Hospital | LENNOX AND ADDINGTON COUNTY GEN HOSPITAL |
| Listowel Memorial Hospital | LISTOWEL MEMORIAL HOSPITAL |
| London Health Sciences Centre | LONDON HLTH SCIENCES CTR-UNIVERSITY SITE |

| | |
|---|---|
| Manitoulin Health Centre | MANITOULIN HEALTH CENTRE-LITTLE CURRENT |
| Manitouwadge General Hospital | MANITOUWADGE GENERAL HOSPITAL |
| Markham Stouffville Hospital | MARKHAM STOUFFVILLE HOSPITAL |
| Mattawa General Hospital | MATTAWA GENERAL HOSPITAL |
| Montfort Hospital | HOPITAL MONTFORT |
| Mount Sinai Hospital | MOUNT SINAI HOSPITAL |
| Muskoka Algonquin Healthcare | MUSKOKA ALGONQUIN HEALTHCARE-BRACEBRIDGE |
| Niagara Health System | NIAGARA HEALTH SYSTEM |
| Nipigon District Memorial Hospital | NIPIGON DISTRICT MEMORIAL HOSPITAL |
| Norfolk General Hospital | NORFOLK GENERAL HOSPITAL |
| North Bay General Hospital | NORTH BAY GENERAL HOSP-ST JOSEPH'S SITE |
| North Wellington Health Care Corporation | NORTH WELLINGTON HLTH CARE-MOUNT FOREST |
| North York General Hospital | NORTH YORK GENERAL HOSPITAL |
| Northeast Mental Health Centre | NORTHEAST MENTAL HEALTH CTR-NORTH BAY CA |
| Northumberland Hills Hospital | NORTHUMBERLAND HILLS HOSPITAL |
| Orillia Soldiers' Memorial Hospital | ORILLIA SOLDIERS' MEMORIAL HOSPITAL |
| Pembroke Regional Hospital Inc. | PEMBROKE REGIONAL HOSPITAL INC. |
| Penetanguishene General Hospital | PENETANGUISHENE GENERAL HOSPITAL |
| Perth & Smiths Falls District Hospital | PERTH & SMITHS FALLS DIST-PERTH SITE |
| Peterborough Regional Health Centre | PETERBOROUGH REGIONAL HEALTH CENTRE |
| Providence Care Centre | ST. MARY'S OF THE LAKE HOSPITAL |
| Providence Healthcare | PROVIDENCE HEALTHCARE (SCARBOROUGH) |
| Queensway Carleton Hospital | QUEENSWAY-CARLETON HOSPITAL |
| Quinte Healthcare Corporation | QUINTE HEALTHCARE CORPORATION |
| Red Lake Margaret Cochenour Memorial Hospital | RED LAKE MARG COCHENOUR MEM HOSP (THE) |
| Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston | HOTEL DIEU HOSPITAL-KINGSTON |
| Religious Hospitallers of Saint Joseph of the Hotel Dieu of St.Catharines | RELIG HOSP OF ST.JOSEPH OF HOTEL DIEU |
| Renfrew Victoria Hospital | RENFREW VICTORIA HOSPITAL |
| Riverside Health Care Facilities Inc. | RIVERSIDE HEALTH CARE FAC-RAINY RIVER |

| | |
|---|---|
| Rouge Valley Health System | ROUGE VALLEY HEALTH SYSTEM |
| Royal Ottawa Health Care Group | ROYAL OTTAWA HEALTH CARE GROUP |
| Sault Area Hospital | GREAT NORTHERN NURSING CTR (SAULT AREA) |
| SCO Health Service | SISTERS OF CHARITY OF OTTAWA HOSPITAL |
| Sensenbrenner Hospital | SENSENBRENNER HOSPITAL (THE) |
| Sioux Lookout Meno-Ya-Win Health Centre | SIOUX LOOKOUT MENO-YA-WIN HLTH CTR-DISTR |
| Smooth Rock Falls Hospital | SMOOTH ROCK FALLS HOSPITAL |
| South Bruce Grey Health Centre | SOUTH BRUCE GREY HEALTH CENTRE-CHESLEY |
| Southlake Regional Health Centre | SOUTHLAKE REGIONAL HEALTH CENTRE |
| St. Francis Memorial Hospital | ST FRANCIS MEMORIAL HOSPITAL |
| St. John's Rehabilitation Hospital | ST JOHN'S REHABILITATION HOSPITAL |
| St. Joseph's Care Group (Thunder Bay) | ST. JOSEPH'S CARE GROUP |
| St. Joseph's General Hospital Elliot Lake | ST JOSEPH'S GENERAL HOSPITAL |
| St. Joseph's Health Care, London | ST.JOSEPH'HEALTH CARE,LONDON-LONDON MH |
| St. Joseph's Health Centre (Toronto) | ST JOSEPH'S HEALTH CENTRE |
| St. Joseph's Health Centre, Guelph | ST JOSEPH'S HEALTH CENTRE,GUELPH |
| St. Joseph's Healthcare Hamilton | ST JOSEPH'S COMMUNITY HEALTH CENTRE |
| St. Mary's General Hospital | ST MARY'S GENERAL HOSPITAL |
| St. Michael's Hospital | ST MICHAEL'S HOSPITAL |
| St. Thomas Elgin General Hospital | ST THOMAS-ELGIN GENERAL HOSPITAL |
| Strathroy Middlesex General Hospital | STRATHROY MIDDLESEX GENERAL HOSPITAL |
| Sunnybrook Health Sciences Centre | SUNNYBROOK HEALTH SCIENCES CENTRE |
| Temiskaming Hospital | TEMISKAMING HOSPITAL |
| The Arnprior and District Memorial Hospital | ARNPRIOR & DISTRICT MEMORIAL HOSP.(THE) |
| The Board of Governors of the Kingston Hospital | KINGSTON GENERAL HOSPITAL |
| The Credit Valley Hospital | CREDIT VALLEY HOSPITAL (THE) |
| The Ottawa Hospital | OTTAWA HOSPITAL ( THE ) |
| The Royal Victoria Hospital of Barrie | ROYAL VICTORIA HOSPITAL OF BARRIE (THE) |
| The Scarborough Hospital | SCARBOROUGH HOSPITAL (THE) |
| The Stevenson Memorial Hospital | STEVENSON MEMORIAL HOSPITAL ALLISTON |

| | |
|---|---|
| The Toronto East General Hospital | TORONTO EAST GENERAL HOSPITAL (THE) |
| The West Nipissing General Hospital | WEST NIPISSING GENERAL HOSPITAL |
| Thunder Bay Regional Health Sciences Centre | THUNDER BAY REGIONAL HLTH SCIENCES CTR |
| Tillsonburg District Memorial Hospital | TILLSONBURG DISTRICT MEMORIAL HOSPITAL |
| Timmins & District Hospital - L'Hopital de Timmins et du district | TIMMINS & DISTRICT GENERAL HOSPITAL |
| Toronto Rehabilitation Institute | TORONTO REHABILITATION INST |
| Trillium Health Centre | TRILLIUM HEALTH CENTRE-MISSISSAUGA |
| University Health Network | UNIVERSITY HEALTH NETWORK |
| West Lincoln Memorial Hospital | WEST LINCOLN MEMORIAL HOSPITAL |
| West Park Healthcare Centre | WEST PARK HEALTHCARE CENTRE (YORK CITY) |
| Whitby Mental Health Centre | WHITBY MENTAL HEALTH CENTRE |
| William Osler Health Centre | WILLIAM OSLER HEALTH CENTRE |
| Wilson Memorial General Hospital | WILSON MEMORIAL GENERAL HOSPITAL |
| Windsor Regional Hospital | WINDSOR MEN'S DETOXIFICATION CENTRE |
| Wingham and District Hospital | WINGHAM AND DISTRICT HOSPITAL |
| Woodstock General Hospital | WOODSTOCK GENERAL HOSPITAL |
| York Central Hospital | YORK CENTRAL HOSPITAL |

## APPENDIX 4-9: LIST OF HOSPITALS PARTICIPATING IN E-HEALTH ADOPTION TO INVESTMENT CHAPTER

Alexandra Hospital
Alexandra Marine & General Hospital
Atikokan General Hospital
Blind River District Health Centre
Bloorview Kids Rehab
Bluewater Health
Bridgepoint Hospital
Brockville General Hospital
Cambridge Memorial Hospital
Campbellford Memorial Hospital
Carleton Place & District Memorial Hospital
Centre for Addiction & Mental Health
Children's Hospital of Eastern Ontario
Collingwood General and Marine Hospital
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Dryden Regional Health Centre
Englehart & District Hospital
Espanola General Hospital
Four Counties Health Services
Glengarry Memorial Hospital
Grand River Hospital Corporation
Grey Bruce Health Services
Guelph General Hospital
Halton Healthcare Services Corporation
Hanover and District Hospital
Hawkesbury & District General Hospital
Headwaters Health Care Centre
Hopital regional de Sudbury Regional Hospital Corporation
Hornepayne Community Hospital
Hospital for Sick Children
Hotel-Dieu Grace Hospital (Windsor)
Humber River Regional Hospital
Huron Perth Healthcare Alliance
Huronia District Hospital
Joseph Brant Memorial Hospital
Kemptville District Hospital
Kirkland and District Hospital
Lake of the Woods District Hospital
Lakeridge Health Corporation

Lennox and Addington County General Hospital
Listowel Memorial Hospital
London Health Sciences Centre
Manitoulin Health Centre
Manitouwadge General Hospital
Markham Stouffville Hospital
Mattawa General Hospital
Montfort Hospital
Mount Sinai Hospital
Niagara Health System
Nipigon District Memorial Hospital
Norfolk General Hospital
North Bay General Hospital
North Wellington Health Care Corporation
North York General Hospital
Northeast Mental Health Centre
Northumberland Hills Hospital
Orillia Soldiers' Memorial Hospital
Pembroke Regional Hospital Inc.
Penetanguishene General Hospital
Perth & Smiths Falls District Hospital
Providence Continuing Care Centre
Providence Healthcare
Queensway Carleton Hospital
Quinte Healthcare Corporation
Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston
Royal Ottawa Health Care Group
Sault Area Hospital
SCO Health Service
Sensenbrenner Hospital
Sioux Lookout Meno-Ya-Win Health Centre
Smooth Rock Falls Hospital
South Bruce Grey Health Centre
Southlake Regional Health Centre
St. Francis Memorial Hospital
St. John's Rehabilitation Hospital
St. Joseph's Care Group (Thunder Bay)
St. Joseph's General Hospital Elliot Lake
St. Joseph's Health Care, London
St. Joseph's Health Centre, Guelph
St. Joseph's Healthcare Hamilton
St. Mary's General Hospital

