Assessing Primary Care Physicians’ Attitudes Towards Adoption of an Electronic Tool to Support Cancer Diagnosis

By

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A thesis submitted in conformity with the requirements for the degree of Master of Science
Graduate Department of Health Policy, Management, and Evaluation
University of Toronto

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ABSTRACT

The objective of this study was to assess Primary Care Physicians’ (PCPs) attitudes towards adoption of the Diagnostic Assessment Program-Electronic Pathway Solution (DAP-EPS), an electronic tool for improving cancer diagnostic processes. The implementation of DAP-EPS is a provincial activity supported by Cancer Care Ontario in collaboration with the Canadian Cancer Society.

We conducted an online survey of Ontario PCPs. To guide our study, we used an integrated theoretical framework combining the Technology Acceptance Model and Diffusion of Innovation.

Study results suggested a strong influence of perceived usefulness of the DAP-EPS tool on physicians’ attitudes towards adoption of the tool. The results also found that perceived usefulness was more important than perceived ease-of-use within the PCP context.

The study revealed that perceived usefulness is the main predictor of the attitude towards adoption of the DAP-EPS tool. The findings also suggested that the management and implementation team should emphasize the usefulness of the DAP-EPS to increase its adoption among PCPs.
This research project would not have been possible without the great support and guidance of my thesis supervisor, Dr. David Wiljer. I would like to thank Dr. Wiljer for his ongoing support and mentorship throughout the entire process of this research project. In addition, I would like to thank the members of my research committee, Dr. Julie Gilbert and Dr. Kevin Leonard, who offered invaluable guidance, encouragement and insight. Moreover, I would like to thank Cancer Care Ontario for providing funding and support, and the Center for Effective Practice for their contribution to this research. I would like to acknowledge the Department of Health Policy Management and Evaluation (HPME) University of Toronto, and the Canadian Institute for Healthcare Research (CIHR) for awarding me graduate scholarships towards my study. I would like to thank the staff at the ELLICS (Electronic Living Laboratory for Interdisciplinary Cancer Survivorship Research) Survivorship Center, Toronto General Hospital, for their support, and providing a friendly atmosphere for me to work. Furthermore, I would like to thank my dear husband, Rahim, for his ongoing support and encouragement throughout this process. Lastly, I would like to thank other members of my family and friends for their encouragement.
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CHAPTER 1 : INTRODUCTION

1.1. Background and Context

Cancer is a major health concern in Canada and other countries around the world. Despite numerous efforts for prevention and early detection, its incidence is expected to rise due to the growing and aging population (Walsh, et al., 2010).

In 2011, the number of new cases of cancer was estimated to be 177,800 and the number of related deaths estimated to be 75,000. Current mortality rates indicate that 24% of women and 29% of men, or approximately one out of every four Canadians, will die from cancer (Canadian Cancer Statistics 2011). In the province of Ontario with approximately 12 million people, around 65,000 new cases of cancer are predicted each year, with most patients diagnosed with lung, breast, colorectal, or prostate cancer (Canadian Cancer Statistics 2011). By the year 2020, the number of new cases of cancer in Ontario is expected to rise even further to two-thirds and double by 2028 (Schwartz, Evans, Sullivan, & Angus, 2004). The current number of survivors or those who are still living with cancer is reported to be half a million in this province (Schwartz, et al., 2004).

The growing prevalence of cancer adds to a greater need for resources and cancer services. Thus, the growing number of requests for cancer diagnostics and treatment will lead to higher demands and increased costs for the healthcare system. For example, some cases may require one-time services, such as radiotherapy and cancer surgery, while others may require ongoing treatment and have long-lasting needs for diagnostic services including laboratory and imaging, systemic therapy and supportive care (Baker & Schwartz, 2005).

According to the Canadian Cancer Society, the estimated direct cost of cancer care by the year 2020 will increase to $2 billion in Ontario, compared with $1.22 billion in 2001/02. The exponential rise of cancer, makes this disease a major consideration in Ontario’s healthcare resources and financial plan ("Canadian Cancer Society ", 2011).
In Canada lung cancer is the leading cause of death among cancer deaths, representing over one-quarter (27%) of all cancer deaths ("Canadian Cancer Society ", 2010). Colorectal cancer is the second leading cause of cancer death with a significant impact on mortality for men and women ("Canadian Cancer Society ", 2011). In 2011, an estimated 22,200 Canadians were diagnosed with colorectal cancer and 8,900 died from this disease. Similarly, 25,300 Canadians were diagnosed with lung cancer in 2011 and 20,600 died of this disease (Canadian Cancer Statistics 2011).

Each year, more people die of lung cancer than breast, colon, and prostate cancers combined. Lung cancer has been shown to be more common in older adults. Cigarette smoking has been proven to be the leading cause of lung cancer (Canadian Cancer Statistics 2011). Lung cancer also occurs in people who have never smoked. Secondhand smoke (breathing the smoke of others) increases the risk of lung cancer ("Lung Cancer Canada," 2008). According to the American Cancer Society, an estimated 3,000 non-smoking adults will die each year from lung cancer related to breathing secondhand smoke ("Lung Cancer Canada," 2008). Although there is no cure, preventative measures can drastically reduce a person's risk of developing lung cancer ("Lung Cancer Canada," 2008).

Colorectal cancer is another type of cancer with a high rate of mortality. According to the Canadian Cancer Society, colorectal cancer is the third most common cancer and the second most common cause of death for both sexes in Canada ("Canadian Cancer Society ", 2011). Colorectal cancer is a highly treatable disease with early detection and up to 95% preventable with timely screening and/or testing ("Colon Cancer Canada," 2011). The majority of colorectal cancers begin as benign growths in the lining of the colon called adenomatous polyps. Over the years, these polyps proliferate, increasing the risk of the cells becoming cancerous. Timely removal of these growths will prevent colorectal cancer from developing. Thus, it is important to identify and remove these polyps as soon as possible. Regrettably, as it stands today, nearly half of those who are diagnosed discover the cancer too late ("Colon Cancer Canada," 2011).
1.1.1. The Cancer Journey

The cancer journey for patients and their caregivers is complex*. Patients take many steps as they make their way through the system. Figure 1-1 on page 4, illustrates the complex journey that patients need to take. The process begins with screening or a visit to a primary care physician, continues with various diagnostic and treatment modalities and ends with long-term recovery or end-of-life care. The patient journey demonstrates the complexity of the cancer system and the problems caused by waiting for care at numerous stages (Baker & Schwartz, 2005).

During this journey, patients and their caregivers require supportive care. This care can be defined as those health services and related activities designed to help patients and their families with their cancer experience before and during the diagnostic, treatment, follow-up, and palliative phases (Whelan, et al., 1997). These supportive services can include physical and symptom support, instrumental and social care, psychological support, and the provision of information. Cancer patients also have significant problems and needs due to their co-morbid health conditions, and uncertainty about their diagnosis of cancer (Whelan, et al., 1997). Thus, recognizing the need to provide comprehensive services and supportive care to all cancer patients at any stage of their illness is important. The period between diagnosis and transfer to the formal cancer system (i.e. cancer center) is reported to be a critical period for supportive care needs of patients (Brazil, Sussman, Bainbridge, & Whelan, 2010). A systematic review reported the proportion of unmet needs of patients who were newly diagnosed with cancer. Unmet needs were documented as activities of daily living (5–10%), economic (11%), information (10–24%), physical (44%), psychosocial (6–69%), and psychological (12–17%) (Harrison, Young, Price, Butow, & Solomon, 2009).

* Note: A glossary of terms and concepts used throughout this thesis report has been provided in Appendix A.
In the past decade, numerous scientific studies and reports have documented the existing problems and issues with Ontario’s cancer system. Among these pieces of evidence, there is a high degree of consistency on the type of problems and actions that need to be taken to address these issues ("The Ontario Cancer Plan 2005 – 2008," 2004; Salomaa, Sallinen, Hiekkanen, & Liippo, 2005; Wait Time Alliance for Timely Access to Health Care.," 2005). For example, there is evidence of individuals waiting at every point of care patients receiving duplicates of tests and workups as they move from one institution or provider to another, people falling through the cracks as the cancer system fails to ensure that all the appropriate information for clinical decision making is properly shared and available in an efficient and timely manner, and
other issues such as people receiving a different level of care depending on where they live ("The Ontario Cancer Plan 2005 – 2008," 2004).

A report by the Ontario division of the Canadian Cancer Society, “Breaking Down the Barriers”, specifically described the needs of cancer patients and their families. The report revealed major gaps in the delivery of services, the provision of supportive care, and dissemination of information. It identified patients and their caregivers’ major challenges as long wait times for diagnostic tests and specialist appointments, fragmented and rushed delivery of care and the lack of afterhours services, unmet information needs, communication challenges with healthcare providers, unmet emotional support needs of patients, and finally, challenges related to lack of coordination and fragmentation of care that make navigating the system problematic for patients and their caregivers ("Breaking Down the Barriers: Study of Cancer Patient and Caregiver Needs in Ontario," 2003).

Similarly, another published study by Wagner et al. (2010) identified a series of problems facing individuals with a suspicion or diagnosis of cancer, and their families. The reported problems were delays in and lack of care coordination, patient information gaps, inadequate attention to emotional and social problems, and difficulty accessing services due to living in rural areas. The study pointed out that fragmentation and uncertain availability of cancer care contribute to these issues. To address such concerns, the authors suggested connecting patients with a care navigator or manager and using computer technology to better inform and support patients and connect providers (Wagner, et al., 2010).

To improve the wellbeing of these patients, a study by Podnos et al. suggested optimizing care coordination for cancer services and placing necessary resources in areas that will be most beneficial for patients (Podnos, Borneman, Koczywas, Uman, & Ferrell, 2007).

More efficient use of healthcare resources would not only benefit patients, but also would lead to reduced healthcare costs as well as reduced patient wait times, which are considered to be the two key performance indicators for improving the Canadian healthcare system. The review of the report “The Economic Cost of Wait Times in Canada” revealed that decreased waiting times is
an important factor in improving healthcare quality and saving healthcare resources (The economic cost of wait times in Canada, 2008). The growing cancer incidence adds additional pressure to wait times (Schwartz, et al., 2004). Each stage in the journey involves a number of steps and patients often have to wait for receiving care at each phase through the journey. Long waiting times for cancer services may cause anxiety, frustration and possibly have adverse consequences for patients. The complexity of the system is a major challenge in reducing wait times (Baker & Schwartz, 2005). In the cancer journey, pre-diagnostic period is one of the stages that patients experience wait times ("Wait Time Alliance for Timely Access to Health Care. ," 2005). The pre-diagnostic period has been reported to critically impact subsequent outcomes (Richards, Westcombe, Love, Littlejohns, & Ramirez, 1999), and has been shown to be associated with both patient and family psychosocial distress and anxiety (Stevens, Bondy, & Loblaw, 2010). The concern among physicians and patients is that prolonged wait times for diagnosis and treatment may result in cancers being treated at more advanced stages and with worse prognosis (Stevens, et al., 2010).

A Canadian study by Grunfeld et al. (2009) measured pre-diagnostic and surgical wait time intervals for patients with suspected colorectal, lung, and prostate cancer; it was found that the median wait times were 71, 37 and 81 days respectively. In their study, Grunfeld and colleagues suggested prolonged wait times in the pre-diagnostic period may critically impact subsequent outcomes, such as survival rates and stage of cancer at the time of diagnosis. These findings led to the suggestion for timely referral processes and early diagnoses (Grunfeld, et al., 2009).

Other studies have found that wasteful and inefficient use of healthcare resources impact various stages of cancer treatment. Brouwers et al. (2009) found that inefficient use of diagnostic imaging procedures, such as duplication of tests, can have substantial resource implications and can delay patient treatment. In the province of Ontario there is considerable evidence of lengthy waiting times for diagnostic imaging and inefficiencies, such as duplicated procedures, in the system. In their report, “Gaining Access to Appropriate Cancer Services”, Schwartz and colleagues (2004) stated that a reorganization of the entry and diagnostic processes of the cancer system could reduce duplication of tests, improve efficiency, and impact waiting times. The authors suggested the Diagnostic Assessment Unit (DAU) as a model for reorganization of
diagnostic processes. The DAU was described as a cancer-site-specific unit that has a multidisciplinary team consisting of primary care physicians, specialists, nurses, and other allied healthcare professionals, working with specialized equipment to facilitate rapid diagnosis. The report described the role of the DAU in reducing the delay between first presentation by a patient to a physician and the start of therapy, and improving survival rates. Schwartz and colleagues also suggested that DAUs have the potential to provide timely, comprehensive, multidisciplinary care during the pre-diagnostic period (2004).

In another investigation, an organized entry into the cancer system with timely diagnostic processes was outlined as the first step in managing wait times, and determining supportive care strategies for newly diagnosed cancer patients (Brouwers, et al., 2009). Similarly, Whelan and colleagues (1997) recognized the initial visit to the cancer system as a point in the cancer journey where interventions could be effective in improving the health and wellbeing of cancer patients.

1.2. Role of Primary Care Physicians in Cancer Care

A number of studies have demonstrated the importance of primary care in providing cancer care services to patients. Primary care physicians (PCPs) fulfill a number of essential roles that spans the full spectrum of cancer care including prevention, screening, diagnosis, supportive care, and palliative care (McAvoy, 2007). With respect to these roles, PCPs’ make referrals, coordinate care, and manage symptoms and co-morbid conditions (Klabunde, et al., 2009). For most cancer patients entry into the system is through a primary care setting (Carlson & Jackson, 2010). In general, PCPs are the initial point of contact for obtaining screening or evaluating symptoms, and provide an entry point into the cancer care system. The gatekeeping nature of primary care sustains the rest of the healthcare system through its referral processes. A patient makes an appointment with his/her primary care physician. Then, the primary care physician advises the patient in terms of his/her medical care, which may include a referral to a specialist (Klabunde, et al., 2009). There are numerous studies in support of PCPs’ involvement in providing care for various phases of cancer from prevention and screening to end-of-life care and survivorship (Johansson, Berglund, Hoffman, Glimelius, & Sjödén, 2000; Klabunde, et al., 2009; Levitt & Lupea, 2009). In their study, Klabunde and colleagues (2009) reported PCPs’ involvement in
fulfilling multiple roles related to the care of lung and colorectal cancer patients. Through the use of administrative data, an Ontario team of investigators have confirmed that about 25% of all encounters in family physician offices are related to cancer at some stage in the journey. These encounters range from prevention and screening to palliative care, indicating the high degree of PCPs’ involvement in all aspects of cancer care (Del Giudice, Bondy, Chen, & Maaten, 2006).

Despite the great involvement of PCPs in cancer care, various challenges and barriers have been identified that affect the ability of PCPs to take more responsibility in the care of their patients. There is an abundance of literature supporting the need for improved care coordination for patients with chronic illnesses, including cancer (Bickell & Young, 2001; Bodenheimer, 2008a; Walsh, et al., 2010). In a qualitative study by Walsh and colleagues (2010) healthcare professionals involved in providing cancer care were interviewed to identify the current barriers to effective cancer care coordination. The study identified three major barriers: 1) inadequate communication between specialist and primary care, 2) inequitable access to health services, and 3) poor management of scarce resources. In the same study, three key elements essential to care coordination were also identified as: timely referral, information provision and individualized treatment that considers each patient’s needs and preferences. The authors further pointed out that a lack of coordinated care could lead to discontinuation of care. This fragmentation of care would cause patients to be ‘lost’ in the system and they would fail to access appropriate services (Walsh, et al., 2010). In a review of the literature, Berta and colleagues (2008) reported two of the most important challenges currently facing primary care: improving coordination of patient care and mitigating the effects that increasing medical specialization has had on both coordination and continuity of care. In another study, Hess and colleagues (2010) confirmed system integration as a barrier that needed to be improved in order to enhance quality of care in the area of diagnosis and treatment of life threatening conditions, including cancer.

1.3. Care Coordination

The need for improved coordination of cancer services across the entire patient journey has been identified as a priority for action in Canada, the United States and other developing countries (Calman & Hine, 1995; McDonald, et al., 2007; NSW Cancer Plan 2007-2010," 2006; Schwartz,
et al., 2004). There are numerous reasons for poor care coordination: lack of information transfer between PCPs and specialists, duplication of tests or services, poor discharge planning, and provision of conflicting information from different clinicians (Walsh, et al., 2011).

Care coordination is a wide-ranging approach to achieve high quality care for patients. This approach aims to ensure that care is delivered in a consistent, connected and timely manner so that the medical and personal needs of patients are met. Traditional healthcare delivery structures often hinder rather than facilitate the flow and sharing of information between services, contributing to difficulties in coordinating patient care. Since provision of cancer care is multifaceted, good coordination between a multidisciplinary team of providers (primary care physicians, specialists, nurses, and other allied healthcare professionals) is vital in order to provide quality care. Care coordination generally depends on information exchange and regular communication flow between patients, Primary Care Providers (PCPs), specialists, and support services (Fennell, Prabhu Das, Clauser, Petrelli, & Salner, 2010). Recent studies have reported the challenges of transferring information and responsibility for patients among providers and institutions (Sussman & Baldwin, 2010; Taplin & Rodgers, 2010). These studies confirmed a failure in communication between various healthcare providers. The resulting interruption in transition of care could cause delays in treatment planning and implementation. These failures could also result in unnecessary duplication of tests, incomplete follow-ups, increased patient anxiety, decreased patient satisfaction, and declines in quality of life (Taplin & Rodgers, 2010).

Given the complexity of cancer, effective care coordination is essential to ensure that all patients receive timely and appropriate healthcare in an efficient manner in order to optimize patients’ experience of care and maximize health service efficiency. Thus, identifying current challenges facing care coordination is critical in order to implement strategies that can address these barriers on organizational, team, and individual levels of care (Walsh, et al., 2010). The current care coordination obstacles represent quality-improvement opportunities in various areas and stages of cancer. One of the areas in which strategies can be implemented to improve care coordination is communication across the boundaries of primary and secondary care. Communication is one of the key elements of delivering high quality care throughout the cancer journey.
1.4. Strategies to Help Improve Efficiency

Cancer patients are increasingly seen by a range of healthcare providers in various healthcare organizations, raising concerns about fragmentation of care. Policy reports and charters worldwide have indicated the need for intensive efforts to enhance care coordination (Reid, Haggerty, & McKendry, 2002). Increasing the use of organized and centralized cancer care programs, with a focus on multidisciplinary teams, has been shown to have the potential for streamlined delivery of cancer care by improving care coordination, and sharing information (Brouwers, et al., 2009).