St. Michael's Hospital
St. Thomas Elgin General Hospital
Strathroy Middlesex General Hospital
Sunnybrook Health Sciences Centre
Temiskaming Hospital
The Arnprior and District Memorial Hospital
The Board of Governors of the Kingston Hospital
The Credit Valley Hospital
The Royal Victoria Hospital of Barrie
The Scarborough Hospital
The Stevenson Memorial Hospital
The Toronto East General Hospital
The West Nipissing General Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district
Toronto Rehabilitation Institute
Trillium Health Centre
University Health Network
West Lincoln Memorial Hospital
West Park Healthcare Centre
William Osler Health Centre
Wilson Memorial General Hospital
Windsor Regional Hospital
Wingham and District Hospital
Woodstock General Hospital
York Central Hospital

## APPENDIX 4-10: LIST OF HOSPITALS UNDER THE COMMUNITY PEER GROUP

Bluewater Health
Brockville General Hospital
Cambridge Memorial Hospital
Collingwood General and Marine Hospital
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Grand River Hospital Corporation
Grey Bruce Health Services
Guelph General Hospital
Halton Healthcare Services
Headwaters Health Care Centre
Hotel-Dieu Grace Hospital (Windsor)
Humber River Regional Hospital
Huron Perth Healthcare Alliance
Huronia District Hospital
Joseph Brant Memorial Hospital
Lakeridge Health Corporation
Markham Stouffville Hospital
Montfort Hospital
Niagara Health System
Norfolk General Hospital
North Bay General Hospital
North York General Hospital
Northumberland Hills Hospital
Orillia Soldiers' Memorial Hospital
Pembroke Regional Hospital Inc.
Perth & Smiths Falls District Hospital
Queensway Carleton Hospital
Quinte Healthcare Corporation
Sault Area Hospital
Southlake Regional Health Centre
St. Mary's General Hospital
St. Thomas Elgin General Hospital
Temiskaming Hospital
The Credit Valley Hospital
The Royal Victoria Hospital of Barrie
The Scarborough Hospital
The Toronto East General Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district
Trillium Health Centre
William Osler Health Centre

Windsor Regional Hospital
Woodstock General Hospital
York Central Hospital

## APPENDIX 4-11: LIST OF HOSPITALS UNDER THE SMALL HOSPITAL PEER GROUP

Alexandra Hospital
Alexandra Marine & General Hospital
Atikokan General Hospital
Blind River District Health Centre
Campbellford Memorial Hospital
Carleton Place & District Memorial Hospital
Dryden Regional Health Centre
Englehart & District Hospital
Espanola General Hospital
Four Counties Health Services
Glengarry Memorial Hospital
Hanover and District Hospital
Hawkesbury & District General Hospital
Hornepayne Community Hospital
Kemptville District Hospital
Kirkland and District Hospital
Lake of the Woods District Hospital
Lennox and Addington County General Hospital
Listowel Memorial Hospital
Manitoulin Health Centre
Manitouwadge General Hospital
Mattawa General Hospital
Nipigon District Memorial Hospital
North Wellington Health Care Corporation
Sensenbrenner Hospital
Sioux Lookout Meno-Ya-Win Health Centre
Smooth Rock Falls Hospital
South Bruce Grey Health Centre
St. Francis Memorial Hospital
St. Joseph's General Hospital Elliot Lake
Strathroy Middlesex General Hospital
The Arnprior and District Memorial Hospital
The Stevenson Memorial Hospital
The West Nipissing General Hospital
West Lincoln Memorial Hospital
Wilson Memorial General Hospital
Wingham and District Hospital

**APPENDIX 4-12: LIST OF HOSPITALS UNDER THE TEACHING PEER GROUP**

Children's Hospital of Eastern Ontario
Hopital regional de Sudbury Regional Hospital Corporation
Hospital for Sick Children
London Health Sciences Centre
Mount Sinai Hospital
Religious Hospitaliers of Saint Joseph of the Hotel Dieu of Kingston
St. Joseph's Health Care, London
St. Joseph's Healthcare Hamilton
St. Michael's Hospital
Sunnybrook Health Sciences Centre
The Board of Governors of the Kingston Hospital
University Health Network

## APPENDIX 4-13: LIST OF HOSPITALS UNDER THE CCC, REHAB & MENTAL HEALTH PEER GROUP

Bloorview Kids Rehab
Bridgepoint Hospital
Centre for Addiction & Mental Health
Northeast Mental Health Centre
Penetanguishene General Hospital
Providence Continuing Care Centre
Providence Healthcare
Royal Ottawa Health Care Group
SCO Health Service
St. John's Rehabilitation Hospital
St. Joseph's Care Group (Thunder Bay)
St. Joseph's Health Centre, Guelph
Toronto Rehabilitation Institute
West Park Healthcare Centre

**APPENDIX 5-1: ORGANIZATIONS THAT WORK WITH THE HRRC TO DEVELOP HOSPITAL REPORT SERIES**

(Source: http://www.hospitalreport.ca/about/partner_organisations.html)

| ORGANIZATION | ROLE |
|---|---|
| Canadian Institute for Health Information (CIHI) | As of 2007, CIHI is responsible for production of Hospital Report series related to Acute Care, Complex Continuing Care, Emergency Department Care, and Rehabilitation |
| Department of Health Policy, Management and Evaluation (HPME) at University of Toronto | Project Management and Support (as of 1997) |
| The ideas FOR HEALTH informatics cluster (University of Waterloo) | Managing the e-Tools associated with the Hospital Report Series (as of 2005) |
| Institute for Clinical Evaluative Services (ICES) | Key role in calculation of indicators in the Hospital Report series that rely on clinical data |
| Ontario Hospital Association (OHA) | Co-funder of the project; OHA members service on various advisory panels which are important to success of the project |
| Ontario Ministry of Health and Long Term Care (MOHTLC) | Co-funder of the project; provides access to data needed to perform analysis within Hospital Report Series |
| Ontario Women's Health Council (OWHC) | Sponsors integration of women's health into Hospital Report Series |

## APPENDIX 5-2: METHODOLOGY FOR SELECTED ACUTE CARE INDICATORS

(Source: http://www.hospitalreport.ca/downloads/2008/AC/2008_AC_sic_techreport.pdf; http://www.hospitalreport.ca/downloads/2008/AC/2008_AC_cuo_techreport.pdf)

| Indicator | Source | Methodology |
|---|---|---|
| Use of Clinical IT | *Hospital e-Scorecard Report 2008: Acute Care* System Integration and Change Technical Summary[75] | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 103 acute care hospitals completed and returned the surveys giving a response rate of 82%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If question does not apply, question is removed from denominator.<br><br><u>Calculation of Use of Clinical IT Indicator:</u><br><br>This indicator consists of two components:<br><br>**Component 1 (53% weighting):**<br><br>Use of IT:<br>-Existence of staff roles within the organization<br>-Extent to which electronic records and data used as primary source of information (i.e. diagnostic imaging, electronic medical images, diagnostic lab results, etc.)<br>-Whether patient care staff able to perform 7 specific functions online (i.e. ordering diagnostic tests or imaging, making referrals to care providers, etc.<br><br>**Component 2 (47% weighting):**<br><br>Access to IT:<br>-Extent to which physicians, nurses, and other patient care staff have IT resources available to them. Respondents asked to indicate percentage of staff with access to specific resources.<br><br>**A higher score for this indicator is desirable.** |

[75] This report is available online at http://www.hospitalreport.ca/downloads/2008/AC/2008_AC_sic_techreport.pdf

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| Use of Data for Decision-Making | *Hospital e-Scorecard Report 2008: Acute Care* System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 103 acute care hospitals completed and returned the surveys giving a response rate of 82%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Use of Data for Decision-Making Indicator:</u><br><br>This indicator consists of five components:<br><br>**Component 1 (20% weighting)**<br><br>Clinical Data Dissemination and Benchmarking:<br><br>-Organizations indicated whether they were collecting data related to 11 clinical measures. If so, organizations were asked to indicate extent to which data were shared and benchmarked.<br><br>**Component 2 (20% weighting)**<br><br>Safety and Utilization Management:<br><br>-Organizations indicated if hospital's reporting system for actual and potential adverse events recorded<br>-Whether hospital maintained registry of sentinel events<br>-Whether organizations conducted at least one patient safety-related analysis per year and implemented improvements<br>-Whether specific patient safety strategies used to improve patient safety<br><br>**Component 3 (20% weighting)**<br><br>Staff Information-Based Roles:<br><br>-Existence of staff roles in the organization.<br>-Participation in Continuing education activities for staff |

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| | | **Component 4 (20% weighting)**<br><br>Dissemination of Information:<br><br>-How organizations disseminated employee satisfaction results<br>-How changes made from patient satisfaction results disseminated amongst different groups in the organization<br><br>**Component 5 (20% weighting)**<br><br>Benchmarking of Information:<br><br>-If organizations engaged in external benchmarking practices<br><br>**A higher score for this indicator is desirable.** |
| Patient Safety Reporting and Analysis | *Hospital e-Scorecard Report 2008: Acute Care* System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 103 acute care hospitals completed and returned the surveys giving a response rate of 82%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Patient Safety Reporting and Analysis Indicator:</u><br><br>This indicator consists of two components:<br><br>**Component 1 (80% weighting):**<br><br>Patient Safety Reporting Processes:<br><br>-Whether hospitals provide quarterly reports to the board on patient safety<br>-If hospitals maintain registry of sentinel events<br>-If hospitals implemented a formal policy and process of disclosure of adverse events to patients/families<br>-If hospitals developed a reporting system to collect information from employees that could lead to near misses or adverse events |

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| | | **Component 2 (20% weighting)**<br><br>Patient Safety Analysis Activities:<br><br>-Whether hospitals conducted targeted chart audits<br><br>**A higher score for this indicator is desirable.** |
| Performance Management in Ambulatory Care | *Hospital e-Scorecard Report 2008: Acute Care* System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 103 acute care hospitals completed and returned the surveys giving a response rate of 82%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Performance Management in Ambulatory Care Indicator:</u><br><br>This indicator consists of three components:<br><br>**Component 1 (41% weighting):**<br><br>Use and Monitoring of Performance Indicators Internally:<br><br>-What proportion of hospitals' ambulatory care clinics monitor performance indicators internally<br><br>**Component 2 (26% weighting)**<br><br>Use and Monitoring of Performance Indicators Externally:<br><br>- What proportion of hospitals' ambulatory care clinics monitor performance indicators externally |