One of the important phases of the cancer journey is the time between suspicion of cancer and diagnosis. The need for tests and consultations coupled with uncertainty and confusion often create a high level of anxiety for suspected cancer patients. To improve and expedite access to cancer services in the diagnosis phase, and to provide a coordinated approach to patient care from referral to definitive diagnosis, CCO has supported the establishment of diagnostic assessment programs (DAPs). Diagnostic Assessment Programs provide a single point of access and coordination for the diagnostic processes. To support the DAPs, Cancer Care Ontario (CCO) in collaboration with the Canadian Cancer Society (CCS) is implementing an interactive web-based tool, the Diagnosis Assessment Program- Electronic Pathway Solution (DAP-EPS) that will show patients and their primary care providers where they are on the journey to diagnosis.

Using the DAP-EPS, patients and providers will be able to view tests, the next steps, test results and the plan for patient care. Patients and providers will be able to access this tool at any time to get information specific to their own situation, as well as links to resources that can provide support through this stressful time. The following section describes the DAP, a program that aims to improve access to a more efficient and rapid diagnosis through an organized and structured care system.

1.4.1. Diagnostic Assessment Programs (DAPs)

To improve care coordination, reduce wait times and improve the patient experience, CCO has been supporting the development and implementation of DAPs throughout Ontario.
DAPs are a single point of access for diagnostic services that concentrate and coordinate care, and provide information and support to patients throughout the process. They facilitate access to comprehensive diagnostic services, multidisciplinary consultative expertise, patient information resources, and psychosocial supports (Brouwers, et al., 2009). The DAPs are also designed to help PCPs gain access to diagnostic tests for their patients, test results and other patient information. Such programs have been reported to have high patient satisfaction (Boghossian, et al., 1996; Gui, Allum, & Perry, 1995), show a reduction in time from diagnosis to the initiation of treatment for various disease sites (Davies, et al., 1999; Edge, Peterson, & Ward, 1999), and have the potential for improvements in clinical outcomes (Barchielli, et al., 1999; Ganz, 2002).

1.4.2. Diagnostic Assessment Program-Electronic Pathway Solution (DAP-EPS)

Cancer Care Ontario (CCO) and the Canadian Cancer Society (CCS) share common goals to reduce the burden of cancer in Ontario. To assist with streamlining referral and diagnostic testing, Cancer Care Ontario in partnership with the Canadian Cancer Society are in the process of developing the Electronic Pathway Solution (EPS), a component of the DAP program. The DAP-EPS has been designed to assist PCPs, patients and specialists in sharing information and understanding the diagnostic process. The DAP-EPS is an interactive web-based application connecting PCPs and patients to the Regional Diagnostic Assessment Programs, thereby enabling timely and seamless access to diagnostic services and information. The DAP-EPS tool is being built according to validated clinical diagnostic pathways and shared care decision-making models. The purpose of the tool is to provide relevant and timely patient-focused information and to offer navigational support and workflow management capabilities. The functionality of the DAP-EPS will focus on improving the patient experience by enhancing decision supports that assist patients and their providers move along the diagnostic pathway. The DAP-EPS will connect and integrate relevant patient-centric information and support systems through the utilization of a scalable and interactive diagnostic pathway. It will also enable improvements in patient outcomes and quality of care ("Diagnostic Assessment Programs ", 2008). The DAP-EPS tool enables PCPs to refer and track their patients’ progression in the DAP and provides specialists with immediate access to patient diagnostic information. The following figure 1-2 illustrates the electronic connection between the PCPs and DAP.
Innovative approaches to information management, such as the DAP-EPS are designed to impact the quality of care by making information accessible to patients and healthcare providers. Such approaches have the potential to reduce system information deficiencies that could lead to unnecessary duplication of diagnostic tests, medication and prescription errors, and unnecessary delays in referral and treatment processes (Bodenheimer, 2008b; Zimny, 1992).

1.5. Information Communication Technology (ICT) in Healthcare

The introduction of e-Health innovations represents the promise of information and communication technologies to improve health and the healthcare system (Oh, Rizo, Enkin, & Jadad, 2005). The use of Information Communication Technologies (ICTs) in healthcare is defined by the World Health Organization (WHO) as “the cost-effective and secure use of ICT in support of health and health-related fields and activities, including healthcare services, surveillance, literature, education, knowledge, and research” (Horsley & Forster, 2005).

Advancements in ICTs and interest in e-Health initiatives hold promise in mitigating and, in some cases, eliminating a number of challenges the healthcare system is currently facing (Alvarez, 2002). ICTs remain a key driver of e-Health innovations that facilitate integration of clinical information and standardization of care processes. These technological advancements
provide means for accessing and sharing clinical information without restrictions to any physical location. They support remote clinical examination, diagnosis and treatment. E-Health advancements increase our ability to meet challenges in providing healthcare services in various aspects of primary, secondary and tertiary care. Healthcare providers in all levels of care as well as patients can benefit from e-Health innovations in providing and receiving care. These new initiatives have the potential to reduce or prevent adverse patient outcomes, and reduce costs imposed on the system by preventing duplication of tests. Furthermore, they support clinical decision-making by means of accessing patient records from various healthcare professionals, and sharing information between clinicians (Alvarez, 2002).

Despite the recognized benefits and potentials of e-Health to improve delivery of care, adoption rates among healthcare professionals have been reported to be lower than expected (Hersh, 2004; Poon, et al., 2004). A study by DesRoches and colleagues (2008) assessed physicians' adoption of outpatient Electronic Health Records (EHR) in the United States, and found that only 4% of physicians used a fully functional EHR system. In Canada, the current rate of EMR implementation is 37%, but the usage rate is 14% among physicians (Morgan Price & James, 2011).

To increase adoption rates, it is important to determine the potential challenges that might arise when implementing these applications in clinical settings. Understanding the root cause of barriers to technology adoption may help us explain the low rate of adoption among healthcare professionals and develop effective strategies to mitigate the obstacles (Lin, Lin, & Roan, 2011).

1.6. Rationale

One of the most important factors for a successful implementation of a new technology is users’ adoption of the technology. Healthcare professionals such as Primary Care Physicians have a considerable influence on adoption of e-Health innovations in various healthcare settings. Although the DAP-EPS tool has the potential to impact care coordination by enhancing provider-provider and patient-provider communication through enabling timely and accessible clinical information, the implementation of this tool is not free from challenges. Technology adoption
rates among healthcare professionals have been reported lower than expected (Hersh, 2004; Poon, et al., 2004). Challenges have been reported repeatedly in the literature regarding adoption of e-Health innovations such as Electronic Medical Records, Computerized Physicians Order Entry, Telemedicine, etc. by healthcare professionals (DesRoches, et al., 2008; Jahanbakhsh, Tavakoli, & Mokhtari, 2011; Sanders & Bashshur, 1995; Zandieh, et al., 2008).

In order to make the DAP-EPS implementation and adoption smoother, it is important to determine potential challenges that might arise prior to and during implementation. Identifying factors that affect physicians’ attitudes will permit the implementers to take proactive action in mitigating potential challenges, thereby increasing adoption. In addition, assessment of physicians’ attitudes will provide guidance to the implementation team so they can understand the physicians’ needs and expectations of the DAP-EPS.

1.7. Research Objectives

The primary objective of this study was to determine Primary Care Physicians’ (PCPs) attitudes towards adoption of the new DAP-EPS tool. Studying PCPs’ characteristics (age, years of practice experience, previous computer experience, and prior attitudes towards computers), contextual factors (physician involvement, adequate training, physician autonomy, physician-patient relationship, and management support), and technology factors (ease-of-use and usefulness) can help us to determine what factors affect physicians’ attitudes and beliefs towards adoption of the DAP-EPS tool.

Previous studies have examined PCPs’ attitudes towards adoption of e-health innovations in various healthcare settings. There is a gap in the literature to determine factors that influence physicians’ attitudes towards adoption of new and unique electronic tools. As such, we attempted to assess PCPs’ attitudes towards adoption of the DAP-EPS and to identify various factors influencing PCPs’ behavior towards adoption of the tool. Data were collected using the DAP-EPS Readiness Survey instrument (see Appendix B). The DAP-EPS survey is a modification of a pre-existing and validated survey tool by Morton & Wiedenbeck (2009). The original survey was based on an integrated theoretical framework that unified the Diffusion of
Innovations (DOI) theory (Rogers, 1995) with the Technology Acceptance Model (TAM) (Davis, 1989). The results from assessing physicians’ attitudes towards adoption of the DAP-EPS allow us to examine PCPs perceived needs and beliefs prior to the implementation phase. The identified factors can then be addressed in order to mitigate potential barriers to adoption of the DAP-EPS tool within this group.

1.8. Research Questions

We based our research questions on the unified framework (DOI and TAM) by Morton & Wiedenbeck (2009). The DOI element of the unified theory examines how new innovations affect social change within an organization. The TAM component, on the other hand, allows researchers to both predict and explain why a particular system may or may not be accepted by the users (Davis et al., 1989). The TAM hypothesizes that the two beliefs, perceived ease-of-use and perceived usefulness, are the main determinants of user acceptance. The TAM suggests that external variables indirectly determine an individual’s attitude towards technology adoption by influencing perceived usefulness and perceived ease-of-use (Davis, 1989; Davis et al., 1989). External variables might include user characteristics, social factors or those relating to users’ profession.

Dependent variables that are generated within the TAM include perceived ease-of-use, perceived usefulness, and attitude towards adoption of the system (DAP-EPS) (Davis, 1989; Davis et al., 1989). The values of these dependent variables are predicted by the independent variables that are external to the TAM model in our study. The independent variables for this study are related to the DOI theory and were drawn from the Health Informatics (HI) literature. These independent variables include both individual physician characteristics and social contextual factors.

Physician characteristics can help place physicians in various adopter categories: innovators, early adopters, early majority, late majority, and laggards. On the other hand, social contextual factors are related to the physicians’ social context and environment, which will help us to determine physicians’ attitudes towards adoption of the DAP-EPS. The developed survey instrument was designed to answer four principal questions:
**Question 1:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool, and PCPs’ demographics and practice characteristics?

**Question 2:** Is there a relationship between contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support), and technology factors (perceived ease-of-use and perceived usefulness)?

**Question 3:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)?

**Question 4:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and technology factors (perceived ease-of-use and perceived usefulness)?
CHAPTER 2 : LITERATURE REVIEW

2.1- Introduction

This chapter begins with a review of Primary Care Physicians’ (PCPs) role in the provision of cancer care and care coordination activities. The second section explains the importance of care coordination in the cancer trajectory. The third section discusses the application of ICTs in healthcare, and its critical role in optimizing the delivery of healthcare services through the introduction of new and innovative ways. The forth section explores technology adoption among physicians, explaining their attitudes towards adoption, and the existing barriers physicians are experiencing in the adoption of the emerging e-Health technologies.

2.2. Role of Primary Care Physicians in Cancer Care

Virtually all essential services related to cancer care are provided through primary care. These services include preventative care, early detection and access to specialty services, and provision of various psychological and physical support for patients with cancer (Campbell, MacLeod, & Weller, 2002). Primary Care Physicians have essential and growing roles in all aspects of the cancer journey, from primary prevention to screening, diagnosis, treatment to palliative care. In particular, they assume a vital role in arriving at a timely diagnosis for patients presenting with cancer symptoms, and in accessing treatment following diagnosis (Wender, 2007). (Birgitta Johansson, 2000; Demagny, et al., 2009; Johansson, et al., 2000; Klabunde, et al., 2009; McAvoy, 2007).

Primary Care Physicians are often the starting point for patients in obtaining screening, or evaluating symptoms (Klabunde, et al., 2009). Campbell and colleagues confirmed the vital role of PCPs and their involvement in all stages of cancer from diagnosis to the end of life. The authors further stated that the cancer journey for a vast majority of cancer patients starts with presenting their symptoms to primary care (Campbell, MacLeod, & Weller, 2002).
Similarly, a survey study assessed the extent of PCPs’ work with cancer patients in France and Norway. The investigation examined the PCPs involvement in diagnosis, treatment, follow-up, and terminal care. The survey found 80% of French patients and 73% of Norwegian patients consulted their PCP before their cancer was diagnosed. The survey also confirmed that in both countries PCPs were greatly involved in the diagnosis. The PCPs considered themselves to be at the origin of the process of discovering cancer for 78% of the patients in France and for 83% in Norway (Demagny, et al., 2009). Another study in South East Scotland surveyed lung cancer patients (n= 622), and confirmed that more than 80% of the patients first presented their symptoms to their PCP and were referred to a specialist by their physician (Fergusson, Gregor, Dodds, & Kerr, 1996).

However, there are many challenges facing PCPs in providing comprehensive cancer care across all stages of cancer. The complexity of diagnosis and treatment, as well as the broad range of settings in which cancer services are delivered often lead to disorderly and delayed care causing frustration for both healthcare providers and patients (Farquhar, et al., 2005; Walsh, et al., 2010). Jiwa and colleagues reported on various challenges that primary care practices faced in providing cancer care. One of the main challenges reported was lack of coordination between primary care practice and other parts of the healthcare system. The study emphasized on the importance of integrated care at all stages of the cancer journey (Jiwa, Saunders, & Thompson, 2008).

2.3. Care Coordination in Cancer Trajectory

Undoubtedly, coordinated care is one of the most consistent predictors of quality care across a range of practices (Campbell, et al., 2001). The complexity of the healthcare system and the increase in the number of patients in need of care from multiple providers, give rise to effective coordination for delivery of high-quality care (Walsh, et al., 2011). The importance of care coordination has been raised in the literature numerous times (Freeman & Hjortdahl, 1997; Gysels, Higginson, Rajasekaran, Davies, & Harding, 2003; Stille, Jerant, Bell, Meltzer, & Elmore, 2005). Care coordination has been associated with greater patient satisfaction, reduced wait times, fewer laboratory tests, less hospitalizations and emergency department visits, and lower costs (Baker & Schwartz, 2005; Mainous & Gill, 1998; Mcmurchy, 2009; Rosenblatt,
Patients with cancer often receive multiple treatments from a diverse range of healthcare professionals in both hospital and community settings over extended periods of time (Walsh, et al., 2010). A British study reported that cancer patients within one year of diagnosis, on average, visited 28 healthcare providers since their diagnosis (Smith, Nicol, Devereux, & Cornbleet, 1999). As result of this shuffling, cancer patients can easily fall through the cracks and be ‘lost’ in the cancer system. The lack of access to appropriate services could subsequently lead to high anxiety and unnecessary morbidity for these patients (Walsh, et al., 2010). Given the importance and complexity of providing cancer services, effective care coordination is crucial to ensure that all patients receive timely and appropriate healthcare in an efficient manner (Walsh, et al., 2010).

Nonetheless, the task of care coordination among multidisciplinary entities (primary care physicians, specialists, nurses, and other allied healthcare professionals) has been reported to one of the main areas where healthcare delivery could be improved (Bodenheimer, 2007). In particular, Yates (2004) identified the need for major improvements in coordination of cancer services. Existing literature has reported many issues that are due to the fragmented cancer services: the absence of timely clinical information caused by a delay between primary and specialist care, duplication of tests or services, poor discharge planning, and provision of conflicting information from different health professionals within the multidisciplinary team (Farquhar, et al., 2005; Gandhi, et al., 2000; Kripalani, et al., 2007; Walsh, et al., 2011).

In another study, O’Mally et al. (2010) identified six major tasks necessary for effective care coordination: 1) maintaining patient continuity with the primary care team, 2) documenting and compiling patient information generated within and outside the primary care office, 3) using information to coordinate care for individual patients and for tracking different patient populations within the primary care office, 4) referrals and consultations (initiating,
communicating and tracking), 5) sharing care with clinicians across practices and settings, and 6) providing care and exchanging information for transitions and emergency care.

Other studies also reported on the importance of care coordination and suggested strategies to improve it. For instance, in 2003, a major systematic review conducted by the National Institute of Clinical Excellence in the UK combined the existing evidence on the coordination of cancer care. The reviewed articles, published between 1966 and March 2003, identified interventions to improve service configurations for supportive and palliative care for those affected by cancer. With respect to care coordination, 13 studies evaluated interventions including the appointment of nurse coordinators, multidisciplinary team interventions, the introduction of standardized guidelines and protocols, and the implementation of methods for improving communication, such as patient held records. The review concluded that well coordinated care could improve care practice for healthcare professionals and provide quality health service delivery for patients (Gysels, et al., 2003).

Many national and international institutions have identified enhancement of care coordination as a priority for improving their healthcare system (Baker & Schwartz, 2005; Gysels, et al., 2003; NSW Cancer Plan 2007-2010," 2006; The Ontario Cancer Plan 2005 – 2008," 2004). The reported strategies to enhance care coordination were improved communication channels and coordination among multidisciplinary teams, restructuring cancer services to deliver them in a complementary and timely manner, and the appointment of cancer care nurse coordinators to improve the patient journey (Walsh, et al., 2011). One of the most emphasized areas in the literature is effective communication of clinical information among healthcare professionals. Thus, realizing an improvement in coordinated care must rely heavily on the introduction of models that would emphasize timely availability of comprehensive clinical information (Graetz, et al., 2009).

2.4. Communication and Information Transfer

Throughout the literature, effective communication has been reported to be an essential element in the efficiency and effectiveness of healthcare delivery and, a key component of good
coordination between various levels of care (Westerman, Hull, Bezemer, & Gort, 1990). Effective communication means timely availability of comprehensive clinical information that is well integrated and shared among healthcare professionals across various levels of care (Stille, et al., 2005).

The availability of clinical information about a patient’s medical history, and the recognition of that information for continuity of care, has been described as being fundamental to care coordination (Starfield, 1998b). Other studies have also suggested that communication between specialist and primary care services is an essential component for the improvement of care coordination (Pascoe, Neal, Allgar, Selby, & Wright, 2004; Weller & Harris, 2008). For example, Pascoe et al. (2004) found that effective communication resulted in greater involvement of primary care during acute treatment and improved care coordination overall. The authors further commented that poor communication causes fragmented care for many patients, and leads to the absence of timely clinical information for PCPs to understand the progress of their patients. Similarly, Farquhar and colleagues examined PCPs’ views of communication with respect to ovarian cancer. They wanted to know how earlier diagnosis of ovarian cancer could be facilitated in primary care, and how collaboration between primary and secondary care could be enhanced across the cancer patient journey. The study reported a lack of timeliness of clinical information and a lack of recognition of the information needs of PCPs, as the existing barriers to effective communication between primary and secondary care (Farquhar, et al., 2005).