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| | | **Component 3 (33% weighting)**<br><br>Use of Ongoing Quality Improvement Projects:<br><br>-What proportion of hospital's clinics has ongoing quality improvement initiatives<br><br>**A higher score for this indicator is desirable.** |
| Medication Documentation and Reconciliation | *Hospital e-Scorecard Report 2008: Acute Care* System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 103 acute care hospitals completed and returned the surveys giving a response rate of 82%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Medication Documentation and Reconciliation Indicator:</u><br><br>This indicator consists of two components:<br><br>**Component 1 (50% weighting)**<br><br>Documentation of Medications upon Admission:<br><br>-Whether organization documents a complete list of each patient's current medications upon admission<br><br>**Component 2 (50% weighting)**<br><br>Reconciliation and Communication of Medication Information upon Referral or Transfer:<br><br>- Whether complete list of patient's medications is communicated to next provider of health care service when patient is referred or transferred to another setting or practitioner<br><br>**A higher score for this indicator is desirable.** |

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| Nurse-Sensitive Adverse Events (Medical) | *Hospital e-Scorecard Report 2008: Acute Care* Clinical Utilization and Outcomes Technical Summary[76] | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[77] and CCI[78].<br><br>CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario.<br><br>Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator specifically identifies medical patient groups with:<br><br>-post-admission pressure ulcers<br>-post-admission fractures from falls (hip and limb fractures)<br>-post-admission pneumonia<br><br>This indicator is the sum of nurse-sensitive adverse events for acute myocardial infarction (AMI), asthma, GI bleed, stroke, and heart failure.<br><br>Medical cases must start as an inpatient case with a diagnosis of interest in first hospitalization of episode.<br><br>A provincial medial Length of Stay (LOS) is used to identify cases where adverse event likely impacted patient's overall LOS (i.e. for Asthma cases – episode LOS is greater than provincial median of 3 days)<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |

[76] This report is available online at http://www.hospitalreport.ca/downloads/2008/AC/2008_AC_cuo_techreport.pdf

[77] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[78] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

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| Nurse-Sensitive Adverse Events (Surgical) | *Hospital e-Scorecard Report 2008: Acute Care* Clinical Utilization and Outcomes Technical Summary | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[79] and CCI[80].<br><br>CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario.<br><br>Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator specifically identifies medical patient groups with:<br><br>-post-admission urinary tract infections<br>-post-admission pressure ulcers<br>-post-admission fractures from falls (hip and limb fractures)<br>-post-admission pneumonia<br><br>This indicator is the sum of nurse-sensitive adverse events for cholecystectomy, hysterectomy, and prostatectomy.<br><br>Surgical cases may start as an inpatient case or day procedure case with a procedure of interest in first hospitalization of episode.<br><br>A provincial medial Length of Stay (LOS) is used to identify cases where adverse event likely impacted patient's overall LOS.<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |

[79] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[80] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

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| Adverse Events (Labour and Delivery) | *Hospital e-Scorecard Report 2008: Acute Care* Clinical Utilization and Outcomes Technical Summary | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[81] and CCI[82].<br><br>CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario.<br><br>Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator looks at the proportion of women undergoing labour and/or delivery who experience adverse events, which may be attributed to the hospital treating the patient when the complication developed.<br><br>Labour and delivery cases must start with a delivery code of interest in first hospitalization of the episode.<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |
| Readmissions – Specific Medical Conditions | *Hospital e-Scorecard Report 2008: Acute Care* Clinical Utilization and | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[83] and CCI[84].<br><br>CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario. |

[81] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[82] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

[83] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[84] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

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| | Outcomes Technical Summary | Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator is the sum of readmission rates for AMI, heart failure, asthma, GI bleed, and stroke (medical).<br><br>Readmissions are defined using information from both the initial episode and subsequent hospitalization. A readmission is considered to have occurred if all of the following criteria are met:<br><br>-subsequent hospitalization was for a diagnosis of procedure that was defined by an expert panel as relevant to the initial surgery<br>-initial episode did not end with patient signing him/herself out against medical advice (or died)<br>-If patient is admitted more than 24 hours following discharge, not considered a transfer and treated as new episode<br>-If subsequent admission was not elective<br>Readmissions are excluded if they are for procedures that constitute part of expected care following a specific type of hospitalization.<br><br>Medical cases must start as an inpatient case with a diagnosis of interest in first hospitalization of episode.<br><br>For multi-hospital episodes of care, readmissions attributed to last hospital from which patient was discharged before the readmission.<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |
| Readmissions – Specific Surgical Procedures | *Hospital e-Scorecard Report 2008: Acute* | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[85] and CCI[86]. |

[85] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[86] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

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| | *Care* Clinical Utilization and Outcomes Technical Summary | CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario.<br><br>Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator is the sum of readmission rates cholecystectomy, hysterectomy, and prostatectomy.<br><br>Readmissions are defined using information from both the initial episode and subsequent hospitalization. A readmission is considered to have occurred if all of the following criteria are met:<br><br>-subsequent hospitalization was for a diagnosis of procedure that was defined by an expert panel as relevant to the initial surgery<br>-initial episode did not end with patient signing him/herself out against medical advice (or died)<br>-If patient is admitted more than 24 hours following discharge, not considered a transfer and treated as new episode<br>-If subsequent admission was not elective<br><br>Readmissions are excluded if they are for procedures that constitute part of expected care following a specific type of hospitalization.<br><br>Surgical cases may start as either an inpatient or day procedure case with a procedure of interest in first hospitalization of episode.<br><br>For multi-hospital episodes of care, readmissions attributed to last hospital from which patient was discharged before the readmission.<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |

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| Readmissions – Labour & Delivery | *Hospital e-Scorecard Report 2008: Acute Care* Clinical Utilization and Outcomes Technical Summary | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[87] and CCI[88].<br><br>CIHI maintains the National Ambulatory Care Reporting System (NACRS) database, which includes data from day procedure units, emergency departments, and other ambulatory care clinics. This data was selected from NACRS based on MIS functional centers mandated by Ministry of Health and Long-Term Care of Ontario.<br><br>Selection of patient groups relied on diagnostic, demographic and procedural information that was submitted to CIHI by Ontario hospitals.<br><br>There were specific exclusions made to lessen data quality problems:<br><br>• Patients who could not be linked from hospital to hospital;<br>• Patients who would require specific or unusual management;<br>• Diagnosis codes for cancer, AIDS/HIV, and trauma;<br>• Patients without an Ontario residence;<br>• Patients without a valid health insurance number;<br>• Patients less than 15 years of age or greater than 84 years of age;<br>• Care provided outside Ontario; and<br>• Gender not specified.<br><br>This indicator is rate of hospital readmissions within 14 days of discharge in women undergoing labour and delivery, for all deliveries.<br><br>Labour and delivery cases must start with a delivery code of interest in first hospitalization.<br><br>For multi-hospital episodes of care, readmissions attributed to last hospital from which patient was discharged before the readmission.<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between hospitals. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |

[87] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[88] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

## APPENDIX 5-3: METHODOLOGY FOR SELECTED REHABILITATION INDICATORS

(Source: http://www.hospitalreport.ca/downloads/2008/rehab/2008_REHAB_cuo_techreport.pdf)

| Indicator | Source | Methodology |
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| Average Active Rehabilitation LOS (All RCG[89])[90] | *Hospital Report e-Scorecard 2008:* Rehabilitation Clinical Utilization and Outcomes Technical Summary | The average active Rehabilitation LOS is the number of days between date on which client is admitted to the rehabilitation facility and date on which client is discharged from rehabilitation facility, MINUS any service interruption days and days waiting for discharge from inpatient rehabilitation.<br><br>The primary data source for this indicator is the National Rehabilitation Reporting System (NRS). The NRS was developed by CIHI.<br><br>In Ontario, NRS contains data on adult clients (over 18 years of age) receiving care in designated rehabilitation beds. Focus is primarily on clients with time-limited episode of service, predicted discharge date, and expected improvement in functional status.<br><br>Assessment instrument used in NRS is FIM[91] instrument. FIM instrument is a proprietary instrument used to measure functional independence at admission and discharge. The FIM instrument is comprised of 18 items, which are rated on a scale ranging from independent (7) to dependent (1) function. The FIM instrument is used to measure disability. Data using the FIM instrument are collected at admission to and discharge from hospitals for each rehabilitation visit. Data may also be collected 3 to 6 months following discharge from inpatient rehabilitation.<br><br>Admission data must be completed within 72 hours after admission and data must be collected within 72 hours before discharge from the rehabilitation program. Data related to socio-demographic information and rehabilitation LOS included in the NRS are derived from sources such as the chart, the client, other staff, or family members.<br><br>The data included in this indicator is based on FIM instrument data collected between April 1, 2006 to March 31, 2007.<br><br>Records that did not clearly identify sex were excluded.<br><br>Each client within NRS is classified into a group called a Rehabilitation Client Group (RCG). The RCG classifies patients based on impairments, activity limitations, and/or participation restrictions to a total of 17 RCGs.<br><br>Participation in NRS is mandatory for Ontario hospitals and includes 58 hospital corporations.<br><br>**A lower score for this indicator is desirable.** |

[89] RCG stands for Rehabilitation Client Group (i.e. stroke, cardiac, burns, etc.)
[90] This report is available online at http://www.hospitalreport.ca/downloads/2008/rehab/2008_REHAB_cuo_techreport.pdf
[91] The FIM instrument is the property of Uniform Data System for Medical Rehabilitation