In another study, Branger and colleagues explored the types of problems, and subsequent consequences, encountered by PCPs when communicating with internal medicine consultants. The authors explained the importance of maintaining a high standard of communication across all levels of care. The study concluded that communication problems mainly arise from a lack of timely delivery of information, and specialists not understanding the information needs of the general practitioner. The authors recommended electronic mail as one potential option to assist physicians in maintaining protocol-based communication (Branger, Van Der Wouden, Duisterhout, & Van Der Lei, 1995). In a study regarding the treatment of asthma patients, Berta, et al. addressed the communication barriers between primary and specialty practitioners. The authors suggested that coordinating timely access to appropriate care was an outcome of high
quality decision making, which was, in turn, profoundly affected by “informational continuity”. This term was defined as the effective integration, management, sharing and timely transfer of patient information among care providers (Berta, et al., 2009).

Overcoming barriers in the provision of cancer care, particularly in the primary care setting, is vital in assisting physicians provide timely diagnoses for their patients. The recently recommended models for the provision of care heavily emphasize the use of emerging e-Health technologies to improve care coordination. E-Health based strategies have the potential to improve delivery of care by improving the communication channels across the spectrum of cancer care. For example, the use of Electronic Health Records (EHR) can help coordinate the care of patients with multiple chronic conditions by secure exchange of clinical data (Burton, Anderson, & Kues, 2004).

2.5. E-Health Innovations

Studies have frequently demonstrated the connection between Information Communication Technology (ICT) and quality of care (Parente & McCullough, 2009). Information management is critical to the successful delivery of healthcare services (Chaudhry, et al., 2006). Although the knowledge and practices of healthcare professionals are fundamental in providing high-quality patient care, clinicians cannot deliver this care independently. As such, practicing within groups and systems of care has become more prevalent among healthcare professionals. Thus, coordinating care across settings and practitioners, and ensuring that relevant and accurate healthcare information is available when needed are critical factors in ensuring high-quality care (Chassin, Galvin, & and the National Roundtable on Healthcare Quality, 1998). Nonetheless, existing evidence indicates that healthcare professionals seldom have access to comprehensive and timely clinical information, especially when the patient is transferred to different providers. Also, this may compromise patient safety as well as the overall quality of care during these transitions.

One of the suggested strategies for improving health service delivery is e-Health innovations. These innovations, including electronic medical records, computerized physician order entry,
and clinical decision support systems, have considerable potential to improve healthcare delivery and improve information exchange among healthcare practitioners (Chaudhry, et al., 2006; Garg, et al., 2005; Kaushal, Shojania, & Bates, 2003). Other existing studies have highlighted the usefulness of technology applications to optimize quality, reduce costs, and improve patient safety (Chaudhry, et al., 2006; Garg, et al., 2005; Parente & McCullough, 2009). A cross-sectional study of 72 urban hospitals in Texas measured a hospital's level of automation based on physician interactions with the information system using a technology assisted tool called the Clinical Information Technology Assessment; it was found that patients treated in hospitals with automated notes and records, order entry, and clinical decision support systems had fewer complications and lower mortality rates (Amarasingham, Plantinga, Diener-West, Gaskin, & Powe, 2009).

In the current healthcare system, many health professionals have yet to optimize electronic management tools. They often have limited access to information systems that enable them to manage and retrieve clinical information, and share that information effectively with other providers (Taylor, et al., 2005). Thus, identifying practice factors that impact effective care coordination, including referral processes and the flow of clinical information, can bring about opportunities and efforts to enhance these processes (O'Molley, Tynan, Cohen, Kemper, & Davis, 2009).

2.6. Informational Continuity and Referral Processes

Current trends in service organizations, population growth, prevalence of chronic diseases, and the growing number of elderly people increase the need for systems that enable better information sharing and coordination to improve care delivery for patients (Knight, 1995). A qualitative study by Farquhar et al. (2005) described Primary Care Physicians’ (PCPs) views of the communication issues between the primary and secondary care in relation to ovarian cancer patients. The participant PCPs expressed their concerns regarding the time delay, content and format of communications among healthcare professionals. Concerns were around the time delay in communication. The study reported the time lag between dictation and typing letters ranged from 0 to 27 days, with a delay of up to 8 days for signing before transit through various mail...
systems to the PCPs. The study more specifically explained the need for prompt information regarding the results of tests and diagnoses, and the need for clearer guidance on the use of tests and fast-track referrals in the pre-diagnostic and diagnostic stage of the cancer journey. The author suggested developing interventions such as Electronic Health Records (EHR) to enhance the content and speed of communications between secondary and primary care (Farquhar, et al., 2005).

A survey study by Gandhi et al. (2000) identified the referral process as a critical component of quality clinical care. Gandhi and colleagues evaluated specialists’ and PCPs satisfaction with communication processes between physicians and identified major issues with the current referral process. The major issues were physician dissatisfaction, lack of timeliness, and inadequate content of physician-to-physician communication. The study further commented that breakdowns in communication can lead to poor continuity of care, delayed diagnoses, an increase in unnecessary testing, and a decrease in quality of care.

The review of the literature in communication and care coordination clearly indicates the current issues with clinical information continuity, including lack of timely transfer of information when patients are transitioning across healthcare providers, and unsatisfactory access to information by clinicians (Graetz, et al., 2009). The limitations of paper-based information management are clearly apparent given the fragmentation in healthcare services and the large volume of transactions in the system. Existing evidence clearly suggests that there is a need to integrate new information management activities into practice (Chaudhry, et al., 2006). Clinical information systems have been reported to have considerable potential for optimization of communication and improvement of the quality of service delivery and outcomes in healthcare (Follen, et al., 2007). However, adopting new information systems in healthcare has proven difficult and rates of use have been limited (Ash, Gorman, Seshadri, & Hersh, 2004; Chaudhry, et al., 2006; Valdes, Kibbe, Tolleson, Kunik, & Petersen, 2004).
2.7. Technology Adoption Among Physicians

Strategies using e-Health innovations including Electronic Health Records (EHR), Computerized Physician Order Entry (CPOE), Clinical Decision Support Systems (CDSS) and the like have been widely suggested for improving the delivery of care in the medical domain. These approaches have been recommended for supporting physicians’ tasks in reducing medical errors, supporting decision making activities, improving the quality of health services, and reducing costs (Ford, Menachemi, & Phillips, 2006). However, despite potential benefits of e-Health applications, healthcare delivery has been relatively slow in embracing these new technologies. The slow progress of clinical healthcare computerization has been attributed to the lack of adoption of and resistance to technology (Wiley-Patton & Malloy, 2004). For example, numerous studies have raised concerns about the adoption of EHR by healthcare professionals (Ash & Bates, 2005; Ford, et al., 2006). Morton and Wiedenbeck examined the adoption of EHR in their study and confirmed that nearly 75% of all e-Health and 30% of EHR implementation projects fail to succeed due to the poor rate of adoption (Morton & Wiedenbeck, 2009). In order to optimize acceptance among physicians, it is essential to identify factors that would shape their beliefs and attitudes towards technology, and determine the possible barriers to implementation.

2.7.1. Physicians’ Attitudes Towards Technology Adoption

Understanding why physicians adopt or reject new technologies has proven to be very challenging, making it difficult for healthcare organizations and practice settings to exploit new technologies (Ash & Bates, 2005; Elizabeth & Dan, 2007; Yarbrough & Smith, 2007). Physicians’ perception of, and attitudes towards new technologies is a crucial element in the implementation of new technology projects in the current healthcare system (Dansky, Gamm, Vasey, & Barsukiewicz, 1999; Ernstmann, et al., 2009). Previous studies in the field of medical informatics assessed physician attitude towards the adoption of information systems. Most studies have examined physicians’ attitude towards adoption of Electronic Medical Records (EMR). A study by Dansky et al. investigated factors that influenced successful implementations of EMR in ambulatory care settings. The study had two objectives: to identify specific factors that should be targeted before the implementation of
an EMR project, and to demonstrate empirical support for a model of perceived usefulness of EMRs. The investigation found that computer experience, computer anxiety and perceptions of organizational support predict the degree to which physicians and other healthcare practitioners viewed the EMR effort positively. The investigation also reported on the strategies for the successful management of EMR implementation, including engaging physicians and practitioners in computer activities prior to implementation and providing strong organizational support before and during the redesign efforts (Dansky, et al., 1999). Gadd and Penrod examined physician attitudes and feelings prior to and after an EHR implementation. Results indicated that perceived usefulness was a significant predictor before and after implementation. The study also reported on concerns regarding patient privacy, interference with physician patient rapport, workflow, efficiency and autonomy (Gadd & Penrod, 2000).

A pre- and post-implementation assessment of physician attitudes was conducted as part of the evaluation of a pilot implementation of an outpatient EMR in an academic health centre. The results demonstrated that the participant physicians were willing to adopt a technology tool or application when it demonstrated added value for the effort required to use it. These physicians utilized services like email, the Internet, remote access to computer systems, and personal productivity software because they believed that these services and applications served a valuable purpose in their academic and clinical work, and in their personal lives. However, the most critical factor to the acceptance of an EMR by physicians was found to be its ability to facilitate efficient clinical workflow, which prevented negative impacts on the doctor-patient relationship, quality of care, and privacy (Gadd & Penrod, 2001).

Other studies have reported findings regarding major predictors of attitudes towards adoption of technology. Some studies have found physicians with prior knowledge of computers and informatics concepts have more favorable attitudes towards computers in healthcare (Cork, Detmer, & Friedman, 1998; Detmer & Friedman, 1994; Gordana, et al., 2005). Other variables found to be positively correlated with attitude include systems training, clinical specialization, and job satisfaction (Cork, et al., 1998; Detmer & Friedman, 1994; Gordana, et al., 2005). Two separate studies by Gardner & Lundsgaarde (1994), and Brown and Coney (1994) measured the attitude of physicians towards accepting clinical information systems and other medical
computer applications, and reported that age, gender, specialty, and general computer experience did not correlate with attitude (Brown & Coney, 1994; Gardner & Lundsgaarde, 1994).

Various factors may affect the rate of adoption, including the characteristics of the innovation, and various economic, sociological, organizational, and physiological factors. Therefore, understanding the rate of adoption in any setting requires analyzing variables that may facilitate or hinder the adoption (Butler & Sellborn, 2002).

2.7.2. Physicians Characteristics & Computer Competency

Physicians’ characteristics have also been identified as factors influencing physician technology adoption. To examine the association between physician characteristics and adoption of EMR, O’Neill and colleagues surveyed PCPs in Kentucky, United States. The study found that physicians’ age and sex influenced technology adoption among physicians. Younger physicians in smaller practices were more likely to adopt EMRs than older physicians (2009). Another study by Felt-Lisk and colleagues (2009) also confirmed that age was associated with adoption of EHR. While some studies have found age and sex as predictors influencing technology adoption, other studies have not (Audet, et al., 2004; Brown & Coney, 1994; Clayton, Pulver, & Hill, 1993; Dansky, Gamm, Vasey, & Barsukiewicz, 1999; Gardner & Lundsgaarde, 1994; Kattan, 1994; Kattan & Adams, 1994; Laerum, Ellingsen, & Faxvaag, 2001; Morton & Wiedenbeck, 2010).

In other existing literature, computer skills or familiarity with technology have been identified as potential barriers to and predictors of technology adoption among physicians (Dansky, et al., 1999; Garrett, et al., 2006; Joos, Chen, Jirjis, & Johnson, 2006; Ludwick & Doucette, 2009; Simon, et al., 2007; Yarbrough & Smith, 2007). The majority of physicians perceived the technology as complicated and difficult to learn, which would add extra time and personal pressure to their already busy schedules (Garrett, et al., 2006). Physicians’ anxiety resulted from lack of computer skills also was found to be a predictor influencing technology adoption among physicians (Dansky, et al., 1999; Ludwick & Doucette, 2009).
2.7.3. Practice Characteristics

Recent studies identified organizational characteristics as another important and potential predictor to physician technology acceptance (Audet, et al., 2004; Boonstra & Broekhuis, 2010; Lee, Cain, Young, Chockley, & Burstin, 2005). For example, a survey of physicians in the United States confirmed that organizational characteristics significantly influence technology acceptance. The study identified practice size as a significant predictor of technology adoption among physicians. Physicians in groups larger than 50 were significantly more likely use technology than solo-practices. This pattern was consistent regardless of the type of technology (Audet, et al., 2004). A similar review study by Boonstra & Broekhuis discussed barriers to adoption of EMRs perceived by physicians. The review reported organizational characteristics as one of the main predictors of EMR adoption among physicians. The study further suggested that the size and type of practice might influence physicians’ attitudes towards adoption of EMRs (Boonstra & Broekhuis, 2010).

2.7.4. Contextual Factors

Literature has confirmed the influence of environmental and social factors on physicians’ adoption on technology. Results from a study by Morton and Wiedenbeck (2009) emphasized the need for strong physician leadership and management support in the EHR implementation process. In another study by Lee et al. (2005), rate of technology adoption among physicians in small practice settings was examined. The authors stated that strong organizational leadership is important in successful implementation of new technology.

High levels of organizational leadership with respect to moral and financial support, existence of opinion leaders, training programs, and clinical and technical support, were identified as contributing factors to the adoption of an EHR system (Ash & Bates, 2005). Simon and colleagues (2007) also identified the role of organizational culture as an important predictor in the adoption of technology. The authors suggested that organizations that were supportive and emphasized quality and innovation positively influenced and facilitated technology adoption among physicians. Another study evaluated the use of an Internet-linked handheld computer.
critical care knowledge access system by physicians and found that technology-specific training was a predictor of physician technology acceptance (Lapinsky, et al., 2004).

Another influential factor determining technology adoption by physicians is their involvement in design and implementation processes. Research has confirmed the active role of physicians in implementation of technology. Physicians’ participation leads to higher rates of adoption and lower stress and dissatisfaction (Karsh, 2004; Morton & Wiedenbeck, 2009).

Other studies confirmed the effect of physician autonomy on technology adoption. Walter and Lopez (2008) study showed that a perceived threat to professional autonomy is an important factor affecting physician acceptance of technology. The results of this study showed that a perceived threat to professional autonomy has a significant, negative direct influence on perceived usefulness of a technology and on intention to use that technology. Morton and Wiedenbeck (2009) also found physicians autonomy to have a strong negative direct relationship to attitude towards EHR use.

2.7.5. Ease of Use and Usefulness of Technology

The speed and flexibility of new technology and the ability to customize and organize the knowledge captured on a local level is critical for physician technology adoption. Moreover, physician’s level of comfort with the systems, ease-of-use and usefulness are also major driving factors in physician adoption of technology.

Issues that are specifically related to new technologies, including usability and complexity of the systems, have been identified as other predictors to technology acceptance among physicians. For example, system usability issues have been known to result in EHR implementation failure. A survey conducted by Linder and colleagues (2006) explored the reasons why an EHR system was underutilized by a group of primary care physicians. Thirty-five percent of physicians reported specific issues related to EHR usability. The most common problems mentioned were issues with screen navigation, failure to access secondary functions, and concerns with loss of data. In an American study, EHR system-specific issues were explored by Felt-Lisk and
colleagues. The authors studied small physician practices in four states and identified various factors, including system limitations, as contributors to physicians’ adoption of the system. Some system-specific problems described by the practices were a lack of a standard places to put key clinical data in the chart, an inability to generate lists of patients with certain criteria, and no condition-specific prompts or reminders (Felt-Lisk, et al., 2009).

While some studies found ease-of-use as an important factor influencing technology adoption among physicians, others did not. Morton & Wiedenbeck (2010) and several other studies reported usefulness to be more important than ease-of-use (Chau & Hu, 2002; Chismar & Wiley-Patton, 2003; Keil, Beranek, & Konsynski, 1995). As physicians’ attitudes and beliefs shape their behavior towards using a new technology, it is important to understand physicians’ attitudes and determine the factors that could influence physicians’ adoption of the DAP-EPS tool.

The observations of the literature review regarding the related factors to adoption of a new technology by healthcare providers guided us to identify factors influencing adoption of a new technology. Literature showed that physician characteristics, practice characteristics, contextual, ease of use and usefulness are important factors that are associated with technology adoption by healthcare providers. A theoretical framework that has been developed to systematically study such factors influencing technology adoption by healthcare providers is the theoretical framework that was introduced by Morton & Wiedenbeck (2009). This theoretical framework was adopted to answer the research questions.

The following chapter provides a brief review of the literature on a number of technology adoption theories that have been used in studies of innovation diffusion and adoption. Chapter three also presents the details of the integrated theoretical framework that we used to answer our research questions.
CHAPTER 3 : THEORETICAL FRAMEWORK

3.1. Overview

Despite the potential advantages of e-Health innovations and technological advancements in healthcare, physicians have not yet fully embraced the valuable resource of emergent technologies. As such, the adoption rate in healthcare settings and organizations has been lower than expected (Leonard, 2004; Treister, 1998). Understanding why physicians accept or reject technology is important and has proven to be one of the most challenging issues in the field of information technology (IT) research (Davis, Bagozzi, & Warshaw, 1989). Recognizing the challenges of technology adoption will require a better understanding of why physicians resist using technological innovations. This understanding will help designers develop practical solutions and predict users’ responses to these systems. As such, system designers have been continuously seeking methods for evaluating the uptake of systems as early as possible in the design and implementation process (Davis et al., 1989).

There have been a number of theoretical models employed to study user behavior and acceptance of new technology. Researchers in the IT area have suggested behavioral intention models from social psychology for research on the determinants of user behavior (Davis et al., 1989). For example, the Theory of Reasoned Action (TRA) is a well-known model developed by Fishbein and Ajzen (1975). The model uses two main constructs, attitude towards behavior, and subjective norm, in order to predict behaviors. Following the TRA model, many researchers have attempted to expand the theory by adding new constructs and applying the model in different contexts. The Theory of Planned Behavior (TPB) (Ajzen, 1991) and the Technology Acceptance Model (TAM) (Davis, 1989) are two such models that expanded the TRA.

TPB (Ajzen, 1991) was developed by adding another element, the concept of perceived behavioral control, to the TRA, whereas TAM is an adaptation of TRA that uses the same principles of predicting individuals’ behavior in adopting IT applications (Davis, et al., 1989). The TRA and TPB have been used in various domains, including the IT domain, to explain the adoption process from individual perspectives (Legris, Ingham, & Collerette, 2003). The TAM
theory, however, more specifically applies to information systems, and to predicting technology acceptance (Davis, et al., 1989).

Another line of IT research has used the Diffusion of Innovation (DOI) theory by Rogers (1995) to predict technology adoption within information systems. This theory provides a general framework within which the social impact of a technology can be modeled to provide insights into the characteristics of the groups who will adopt a technology at different stages. The theory proposes five beliefs or constructs that influence the adoption of any innovation: relative advantage, complexity, compatibility, observably, and trialability (Rogers, 1995).

Clearly, each theory adds to our knowledge about user adoption of technology. However, these theoretical frameworks in and of themselves may not be a complete methodology for explaining technology acceptance as it applies to Primary Care Physicians (PCPs). Given physicians differ quite markedly from general users and the unique occupational dynamics of the healthcare system, potential factors influencing adoption within this group may exist at various individual, social and organizational levels. Thus, in order to predict physicians’ attitudes towards adoption of the DAP-EPS technology in this study, we propose using a pre-existing unified model that can examine these factors at various levels. This model was developed and tested by Morton and Wiedenbeck (2009). The unified theory uses TAM to predict adoption at individual and DOI at the social and organizational level.

In the following sections, 3.2 and 3.3, the theories stated above, as well as the integrated model utilized in this research project have been explained in greater detail.

3.2. Theoretical Development

To examine the relative influence of beliefs, attitudes, and external variables on physicians’ acceptance of information technology, this section discusses the theoretical models that were developed during the past several decades to explain the factors influencing technology adoption in organizations, with an emphasis on explaining human behaviors in the adoption process. The review of the frameworks and theories examines a body of literature in an attempt to explore and
understand key factors affecting physicians’ attitudes towards implementation and adoption of emergent technology.

3.2.1. Theory of Reasoned Action

The Theory of Reasoned Action (TRA) is one of the most influential intention theories used to explain the relationship between human behavior and intention to adopt an innovation. This theory was developed by Fishbein and Ajzen (1975) and has been successful in predicting and examining behavior across a wide variety of domains. TRA provides a framework to study attitudes towards behaviors and explains the relationship between an individual’s behavior and their intention to adopt an innovation.

The foundation of the TRA conceptual framework is based on the distinction between beliefs, attitudes, intentions, and behaviors. An individual’s performance of a specified behavior is determined by his or her behavioral intention to perform the behavior (Gahtani & King, 1999). The attitude towards behavior is defined as a “person’s positive or negative feelings about performing target behavior” (Fishbein & Ajzen, 1975, p. 216). A subjective norm is the influence of social pressure that is perceived by the individual to perform or not perform a certain behavior, and refers to perceptions that those who really matter to the individual think that they either should or should not perform the behavior in question (Fishbein & Ajzen, 1975). The behavioral intention states that an individual’s motivation to engage in a behavior is defined by the attitude that influences the behavior (Fishbein & Ajzen, 1975). Behavior intention indicates the level of commitment that an individual would like to place on performing such behavior. Behavior intention is determined by attitude and subjective norms (Fishbein & Ajzen, 1975). Behavior is the transmission of intention or perceived behavioral control into action.

One of the criticisms of the TRA is that it neglects the important element of social factors, which could be a determinant of individual behavior (Grandon & Mykytyn, 2004). Social factors refer to all the environmental influences surrounding an individual (such as norms) which may influence their behavior (Ajzen 1991). To overcome this limitation, Ajzen (1991) modified the Theory of Reasoned Action by adding a third element of intention called perceived behavioral
control that led to the Theory of Planned Behavior. Ajzen stated that the TRA was unable to deal with behaviors over which people have incomplete self-control. Perceived behavioral control reflects that there are individually perceived personal and situational impediments to the performance of behavior. Ajzen suggested that favorable attitudes and subjective norms and greater perceived behavioral control will strengthen an individual's intention to perform a behavior (Grandon & Mykytyn, 2004).

3.2.2. Theory of Planned Behavior

The Theory of Planned Behavior (TPB) (Figure 3-1, page 35) was proposed by Ajzen (1991). He added the construct to the TPB: of perceived behavioral control (PBC) to the TPB, which refers to the degree to which a person feels that performance or non-performance of the behavior in question is under his or her free will. The theory of planned behavior emphasizes that human behaviors are ruled not only by personal attitude, but also by social pressures and a sense of control (Ajzen, 1991). In general, a more favorable individual attitude and subjective norm, and a greater perceived behavioral control will lead to a stronger intention to perform the behavior under question (Bosnjak, Obermeier, & Tuten, 2006).

However, Ajzen (1991) suggests that people tend not to form strong intentions to perform behaviors if they believe that they do not have the resources or opportunities to do so, even if they hold positive attitudes towards the behavior and believe that others would approve of the behavior (subjective norm) (Ajzen, 1991).

The TPB has also been analyzed in the information systems literature to identify and model the specific antecedents to attitude, subjective norm, and perceived behavioral control relevant to the use of technology. Taylor and Todd (1995) suggested perceived usefulness, perceived ease-of-use, and compatibility as determinants of attitudes, which is largely consistent with TAM theory. Moreover, they proposed that peer influence and superiors' influence form the subjective norm. Additionally, they modeled self-efficacy, resource-facilitating and technology facilitating conditions as determinants of perceived behavioral control.
3.2.3. Technology Adoption Theories

Davis and colleagues (1989) describe technology adoption theories as information system frameworks that have been used in studies of innovation diffusion and adoption. These theories have provided a theoretical foundation for examining the factors influencing technology adoption in organizations. According to these theories, the adoption and usage of new technological innovations is determined by user’s beliefs and attitude towards the new technology (Davis, 1985). As suggested in the previous section, the most influential theoretical frameworks used in technology adoption are the adaptation of the intention theories including the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), and Rogers’ Diffusion of Innovations Theory (DOI).

Technology Acceptance Model

One of the most widely applied models of user acceptance of new technology is the Technology Acceptance Model (TAM) (Figure 3-2, page 36) developed by Davis and colleagues (1989). TAM is an adaptation of the Theory of Reasoned Action (TRA) specifically tailored for modeling user acceptance of technology. TAM is used for predicting and explaining individuals’ adoption of new technology. Within the context of the information systems literature, TAM has been applied widely to explain and predict technology adoption though causal relationships
between systems design characteristics, perceived ease-of-use, perceived usefulness, attitude towards usage, and actual usage. The goal of TAM is to predict technology acceptance and diagnose design problems before users have experience with a system. TAM predicts user acceptance of any technology by determining two factors: perceived usefulness and perceived ease-of-use (Davis, 1989; Davis, et al., 1989). TAM emphasizes the factors that determine users’ behavioral intentions towards using a new technological innovation.

The theory suggests that user acceptance of a new system is determined by the users’ intention to use the system, which is influenced by the users’ beliefs about the perceived usefulness and perceived ease-of-use of the system. Perceived usefulness is defined as the extent to which a person believes that using a particular system will enhance his or her performance, whereas perceived ease-of-use refers to the extent to which a person believes that using a particular system will be free of effort (Yi, Jackson, Park, & Probst, 2006). A study by Mathieson (1991) compared both TAM and TPB frameworks and identified TAM as a more parsimonious and easier to apply model than TPB. Moreover, the TAM provided more general information on users’ opinions about a system than TPB. The study also pointed out that both models predicted intention to use a new technology quite well, although the TAM had a slight empirical advantage over TPB.

**Figure 3-2: Technology Acceptance Model (TAM)**

Application of TAM in Clinical Information Systems

Within the technology adoption literature, the Technology Acceptance Model (TAM) has been widely used to predict and explain end-user reactions to new technological innovations in healthcare systems. In a review study, 18 published articles on physician technology acceptance were reviewed. These studies either used TAM or an extended version of the model to explain physicians’ attitude towards technology adoption. The extended model facilitated better understanding of the barriers in physicians’ acceptance of technology (Yarbrough & Smith, 2007). Some of these studies were in the areas of Internet based applications (Chismar & Wiley-Patton, 2003) Computer Physician Order Entry (CPOE) (Paré, Sicotte, & Jacques, 2006), Electronic Medical Record (EMR) (Dansky, et al., 1999) and telemedicine (Chau & Hu, 2001; Hu, Chau, Uiu Shang & Tam, 1999; Hu & Chau, 1999). In a study by Hu and colleagues (1999), the TAM framework was used to examine physician decisions to accept telemedicine. The study found that TAM provided a reasonable depiction of physician’s intention to use telemedicine technology. The authors also found perceived usefulness to be a significant determinant of attitude and intention, but perceived ease-of-use was not. Saga and Zmud (1994) reviewed previous adoption studies in the information technology stream and identified twenty empirical studies that investigated the nature and determinants of technology acceptance. Within these studies, TAM was found to be one of the most influential models, and in comparison with other frameworks, TAM had advantages in parsimony, technology specificity, theoretical basis, and empirical support.

Diffusion of Innovation

The Diffusion of Innovation (DOI) theory by Rogers (1995) suggests innovations as being communicated through certain channels over time and among a particular social system. Individuals are seen as possessing different degrees of willingness to adopt innovations. Innovation diffusion theory has attempted to explain the variables that influence potential adopters to accept an innovation or a new idea. Individuals are segregated into the following five categories of innovativeness: (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards. These categories follow a standard deviation-curve where a small group of innovators adopt the innovation in the beginning (2,5%), followed by early adopters
(13.5%) , the early majority (34%), the late majority (34%), and finally, the laggards (16%) (E. M. Rogers, 1995).

According to Rogers (1995), there are five process factors that may influence the rate of adoption: (1) the individual adopter’s perceived relative advantage of the innovation, (2) the innovation’s compatibility with existing values and needs of potential adopters, (3) the perceived degree of difficulty involved in adopting the innovation, (4) the trialability of the innovation, the degree to which a potential adopter may experiment with it, on a limited basis, and (5) the visibility of the result of innovation to adopters. Innovations that are perceived as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly.

Application of DOI in Clinical Information Systems

In the context of healthcare services and medical practice, diffusion of innovations theory has been used to describe physicians’ adoption of medical technology such as computerized physicians order entry (CPOE) (Ash, Lyman, Carpenter, & Fournier, 2001), telemedicine (Nir Menachemi, Burke, & Ayers, 2004; Spaulding, Russo, Cook, & Doolittle, 2005), telehealth (Helitzer, Heath, Maltrud, Sullivan, & Alverson., 2003), healthcare professional’s online searching (Marshall, 1989), and Internet use (Chew, Grant, & Tote, 2004).

In summary, each theoretical approach adds to our understanding about the perspective of user adoption. The Theory of Reasoned Action and its derivatives, the Technology Acceptance Model, and the Theory of Planned Behavior provide useful and robust viewpoints on the matter of technology adoption. These theoretical approaches have provided significant contributions to the information technology research stream, and additional studies have been attempting to build on the existing body of knowledge in this area. In addition, Diffusion of Innovation (DOI) theory suggests the importance of factors at individual levels, and examines how new innovations affect social change within an organization. The theory provides a general framework within which the social impact of a technology can be modeled in order to provide insights about the characteristics of individuals who will adopt a technology at various phases (Dillon & Morris, 1996).
In the subsequent section (3.3. Research Model), we present an integrated model proposed for this study to explain PCP’s attitudes towards adoption of the DAP-EPS from both perspectives of the Technology Adoption Model (TAM) and Diffusion of Innovation (DOI) theories. The proposed framework was developed and tested in a previous study, where it was used to assess the attitude of physicians towards the use of Electronic Health Record (EHR) (Morton & Wiedenbeck, 2009).

3.3. Research Model

The Diffusion of Innovations (DOI) theory and the Technology Acceptance Model (TAM) provide a combined theoretical framework for this study. Both models have been used extensively in prior Information Technology (IT) adoption studies. The following section revisits the Diffusion of Innovations (DIO) theory and the Technology Acceptance Model (TAM), and provides a detailed discussion of the unified concept of both theories proposed for this study.

3.3.1. A Unified Theory

In the past twenty years, several studies have proposed theoretical frameworks, mainly from behavioral and intention theories, for research in the acceptance of information technology (Ajzen, 1991; Davis, 1989; Davis, et al., 1989; Mathieson, 1991; S. Taylor, 1995). Among them, the technology acceptance model (TAM) is believed to be most robust, parsimonious, and influential in explaining technology adoption behavior (Davis, 1989; Davis, et al., 1989; Mathieson, 1991; Saga & Zmud, 1994). As discussed in the previous section, the TAM hypothesizes that a user's intended behavior predicts actual system use. The concepts from this theory focus exclusively on factors that determine users' behavioral intentions towards using a new information technology, specifically, perceived usefulness and perceived ease-of-use (Davis, 1989).

TAM assumes that the primary determinants of IT adoption in organizations are beliefs about usefulness and ease-of-use. According to TAM, these two determinants serve as the basis for
attitudes towards using a particular system, which in turn determines the intention to use, and then generates the actual usage behavior (Davis, 1989).

Despite extensive empirical support that TAM has received for its power to predict use of information systems (Davis, 1989; Davis, et al., 1989; Mathieson, 1991), the model appears to lack specificity when examining physicians’ attitude formation and intention development towards technology adoption. It may well be that physicians’ attitudes towards adoption may be influenced by other external variables such as the type of healthcare and the nature of physicians’ profession (Hu, Chau, Sheng, & Tam, 1999). As such, there is a need for TAM to incorporate additional factors or integrate with other IT acceptance models in order to improve its explanatory utility (Hu, et al., 1999; Lu, Yu, Liu, & Yao, 2003; Mathieson, 1991). This integration of TAM with other IT models or the addition of other factors to the model will provide a basis for discovering the impact of external variables on internal beliefs, attitudes, and intentions. Legris and colleagues (2003) analyzed TAM and suggested that it should be integrated into a broader model that includes organizational and social factors, such as DOI, to increase the predictive capacity of TAM.

Apart from the individual context, other variables such as social and organizational context may also influence the behavioral intention to adopt new technologies. For example, organizational attributes such as the degree to which new technologies can be integrated with existing technology, management commitment, training, end-user participation, and organizational support have been suggested to be influential in predicting technology adoption (Ernstmann, et al., 2009).

As explained in the previous section, a second line of research has examined the adoption and usage of information technology from the perspective of innovation diffusion (Rogers, 1983). Compared to TAM, this line of research pays more attention to specific settings and external factors that influence technology adoption. The concepts from Roger’s DOI theory help us explore social characteristics that impact an individual's decision to adopt or reject a new innovation. DOI classifies adopters into categories based on these characteristics (Rogers, 1995). This theory addresses various factors that could affect implementation of an innovation,
including attributes of the innovation itself, the process of implementation, individual characteristics, and social organizational factors (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004).

Both DOI and TAM models can be used together quite effectively in order to identify factors influencing the adoption of DAP-EPS among PCPs prior to implementation. Commonalities between TAM and DOI theories include the characteristics of the individual, the technology, and the organizational context, all of which are important in physicians’ attitudes formation towards the DAP-EPS adoption. Identifying these factors can then help in developing multi-level intervention strategies for building effective DAP-EPS implementation plans (Kukafka, Johnson, Linfante, & Allegrante, 2003).

The use of an integrated framework is appropriate for this study. Primary Care Physicians are part of a healthcare system that is a very complex social system comprised of professionals with varying backgrounds, experiences, and values. As such, a single framework in and of itself may not be an appropriate methodology for explaining technology acceptance as it applies to Primary Care Physicians. Thus, a framework from both perspectives of TAM and DOI will help us examine behavioral, social and organizational factors that are proven to be important in adopting new technological applications (Ash, 1997; Ernstmann, et al., 2009; Igbaria, Zinatelli, Cragg, & Cavaye, 1997; Karsh, 2004).

The integrated framework was developed and tested by Morton & Wiedenbeck (2009; 2010) (Figure 3-3, page 43). The unified framework was used to investigate the factors influencing physician attitudes towards adoption of an ambulatory Electronic Health Record (EHR) system. The model explained 73% of the variance in attitude towards EHR use, which suggests that the model was an appropriate mechanism for explaining pre-adoption attitude. The theory suggests that external variables, e.g. human, social and organizational factors, indirectly determine an individual’s attitude towards technology acceptance by influencing perceived usefulness and perceived ease-of-use (Morton & Wiedenbeck, 2010). There are also other existing IT adoption studies that used the integrated version of the two theories to explain adoption (Agarwal & Prasad, 1997, 1999; Carter & Bélanger, 2005; Moore & Benbasat, 1991).
However, to date there are no known studies that have used this integrated model for examining physicians’ adoption of an electronic tool such as the Diagnostic Assessment Program-Electronic Pathway Solution (DAP-EPS) for streamlining processes of cancer diagnosis. The components of the unified TAM-DOI framework are explained in the following section.

Components of the Unified Framework

Using the unified TAM-DOI framework allows us to capitalize on both models and the dimensions of technology adoption that they address. The unified model can be more effective than a single framework in assessing behavioral, social and organizational factors in a complex system such as healthcare.

The DOI element of the model helps to examine how new innovations spread through a community and affect social change. The TAM component, however, allows not only prediction value, but also explains why a new technology may or may not be acceptable to users (Morton & Wiedenbeck, 2010). Variables that are intrinsic to the TAM are perceived ease-of-use and perceived usefulness, and variables that are related to the DOI theory in this model are the external factors that were drawn from the existing literature. These factors are individual physicians’ characteristics, practice characteristics, and contextual factors (components of the social and professional environment surrounding the DAP-EPS diffusion). Physician characteristics can help determine which individuals will comprise the various adopter categories: innovators, early adopters, early majority, late majority, and laggards. Additionally, the social surroundings (contextual factors) can explain why physicians may or may not have positive attitude or behavioral intentions towards adoption of the DAP-EPS tool.

The unified framework (Diffusion of Innovations theory and the Technology Acceptance Model) can explain physicians’ attitudes towards adoption of the DAP-EPS at all three levels: 1) individual (demographics, attitude, and physician involvement), 2) group (practice characteristics), and 3) organization (leadership and support). The DOI theory explores the social characteristics that could influence PCPs decision to adopt or reject the DAP-EPS tool. The TAM examines the factors that determine PCP’s behavioral intention towards adopting the DAP-
EPS, in particular, perceived ease-of-use and perceived usefulness. This model allows us to determine perceived usefulness, perceived ease-of-use, and attitude towards the DAP-EPS tool in our target population, the primary care physicians of Ontario.

Figure 3-3: TAM & DOI unified theoretical framework

Note: “Behavioral intention to use” and “actual system use” factors of are beyond our analysis in this study.
4.1. Introduction

This chapter provides a detailed review of the research methodology used in this study. The main purpose of the study was to investigate the perceptions and attitudes of Primary Care Physicians (PCPs) practicing in the Province of Ontario regarding adoption of the Diagnostic Assessment Program-Electronic Pathway Solution (DAP-EPS) tool in outpatient clinical settings. We applied a pre-existing unified framework developed from both perspectives of the Technology Acceptance Model (TAM) and the Diffusion of Innovation (DOI) in order to predict and explain the extent to which the DAP-EPS is perceived as useful and easy to use by PCPs.

4.2. Study Design

We used a cross-sectional self-administered quantitative survey design for this study. This quantitative approach was used because it facilitated studying a larger sample population with the least intrusion on the participants. Furthermore, a survey-based data gathering technique was more in line with time and budget constraints. This study utilized several statistical approaches to study the relationship between acceptance of technology as measured by the integrated theoretical framework and the various demographic characteristics in the sample population.