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| Average Active Rehabilitation LOS (Stroke) | *Hospital Report e-Scorecard 2008:* Rehabilitation Clinical Utilization and Outcomes Technical Summary | The average active Rehabilitation LOS is the number of days between date on which client is admitted to the rehabilitation facility and date on which client is discharged from rehabilitation facility, MINUS any service interruption days and days waiting for discharge from inpatient rehabilitation. This indicator is specific to stroke patients.<br><br>The primary data source for this indicator is the National Rehabilitation Reporting System (NRS). The NRS was developed by CIHI.<br><br>In Ontario, NRS contains data on adult clients (over 18 years of age) receiving care in designated rehabilitation beds. Focus is primarily on clients with time-limited episode of service, predicted discharge date, and expected improvement in functional status.<br><br>Assessment instrument used in NRS is FIM[92] instrument. FIM instrument is a proprietary instrument used to measure functional independence at admission and discharge. The FIM instrument is comprised of 18 items, which are rated on a scale ranging from independent (7) to dependent (1) function. The FIM instrument is used to measure disability. Data using the FIM instrument are collected at admission to and discharge from hospitals for each rehabilitation visit. Data may also be collected 3 to 6 months following discharge from inpatient rehabilitation.<br><br>Admission data must be completed within 72 hours after admission and data must be collected within 72 hours before discharge from the rehabilitation program. Data related to socio-demographic information and rehabilitation LOS included in the NRS are derived from sources such as the chart, the client, other staff, or family members.<br><br>The data included in this indicator is based on FIM instrument data collected between April 1, 2006 to March 31, 2007.<br><br>Records that did not clearly identify sex were excluded.<br><br>Each client within NRS is classified into a group called a Rehabilitation Care Group (RCG). The RCG classifies patients based on impairments, activity limitations, and/or participation restrictions to a total of 17 RCGs.<br><br>Participation in NRS is mandatory for Ontario hospitals and included 58 hospital corporations.<br><br>**A lower score for this indicator is desirable.** |
| Average Active Rehabilitation LOS (Ortho) | *Hospital Report e-Scorecard 2008:* Rehabilitation Clinical Utilization and | The average active Rehabilitation LOS is the number of days between date on which client is admitted to the rehabilitation facility and date on which client is discharged from rehabilitation facility, MINUS any service interruption days and days waiting for discharge from inpatient rehabilitation. This indicator is specific to orthopaedic patients.<br><br>The primary data source for this indicator is the National Rehabilitation Reporting System (NRS). The NRS was developed by CIHI. |

[92] The FIM instrument is the property of Uniform Data System for Medical Rehabilitation

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| | Outcomes Technical Summary | In Ontario, NRS contains data on adult clients (over 18 years of age) receiving care in designated rehabilitation beds. Focus is primarily on clients with time-limited episode of service, predicted discharge date, and expected improvement in functional status.<br><br>Assessment instrument used in NRS is FIM[93] instrument. FIM instrument is a proprietary instrument used to measure functional independence at admission and discharge. The FIM instrument is comprised of 18 items, which are rated on a scale ranging from independent (7) to dependent (1) function. The FIM instrument is used to measure disability. Data using the FIM instrument are collected at admission to and discharge from hospitals for each rehabilitation visit. Data may also be collected 3 to 6 months following discharge from inpatient rehabilitation.<br><br>Admission data must be completed within 72 hours after admission and data must be collected within 72 hours before discharge from the rehabilitation program. Data related to socio-demographic information and rehabilitation LOS included in the NRS are derived from sources such as the chart, the client, other staff, or family members.<br><br>The data included in this indicator is based on FIM instrument data collected between April 1, 2006 to March 31, 2007.<br><br>Records that did not clearly identify sex were excluded.<br><br>Each client within NRS is classified into a group called a Rehabilitation Care Group (RCG). The RCG classifies patients based on impairments, activity limitations, and/or participation restrictions to a total of 17 RCGs.<br><br>Participation in NRS is mandatory for Ontario hospitals and includes 58 hospital corporations.<br><br>**A lower score for this indicator is desirable.** |

[93] The FIM instrument is the property of Uniform Data System for Medical Rehabilitation

## APPENDIX 5-4: METHODOLOGY FOR SELECTED EMERGENCY DEPARTMENT CARE INDICATORS

(Source: http://www.hospitalreport.ca/downloads/2008/EDC/2008_ED_sic_techreport.pdf; http://www.hospitalreport.ca/downloads/2008/EDC/2008_ED_cuo_techreport.pdf)

| Indicator | Source | Methodology |
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| Clinical Data Collection and Dissemination | *Hospital e-Scorecard Report 2008:* Emergency Department Care System Integration and Change Technical Summary[94] | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 102 Emergency Department Care hospitals completed and returned the surveys giving a response rate of 81.6%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br>General Indicator Scoring:<br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br>Calculation of Clinical Data Collection and Dissemination Indicator:<br><br>This indicator consists of four components:<br><br>**Component 1 (37.5% weighting):**<br><br>Clinical Data Collection:<br><br>-Whether and how currently data is collected to improve care delivery processes<br><br>**Component 2 (21.2% weighting)**<br><br>Clinical Data Dissemination:<br><br>-Indicate which groups and in what format data was shared that was collected for clinical quality improvement |

[94] This report is available at http://www.hospitalreport.ca/downloads/2008/EDC/2008_ED_sic_techreport.pdf

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| | | **Component 3 (23.4% weighting)**<br><br>Communication About Data Use and Dissemination:<br><br>-Extent to which a committee exists that includes a given activity as part of its mandate<br><br>**Component 4 (17.9% weighting)**<br><br>Existence of Staff Roles to Facilitate Data Use and Dissemination:<br><br>-Identify which staff roles existed at time of survey<br><br>**A higher score for this indicator is desirable.** |
| Internal Coordination of Care | *Hospital e-Scorecard Report 2008:* Emergency Department Care System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 102 Emergency Department Care hospitals completed and returned the surveys giving a response rate of 81.6%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Internal Coordination of Care Indicator:</u><br><br>This indicator consists of three components:<br><br>**Component 1 (33.7% weighting):**<br><br>Patient Flow Strategy Development and Use:<br><br>-Extent to which different strategies to address patient flow issues had been developed |

| | | |
|---|---|---|
| | | **Component 2 (36.5% weighting)**<br><br>Internal Coordination Communication:<br><br>-If organization had a committee and to what extent they discussed following issues.<br><br>**Component 3 (29.8% weighting)**<br><br>Existence of Different Staff Roles to Promote Internal Care Coordination:<br><br>-Identify which staff roles existed at time of survey.<br><br>**A higher score for this indicator is desirable.** |
| Use of Clinical Information Technology | *Hospital e-Scorecard Report 2008:* Emergency Department Care System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 102 Emergency Department Care hospitals completed and returned the surveys giving a response rate of 81.6%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Use of Clinical Information Technology Indicator:</u><br><br>This indicator consists of three components:<br><br>**Component 1 (32.5% weighting):**<br><br>Use or Development of an Electronic Patient Tracking System:<br><br>-Extent to which organizations are developing and using an electronic patient tracking system |

| | | |
|---|---|---|
| | | **Component 2 (37.5% weighting)**<br><br>Use of Electronic Records as a Primary Information Source:<br><br>-If organizations are using electronic records and data as primary source of information<br><br>**Component 3 (30% weighting)**<br><br>Online Functionality of Selected Activities:<br><br>-Extent to which selected functions could be performed online by patient-care staff in a clinical area.<br><br>**A higher score for this indicator is desirable.** |
| Use of Standardized Protocols | *Hospital e-Scorecard Report 2008:* Emergency Department Care System Integration and Change Technical Summary | The data for this indicator was obtained as part of an online survey called the "SIC (System Integration and Change) Survey." This survey was completed online by specific Ontario hospitals.<br><br>The survey was administered in December of 2007. 102 Emergency Department Care hospitals completed and returned the surveys giving a response rate of 81.6%. The survey was web-based and sent via email to a specific contact at the hospitals. Participants signed off on the survey once completed. Data quality checks were performed on completed surveys to ensure mandatory questions were completed.<br><br><u>General Indicator Scoring:</u><br><br>Each question was multiplied by a specific weighting. i.e. Hospital X received 10 points for Question 1 out of a possible 25 points. A calculation was performed to determine the contribution of this question to the indicator score by:<br><br>DIVIDE Hospital X's score (10) by total possible points (25) and multiply by specified weighting for Question 1 (22%). Therefore, Hospital X received 8.8% of total indicator score for Question 1. The weights are provided for each indicator. Weighted scores are summed to give overall score for that component of the indicator. If a question is not applicable to a hospital, the question is removed from the denominator.<br><br><u>Calculation of Use of Standardized Protocols Indicator:</u><br><br>This indicator consists of two components:<br><br>**Component 1 (47.1% weighting):**<br><br>Clinical Practice Guidelines Development and Use:<br><br>-Extent to which 12 clinical practice guidelines were developed and used in Emergency Department |

| | | |
|---|---|---|
| | | **Component 2 (52.9% weighting)**<br><br>Medical Directives Development and Use:<br><br>-Extent to which 6 medical directives developed and in use in Emergency Department<br><br>**A higher score for this indicator is desirable.** |
| Chest X-Ray Rate for Asthma – Pediatric | *Hospital e-Scorecard Report 2008:* Emergency Department Care Clinical Utilization and Outcomes Technical Summary | This indicator measures the proportion of pediatric patients with a diagnosis of asthma who receive a chest x-ray.<br><br>The National Ambulatory Care Reporting System (NACRS) database was used to provide information on this indicator. NACRS is managed by CIHI. When a patient is registered at an Emergency Department, a record within NACRS is generated and submitted to CIHI. This data is derived from data from April 1, 2006 to March 31, 2007. All Emergency Department patients who are admitted to an acute care hospital have a second summary abstract created in the Discharge Abstract Database (DAD). The DAD is also managed by CIHI. Data from the DAD was linked to NACRS to provide comprehensive information on a patient's entire stay in hospital.<br><br>Data from all eligible Emergency Departments in Ontario was used to contribute to the NACRS database. Data were limited to residents of Ontario. Records with invalid Ontario health care numbers or records that were exact duplicates of an existing record were excluded from analysis. Individuals with missing values for individual data elements were excluded from specific analyses. Records with negative ages or age greater than 105 years old were excluded.<br><br>Emergency Department Care indicators information gathered from literature review and consultations with Emergency Department physicians and nurse managers to identify clinical conditions for which care could have important implications for treatment and patient outcomes.<br><br>This indicator is calculated by:<br><br>**Denominator:**<br><br>Including cases with an asthma diagnosis (1-19 years)<br><br>**Numerator:**<br><br>Cases in denominator with a chest x-ray<br><br>All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[95] and CCI[96]. |