4.3. Sample Size

The sample size is based on the primary analysis of this study: multivariate linear regression with a large number of predictors. In regression analysis it is normally recommended to have no more than one predictor per 10 cases (Nunnally & Bernstein, 1994). We anticipated that the numbers of predictors to be approximately 20. Therefore, to have reliable parameter estimates the calculated sample size was 200 for this study.
4.4. Population and Sample

The population of interest is PCPs who practice in the province of Ontario. A sample from the College of Physicians and Surgeons of Ontario (CPSO) was accessed through a third party organization, the Centre for Effective Practice (CEP). The CPSO database contains 10,000 PCPs across Ontario, of which approximately 2,000 have provided their email addresses. The survey was distributed by e-mail to 1,970 physicians of whom 1,940 received the email containing the link to the survey. Of those who received the email, 506 physicians visited the link to the survey.

4.5. Ethical Consideration

Our research study was reviewed and approved by both the University Health Network and University of Toronto Research Ethic Boards in September 2010. Participants implied their consent by completing the survey online. A letter containing overview information regarding the survey was sent along with the link to the potential study participants. The survey offered the option of exiting the survey process at any time. The survey did not ask for any personal identifiable information, such as name, address or date of birth. Instead, each completed survey questionnaire was identified by an identification (ID) number for the analysis. The data for the study were stored electronically at the Center for Effective Practice, and were sent to us upon conclusion of the study.

4.6. Online Survey Development

To guide and facilitate the study, a theoretical foundation using the Diffusion of Innovations theory and the Technology Acceptance Model tested and used by Morton & Wiedenbeck (2009) was utilized to examine PCPs attitudes towards adoption of the DAP-EPS tool, as described in Chapter 3.

We adapted an existing survey tool that was originally developed and validated by Aldosari (2003) and modified by Morton & Wiedenbeck (2009). We further tailored the survey tool by removing some of the items from the constructs, and by incorporating a few demographic questions. These demographic questions were derived from a validated tool developed by
Sussman et al. (2009). The focus of the Sussman study was twofold: to determine how the Regional Cancer Program can enhance the quality of care to cancer patients and to support the important role of family physicians in the cancer care process. We modified the survey tool to make it suitable for our sample, and to increase the rate of response by shortening the survey as it was recommended by the literature (Nakash, Hutton, Jørstad-Stein, Gates, & Lamb, 2006).

Section 1 of the study survey elicits general demographic and practice related information about the respondents. Sections 2 through 9 collect data regarding eight constructs: management support, physician involvement, adequate training, physician autonomy, doctor-patient relationship, perceived ease-of-use, perceived usefulness, and attitude about the DAP-EPS adoption in clinical settings. The final section gives respondents an opportunity to identify potential benefits and barriers associated with the use of the DAP-EPS tool from a set of predetermined options. Questions, except those in the general information and final (Qs 23-25) sections, capture responses via a five-point Likert scale with responses ranging from “strongly disagree” to “strongly agree”. The survey tool is included in Appendix B.

4.7. Content Validity and Pilot Testing

In order to ensure content validity of the survey tool, experts in the field of health informatics from the University of Toronto and Cancer Care Ontario provided valuable feedback on the content of the survey tool. The experts reviewed the questions for proper wording, clarity of instructions, and appropriateness of the survey tool and its format for the sample. We also evaluated the content validity of the survey tool in a pre-test phase. The survey was administered to a small group of primary care physicians in order to collect feedback on the content of each measure, the length of the survey, the format of the scale, the clarity of the questions and the time to complete the questionnaire.

4.8. Survey Administration

The survey administration and data collection were carried out by the Centre for Effective Practice.
4.8.1. Online Survey Administration

The electronic survey methodology was selected because it is a good technique for gathering baseline data for use of a new tool and informing future research (Babbie, 2001). Web-based surveys, in particular, make larger samples feasible. Thus, findings tend to be more generalizable, and can describe the characteristics of large populations. Furthermore, web surveys are cost effective and efficient. Moreover, anonymity of respondents may result in more honest answers to sensitive questions (Rubin & Babbie, 2009).

The survey was administered between September and October 2010 to members of the College of Physicians and Surgeons of Ontario (CPSO). The CPSO database was accessed through the Centre for Effective Practice (CEP). This database contains information on about 10 thousand primary care physicians across Ontario, of which approximately 2,000 have email addresses. The survey was distributed by e-mail. A letter explaining the project and the survey were emailed to each of the potential participants. The cover letter was a brief, personalized and positively worded that briefly described the study and its objectives. The survey was emailed to 1,970 physicians of whom 1,949 received the survey. Out of those who received the survey, 506 opened the link to the survey.

4.8.2. Survey Follow-up Procedures

Three follow up reminders were sent by email. Those who had already responded to the survey did not receive any reminders. The first follow-up reminder was sent by email ten days after the start of the survey. The second follow-up reminder was sent out on day 20 and a final reminder email was sent on day 27.

4.8.3. In-person Survey Administration

Based on previous experience with surveys of physicians, we expected a response rate of approximately 10% (200 completed questionnaires), but we received 61 completed surveys. As a result, we distributed the paper version of the survey in-person in a number of meetings and
conferences that were specifically tailored for PCPs in Ontario. These meeting were the “Ontario College of Family Physicians’ (OCFP’s) Annual Scientific Assembly” with 1,000 attendees and a two-day event “Friday and Saturday at the University” with 400 attendees. Prior to the “Friday and Saturday at the University” event, the study overview and the questionnaire were emailed by the CEP to 400 family physicians who were attending both days meetings. We received an additional 10 completed surveys from the in-person administration of the survey, giving us a total of 71 completed surveys.

4.9. Statistical Analysis

In the following section we briefly describe the statistical methods used for analyzing the data. Data were transferred from Survey Monkey to a Microsoft Excel worksheet, and then were converted to a SAS data file for data manipulation and statistical analysis.

4.9.1. Survey Data Analysis

The attitude towards adoption of the DAP-EPS (primary outcome) was measured using the “attitude about the DAP-EPS adoption in clinical settings” section of the survey. This component is comprised of six questions. The responses range from 1 to 5 where 1 represents “strongly disagree” and 5 represents “strongly agree”. The average of the responses to the six questions measures the PCPs’ attitude about the DAP-EPS adoption. A higher value indicates greater likelihood of using the DAP-EPS and, therefore, a more positive attitude towards adoption of the tool.

To assess the PCPs’ perceptions of ease-of-use and usefulness of the DAP-EPS tool, and to determine factors associated with perceived ease-of-use and usefulness, the responses (ranging from 1 to 5) from the “perceived ease-of-use” (4 questions), and the “perceived usefulness” sections (7 section) were averaged for each section. A higher score for ease-of-use indicates easier use of the DAP-EPS and a higher usefulness score indicates a greater level of agreement with the usefulness of the DAP-EPS by the PCPs. We asked PCPs participants to select from a list of several potential benefits and barriers provided in the questionnaire.
4.9.2. SurveyDomains

In order to calculate the score for each domain for every respondent, first we assigned a score of 2 to ‘Strongly Agree’ responses, a score of 1 to ‘Agree’, a score of 0 to ‘Neither Disagree/Agree’, a score of -1 to ‘Disagree’, and a score of -2 to ‘Strongly Disagree’. A positive value indicates agreement and a negative value indicates disagreement. Then, the final score for each of the domains was calculated as the average score of the components. The values of each domain range between -2 and 2.

4.9.3. Reliability

The reliability of all domains within the instrument was assessed by the Cronbach alpha reliability coefficient. A coefficient close to or above the conventional level of 0.70 was considered acceptable based on the common threshold values recommended by the literature (Nunnally & Bernstein, 1994). The 95% confidence intervals were calculated using the method suggested by Dawn Iacobucci and Adam Duhachek (2003).

4.9.4. Analysis

Statistical analysis and data manipulation were performed using SAS 9.2. Descriptive statistics, such as mean and standard deviation for continuous measurements and percentages for categorical variables, were used to describe the data. Bivariate analyses were conducted for assessing associations between the dependent variable, attitude towards adoption of the DAP-EPS, and the independent variables such as age, sex, and practice setting. We used the t-test to assess associations between binary classification variables such as sex and a continuous outcome. Analysis of variance was used when the classification variable had more than two categories. The Pearson correlation was used for measuring the correlation between two continuous measurements. To determine significant predictors of the attitude towards adoption of the DAP-EPS controlling for the other covariates, multivariate analysis was conducted using multiple linear regression.
Regression analysis includes techniques for modeling and analyzing several variables when the focus is on the relationship between a dependent variable and one or more independent variables. More specifically, regression analysis helps us understand how the typical value of the dependent variable changes when any one of the independent variables is varied while the other independent variables are held constant.

In this analysis, we used bivariate and multivariate regressions to examine several potential predictors in order to determine which factors influence the PCPs’ attitudes towards adoption of the DAP-EPS tool. Since our sample size was relatively small (n=71), and we had a large number of predictors, we performed a bivariate analysis prior to the multivariate regression analysis to reduce the number of potential predictors. This was done to obtain more accurate estimates. It is recommended not to have more than one predictor in the regression analysis per each 10 subjects (Nunnally & Bernstein, 1994). Bivariate analysis is concerned with the relationships between pairs of variables (the independent and dependent variables).

Furthermore, we performed the bivariate and multivariate regression analyses based on the relationship suggested in our research framework, the unified Technology Acceptance Model (TAM) and Diffusion of Innovation (DOI). Based on the framework, PCPs’ demographics (age, sex, years in practice, personal computer use, prior computer training and experience) and their practice characteristics (practice organization, practice setting, number of patients in practice and number of suspected cancer patients seen annually) have an influence on the contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support). In turn, the contextual factors have an impact on the technology factors (perceived ease-of-use and perceived usefulness) adjusted for demographics, and the technology factors influence PCPs’ attitudes towards adoption of the DAP-EPS adjusted for the contextual and demographics.

Before we conducted our regression analysis, certain assumptions regarding the original data were examined; a) To assess the approximate normal distribution of the dependent variables, we plotted histograms for the variables ease-of-use, usefulness, and attitude towards adoption of the DAP-EPS to visually examine their distribution shape; b) To ensure linear relationships between...
the independent and dependent variables, we plotted scatter plots for the dependent variables (attitude towards adoption of the DAP-EPS, usefulness, and ease-of-use) and the independent variables (contextual factors); c) We investigated the assumption of homoscedasticity (for any set of independent variables, the variance of dependent variable should be the same) and assessed the outliers after fitting the regression model by examining the residuals.

In order to assess the possibility of multicollinearity among independent variables in multivariate linear regression, a correlation matrix was obtained. Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly linearly related. If a correlation matrix demonstrates correlations of 0.85 or higher among independent variables, there may be multicollinearity (Munro, 2005). As such, the interrelationship between the independent variables was assessed by obtaining a correlation matrix for all of the independent variables in the regression model.

4.9.5. Diagnostic Checking

Residual analysis is a useful technique for evaluating goodness of fit of a regression model. Examining the residuals of the fitted model is a standard protocol for checking whether the underlying assumptions for the regression model are valid. Residuals plots (plots of residuals versus fitted values and versus independent variables) have been widely used to detect model inadequacies in linear regression analysis. In general, a linear plot indicates that there is no reason to believe that the relationship between the dependent and independent variables is not linear. A curved plot indicates non-linearity and a fan-shaped plot pattern indicates heteroscedasticity. The linearity of the normal QQ Plot of the residuals confirms the normality of the residuals. In linear regression, Cook’s distance plot is a commonly used method for identifying influential observations. Influential data points are the observations that are particularly worth checking for validity. There are different opinions regarding what cut-off values to use for spotting outliers. A simple operational guideline of larger than 1 has been suggested (Cook & Weisburg, 1982).
CHAPTER 5 : RESULTS

The purpose of this study was to assess primary care physicians’ (PCPs) attitudes towards adoption of the Diagnostic Assessment Program – Electronic Pathway Solution (DAP-EPS) tool. To guide and facilitate the study, a unified theoretical foundation that integrated theories of Diffusion of Innovations (DOI) and the Technology Acceptance Model (TAM) was used to examine the Primary Care Physicians (PCPs) attitude towards adoption of the DAP-EPS (Figure 5-1, current page). The theoretical model was originally proposed and tested by Morton & Wiedenbeck (2009). This chapter presents the results of the study using descriptive and inferential statistical analyses. The descriptive statistics include frequencies and percentages related to the sample population demographics, practice characteristics, and computer experience. In addition, this chapter demonstrates how participants responded to the DAP-EPS survey questions regarding perceived ease-of-use, perceived usefulness, and attitude towards adoption of the DAP-EPS tool. The result of the statistical analysis for each of the following research questions has been presented in this chapter.

**Research Questions:**

- Age
- Sex
- Years in practice
- Prior computer training
- Prior computer experience
- Internet access in practice
- EMR use in practice
- Practice setting
- Practice organization
- Number of patients in practice
- Number of suspected cancer patients seen annually
- Physician involvement
- Training
- Physician autonomy
- Doctor-Patient relationship
- Management support

**Figure 5-1:** TAM unified theoretical framework

*Source:* © (Morton & Wiedenbeck, 2009)

*Note:* “Behavioral intention to use” and “actual system use” factors are beyond our analysis in this study.
5.1. Research Questions

The survey instrument was designed to answer four principal questions:

**Question 1:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS and their demographic and practice characteristics?

**Question 2:** Is there a relationship between the contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support), and technology factors (perceived ease-of-use and perceived usefulness)?

**Question 3:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)?

**Question 4:** Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and technology factors (perceived ease-of-use and perceived usefulness)?

The four research questions and their related dependent and independent variables are presented in Table 5-1, current page.

In order to answer the research questions, the analysis was conducted in several stages guided by the integrated framework presented in Figure 5-1 on page 53. First, descriptive analysis was performed on PCPs’ demographics, their practice settings and their computer sophistication and experience. Subsequently, we attempted to test the underlying assumptions for regression analysis prior to performing regression analysis. Then, we performed bivariate and multivariate regression analyses to examine the relationships between the predictors and dependent variable/s in several stages.

**Table 5-1:** Research questions and related dependent and independent variables

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Dependent Variable</th>
<th>Independent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is there a relationship between the PCPs’ attitudes towards adoption of the DAP-EPS tool and their demographic and practice characteristics?</td>
<td>Attitude towards adoption of DAP-EPS</td>
<td>PCPs’ demographics and their practice characteristics</td>
</tr>
<tr>
<td>2. Is there a relationship between contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support), and technology factors (perceived ease-of-use and perceived usefulness)?</td>
<td>Ease-of-Use and Usefulness</td>
<td>Contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)</td>
</tr>
<tr>
<td>3. Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)?</td>
<td>Attitude towards adoption of DAP-EPS</td>
<td>Contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)</td>
</tr>
<tr>
<td>4. Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and technology factors (perceived ease-of-use and perceived usefulness)?</td>
<td>Attitude towards adoption of the DAP-EPS</td>
<td>Perceived ease-of-use and perceived usefulness</td>
</tr>
</tbody>
</table>
5.2. Sample Characteristics

The Online survey instrument was administered by the Center for Effective Practice to 1,970 Ontario Primary Care Physicians. Of that number, 68 responded to the survey. Two of the returned questionnaires were not family physicians and five other questionnaires provided almost no data; therefore, seven were excluded from the online surveys (n=61). We also collected 10 completed paper surveys resulting in total of 71 surveys.

We compared the physician demographic, practice characteristics, and the contextual factors of the online and paper surveys participants prior to performing statistical analysis. The results are given in Table 5-2, current page.

Table 5-2: Comparing respondents’ characteristics of the online and the paper surveys

<table>
<thead>
<tr>
<th>Variable</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0.0123</td>
</tr>
<tr>
<td>Age</td>
<td>0.9137</td>
</tr>
<tr>
<td>Practice setting</td>
<td>0.3007</td>
</tr>
<tr>
<td>Practice organization</td>
<td>0.1645</td>
</tr>
<tr>
<td>Number of patients in your practice</td>
<td>0.3629</td>
</tr>
<tr>
<td>Number of suspected cancer patients</td>
<td>0.6264</td>
</tr>
<tr>
<td>Access to the Internet</td>
<td>0.1884</td>
</tr>
<tr>
<td>Using EMR</td>
<td>0.7236</td>
</tr>
<tr>
<td>Computer usage</td>
<td>0.5589</td>
</tr>
<tr>
<td>Training</td>
<td>0.2735</td>
</tr>
<tr>
<td>Physician Involvement</td>
<td>0.9602</td>
</tr>
<tr>
<td>Adequate Training</td>
<td>0.4585</td>
</tr>
<tr>
<td>Physician Autonomy</td>
<td>0.7612</td>
</tr>
<tr>
<td>Doctor -Patient relationship</td>
<td>0.6923</td>
</tr>
<tr>
<td>Ease-of-Use</td>
<td>0.8344</td>
</tr>
<tr>
<td>Usefulness</td>
<td>0.9620</td>
</tr>
<tr>
<td>Attitude</td>
<td>0.9095</td>
</tr>
<tr>
<td>Management Support</td>
<td>0.2255</td>
</tr>
</tbody>
</table>

Out of 18 comparisons, sex was the only variable that was significant between respondents whose data were collected by email versus by paper version (p=0.0123).
Descriptive data on the physicians’ characteristics including sex, age, years of practice experience are presented in Table 5-3, (page 56).

In order to assess the extent to which our study sample was representative of the Ontario PCP population, we compared the demographics (age, sex and years of practice experience) of the study sample with demographic data from the 2007 Canadian National Physician Survey (NPS) ("National Physician Survey: National Demographics," 2007). With respect to sex, our sample was fairly balanced with 51.4% male and 48.6% female, whereas the majority of the physicians in Ontario were male (73%). Regarding the age demographic, the age categories in our sample included under 30 years (2.8%), 30-39 years (12.7%), 40-49 years (26.7%), 50-59 years (33.8%), and 60 years and older (23.9%), which were different compared to the Ontario PCP reported age categories, under 34 years (4.25%), 35-44 years (25.09%), 45-54 years (30.66%), 55-64 years (23.74%), and 65 years and over (14.58%). With respect to the years of practice experience, the result of the Ontario PCP population survey showed that 14% of the PCPs had 15-19 years and 53% had 20 years and above years of practice experience, while our sample showed that 72% of the PCPs had more than 15 years of experience in practice. Thus, our data may not be a representative of the Ontario PCP population.
Table 5-3: Characteristics of the respondents (n=71)

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Variables</th>
<th>Frequency N=71</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3-1</td>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>34</td>
<td>48.6</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>36</td>
<td>51.4</td>
</tr>
<tr>
<td>Q3-2</td>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Under 30 years</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>30-39 years old</td>
<td>9</td>
<td>12.7</td>
</tr>
<tr>
<td></td>
<td>40-49 years old</td>
<td>19</td>
<td>26.7</td>
</tr>
<tr>
<td></td>
<td>50-59 years old</td>
<td>24</td>
<td>33.8</td>
</tr>
<tr>
<td></td>
<td>60 years and older</td>
<td>17</td>
<td>23.9</td>
</tr>
<tr>
<td>Q3-3</td>
<td>Years of practice experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than 2 years</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>2-5 years</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>6-10 years</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>11-15 years</td>
<td>10</td>
<td>14.0</td>
</tr>
<tr>
<td></td>
<td>More than 15 years</td>
<td>51</td>
<td>71.8</td>
</tr>
</tbody>
</table>

Descriptive data were also collected on the respondents’ practice characteristics including: practice setting, practice organization, number of patients in practice, number of patients with suspected cancer seen annually in practice, and use of the Internet and Electronic Medical Record (EMR) in their practice. Fifty two of the respondents (74.3%) practiced in private offices/clinics and 27 (38%) described their practice organization as being a Family Health Team. Of those reported ‘other’, 1 specified ‘Student Health University’, 1 specified ‘Home Palliative Care Service’, 1 specified ‘Hospital Community Health Centre’, and 2 specified ‘Academic Community Family Physician Private Office’. The majority of the respondents (98.5%) had access to the Internet and used Electronic Medical Record (81.2%) in their practice (Table 5-4, page 57). With respect to the number of patients per practice, the majority of the respondents (29.6%) reported having 1,000-1,499 patients in their practice followed by 25.3% reporting 1,500-1,999 patients. Regarding the number of suspected cancer patients, the majority (33.8%) reported seeing 10-20 suspected cancer patients in their practice over past year, followed by 28.2% who reported seeing more than 20 suspected cancer patients.
<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice Setting</td>
<td>N=71</td>
<td></td>
</tr>
<tr>
<td>Private office/Clinic excluding walk-in clinics</td>
<td>52</td>
<td>74.3</td>
</tr>
<tr>
<td>Community healthcare center</td>
<td>4</td>
<td>5.7</td>
</tr>
<tr>
<td>Academic family medicine teaching unit</td>
<td>10</td>
<td>14.3</td>
</tr>
<tr>
<td>Free-standing walk-in clinics</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>5.7</td>
</tr>
<tr>
<td>Practice organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solo practice</td>
<td>11</td>
<td>15.5</td>
</tr>
<tr>
<td>Family physician group medical practice</td>
<td>23</td>
<td>32.4</td>
</tr>
<tr>
<td>Family health team</td>
<td>27</td>
<td>38</td>
</tr>
<tr>
<td>Family physician/specialist group medical practice</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>8.5</td>
</tr>
<tr>
<td>Number of patients in practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-499</td>
<td>8</td>
<td>11.3</td>
</tr>
<tr>
<td>500-999</td>
<td>11</td>
<td>15.5</td>
</tr>
<tr>
<td>1000-1499</td>
<td>21</td>
<td>29.6</td>
</tr>
<tr>
<td>1500-1999</td>
<td>18</td>
<td>25.3</td>
</tr>
<tr>
<td>2000-2999</td>
<td>11</td>
<td>15.5</td>
</tr>
<tr>
<td>&gt; 3000</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td>No. of suspected cancer patients seen annually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-4</td>
<td>12</td>
<td>16.9</td>
</tr>
<tr>
<td>5-9</td>
<td>15</td>
<td>21.1</td>
</tr>
<tr>
<td>10-20</td>
<td>24</td>
<td>33.8</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>20</td>
<td>28.2</td>
</tr>
<tr>
<td>Internet access in practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>68</td>
<td>98.5</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Use EMR in practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>56</td>
<td>81.2</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>18.8</td>
</tr>
</tbody>
</table>
5.2.1. Computer Competency

When asked about their use of computers, a total of 56 (24.1%) physicians reported using computers to access their patients’ medical information; 61 (26.3%) used computer or handheld devices to access their email; 63 (27.2%) accessed health/clinical resources or journals online; and a smaller proportion 52 (22.4%) reported using computers/handheld for other web-based patient management tools. “Self-guided learning” was the most common form of prior computer experience described, as reported by 63% of participants. Thirty one respondents (45.6%) considered themselves to be sophisticated computer users and 18 (26.5%) of the respondents rated themselves as having “experience and being able to assist others”. Three respondents (4.4%) rated themselves as being “beginner with limited skills” in this area (see Table 5-5, current page).

Table 5-5: Prior Computer experience and sophistication

<table>
<thead>
<tr>
<th><strong>Variable</strong></th>
<th><strong>Frequency</strong></th>
<th><strong>Percent</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q 4-3</strong> Personal Computer Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients’ medical information</td>
<td>56</td>
<td>24.1</td>
</tr>
<tr>
<td>Email</td>
<td>61</td>
<td>27.3</td>
</tr>
<tr>
<td>Online health/clinical resources or journals</td>
<td>63</td>
<td>27.2</td>
</tr>
<tr>
<td>Other web-based tools designed for patient management</td>
<td>52</td>
<td>22.4</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Q 4-4</strong> <em>Former Computer Experience/Training</em></td>
<td><strong>N=92</strong>*</td>
<td></td>
</tr>
<tr>
<td>Formal medical school training</td>
<td>2</td>
<td>2.2</td>
</tr>
<tr>
<td>Formal residency or fellowship training</td>
<td>4</td>
<td>4.3</td>
</tr>
<tr>
<td>Formal workshops or conferences</td>
<td>17</td>
<td>18.5</td>
</tr>
<tr>
<td>None</td>
<td>11</td>
<td>12.0</td>
</tr>
<tr>
<td>Self-guided learning</td>
<td>58</td>
<td>63.0</td>
</tr>
<tr>
<td><strong>Q 4-5</strong> Computer Sophistication/ Competency</td>
<td><strong>N=68</strong></td>
<td></td>
</tr>
<tr>
<td>Novice - with limited skills</td>
<td>3</td>
<td>4.4</td>
</tr>
<tr>
<td>Advanced beginner- no significant expertise</td>
<td>16</td>
<td>23.5</td>
</tr>
<tr>
<td>General - started to become well-rounded</td>
<td>31</td>
<td>45.6</td>
</tr>
<tr>
<td>Advanced - experienced and able to assist others</td>
<td>18</td>
<td>26.5</td>
</tr>
</tbody>
</table>

* Note: Participants had the option of selecting more than one choice.
5.2.2. Ability to Influence other Physicians

With respect to the ability of PCPs to influence colleagues in their groups to use the DAP-EPS tool, 33 participants (40.3%) reported they had influence on their colleagues, 4 (6.4%) reported they had no influence, and 25 (53.2%) were unsure (see Figure 5-2, current page).

![Ability to Influence My Group to Use The DAP-EPS Tool](image)

**Figure 5-2**: The ability to influence other physicians

5.2.3. How Physicians Learn Best

With respect to the DAP-EPS training, how physicians learn best, 27 (38.0%) of the participants reported group setting, 39 (54.9%) reported face-to-face, 34 (47.9%) reported self-directed, 17 (23.9%) reported web-based, and 3 (4.2%) participants reported other methods (see Figure 5-3, page 60).
5.3. Perceived Barriers to Adoption

We examined physicians’ perceived barriers to adoption of the DAP-EPS across practice settings. We asked physicians to indicate their perceived barriers from a set of predetermined barriers. Practice setting was a factor that had influenced the degree of importance for each barrier. The reported top 3 barriers were high initial physician time (25.5%), inadequate technical support (20.2%), and challenges with workflow redesign (18.7%) (Table 5-6, page 61).

Physicians in private practice were more likely than physicians in other practice settings to report issues with high initial physicians’ time (77.4%), challenges with workflow redesign (76.9%), and ease-of-use (69.2%). None of the respondents reported walk-in clinics as their main practice setting (Table 5-6, page 61).

Figure 5-3: Physicians’ preferred learning method
### Table 5-6: Perceived barriers to physicians’ adoption of the DAP-EPS tool by practice setting

<table>
<thead>
<tr>
<th><strong>Practice Setting</strong></th>
<th><strong>Q4-16</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived Barriers to Physician Adoption</strong></td>
<td>Private office/Clinic *N=165</td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
</tr>
<tr>
<td>High initial physician time</td>
<td>41(24.8)</td>
</tr>
<tr>
<td>Inadequate technical support</td>
<td>34(20.6)</td>
</tr>
<tr>
<td>Challenges with workflow redesign</td>
<td>30(18.2)</td>
</tr>
<tr>
<td>Financial costs</td>
<td>25(15.2)</td>
</tr>
<tr>
<td>Ease-of-use</td>
<td>18(10.9)</td>
</tr>
<tr>
<td>Difficulty with technology</td>
<td>17(10.3)</td>
</tr>
</tbody>
</table>

*Note: Participants had the option of selecting more than one barrier.*

### 5.4. Perceived Benefits to Adoption

We asked physicians to indicate their perceived benefits of the DAP-EPS tool from a predetermined list of benefits within the questionnaire. The reported top three perceived benefits were coordination of care (19.2), accessibility of the information (16.5), and efficiency and quality of care (15.2). (Table 5-7, page 62).
Table 5-7: Perceived benefits to adoption of the DAP-EPS tool by practice setting

<table>
<thead>
<tr>
<th>Practice Setting</th>
<th>Coordination of care</th>
<th>Accessibility of the information</th>
<th>Efficiency and quality of care</th>
<th>Standardization of care</th>
<th>Timeliness of the information</th>
<th>Physician-physician communication</th>
<th>Patient-physician communication</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private office/Clinic N=226</td>
<td>43(19.0)</td>
<td>38(16.8)</td>
<td>33(14.6)</td>
<td>34(15.0)</td>
<td>32(14.2)</td>
<td>32(14.2)</td>
<td>14(6.2)</td>
<td>58(19.2)</td>
</tr>
<tr>
<td>Walk-in Clinic N=0</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
</tr>
<tr>
<td>Community Health Center N=22</td>
<td>4(18.2)</td>
<td>4(18.2)</td>
<td>3(13.6)</td>
<td>4(18.2)</td>
<td>3(13.6)</td>
<td>2(9.1)</td>
<td>2(9.1)</td>
<td>50(16.5)</td>
</tr>
<tr>
<td>Academic Teaching Unit N=37</td>
<td>7(18.9)</td>
<td>6(16.2)</td>
<td>7(18.9)</td>
<td>6(16.2)</td>
<td>5(13.5)</td>
<td>4(10.8)</td>
<td>2(9.1)</td>
<td>46(15.2)</td>
</tr>
<tr>
<td>Other N=17</td>
<td>4(23.5)</td>
<td>2(11.8)</td>
<td>3(17.6)</td>
<td>2(11.8)</td>
<td>3(17.6)</td>
<td>3(17.6)</td>
<td>0(0)</td>
<td>46(15.2)</td>
</tr>
<tr>
<td>Total N=302</td>
<td>58(19.2)</td>
<td>50(16.5)</td>
<td>46(15.2)</td>
<td>46(15.2)</td>
<td>43(14.2)</td>
<td>41(13.6)</td>
<td>18(6.0)</td>
<td></td>
</tr>
</tbody>
</table>

* Note: Participants had the option of selecting more than one benefits.

Due to the small number of respondents, we did not compare the variation in barriers and benefits across the practice settings. In the following table (5-8, page 63-64), we calculated the mean and standard deviation, the Cronbach alpha, and the 95% confidence interval for each domain. The Cronbach alpha for the domains of “physicians involvement”, “adequate training”, “physician autonomy”, “doctor-patient relationship”, “perceived usefulness of the DAP-EPS”, “perceived ease of the DAP-EPS use”, “attitude toward adoption of the DAP-EPS” and “management support” were 0.92, 0.65, 0.61, 0.87, 0.82, 0.79, 0.63, 0.82 respectively. These values were either close to or above the conventional level 0.70, which is considered acceptable for survey domains. Overall the reliability of the domains within our modified instrument was lower than the original instrument. Therefore, the reliability of our modified instrument should be judged with caution.
Table 5-8: The DAP-EPS survey domains and their reliability

<table>
<thead>
<tr>
<th>Domains</th>
<th>Mean</th>
<th>SD</th>
<th>Cronbach alpha (95% CI)</th>
<th>Original tool α (# of items)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diffusion of Innovation Items</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-6 <strong>Physician Involvement</strong></td>
<td>0.90</td>
<td>0.87</td>
<td>0.93 (0.87-0.99)</td>
<td>0.90 (5)</td>
</tr>
<tr>
<td>My involvement during the EPS implementation and setup phase will make the EPS more useful to me.</td>
<td>0.85</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being involved during the EPS implementation and setup phase will improve my adoption and use of the tool.</td>
<td>0.90</td>
<td>0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-7 <strong>Adequate Training</strong></td>
<td>0.87</td>
<td>0.67</td>
<td>0.65 (0.54-0.77)</td>
<td>0.90 (4)</td>
</tr>
<tr>
<td>My practice has the necessary technology, training, and support resources needed to implement a new clinical information system.</td>
<td>0.60</td>
<td>0.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most physicians and clinical staff in my practice are willing to learn how to use an EPS system.</td>
<td>0.76</td>
<td>0.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training will make it easier for me to use the EPS.</td>
<td>1.35</td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-8 <strong>Physician Autonomy</strong></td>
<td>0.35</td>
<td>0.61</td>
<td>0.61 (0.43-0.80)</td>
<td>0.89 (7)</td>
</tr>
<tr>
<td>Using the EPS will standardize the physicians’ clinical practices and decision-making with regard to cancer diagnosis.</td>
<td>0.77</td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Using the EPS may threaten the physicians’ personal and professional privacy. (reverse coded)</td>
<td>0.40</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Using the EPS may result in legal or ethical problems for the physician. (reverse coded)</td>
<td>0.23</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Using the EPS may limit the physicians’ autonomy in making clinical decisions or judgments. (reverse coded)</td>
<td>0.05</td>
<td>0.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-9 <strong>Doctor-Patient Relationship</strong></td>
<td>0.71</td>
<td>0.47</td>
<td>0.87 (0.77-0.96)</td>
<td>0.94 (4)</td>
</tr>
<tr>
<td>*Using the EPS will likely reduce the patient’s confidence in the physician if used as a diagnostic and referral aid. (reverse coded)</td>
<td>0.75</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Using the EPS will likely threaten the physician’s credibility with his/her patients. (reverse coded)</td>
<td>0.84</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Using the EPS will likely reduce the patient’s satisfaction with the quality of care. (reverse coded)</td>
<td>0.69</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Overall, using the EPS will likely interfere with the effectiveness of the doctor patient interaction. (reverse coded)</td>
<td>0.69</td>
<td>0.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-13 <strong>Management/Physician Leadership Support</strong></td>
<td>0.33</td>
<td>0.62</td>
<td>0.82 (0.67-0.94)</td>
<td>0.88 (7)</td>
</tr>
<tr>
<td>The EPS project will be important to my senior management team</td>
<td>0.44</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4-10</td>
<td><strong>Perceived Ease-of-use</strong></td>
<td>Perceived Usefulness</td>
<td>Attitude Towards Adoption of the DAP-EPS</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------</td>
<td>----------------------</td>
<td>----------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.60</strong></td>
<td><strong>0.79</strong></td>
<td><strong>0.63</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.64</strong></td>
<td><strong>0.82</strong></td>
<td><strong>0.63</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.79</strong> (0.68-0.91)</td>
<td><strong>0.82</strong> (0.74-0.89)</td>
<td><strong>0.63</strong> (0.25-0.76)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.89</strong> (4)</td>
<td><strong>0.96</strong> (7)</td>
<td><strong>0.90</strong> (6)</td>
<td></td>
</tr>
<tr>
<td>Learning to use this new technology will be easy for me.</td>
<td>0.62</td>
<td>0.77</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>I expect to become skilled at using the EPS.</td>
<td>0.73</td>
<td>-0.10</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>Overall, I expect the EPS will be easy for physicians to use.</td>
<td>0.48</td>
<td>0.34</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>The EPS technology will support the physician in providing better patient care.</td>
<td>0.86</td>
<td>0.78</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>I will encourage the use of the EPS among my colleagues.</td>
<td>0.78</td>
<td>0.78</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>I am satisfied with using the conventional patient referral process in my job.</td>
<td>-0.02</td>
<td>0.65</td>
<td>0.86</td>
<td></td>
</tr>
</tbody>
</table>

**Technology Acceptance Model Items**

**Q4-10**

<table>
<thead>
<tr>
<th>Q4-10</th>
<th><strong>Perceived Ease-of-use</strong></th>
<th>Perceived Usefulness</th>
<th>Attitude Towards Adoption of the DAP-EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>0.60</strong></td>
<td><strong>0.79</strong></td>
<td><strong>0.63</strong></td>
</tr>
<tr>
<td></td>
<td><strong>0.64</strong></td>
<td><strong>0.82</strong></td>
<td><strong>0.63</strong></td>
</tr>
<tr>
<td></td>
<td><strong>0.79</strong> (0.68-0.91)</td>
<td><strong>0.82</strong> (0.74-0.89)</td>
<td><strong>0.63</strong> (0.25-0.76)</td>
</tr>
<tr>
<td></td>
<td><strong>0.89</strong> (4)</td>
<td><strong>0.96</strong> (7)</td>
<td><strong>0.90</strong> (6)</td>
</tr>
<tr>
<td>Learning to use this new technology will be easy for me.</td>
<td>0.62</td>
<td>0.77</td>
<td>0.86</td>
</tr>
<tr>
<td>I expect to become skilled at using the EPS.</td>
<td>0.73</td>
<td>-0.10</td>
<td>0.78</td>
</tr>
<tr>
<td>Overall, I expect the EPS will be easy for physicians to use.</td>
<td>0.48</td>
<td>0.34</td>
<td>-0.02</td>
</tr>
<tr>
<td>The EPS technology will support the physician in providing better patient care.</td>
<td>0.86</td>
<td>0.78</td>
<td>-0.02</td>
</tr>
<tr>
<td>I will encourage the use of the EPS among my colleagues.</td>
<td>0.78</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td>I am satisfied with using the conventional patient referral process in my job.</td>
<td>-0.02</td>
<td>0.65</td>
<td>0.86</td>
</tr>
</tbody>
</table>

**N = 71**

**SD = Standard Deviation**

* Items presented from negative perspective

**All items measured on 5 point Likert scale**

-2=strongly disagree, -1=disagree, 0=neither agree/disagree, 1=agree, 2=strongly agree
5.5. Multivariate Linear Regression

In order to determine which factors influence the PCPs’ attitudes towards adoption of the DAP-EPS, as well as their perceived ease-of-use and usefulness, several potential predictors were examined using multivariate linear regression analysis. We plotted histograms for attitude towards adoption of the DAP-EPS, perceived ease-of-use and perceived usefulness to assess their normality. The histograms demonstrate no visual evidence of a severe asymmetry with respect to the distribution of the dependent variables (ease-of-use, usefulness, and attitude towards adoption of the DAP-EPS). The histograms are presented in Figures 5-4, 5-5, 5-6, pages 66-67.