[95] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[96] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

| | | |
|---|---|---|
| | | Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between Emergency Departments. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |
| Return X-Ray Rate for Ankle or Foot Injury Patients (less than or equal to 7 days) | *Hospital e-Scorecard Report 2008:* Emergency Department Care Clinical Utilization and Outcomes Technical Summary | This indicator measures the proportion of patients (5 to 84 years old) who are discharged from the Emergency Department with a diagnosis of ankle or foot injury but without an ankle or foot x-ray, who have a return visit for ankle injury to any Emergency Department within 7 days after the initial Emergency Department discharge and who receive an ankle or foot x-ray on the return visit.<br><br>The National Ambulatory Care Reporting System (NACRS) database was used to provide information on this indicator. NACRS is managed by CIHI. When a patient is registered at an Emergency Department, a record within NACRS is generated and submitted to CIHI. This data is derived from data from April 1, 2006 to March 31, 2007. All Emergency Department patients who are admitted to an acute care hospital have a second summary abstract created in the Discharge Abstract Database (DAD). The DAD is also managed by CIHI. Data from the DAD was linked to NACRS to provide comprehensive information on a patient's entire stay in hospital.<br><br>Data from all eligible Emergency Departments in Ontario was used to contribute to the NACRS database. Data were limited to residents of Ontario. Records with invalid Ontario health care numbers or records that were exact duplicates of an existing record were excluded from analysis. Individuals with missing values for individual data elements were excluded from specific analyses. Records with negative ages or age greater than 105 years old were excluded.<br><br>Emergency Department Care indicators information gathered from literature review and consultations with Emergency Department physicians and nurse managers to identify clinical conditions for which care could have important implications for treatment and patient outcomes.<br><br>This indicator is calculated by:<br><br>**Denominator:**<br><br>Cases with an ankle or foot injury (5 – 84 years old)<br><br>Include cases that were discharged home or to a place of residence<br><br>Exclude cases that had x-ray performed<br><br>**Numerator:**<br><br>Return visit cases linked to NACRS record<br><br>Include cases with an ankle or foot injury that had x-ray performed |

| | | |
|---|---|---|
| | | All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[97] and CCI[98].<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between Emergency Departments. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |
| Return Visit Rate for Asthma (less than or equal to 24 hours) – Adult | *Hospital e-Scorecard Report 2008:* Emergency Department Care Clinical Utilization and Outcomes Technical Summary | This indicator measures the proportion of adult patients (20 to 64 years old) who are discharged from the Emergency Department with a diagnosis of Asthma who have an urgent or emergent return visit for asthma or a related condition to any Emergency Department within 24 hours after the initial discharge.<br><br>The National Ambulatory Care Reporting System (NACRS) database was used to provide information on this indicator. NACRS is managed by CIHI. When a patient is registered at an Emergency Department, a record within NACRS is generated and submitted to CIHI. This data is derived from data from April 1, 2006 to March 31, 2007. All Emergency Department patients who are admitted to an acute care hospital have a second summary abstract created in the Discharge Abstract Database (DAD). The DAD is also managed by CIHI. Data from the DAD was linked to NACRS to provide comprehensive information on a patient's entire stay in hospital.<br><br>Data from all eligible Emergency Departments in Ontario was used to contribute to the NACRS database. Data were limited to residents of Ontario. Records with invalid Ontario health care numbers or records that were exact duplicates of an existing record were excluded from analysis. Individuals with missing values for individual data elements were excluded from specific analyses. Records with negative ages or age greater than 105 years old were excluded.<br><br>Emergency Department Care indicators information gathered from literature review and consultations with Emergency Department physicians and nurse managers to identify clinical conditions for which care could have important implications for treatment and patient outcomes.<br><br>This indicator is calculated by:<br><br>**Denominator:**<br><br>Cases with an asthma diagnosis (20 – 64 years old)<br><br>Exclude cases that left before visit completion, admissions to inpatient, transfers and deaths |

[97] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[98] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

| | | |
|---|---|---|
| | | **Numerator:**<br><br>Return visit cases linked to NACRS record<br><br>Include cases with an asthma diagnosis<br><br>Include cases with an urgent or emergent triage level<br><br>Exclude planned revisits and those seen by non-Emergency Department providers<br><br>All clinical utilization measures obtained from CIHI data. Coding of data based on ICD-10-CA[99] and CCI[100].<br><br>Risk-adjustment techniques used to adjust data for factors such as patient characteristics, which may not allow for comparability of the data between Emergency Departments. Risk adjustment variables and techniques selected on basis of appropriateness.<br><br>**A lower score for this indicator is desirable.** |

[99] The International Statistical Classification of Diseases, 10th Revision is an international standard for reporting clinical diagnoses developed by the World Health Organization

[100] The Canadian Classification of Health Interventions is a new national standard for classifying health care procedures

## APPENDIX 5-5: LIST OF PARTICIPATING HOSPITALS (FOR AT LEAST ONE HOSPITAL REPORT SERIES INDICATOR)

Alexandra Hospital
Alexandra Marine & General Hospital
Atikokan General Hospital
Blind River District Health Centre
Bluewater Health
Bridgepoint Hospital
Brockville General Hospital
Cambridge Memorial Hospital
Campbellford Memorial Hospital
Carleton Place & District Memorial Hospital
Children's Hospital of Eastern Ontario
Collingwood General and Marine Hospital
Cornwall Community Hospital / Hôpital communautaire de Cornwall
Dryden Regional Health Centre
Glengarry Memorial Hospital
Grand River Hospital Corporation
Grey Bruce Health Services
Guelph General Hospital
Halton Healthcare Services Corporation
Hanover and District Hospital
Hawkesbury & District General Hospital
Headwaters Health Care Centre
Hopital regional de Sudbury Regional Hospital Corporation
Hornepayne Community Hospital
Hospital for Sick Children
Hotel-Dieu Grace Hospital (Windsor)
Humber River Regional Hospital
Huron Perth Healthcare Alliance
Huronia District Hospital
Joseph Brant Memorial Hospital
Kemptville District Hospital
Kirkland and District Hospital
Lake of the Woods District Hospital
Lakeridge Health Corporation
Lennox and Addington County General Hospital
Listowel Memorial Hospital
London Health Sciences Centre
Manitoulin Health Centre
Manitouwadge General Hospital
Markham Stouffville Hospital

Mattawa General Hospital
Montfort Hospital
Mount Sinai Hospital
Niagara Health System
Nipigon District Memorial Hospital
Norfolk General Hospital
North Bay General Hospital
North Wellington Health Care Corporation
North York General Hospital
Northumberland Hills Hospital
Orillia Soldiers' Memorial Hospital
Pembroke Regional Hospital Inc.
Penetanguishene General Hospital
Perth & Smiths Falls District Hospital
Providence Continuing Care Centre
Providence Healthcare
Queensway Carleton Hospital
Quinte Healthcare Corporation
SCO Health Service
Sensenbrenner Hospital
Sioux Lookout Meno-Ya-Win Health Centre
Smooth Rock Falls Hospital
South Bruce Grey Health Centre
Southlake Regional Health Centre
St. Francis Memorial Hospital
St. John's Rehabilitation Hospital
St. Joseph's Care Group (Thunder Bay)
St. Joseph's General Hospital Elliot Lake
St. Joseph's Health Care, London
St. Joseph's Health Centre, Guelph
St. Joseph's Healthcare Hamilton
St. Mary's General Hospital
St. Michael's Hospital
St. Thomas Elgin General Hospital
Strathroy Middlesex General Hospital
Sunnybrook Health Sciences Centre
Temiskaming Hospital
The Credit Valley Hospital
The Scarborough Hospital
The Toronto East General Hospital
The West Nipissing General Hospital
Timmins & District Hospital - L'Hopital de Timmins et du district
Toronto Rehabilitation Institute

Trillium Health Centre
University Health Network
West Lincoln Memorial Hospital
West Park Healthcare Centre
William Osler Health Centre
Wilson Memorial General Hospital
Windsor Regional Hospital
Woodstock General Hospital
York Central Hospital

**TABLE 3-6: 2007 OHA SUBSECTIONS CORRELATED WITH BARRIERS AND DEDICATED RESOURCES (DIVIDED UP BY ALL HOSPITALS, PEER GROUPS, LHINS)**

| **ALL HOSPITALS** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1.1** | **1.2** | **1.3** | **1.4** | **1.5** | **2.1** | **3.2** | **3.3** |
| BARRIERS | | | | | | | | p = .036; r = -.184 |
| DEDICATED RESOURCES | p = .000; r = .345 | p = .001; r = .277 | p = .004; r = .251 | p = .000; r = .305 | p = .005; r = .246 | p = .000; r = .534 | p = .001; r = .290 | |
| **Peer Groups** | | | | | | | | |
| *CCC, Rehab* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | | | p = .002; r = .675 | p = .005; r = .626 | |
| *Community* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | p = .026; r = .315 | | p = .000; r = .565 | | |
| *Teaching* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | p = .019; r = .594 | p = .009; r = .646 | | | | | | |
| *Small* | | | | | | | | |
| BARRIERS | | | | | | | | p = .047; r = -.288 |
| DEDICATED RESOURCES | | | | | | | | |
| **LHINS** | | | | | | | | |
| *Central* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | | - |
| DEDICATED RESOURCES | | | | | | | | |
| *Central East* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | | | p = .033; r = .747 | | |
| *Central West* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | - | - | - | - | - | - | - | - |
| *Champlain* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | p = .017; r = .568 | | | | p = .036; r = .512 | | |

*Dashed lines (-) indicate that information is not available

*Definition of Subsections provided at end of table

| | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 2.1 | 3.2 | 3.3 |
|---|---|---|---|---|---|---|---|---|
| *Erie St. Clair* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | | | | | |
| *Hamilton Niagara* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | | | | | |
| *Mississauga* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | | | | | |
| *North East* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | p = .005; r = .614 | | | | | p = .003; r = .646 | | |
| *North Simcoe* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | | | | p = .004; r = .946 | |
| *North West* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | | | | | |
| *South East* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | | | | | |
| *South West* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | | | | | |
| *Toronto Central* | | | | | | | | |
| BARRIERS | - | - | - | - | - | - | - | - |
| DEDICATED RESOURCES | | | | p =.005; r =.708 | | p = .003; r = .723 | p = .019; r = .617 | p = .048; r = .536 |
| *Waterloo* | | | | | | | | |
| BARRIERS | | | | | | | | |
| DEDICATED RESOURCES | | | | | | | | |

*Dashed lines (-) indicate that information is not available

*Definition of Subsections provided at end of table

SECTION 1 (LEVEL of e-Health CAPABILITY AND USE)

*Subsection 1.1 (Patient Registration, Records Management and Registry Services)*

*Subsection 1.2 (Point-of-Care Order Entry)*

*Subsection 1.3 (Clinical Documentation)*

*Subsection 1.4 (Results Reporting)*

*Subsection 1.5 (Information Infrastructure)*

SECTION 2 (LEVEL OF e-Health ORGANIZATIONAL AND HUMAN CAPACITY)

*Subsection 2.1 (e-Health Leadership and Planning)*

SECTION 3 (LEVEL OF REGIONAL/INTER-ORGANIZATIONAL e-Health)

*Subsection 3.2 (Inter-Organizational EMPI)*

*Subsection 3.3 (Interoperability Between Organizations)*

**TABLE 3-7: 2007 IMPROVE-IT E-HEALTH ADOPTION SCORE CORRELATED WITH BARRIERS AND DEDICATED RESOURCES**

| GROUP | BARRIERS | DEDICATED RESOURCES |
|---|---|---|
| ALL Hospitals | | p = .000; r = .389 |
| *Peer Groups* | | |
| CCC, Rehab | | |
| Community | | |
| Teaching | | p = .026; r = .572 |
| Small | | |
| *LHINS* | | |
| Central | - | |
| Central East | - | |
| Central West | - | - |
| Champlain | | p = .036; r = .511 |
| Erie St. Clair | - | - |
| Hamilton Niagara | | |
| Mississauga | - | |
| North East | | |
| North Simcoe | - | p = .044; r = .823 |
| North West | | |
| South East | - | |
| South West | | |
| Toronto Central | - | p = .016; r = .627 |
| Waterloo | | |

*Dashed lines (-) indicate that information is not available

**TABLE 3-8: BREAKDOWN OF DEDICATED RESOURCES ASSOCIATED WITH TABLE 3-7 (FOR ALL SIGNIFICANT CORRELATIONS**

| DEDICATED RESOURCES | TOTAL |
|---|---|
| ***ALL HOSPITALS*** | |
| Project Management | 123 |
| Process Re-engineering | 123 |
| IS Support in End User Departments | 100 |
| Clinical Systems Training | 95 |
| Decision Support | 84 |
| Regional Infrastructure | 66 |
| Interface Development | 65 |
| Nursing Informatics | 60 |
| Change Management | 46 |
| ***TEACHING PEER GROUP*** | |
| Clinical Systems Training | 15 |
| Project Management | 14 |
| Interface Development | 14 |
| Decision Support | 14 |
| IS Support in End User Departments | 13 |
| Change Management | 12 |
| Process Re-engineering | 11 |
| Nursing Informatics | 11 |
| Regional Infrastructure | 10 |
| ***CHAMPLAIN LHIN*** | |
| IS Support in End User Departments | 14 |
| Project Management | 13 |
| Clinical Systems Training | 13 |
| Change Management | 8 |
| Decision Support | 8 |
| Regional Infrastructure | 8 |
| Interface Development | 7 |
| Process Re-engineering | 6 |
| Nursing Informatics | 6 |
| ***NORTH SIMCOE LHIN*** | |
| Nursing Informatics | 5 |
| Clinical Systems Training | 5 |
| IS Support in End User Departments | 4 |
| Decision Support | 4 |
| Interface Development | 2 |
| Regional Infrastructure | 2 |
| Project Management | 0 |
| Change Management | 0 |
| Process Re-engineering | 0 |
| ***TORONTO CENTRAL LHIN*** | |
| IS Support in End User Departments | 14 |
| Clinical Systems Training | 13 |
| Project Management | 12 |
| Decision Support | 12 |
| Interface Development | 10 |
| Process Re-engineering | 9 |
| Change Management | 8 |
| Nursing Informatics | 7 |
| Regional Infrastructure | 6 |

**TABLE 3-9: CHANGE IN ADOPTION SCORE (2006-2007) CORRELATED WITH BARRIERS AND DEDICATED RESOURCES**

| GROUP | BARRIERS | DEDICATED RESOURCES |
|---|---|---|
| ALL Hospitals | | |
| *Peer Groups* | | |
| CCC, Rehab | | p = .021; r = .540 |
| Community | p = .001; r = -.442 | |
| Teaching | | |
| Small | p = .040; r = .298 | |
| *LHINS* | | |
| Central | - | p = .029; r = -.759 |
| Central East | - | |
| Central West | - | - |
| Champlain | | |
| Erie St. Clair | - | - |
| Hamilton Niagara | | |
| Mississauga | - | |
| North East | p = .036; r = .483 | |
| North Simcoe | - | |
| North West | | |
| South East | - | |
| South West | p = .036; r = -.544 | |
| Toronto Central | - | |
| Waterloo | | p = .004; r = -.875 |

*Dashed lines (-) indicate that information is not available

**TABLE 3-10: BREAKDOWN OF DEDICATED RESOURCES ASSOCIATED WITH TABLE 3-9 (SIGNIFICANT CORRELATION)**

| DEDICATED RESOURCES | TOTAL |
|---|---|
| ***CCC REHAB & MENTAL HEALTH PEER GROUP*** | |
| IS Support in End User Departments | 14 |
| Project Management | 12 |
| Clinical Systems Training | 12 |
| Decision Support | 10 |
| Regional Infrastructure | 8 |
| Change Management | 6 |
| Process Re-engineering | 6 |
| Interface Development | 5 |
| Nursing Informatics | 4 |
| ***CENTRAL LHIN*** | |
| Clinical Systems Training | 7 |
| Project Management | 6 |
| IS Support in End User Departments | 6 |
| Decision Support | 6 |
| Interface Development | 5 |
| Nursing Informatics | 5 |
| Process Re-engineering | 4 |
| Regional Infrastructure | 3 |
| Change Management | 3 |
| ***WATERLOO LHIN*** | |
| Project Management | 7 |
| Decision Support | 6 |
| Nursing Informatics | 5 |
| Clinical Systems Training | 5 |
| IS Support in End User Departments | 4 |
| Interface Development | 3 |
| Change Management | 2 |
| Regional Infrastructure | 2 |
| Process Re-engineering | 1 |

**TABLE 3-11: BREAKDOWN OF BARRIERS ASSOCIATED WITH TABLE 3-9 SIGNIFICANT CORRELATION**

| BARRIERS | TOTAL |
|---|---|
| ***COMMUNITY PEER GROUP*** | |
| Lack of adequate financial support | 45 |
| Lack of qualified staff or access to qualified staff | 28 |
| Difficulty in achieving end-user acceptance or use | 15 |
| Lack of infrastructural or prerequisite technology | 11 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 10 |
| Lack of change management strategies and re-engineering processes | 9 |
| Lack of clinician support | 8 |
| Solution not yet scheduled | 6 |
| Need to establish and adopt data standards | 5 |
| Lack of top management support | 4 |
| Lack of strategic Information & Communication Technology (ICT) plan | 3 |
| Hospital has not defined need | 0 |
| None | 0 |
| ***SMALL PEER GROUP*** | |
| Lack of adequate financial support | 36 |
| Lack of qualified staff or access to qualified staff | 15 |
| Lack of infrastructural or prerequisite technology | 15 |
| Need to establish and adopt data standards | 11 |
| Lack of strategic Information & Communication Technology (ICT) plan | 10 |
| Lack of change management strategies and re-engineering processes | 10 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 9 |
| Solution not yet scheduled | 9 |
| Difficulty in achieving end-user acceptance or use | 8 |
| Lack of clinician support | 7 |
| Hospital has not defined need | 5 |
| Lack of top management support | 0 |
| None | 0 |
| ***NORTH EAST LHIN*** | |
| Lack of adequate financial support | 16 |
| Lack of qualified staff or access to qualified staff | 9 |
| Need to establish and adopt data standards | 4 |
| Lack of infrastructural or prerequisite technology | 4 |
| Lack of clinician support | 3 |
| Lack of top management support | 3 |
| Lack of strategic Information & Communication Technology (ICT) plan | 3 |
| Solution not yet scheduled | 3 |
| Lack of change management strategies and re-engineering processes | 2 |
| Difficulty in achieving end-user acceptance or use | 2 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 2 |
| Hospital has not defined need | 0 |
| None | 0 |
| ***SOUTH WEST LHIN*** | |
| Lack of adequate financial support | 11 |
| Lack of change management strategies and re-engineering processes | 7 |
| Difficulty in achieving end-user acceptance or use | 6 |
| Lack of qualified staff or access to qualified staff | 5 |
| Lack of infrastructural or prerequisite technology | 5 |
| Lack of clinician support | 2 |
| Vendor's inability to effectively deliver product/ solution does not meet needs | 2 |
| Need to establish and adopt data standards | 2 |
| Hospital has not defined need | 1 |
| Solution not yet scheduled | 1 |
| Lack of top management support | 0 |
| Lack of strategic Information & Communication Technology (ICT) plan | 0 |
| None | 0 |

**TABLE 4-4: MEANING OF ACRONYMS IN TABLES**

| Acronym | Meaning |
|---|---|
| 08 OHA Scr | 2008 OHA Adoption Score |
| 07 OHA Scr | 2007 OHA Adoption Score |
| 06 OHA Scr | 2006 OHA Adoption Score |
| Chg in OHA Scr 06-07 | Change in OHA Adoption Score between 2006 and 2007 |
| % chg in OHA Scr 06-07 | Percent Change in OHA Adoption Score between 2006 and 2007 |
| Chg in OHA Scr 07-08 | Change in OHA Adoption Score between 2007 and 2008 |
| % chg in OHA Scr 07-08 | Percent Change in OHA Adoption Score between 2007 and 2008 |
| Chg in OHA Scr 06-08 | Change in OHA Adoption Score between 2006 and 2008 |
| % chg in OHA Scr 06-08 | Percent Change in OHA Adoption Score between 2006 and 2008 |
| % IT Cap Exp 07 | Percent IT Capital Expense 2007 |
| % IT Opr Exp 07 | Percent IT Operating Expense 2007 |
| Ttl IT Opr Exp 07 | Total IT Operating Expense 2007 |
| Ttl IT Cap Exp 07 | Total IT Capital Expense 2007 |
| Ttl Cap Exp 07 | Total Capital Expense 2007 |
| Ttl Opr Exp 07 | Total Operating Expense 2007 |
| % IT Cap Exp 06 | Percent IT Capital Expense 2006 |
| % IT Opr Exp 06 | Percent IT Operating Expense 2006 |
| Ttl IT Opr Exp 06 | Total IT Operating Expense 2006 |
| Ttl IT Cap Exp 06 | Total IT Capital Expense 2006 |
| Ttl Cap Exp 06 | Total Capital Expense 2006 |
| Ttl Opr Exp 06 | Total Operating Expense 2006 |
| Sub-sec. 1.1 | Patient Registration, Records Management and Registry Services |
| Sub-sec. 1.2 | Point-Of-Care Order Entry |
| Sub-sec. 1.3 | Clinical Documentation |
| Sub-sec. 1.4 | Results Reporting |
| Sub-sec. 1.5 | Information Infrastructure |
| Sub-sec. 2.1 | e-Health Leadership and Planning |
| Sub-sec. 3.2 | Interoperability for a Shared EHR |
| Ba 06 | Barriers for 2006 |
| DR 06 | Dedicated Resources for 2006 |