We used nonparametric regression to assess the linearity of the relationship between two variables y (dependent) and x (independent). Nonparametric regression is a form of regression analysis in which the predictor does not take a predetermined form but is constructed according to information derived from the data. A special case of the general nonparametric regression model is nonparametric simple regression that is often called ‘scatterplot smoothing’ because it traces a smooth curve through a scatterplot of y against x for assessing the functional form of the relationship between y and x (Fox, 2000). Visual inspection of the scatter plots confirmed the linearity of the relationship between predictors and dependent variables (Figure 5-7, pages 67-68).
**Figure 5-4:** Normal distribution shape of attitude, for the associated independent variables

**Figure 5-5:** Normal distribution shape of ease-of-use, for the associated independent variables
Figure 5-6: Normal distribution shape of usefulness, for the associated independent variables
Figure 5-7: Scatter plots-linear relationships between the independent variables (contextual domains) and the dependent variables (attitude, usefulness, and ease-of-use)
5.5.1. Association between Contextual factors and Demographic Characteristics

We performed a bivariate analysis (Table 5-9, current page) to explore the association between the independent variables from the survey questionnaire regarding the PCPs’ demographics (e.g., age, sex, years in practice, personal computer use, prior computer training and experience), their practice characteristics (e.g., practice setting, practice organization, number of patients in practice, number of suspected cancer patients seen annually, and use of EMR in practice), and contextual factors (e.g. physician autonomy, doctor-patient relationship, physician involvement, adequate training, and management/leadership support). The bivariate analysis revealed that the associations between age and physician involvement ($P=0.03$), EMR use and physician involvement ($P=0.006$), and EMR use and adequate training ($P=0.0001$), to be statistically significant.

**Table 5-9:** Level of significance (p-value) for bivariate association between contextual factors and demographic Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age</th>
<th>Yrs in practice</th>
<th>EMR use</th>
<th>Practice setting</th>
<th>Practice org</th>
<th>No. of patients</th>
<th>No. of suspected cancer patients</th>
<th>Personal computer use</th>
<th>Former computer experience</th>
<th>Computer competency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician involvement</td>
<td>0.30</td>
<td><strong>0.03</strong></td>
<td>0.14</td>
<td><strong>0.006</strong></td>
<td>0.13</td>
<td>0.99</td>
<td>0.18</td>
<td>0.32</td>
<td>0.86</td>
<td>0.98</td>
<td>0.79</td>
</tr>
<tr>
<td>Adequate training</td>
<td>0.73</td>
<td>0.11</td>
<td>0.07</td>
<td><strong>0.0001</strong></td>
<td>0.26</td>
<td>0.26</td>
<td>0.12</td>
<td>0.21</td>
<td>0.90</td>
<td>0.15</td>
<td>0.84</td>
</tr>
<tr>
<td>Physician Autonomy</td>
<td>0.20</td>
<td>0.41</td>
<td>0.62</td>
<td>0.65</td>
<td>0.12</td>
<td>0.09</td>
<td>0.70</td>
<td>0.34</td>
<td>0.26</td>
<td>0.62</td>
<td>0.94</td>
</tr>
<tr>
<td>Physician-Patient</td>
<td>0.71</td>
<td>0.69</td>
<td>0.74</td>
<td>0.38</td>
<td>0.32</td>
<td>0.29</td>
<td>0.18</td>
<td>0.61</td>
<td>0.053</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Relationship</td>
<td>0.74</td>
<td>0.55</td>
<td>0.72</td>
<td>0.68</td>
<td>0.55</td>
<td>0.92</td>
<td>0.15</td>
<td>0.99</td>
<td>0.95</td>
<td>0.85</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Org = Organization  
No = Number  
EMR = Electronic Medical Record  
Yrs = Years  
**Bold:** $P < 0.05$
5.5.2. Relationship between the Contextual and Technology Factors

We used linear regression to assess the relationship between ease-of-use and contextual factors (physician autonomy, doctor-patient relationship, physician involvement, adequate training, and management/leadership support). We included age and EMR use as possible confounders in the regression model. There was a significant relationship between the technology factor, ease-of-use, and the predictors (F = 2.54, P = 0.0274). The coefficient of determination ($R^2$) for the regression was 0.44, and adjusted $R^2$ was 0.27. The parameter estimates (b), their standard errors, and significance level (P value) are given in Table 5-10 (current page). The only contextual factor that was associated with ease-of-use was adequate training (P = 0.0255). That is one unit increase in adequate training score increases the ease-of-use score by 0.42 units.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>$R^2$ (F=2.54, P=0.0274)</th>
<th>Independent variables</th>
<th>Parameter Estimate (b)</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease-of-Use</td>
<td>0.44</td>
<td>Constant</td>
<td>0.158</td>
<td>0.321</td>
<td>0.6259</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician involvement</td>
<td>-0.095</td>
<td>0.128</td>
<td>0.4625</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adequate training</td>
<td>0.420</td>
<td>0.178</td>
<td><strong>0.0255</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician autonomy</td>
<td>0.054</td>
<td>0.177</td>
<td>0.7624</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doctor-patient relation</td>
<td>-0.047</td>
<td>0.191</td>
<td>0.8036</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management support</td>
<td>-0.271</td>
<td>0.173</td>
<td>0.1281</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (yes)</td>
<td>-0.216</td>
<td>0.321</td>
<td>0.5061</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (no)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age &lt; 39</td>
<td>0.797</td>
<td>0.288</td>
<td><strong>0.0099</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 40-49</td>
<td>0.916</td>
<td>0.275</td>
<td><strong>0.0024</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 50-59</td>
<td>0.310</td>
<td>0.242</td>
<td>0.2112</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 60+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

We performed another multivariate linear regression, this time to assess the relationship between the contextual factors (e.g. physician autonomy, doctor-patient relationship, physician involvement, adequate training, and management/leadership support) and the technology factor, usefulness, while adjusting for age and EMR use. There was a significant relationship between usefulness and the predictors (F = 2.63, P = 0.0240). The coefficient of determination for the regression was ($R^2 = 0.46$, adjusted $R^2 = 0.28$). The estimate of the parameters (b), their standard error, and level of significance (P value) are given in Table 5-11 (page 71). The only contextual
factor that was associated with the usefulness was physician autonomy \((P = 0.0012)\). That is one unit increase in physician autonomy score increases the usefulness score by 0.56 units.

**Table 5-11: Multivariate association between usefulness and contextual factors**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(R^2)</th>
<th>Independent variables</th>
<th>Parameter Estimate ((b))</th>
<th>Standard Error</th>
<th>(P) value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usefulness</strong></td>
<td>0.46</td>
<td>Constant</td>
<td>0.499</td>
<td>0.263</td>
<td>0.0686</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician involvement</td>
<td>0.000</td>
<td>0.104</td>
<td>0.9978</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adequate training</td>
<td>-0.091</td>
<td>0.145</td>
<td>0.5346</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician autonomy</td>
<td>0.564</td>
<td>0.157</td>
<td><strong>0.0012</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Doctor-Patient</td>
<td>-0.083</td>
<td>0.183</td>
<td>0.6540</td>
</tr>
<tr>
<td></td>
<td></td>
<td>relationship</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management support</td>
<td>0.286</td>
<td>0.164</td>
<td>0.0937</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (yes)</td>
<td>-0.403</td>
<td>0.265</td>
<td>0.1399</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (no)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age &lt; 39</td>
<td>-0.231</td>
<td>0.234</td>
<td>0.3308</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 40-49</td>
<td>0.379</td>
<td>0.227</td>
<td>0.1061</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 50-59</td>
<td>0.186</td>
<td>0.200</td>
<td>0.3609</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 60 (\geq)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

From the results of the above regression analyses for usefulness and ease-of-use, the predictors age, adequate training, and physician autonomy were associated with the technology factors, ease-of-use and usefulness.

**5.5.3. Identifying the Potential Predictors Directly Associated with Attitude**

To identify potential predictive variables associated with ‘attitude towards adoption of the DAP-EPS’, we conducted a bivariate analysis between attitude towards adoption of the DAP-EPS and the independent variables included in our survey instrument, the demographics (e.g. age, sex, years in practice, personal computer use, prior computer training, and computer sophistication/competency), practice characteristics (e.g. practice setting, practice organization, number of patients in practice, number of suspected cancer patients seen annually, Internet access and use of EMR in practice), contextual factors (e.g. physician autonomy, doctor-patient relationship, physician involvement, adequate training, management/leadership support), technology related factors (e.g. perceived ease-of-use, perceived usefulness). Table 5-12 (pages 72-73) presents the results of the association between ‘attitude’ and predictive variables (physician and practice
characteristics, and computer competency). The bivariate relationships indicate the level of association between each predictive variable and attitude towards adoption of the DAP-EPS. Table 5-13 (page 74) presents the association between the dependent variable attitude towards adoption of the DAP-EPS and the independent variables (contextual and technology factors).

Based on the bivariate analysis results, practice organization ($P=0.02$), physician autonomy ($P=0.0207$), management support ($P=0.0033$), and perceived usefulness ($P=0.0001$) were associated with ‘attitude towards adoption of the DAP-EPS (Tables 5-12 and 5-13).

### Table 5-12: Mean and p-value of “Attitude” for potential predictors

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.60</td>
<td>0.55</td>
<td>-0.67</td>
<td>1.67</td>
<td>0.68</td>
</tr>
<tr>
<td>Female</td>
<td>0.54</td>
<td>0.61</td>
<td>-0.67</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 30 years old</td>
<td>0.50</td>
<td>0.71</td>
<td>0.00</td>
<td>1.00</td>
<td>0.14</td>
</tr>
<tr>
<td>30-39 years old</td>
<td>0.83</td>
<td>0.59</td>
<td>0.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>40-49 years old</td>
<td>0.43</td>
<td>0.57</td>
<td>-0.67</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>50-59 years old</td>
<td>0.44</td>
<td>0.60</td>
<td>-0.67</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>60 years and older</td>
<td>0.82</td>
<td>0.47</td>
<td>0.00</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td><strong>Years of practice experience</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2 years</td>
<td>0.50</td>
<td>0.71</td>
<td>0.00</td>
<td>1.00</td>
<td>0.99</td>
</tr>
<tr>
<td>2-5 years</td>
<td>0.44</td>
<td>0.51</td>
<td>0.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>6-10 years</td>
<td>0.58</td>
<td>0.42</td>
<td>0.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>11-15 years</td>
<td>0.57</td>
<td>0.70</td>
<td>-0.67</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>More than 15 years</td>
<td>0.59</td>
<td>0.58</td>
<td>-0.67</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td><strong>Internet access at the office</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.57</td>
<td>0.58</td>
<td>-0.67</td>
<td>2.00</td>
<td>0.87</td>
</tr>
<tr>
<td>No</td>
<td>0.67</td>
<td></td>
<td>0.67</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td><strong>Use EMR in practice</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.53</td>
<td>0.58</td>
<td>-0.67</td>
<td>2.00</td>
<td>0.18</td>
</tr>
<tr>
<td>No</td>
<td>0.79</td>
<td>0.56</td>
<td>0.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td><strong>Practice Setting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private office/Clinic</td>
<td>0.57</td>
<td>0.54</td>
<td>-0.67</td>
<td>2.00</td>
<td>0.22</td>
</tr>
<tr>
<td>Free standing walk-in clinics</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Community healthcare center</td>
<td>1.08</td>
<td>0.42</td>
<td>0.67</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>Academic family medicine teaching unit</td>
<td>0.52</td>
<td>0.69</td>
<td>0.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.25</td>
<td>0.88</td>
<td>-0.67</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Practice organization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solo practice</td>
<td>0.72</td>
<td>0.44</td>
<td>0.33</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>Family physician group medical practice</td>
<td>0.80</td>
<td>0.59</td>
<td>-0.67</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Family health team</td>
<td>0.35</td>
<td>0.49</td>
<td>-0.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family physician /specialist group medical practice</td>
<td>0.00</td>
<td>0.58</td>
<td>-0.33</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.72</td>
<td>0.68</td>
<td>-0.33</td>
<td>1.67</td>
<td></td>
</tr>
</tbody>
</table>

| Number of patients in practice | 0.86 | 0.69 | 0.00 | 2.00 |
| 500-999 | 0.61 | 0.49 | 0.00 | 1.67 |
| 1,000-1,499 | 0.37 | 0.56 | -0.67 | 1.00 |
| 1,500-1,999 | 0.45 | 0.57 | -0.67 | 1.67 |
| 2,000-2,999 | 0.90 | 0.57 | 0.33 | 2.00 |
| > 3,000 | 0.67 | 0.00 | 0.67 | 0.67 |

| No. of suspected cancer patients seen in the past year | - | - | - | - |
| None | - | - | - | - |
| 1-4 | 0.89 | 0.53 | 0.00 | 2.00 |
| 5-9 | 0.54 | 0.50 | -0.67 | 1.00 |
| 10-20 | 0.55 | 0.57 | -0.33 | 1.67 |
| > 20 | 0.48 | 0.65 | -0.67 | 2.00 |

| Personal Computer Use | 0.54 | 0.58 | -0.67 | 2.00 |
| Patients’ medical information | 0.59 | 0.57 | -0.67 | 2.00 |
| Email | 0.56 | 0.57 | -0.67 | 2.00 |
| Health/clinical resources or journals | 0.61 | 0.62 | -0.67 | 2.00 |
| Other web-based tools designed for patient management | 0.67 | 1.89 | -0.67 | 2.00 |

| Former Computer Training | 0.67 | 0.47 | 0.33 | 1.00 |
| Formal medical school training | 0.50 | 0.43 | 0.00 | 1.00 |
| Formal residency or fellowship training | 0.43 | 0.69 | -0.67 | 2.00 |
| Formal workshops or conferences | 0.55 | 0.31 | 0.00 | 1.00 |

| Computer Sophistication/ Competency | 0.56 | 0.19 | 0.33 | 0.67 |
| Novice - with limited skills | 0.61 | 0.38 | 0.00 | 1.00 |
| Advanced beginner- no significant expertise | 0.55 | 0.54 | -0.67 | 1.67 |
| General - started to become well-rounded | 0.49 | 0.76 | -0.67 | 2.00 |
Table 5-13: Correlation (P value) between attitude and constructs

<table>
<thead>
<tr>
<th></th>
<th>Attitude towards the use of DAP-EPS</th>
<th>Physician Involvement</th>
<th>Adequate training</th>
<th>Physician Autonomy</th>
<th>Doctor-patient relationship</th>
<th>Management/leadership support</th>
<th>Perceived usefulness</th>
<th>Perceived Ease-of-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician Involvement</td>
<td>0.08 (0.5393)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate training</td>
<td>0.17 (0.1675)</td>
<td>0.40 (0.0007)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician Autonomy</td>
<td>0.29 (0.0207)</td>
<td>-0.09 (0.4691)</td>
<td>0.09 (0.4464)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctor-patient relationship</td>
<td>0.14 (0.2844)</td>
<td>-0.23 (0.0821)</td>
<td>-0.07 (0.5837)</td>
<td>0.41 (0.0011)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management/leadership support</td>
<td>0.44 (0.0033)</td>
<td>0.11 (0.4756)</td>
<td>0.29 (0.0631)</td>
<td>0.09 (0.5619)</td>
<td>-0.08 (0.6075)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>0.59 (0.0001)</td>
<td>-0.02 (0.8598)</td>
<td>0.14 (0.2628)</td>
<td>0.39 (0.2628)</td>
<td>0.33 (0.0105)</td>
<td>0.42 (0.0059)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Perceived Ease-of-Use</td>
<td>0.17 (0.1886)</td>
<td>0.05 (0.6831)</td>
<td>0.32 (0.0085)</td>
<td>0.09 (0.4883)</td>
<td>-0.03 (0.7964)</td>
<td>-0.02 (0.9186)</td>
<td>0.34 (0.0059)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Bold: P<0.05

5.5.4. The Relationship between Attitude and Technology Factors

To determine the impact of technology factors, ease-of-use and usefulness on ‘attitude towards adoption of the DAP-EPS’, we conducted two multivariate linear regressions, one for ease-of-use and one for usefulness. In the regression models we adjusted for age (categories: age under 39, 40-49 and 50-59), EMR use, practice organization (family health team, practice solo), adequate training, physician autonomy, and management support. The multivariate analyses revealed that only usefulness was highly associated with the attitude towards the adoption of DAP-EPS.

Those PCPs, who perceived high usefulness of the DAP-EPS tool, possessed a positive attitude towards adoption of the DAP-EPS. That is a one unit increase in usefulness score increases the
attitude score by 0.540 units. Ease-of-use did not have significant impact on attitude (b=0.120, p=0.373) (Tables 5-14 and 5-15, current page).

Table 5-14: Multivariate association between attitude and ease-of-use

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>R²</th>
<th>Independent variables</th>
<th>Parameter Estimate (b)</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>0.44</td>
<td>Constant</td>
<td>0.820</td>
<td>0.254</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician autonomy</td>
<td>0.158</td>
<td>0.135</td>
<td>0.250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management support</td>
<td>0.279</td>
<td>0.144</td>
<td>0.0614</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (yes)</td>
<td>-0.302</td>
<td>0.203</td>
<td>0.146</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (no)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age &lt; 39</td>
<td>0.045</td>
<td>0.265</td>
<td>0.863</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 40-49</td>
<td>0.068</td>
<td>0.269</td>
<td>0.800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 50-59</td>
<td>-0.222</td>
<td>0.221</td>
<td>0.322</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 60+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family Health Team</td>
<td>-0.344</td>
<td>0.165</td>
<td>0.045</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solo practice</td>
<td>0.099</td>
<td>0.283</td>
<td>0.726</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ease-of-Use</td>
<td>0.120</td>
<td>0.133</td>
<td>0.373</td>
</tr>
</tbody>
</table>

Table 5-15: Multivariate association between attitude and Usefulness

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>R²</th>
<th>Independent variables</th>
<th>Parameter Estimate (b)</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>0.56</td>
<td>Constant</td>
<td>0.576</td>
<td>0.240</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physician autonomy</td>
<td>-0.074</td>
<td>0.142</td>
<td>0.605</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management support</td>
<td>0.088</td>
<td>0.140</td>
<td>0.533</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (yes)</td>
<td>-0.037</td>
<td>0.199</td>
<td>0.852</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMR use (no)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age &lt; 39</td>
<td>0.115</td>
<td>0.220</td>
<td>0.605</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 40-49</td>
<td>-0.200</td>
<td>0.228</td>
<td>0.387</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 50-59</td>
<td>-0.353</td>
<td>0.204</td>
<td>0.094</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age 60+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family Health Team</td>
<td>0.182</td>
<td>0.200</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solo practice</td>
<td>0.039</td>
<td>0.249</td>
<td>0.871</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Usefulness</td>
<td>0.540</td>
<td>0.174</td>
<td>0.004</td>
</tr>
</tbody>
</table>
5.5.5. Diagnostic Checking

To check for multicollinearity we calculated correlations among all predictors. The calculated correlations were all less than 0.4 indicating no sign of multicollinearity. Examining the residual plots to assess the adequacy of the linear model confirmed that i) the residuals are approximately normally distributed, ii) the relationship between attitude towards adoption of the DAP-EPS is linear, iii) the variance of the attitude is constant, and iv) none of the observations are outliers. Thus, the validity and goodness of fit for the linear regression model has been determined. Graphs are presented in Appendix C.