**TABLE 4-5: CORRELATIONS USING OHA ADOPTION SCORES (ALL 106 HOSPITALS )(Please Refer to Table 4-4 for Explanation of Acronyms)**

| | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08 OHA Scr | p=.005; r=.273 | | X | X | X | X | p=.011; r=.245 | | X | X | X | X |
| 07 OHA Scr | p=.003; r=.283 | | X | X | X | X | p=.007; r=.262 | p=.043; r=.197 | X | X | X | X |
| 06 OHA Scr | p=.004; r=.276 | | X | X | X | X | p=.013; r=.240 | | X | X | X | X |
| Chg In OHA Scr 06-07 | | | | | | | | | | | | |
| % chg in OHA Scr 06-07 | | | | | | | | | | | | |
| Chg In OHA Scr 07-08 | | | | | | | | | | | | |
| % chg in OHA Scr 07-08 | | | | | | | | | | | | |
| Chg In OHA Scr 06-08 | | | | | | | | | | | | |
| % chg in OHA Scr 06-08 | | | | | | | | | | | | |
| Ba 06 | | | | | | | | | | | | |
| DR 06 | X | X | X | X | X | X | X | X | X | X | X | X |
| **SUBSECTIONS** | | | | | | | | | | | | |
| 1.1 | | | | | | X | | | | | X | X |
| 1.2 | p=.001; r=.314 | | X | X | X | X | p=.012; r=.248 | | X | X | X | X |
| 1.3 | p=.033; r=.207 | | X | | X | X | | | X | | X | X |
| 1.4 | p=.013; r=.240 | | X | X | X | X | p=.030; r=.211 | | X | X | X | X |
| 1.5 | | | | | | X | | | | | X | X |
| 2.1 | | p=.024; r=.219 | X | X | X | X | p=.035; r=.205 | p=.005; r=.274 | X | X | X | X |
| 3.2 | | | | | X | | | | | | X | |

*Slanted line (/) indicates that correlation cannot be computed because at least one of the variables is constant
*Columns for Percent IT Capital Expense (for 2006 and 2007) and Percent IT Operating Expense (for 2006 and 2007) are highlighted because these calculated values allow for comparison of these variables across hospitals.
*Dashed line (-) indicates a perfect correlation (p=1.0)
*"X" indicates that there is a significant correlation

**TABLE 4-6: CORRELATIONS USING OHA ADOPTION SCORES (43 COMMUNITY HOSPITALS)(Please Refer to Table 4-4 for Explanation of Acronyms)**

| | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08 OHA Scr | p=.001; r=.487 | p=.011; r=.386 | X | X | X | X | p=.000; r=.527 | p=.002; r=.454 | X | X | X | X |
| 07 OHA Scr | p=.019; r=.357 | | | | | | p=.002; r=.456 | | | | | |
| 06 OHA Scr | p=.009; r=.395 | | X | | X | | p=.021; r=.351 | | X | | X | |
| Chg In OHA Scr 06-07 | | | | | | | | | | | | |
| % chg in OHA Scr 06-07 | | | | | | | | | | | | |
| Chg In OHA Scr 07-08 | | | X | | X | | | | X | | X | |
| % chg in OHA Scr 07-08 | | | | | X | | | | X | | X | |
| Chg In OHA Scr 06-08 | | | | | | | | | | | | |
| % chg in OHA Scr 06-08 | | | | | | | | | | | | |
| Ba 06 | | | | | | | | | | | | |
| DR 06 | | | X | | X | X | | | X | X* | X | X |
| **SUBSECTIONS** | | | | | | | | | | | | |
| 1.1 | | | | | | | | | | | | |
| 1.2 | | | | | | | | | | | | |
| 1.3 | | | | | | | p=.028; r=.334 | | | | | |
| 1.4 | | | | | | X | | | | | X | X |
| 1.5 | | | | | | | | | | | | |
| 2.1 | | p=.021; r=.352 | X | | X | X | | | X | | X | X |
| 3.2 | | | | | | | | | | | | |

*Slanted line (/) indicates that correlation cannot be computed because at least one of the variables is constant
*Columns for Percent IT Capital Expense (for 2006 and 2007) and Percent IT Operating Expense (for 2006 and 2007) are highlighted because these calculated values allow for comparison of these variables across hospitals.
*Dashed line (-) indicates a perfect correlation (p=1.0)
*"X" indicates that there is a significant correlation

**TABLE 4-7: CORRELATIONS USING OHA ADOPTION SCORES (37 SMALL HOSPITALS)(Please Refer to Table 4-4 for Explanation of Acronyms)**

| | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08 OHA Scr | | | | | | | | | | | | |
| 07 OHA Scr | | p=.050; r=.325 | X | | X | | | p=.038; r=.342 | X | | | |
| 06 OHA Scr | p=.034; r=.350 | p=.007; r=.433 | X | X | X | X | p=.038; r=.342 | p=.033; r=.352 | X | X | | |
| Chg In OHA Scr 06-07 | | | | | | | | | | | | |
| % chg in OHA Scr 06-07 | | | | | | | | | | | | |
| Chg In OHA Scr 07-08 | | | | | | | | | | | | |
| % chg in OHA Scr 07-08 | | | | | | | | | | | | |
| Chg In OHA Scr 06-08 | | | | | | | | | | | | |
| % chg in OHA Scr 06-08 | | | | | | | | | | | | |
| Ba 06 | | | | | | | | | | | | |
| DR 06 | | X | X | | | | | | X | | | |
| **SUBSECTIONS** | | | | | | | | | | | | |
| 1.1 | | | | | | | | | | | | |
| 1.2 | p=.028; r=.377 | | | X | | | | | X | | | |
| 1.3 | | | | | X | X | | | | | X | X |
| 1.4 | p=.035; r=.347 | | | X | X | | | | | X | | |
| 1.5 | | | | | | | | p=.039; r=.341 | | | | |
| 2.1 | | | | | | | | | | | | |
| 3.2 | | | | | | | | | | | | |

*Slanted line (/) indicates that correlation cannot be computed because at least one of the variables is constant
*Columns for Percent IT Capital Expense (for 2006 and 2007) and Percent IT Operating Expense (for 2006 and 2007) are highlighted because these calculated values allow for comparison of these variables across hospitals.
*Dashed line (-) indicates a perfect correlation (p=1.0)
*"X" indicates that there is a significant correlation

**TABLE 4-8: CORRELATIONS USING OHA ADOPTION SCORES (12 TEACHING HOSPITALS)(Please Refer to Table 4-4 for Explanation of Acronyms)**

| | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08 OHA Scr | | | | | | X | | | | | X | X |
| 07 OHA Scr | | | | | | X | | | | | | X |
| 06 OHA Scr | | | | | | | | | | | | |
| Chg In OHA Scr 06-07 | | | | | | | | | | | | |
| % chg in OHA Scr 06-07 | | | | | | | | | | | | |
| Chg In OHA Scr 07-08 | | | | | | | | | | | | |
| % chg in OHA Scr 07-08 | | | | | | | | | | | | |
| Chg In OHA Scr 06-08 | | | | | | | | | | | | |
| % chg in OHA Scr 06-08 | | | | | | | | | | | | |
| Ba 06 | / | / | / | / | / | / | / | / | / | / | / | / |
| DR 06 | | | | | | | | | | | | |
| **SUBSECTIONS** | | | | | | | | | | | | |
| 1.1 | | | | | | | | | | | | |
| 1.2 | | | | | X | X | | | | | X | X |
| 1.3 | | | | | | | | | | | | |
| 1.4 | | | | | | | | | | | | X |
| 1.5 | | | | | | | | | | | | |
| 2.1 | | | | | | | | | | | X | |
| 3.2 | | | | | | | | | | | | |

*Slanted line (/) indicates that correlation cannot be computed because at least one of the variables is constant
*Columns for Percent IT Capital Expense (for 2006 and 2007) and Percent IT Operating Expense (for 2006 and 2007) are highlighted because these calculated values allow for comparison of these variables across hospitals.
*Dashed line (-) indicates a perfect correlation (p=1.0)
*"X" indicates that there is a significant correlation

**TABLE 4-9: CORRELATIONS USING OHA ADOPTION SCORES (14 CCC, REHAB & MENTAL HEALTH HOSPITALS)(Please Refer to Table 4-4 for Explanation of Acronyms)**

| | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08 OHA Scr | | | | | | | | | | | | |
| 07 OHA Scr | | | | | | | | | | | | |
| 06 OHA Scr | | | | | | | | | | | | |
| Chg In OHA Scr 06-07 | | | | | | | | | | | | |
| % chg in OHA Scr 06-07 | | | | X | | | | | | | X | |
| Chg In OHA Scr 07-08 | | | | | | | | | | | | |
| % chg in OHA Scr 07-08 | | | | | | | | | | | | |
| Chg In OHA Scr 06-08 | | | | | | | | | | | X | |
| % chg in OHA Scr 06-08 | | | | | | | | | | | | |
| Ba 06 | | | | | | | | | | | | |
| DR 06 | | | | | | | | | | | | |
| **SUBSECTIONS** | | | | | | | | | | | | |
| 1.1 | p=.040; r=.555 | | | | | | | | | | | |
| 1.2 | p=.025; r=.595 | p=.028; r=.586 | | | | | | | | | | |
| 1.3 | p=.036; r=.562 | | | | | | p=.042; r=.550 | | | | | |
| 1.4 | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | |
| 2.1 | | | | | | | | | | | | |
| 3.2 | | | | | | | | | | | | |

*Slanted line (/) indicates that correlation cannot be computed because at least one of the variables is constant
*Columns for Percent IT Capital Expense (for 2006 and 2007) and Percent IT Operating Expense (for 2006 and 2007) are highlighted because these calculated values allow for comparison of these variables across hospitals.
*Dashed line (-) indicates a perfect correlation (p=1.0)
*"X" indicates that there is a significant correlation

## TABLE 5-7: CORRELATIONS USING ACUTE CARE HOSPITAL REPORT INDICATORS

| | 08 OHA Scr | 07 OHA Scr | 06 OHA Scr | Chg In OHA Scr 06-07 | % chg in OHA Scr 06-07 | Chg In OHA Scr 07-08 | % chg in OHA Scr 07-08 | Chg In OHA Scr 06-08 | % chg in OHA Scr 06-08 | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 | Sub-Sec 1.1 | Sub-Sec 1.2 | Sub-Sec 1.3 | Sub-Sec 1.4 | Sub-Sec 1.5 | Sub-Sec 2.1 | Sub-Sec 3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Use of Clinical IT (76)** | p = .00<br>r = .62 | p = .00<br>r = .60 | p = .00<br>r = .69 | p = .04<br>r = -.24 | p = .00<br>r = -.38 | | | | p = .00<br>r = -.36 | p = .01<br>r = .29 | | X | X | X | X | p = .02<br>r = .28 | p = .03<br>r = .24 | X | X | X | X | p = .00<br>r = .40 | p = .00<br>r = .56 | p = .00<br>r = .46 | p = .00<br>r = .56 | p = .02<br>r = .27 | p = .00<br>r = .42 | |
| **Use of Data for Decision-Making (76)** | p = .00<br>r = .38 | p = .00<br>r = .40 | p = .00<br>r = .40 | | | | | | p = .04<br>r = -.24 | p = .01<br>r = .28 | | X | X | X | X | p = .01<br>r = .29 | | X | X | X | X | p = .03<br>r = .24 | p = .02<br>r = .27 | p = .01<br>r = .32 | p = .00<br>r = .39 | | p = .00<br>r = .33 | |
| **Patient Safety Reporting and Analysis (76)** | p = .04<br>r = .24 | | p = .01<br>r = .30 | | p = .02<br>r = -.27 | | | | p = .04<br>r = -.24 | | | | | | | | | | | | | | | | | p = .02<br>r = .28 | |
| **Performance Management in Ambulatory Care (76)** | | | | | | | | | | | | | | | X | | | | | | X | | | | | | p = .00<br>r = .33 | |
| **Medication Documentation and Reconciliation (76)** | p = .04<br>r = -.23 | | | | | | | | | | | X* | | X* | X* | | | X* | | X* | X* | | | | | | | p = .00<br>r = .32 |
| **Nurse-Sensitive Adverse Events (Medical) (80)** | p = .02<br>r = .26 | p = .04<br>r = .23 | | | p = .03<br>r = .25 | | | | p = .04<br>r = .23 | | p = .00<br>r = .36 | X | | X | X | p = .02<br>r = .26 | p = .00<br>r = .40 | X | | X | X | | | p = .00<br>r = .37 | | | | |
| **Nurse-Sensitive Adverse Events (Surgical) (60)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | p = .03<br>r = .28 |
| **Adverse Events (Labor and Delivery) (62)** | | | | | | | | | | | | | | | | | | | | | | p = .01<br>r = -.31 | | p = .01<br>r = -.33 | p = .01<br>r = -.35 | | | |
| **Readmissions – Specific Medical Conditions (79)** | p = .01<br>r = -.30 | p = .05<br>r = -.22 | p = .00<br>r = -.35 | p = .04<br>r = .24 | p = .01<br>r = .30 | | | | | | | X* | | X* | X* | | p = .04<br>r = -.23 | X* | | X* | X* | | | | | | p = .05<br>r = -.22 | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Readmissions – Specific Surgical Procedures (60)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Readmissions – Labour & Delivery (62)** | p = .00<br><br>r = -.39 | | p = .01<br><br>r = -.31 | | | p = .01<br><br>r = -.31 | p = .01<br><br>r = -.31 | | | | | | | | | | | | | | | | | | | | | |

- **Number of hospitals included in each correlation is in brackets at the end of each indicator name**
- **Asterisk (*) indicates that correlation results are negative**

## TABLE 5-8: CORRELATIONS USING REHABILITATION CARE HOSPITAL REPORT INDICATORS

| | 08 OHA Scr | 07 OHA Scr | 06 OHA Scr | Chg In OHA Scr 06-07 | % chg in OHA Scr 06-07 | Chg In OHA Scr 07-08 | % chg in OHA Scr 07-08 | Chg In OHA Scr 06-08 | % chg in OHA Scr 06-08 | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 | Sub-Sec 1.1 | Sub-Sec 1.2 | Sub-Sec 1.3 | Sub-Sec 1.4 | Sub-Sec 1.5 | Sub-Sec 2.1 | Sub-Sec 3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Average Active Rehabilitation LOS (All RCG) (44)** | p = .01<br>r = -.41 | p = .02<br>r = -.37 | p = .00<br>r = -.44 | | p = .01<br>r = .40 | | | | p = .00<br>r = .43 | | | | | | | | | | | **X*** | | | | p = .01<br>r = -.41 | p = .03<br>r = -.34 | | | |
| **Average Active Rehabilitation LOS (Stroke) (40)** | p = .03<br>r = -.35 | p = .03<br>r = -.34 | p = .04<br>r = -.33 | | | | | | p = .05<br>r = .32 | | | | | **X*** | **X*** | | | | | **X*** | **X*** | | | | | | | |
| **Average Active Rehabilitation LOS (Ortho) (43)** | p = .00<br>r = -.45 | p = .01<br>r = -.41 | p = .00<br>r = -.52 | p = .02<br>r = .35 | p = .00<br>r = .47 | | p = .01<br>r = .37 | p = .03<br>r = .33 | p = .00<br>r = .55 | | | | | **X*** | **X*** | | | | | **X*** | **X*** | | p = .05<br>r = -.31 | p = .00<br>r = -.45 | p = .01<br>r = -.42 | | | |

- **Asterisk (*) indicates that correlation results are negative**
- **Number of hospitals included in each correlation is in brackets at the end of each indicator name**

## TABLE 5-9: CORRELATIONS USING EMERGENCY DEPARTMENT CARE HOSPITAL REPORT INDICATORS

| | 08 OHA Scr | 07 OHA Scr | 06 OHA Scr | Chg In OHA Scr 06-07 | % chg in OHA Scr 06-07 | Chg In OHA Scr 07-08 | % chg in OHA Scr 07-08 | Chg In OHA Scr 06-08 | % chg in OHA Scr 06-08 | % IT Cap Exp 07 | % IT Opr Exp 07 | Ttl IT Opr Exp 07 | Ttl IT Cap Exp 07 | Ttl Cap Exp 07 | Ttl Opr Exp 07 | % IT Cap Exp 06 | % IT Opr Exp 06 | Ttl IT Opr Exp 06 | Ttl IT Cap Exp 06 | Ttl Cap Exp 06 | Ttl Opr Exp 06 | Sub-Sec 1.1 | Sub-Sec 1.2 | Sub-Sec 1.3 | Sub-Sec 1.4 | Sub-Sec 1.5 | Sub-Sec 2.1 | Sub-Sec 3.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Clinical Data Collection and Dissemination (75)** | p = .02<br>r = .28 | p = .01<br>r = .32 | p = .00<br>r = .40 | | p = .02<br>r = -.27 | | | | p = .01<br>r = -.30 | | | X | | X | X | | | X | | X | X | p = .00<br>r = .34 | p = .01<br>r = .30 | p = .01<br>r = .30 | p = .02<br>r = .26 | | p = .00<br>r = .33 | |
| **Internal Coordination of Care (75)** | p = .00<br>r = .37 | p = .00<br>r = .34 | p = .00<br>r = .41 | | p = .03<br>r = -.25 | | | | | p = .01<br>r = .31 | | X | X | X | X | p = .01<br>r = .29 | | X | X | X | X | p = .02<br>r = .27 | p = .03<br>r = .25 | p = .03<br>r = .25 | p = .01<br>r = .32 | | p = .00<br>r = .40 | |
| **Use of Clinical Information Technology (75)** | p = .00<br>r = .53 | p = .00<br>r = .51 | p = .00<br>r = .50 | | | | | | | p = .01<br>r = .29 | | X | X | X | X | p = .01<br>r = .29 | | X | X | X | X | p = .00<br>r = .45 | p = .00<br>r = .48 | p = .00<br>r = .39 | p = .00<br>r = .47 | | p = .00<br>r = .37 | |
| **Use of Standardized Protocols (75)** | p = .03<br>r = .25 | p = .00<br>r = .38 | p = .00<br>r = .33 | | | p = .02<br>r = -.28 | p = .00<br>r = -.35 | | | | | | | | X | | | | | | X | p = .00<br>r = .36 | p = .00<br>r = .42 | p = .01<br>r = .29 | p = .00<br>r = .36 | | | |
| **Chest X-ray Rate for Asthma – Pediatric (80)** | p = .00<br>r = .32 | p = .00<br>r = .35 | p = .00<br>r = .38 | | | | | | | | | | | | X | | | | | | X | p = .00<br>r = .48 | | p = .00<br>r = .33 | | | p = .00<br>r = .41 | |
| **Return X-ray Rate for Ankle or Foot Injury Patients (<= 7 days) (81)** | p = .00<br>r = -.37 | p = .00<br>r = -.35 | p = .00<br>r = -.34 | | | | | | | | | X* | | X* | X* | | p = .04<br>r = -.23 | X* | | X* | X* | p = .01<br>r = -.28 | p = .03<br>r = -.24 | p = .03<br>r = -.25 | | p = .03<br>r = -.24 | p = .00<br>r = -.34 | |
| **Return Visit Rate for Asthma (<=24 hours) – Adult (78)** | | | p = .04<br>r = -.23 | | | | | | | | | | | | | | | | | | | p = .01<br>r = -.28 | | p = .02<br>r = -.27 | | | | |

- **Asterisk (*) indicates that correlation results are negative**
- **Number of hospitals included in each correlation is in brackets at the end of each indicator name**