5.6. Answers to the Research Questions

5.6.1. Research Question 1: Is there a relationship between the PCPs’ attitudes towards adoption of the DAP-EPS tool and their demographics and practice characteristics?

Overall physicians had positive attitudes towards adoption of the DAP-EPS tool. The results of bivariate analyses (Table 5-12) showed that both males and females have positive attitudes towards the adoption of the DAP-EPS (with scores of 0.60 and 0.54 respectively). There was no significant gender difference ($p = 0.68$) in attitudes towards the adoption of the DAP-EPS tool. Physicians age 60 years and over and physicians age 30-39 years had higher mean attitude score towards adoption of the DAP-EPS tool compared to others. The relationship between age and attitude was not statistically significant ($p = 0.14$).

With respect to years of practice experience, there was no statistical significance between the number of years in practice and the attitude towards adoption of the DAP-EPS ($p = 0.99$). Overall, the mean attitude of years of practice ranged from 0.44 to 0.59. The attitude towards adoption of the DAP-EPS was not significantly associated with computer usage activities ($p = 0.97$). There was no statistically significant difference in attitude scores of those who use personal computers for patient’s medical information (0.54), email (0.59), health/clinical resources or journals (0.56), other web-based tools designed for patient management (0.61), or other activities (0.67). Former computer experience and/or training did not have statistically significant associations with attitude towards adoption of the DAP-EPS ($p = 0.94$). Attitude were
positive and the means were similar for those with formal medical school training (0.67), formal residency or fellowship training (0.50), formal workshops or conferences (0.43), or no training (0.55). Computer sophistication/competency was not statistically associated with attitude towards adoption of the DAP-EPS \( (p = 0.93) \). The attitude towards adoption of the DAP-EPS was positive and the means were similar for novices (with limited skills) (0.56), advanced beginners (no significant experience), (0.61), general users (started to become well-rounded) (0.55), and advanced users (experienced and able to assist others) (0.49).

In relation to PCPs’ practice characteristics, there was no statistical significance between the type of practice setting and the attitude towards adoption of the DAP-EPS \( (p = 0.22) \). On average, physicians in various practice settings had positive attitudes towards adoption of the DAP-EPS tool. The mean attitude for practice settings ranged from 0.25 to 1.08. Physicians who practiced in community healthcare centers had higher mean attitude scores (1.08) than physicians practicing in other settings. There was no respondent who reported practicing in a free standing walk-in clinic. Practice organization had a statistically significant association with attitude towards adoption of the DAP-EPS \( (p = 0.02) \). Overall, physicians in various practice organizations had positive attitudes towards adoption of the DAP-EPS (means ranged from 0.00 to 0.80). The agreements varied significantly by the type of practice organization. The family physician group medical practice had the highest (0.80) mean, while the family physician/specialist group medical practice had the lowest (0.00) mean. The number of patients per practice was not significantly associated with attitude towards the use of the DAP-EPS \( (p = 0.15) \). Overall, physicians with various numbers of patients in their practice had positive attitudes towards adoption of the DAP-EPS (mean scores ranged from 0.37 to 0.90). Those Physicians with 2,000-2,999 patients in their practice had the highest mean attitude score (0.90), while those with 1,000-1,499 patients had the lowest mean (0.37). The number of suspected cancer patients seen in the past year did not have statistically significant association with attitude towards adoption of the DAP-EPS \( (p=0.35) \).

Physicians who had seen 1 to 4 suspected cancer patients in the past year had the highest mean attitude score of 0.89 and physicians that had seen more than 20 suspected cancer patients in the past year had the lowest mean 0.48. Having Internet access in the office did not have a
significant association with attitude towards the adoption of the DAP-EPS \((p = 0.87)\). The mean attitudes towards adoption of the DAP-EPS were similar for those physicians who had access to the Internet in their offices \((0.57)\) and those who did not \((0.67)\). With respect to the use of an Electronic Medical Record (EMR), the attitude towards use of the DAP-EPS was positive for both physicians who used EMRs in their practices \((0.53)\) and those who did not \((0.79)\). The association between use of EMRs in practice and attitudes towards adoption of the DAP-EPS was not statistically significant \((p=0.18)\). The mean for physicians who used EMRs in their practice was lower \((0.53)\) than those who did not \((0.79)\). Overall, we can conclude that, except for practice organization \((p=0.02)\), there were no statistically significant relationships between attitude towards adoption of the DAP-EPS tool and the PCPs’ demographic and practice characteristics.

### 5.6.2. Research question 2: Is there a relationship between contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support), and technology factors (perceived ease-of-use and perceived usefulness)?

Tables 5-10 and 5-11 demonstrate the result of the multivariate regressions that were performed to examine the association between the contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support), and the technology factors (ease-of-use and usefulness). These regression models were adjusted for two independent variables (age and EMR use) as potential confounders. The results of the multivariate regressions suggest a significant relationship between ease-of-use and adequate training \((p=0.0255)\), therefore adequate training had direct impact on ease-of-use. That is one unit increase in adequate training, increases the score of ease-of-use by 0.42 units. An association between usefulness and physician autonomy was also shown \((p = 0.0012)\) meaning that physician autonomy had a significant impact on usefulness. That is one unit increase in physician autonomy, increases the score of usefulness by 0.56 units.
5.6.3. Research question 3: *Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS and contextual factors (physician involvement, adequate training, physician autonomy, doctor-patient relationship, management support)?*

The results from table 5-13 suggest a bivariate correlation between attitude towards adoption of the DAP-EPS and contextual factors. Physician involvement (r=0.08, p=0.5393), adequate training (r=0.17, p=0.1675), and doctor-patient relationship (r=0.14, p=0.2844) were not significantly associated with attitude towards adoption of the DAP-EPS. Physician autonomy (r=0.29, p=0.0207) and management support (r=0.44, p=0.0033) were significantly correlated with attitude towards adoption of the DAP-EPS.

5.6.4. Research question 4: *Is there a relationship between PCPs’ attitudes towards adoption of the DAP-EPS tool and technology factors (perceived ease-of-use and perceived usefulness)?*

Tables 5-14 demonstrates the results of the multivariate linear regression assessing the relationship between attitude towards adoption of the DAP-EPS and ease-of-use. Table 5-15 shows the association between attitude towards adoption of the DAP-EPS and usefulness, while adjusting for physician autonomy, management support, age, practice organization, and EMR use found to be significant in the former analyses.

The results of the multivariate regression analyses revealed that the association between attitude towards adoption of the DAP-EPS and ease-of-use was not statistically significant (b= 0.120, p= 0.373). With respect to the relationship between attitude towards adoption of the DAP-EPS and usefulness, the multivariate regression analysis confirmed a significant association (b= 0.540, p= 0.004). That is, one unit increase in the usefulness score will increase attitude towards adoption of the DAP-EPS by 0.540 units; therefore, higher levels of perceived usefulness result in a more positive attitude towards adoption of the DAP-EPS.
CHAPTER 6 : DISCUSSION

In this chapter, we discuss the main findings of this research project and how they are connected to the existing literature on physicians’ adoption of technology.

6.1. Factors Influencing Adoption of the DAP-EPS among physicians

In relation to the first research question of our study, we attempted to determine the association between physicians’ demographics and their attitudes towards adoption of the DAP-EPS. We also examined the relationship between physicians’ practice characteristics and attitude. The results of our study did not show any statistically significant associations between any of the physicians’ characteristics (e.g. age, sex, years in practice, prior computer experience, computer training), and their attitudes towards adoption of the DAP-EPS tool. Previous studies have demonstrated mixed results. While many studies have found physician and practice characteristics predictive of attitudes towards adoption of technology, others have not found these characteristics to be significant.

Our results are consistent with the findings of several earlier studies with respect to age and sex (Audet, et al., 2004; Brown & Coney, 1994; Clayton, et al., 1993; K. Dansky, et al., 1999; Gardner & Lundsgaarde, 1994; Kattan M.W., 1994; Kattan & Adams, 1994; Laerum, et al., 2001; Mary E. Morton & Susan Wiedenbeck, 2010). These studies have reported no association between age and sex, and technology adoption among physicians. Other studies have found age and sex to be predictive factors influencing EHR and other IT adoption among physicians (Felt-Lisk, et al., 2009; N. Menachemi & Brooks, 2006). Inconsistencies in results could be due to variations in sample characteristics. The fact that no particular age or sex group strongly influenced attitudes towards DAP-EPS adoption suggests that technology adoption could have been influenced by other characteristics such as respondents’ computer competency and experience.
In addition, our results did not find years in practice to be a predictor of technology adoption. This finding contradicts an earlier study which found physicians with less number of years in practice tend to use EHRs more than those with longer number of years in practice. The study hypothesized that newer physicians are exposed to technological innovations during their training, and this might be a driving factor for adoption (Bramble, et al., 2010). The inconsistency in our results may be due to the fact that the majority of respondents already used EMRs in their practice.

Among practice characteristics, we found a significant relationship between practice organization and PCPs’ attitudes towards adoption of the DAP-EPS (p=0.02). The respondents in family physician/specialist groups were the least in favor of adopting the DAP-EPS among practice organizations. Our study confirmed that physicians in solo practices had similar attitudes towards DAP-EPS adoption as those who practiced in family physician group practices, and family health teams. Our results did not find practice setting to be significant predictor of attitude towards adoption of the DAP-EPS tool.

We did not collect data related to the size of practice. Previous studies have found practice size to be a predictor influencing technology adoption among physicians. Two investigations by Audet et al. (2004) and Lee et al. (2005) found that the organizational characteristics of a practice influence technology acceptance, with practice size being a significant predictor of technology acceptance. Our results suggested that in the implementation of DAP-EPS efforts, management and implementation teams may need to focus on factors other than practice organization and setting in order to increase adoption of the DAP-EPS.

Our results did not find computer competency to be a predictor influencing physicians’ attitudes to adopt the DAP-EPS. In the literature, computer experience has been found to be an influencing factor in technology adoption (K. Dansky, et al., 1999). Two studies reported that physicians with prior computer knowledge and familiarity with health informatics concepts were more in favor of technology adoption (Cork, et al., 1998; Detmer & Friedman, 1994). The inconsistency between our results and the existing literature might be due to the fact that almost
all of the respondents in our study had computer knowledge; therefore, the predictor of computer competency in our regression model did not have significant variation to influence attitude.

Similar to computer competency, the literature suggests that there is a significant relationship between computer technology training and adoption of technology. A study conducted by Lapinsky and colleagues (2004) suggested technology-specific training was a predictor of physician technology acceptance. The results of our study did not reveal training as a significant predictor of physicians’ attitudes towards adoption of the DAP-EPS ($r=0.17$, $p=0.1675$). This finding is consistent with previous studies conducted by Gardner & Lundsgaarde (1994), Lee et al. (1996), and Morton (2009). While physicians in our study indicated that training needs and difficulty with technology were barriers to their adoption, it appears that their perceptions of training were not necessarily correlated with their perceived attitude to adopt the technology. Perhaps, this is due to the fact that physicians in many cases have supporting staff for operating technologies (Chau & Hu, 2002). Also, this factor might have contributed to physicians’ placing less emphasis on computer training.

Since the data were collected at the pre-implementation stage, the responses for the research questions were based on the respondents’ perceptions rather than the actual use of the DAP-EPS.

In the second research question, we related contextual factors to the technology factors. In this question we attempted to determine the relationship between physician involvement, training, physician autonomy, doctor-patient relationship, management support, and technology related factors (ease-of-use and usefulness).

The results of our study showed a significant relationship between ease-of-use and adequate training ($p=0.0255$), which is consistent with the literature. Davis (1989) addressed why users accept or reject information technology and hypothesized that perceived ease-of-use was determined by external variables such as training, documentation, and the availability of user supports. In addition, a recent study reviewed 22 articles that were published between 1998 and 2009. The investigation identified barriers perceived by physicians to the adoption of Electronic Medical Records (EMR). The study suggested ease-of-use as a key element in the efficiency and
acceptance of EMR systems (Boonstra & Broekhuis, 2010). Our findings suggest that if physicians receive adequate training for the DAP-EPS, they will perceive the tool less complex and easier to use; thus, they will be more in favor of adopting the target system.

Our results did not show a significant association between any of the contextual factors (e.g. physician autonomy, physician involvement, doctor-patient relationship, management support) and the technology factor, ease-of-use. Surprisingly, we did not find a significant relationship between physician involvement and ease-of-use. Our finding is inconsistent with previous research, which has emphasized the importance of user participation in the design process through task analysis and usability evaluation activities. This participation is assumed to make a technology more user-friendly, and may increase the chances of adopting the technology (Dillon & Morris, 1996; Hurley, 1992; Karsh, 2004; Morton & Wiedenbeck, 2009). In our study respondents agreed that being involved in the process would make the DAP-EPS tool more usable. The discrepancy could be due to the fact that the sample size was small and the study did not have sufficient power.

The results of our study suggested a significant association between physician autonomy and usefulness ($r=0.564$, $p=0.002$). Consistent with our findings, results from a recent US study of physicians showed that perceived threat to professional autonomy had a significant direct influence on perceived usefulness of a system such as an EMR or a Clinical Decision Support (CDS) system. The effect of a perceived threat to professional autonomy was reported for both EMR and CDS systems but the effect was suggested to be greater for CDS than for EMR systems (Walter & Lopez, 2008). This indicates that a perceived threat to physician autonomy is an important antecedent to perceived usefulness. Our findings suggest if physicians believe that using a new innovation such as the DAP-EPS tool would decrease their control over their work, they may be reluctant to adopt the technology, even though the DAP-EPS tool is perceived as useful.

In question three, we related the contextual factors to the TAM construct of attitude in our research model in order to address factors at organization, group and individual levels. In this question we attempted to determine the relationship between the contextual factors (physicians’
involvement, adequate training, physician autonomy, doctor-patient relationship, and management support) and physicians’ attitudes towards adoption of the DAP-EPS. Our results revealed a positive and significant association between physician autonomy ($r=0.29$, $p=0.0207$) and attitude towards adoption of the DAP-EPS tool. Our result is consistent with the findings of prior studies (Morton & Wiedenbeck, 2010; Walter & Lopez, 2008; Zaman, et al., 2010). These studies have found concerns prior to and after the implementation regarding physician autonomy and intention to use innovative technology, such as EMR systems. Our results indicate that professionals such as physicians may approach adoption of technology differently from other users. Such findings provide further support that characteristics of different user populations should be taken into consideration when studying user attitude towards technology adoption. Physicians may not adopt a sophisticated system such as the DAP-EPS tool, if it is perceived as threatening to their professional autonomy.

We also found a significant relationship between management support and attitude towards adoption of the DAP-EPS ($r=0.44$, $p=0.0033$). Our finding is consistent with previous research studies (Morton & Wiedenbeck, 2009; Morton & Wiedenbeck, 2010; Poon, et al., 2004). The results of our study indicate the need for strong management that believes in the DAP-EPS and can provide the resources necessary to support the implementation process.

In the fourth and final question, we attempted to determine the relationship between technology factors, perceived ease-of-use and usefulness of the DAP-EPS, and physicians’ attitudes towards adoption of the tool. In agreement with the TAM component of our study framework, perceived usefulness was found to be significantly associated with and had a strong influence on physicians' attitudes to adopt the DAP-EPS tool. This finding is consistent with other existing studies (Chismar & Wiley-Patton, 2003; Ernstmann, et al., 2009; Yarbrough & Smith, 2007). Our results suggest the pragmatic nature of physicians, and their tendency to focus on the usefulness of the tool itself. Therefore, for the DAP-EPS to be adopted by physicians, the usefulness of the tool should be clearly presented. This implies the importance of appropriate training in order to influence physicians’ perceptions of the usefulness of the tool. The implementation and management teams may consider making arrangements for PCPs to use a
trial version of the DAP-EPS so that they can see the usefulness of the tool in supporting daily tasks and services.

Our results did not find a direct impact of ease-of-use on physicians’ attitudes towards adoption of the DAP-EPS. This finding is consistent with previous research by Morton & Wiedenbeck (2010). Several other studies also reported the importance of usefulness over ease-of-use within professional populations (Chau & Hu, 2002; Chismar & Wiley-Patton, 2003; Keil, et al., 1995). Our findings suggest that physicians tend to focus more on the usefulness of the technology than on its ease-of-use. This may indicate that physicians, due to their relatively higher cognitive capacity, believe they have the ability to learn technology quickly, regardless of its complexity.

Our findings revealed a correlation between ease-of-use and usefulness ($r=0.34$, $p=0.0059$). This association implies that any enhancement in ease-of-use and usability of the DAP-EPS would directly impact usefulness of the tool, which in turn would influence physicians’ attitudes and DAP-EPS adoption. Thus, in physicians’ context, our study framework suggests that the degree to which the DAP-EPS tool is easy to use would affect both perceptions of usefulness and attitudes towards adopting the tool.

In our study we also asked physicians to indicate their perceived barriers to adoption of the DAP-EPS from a set of predetermined barriers within the questionnaire. Physicians reported financial costs, difficulty with technology, and inadequate training as the top three barriers. These reported barriers are consistent with the literature (Boonstra & Broekhuis, 2010; Miller & Sim, 2004; Yarbrough & Smith, 2007). Our results suggest by effectively offsetting barriers physicians will be in a better position to adopt the DAP-EPS tool.

We also asked physicians to indicate their perceived benefits of the DAP-EPS tool. Improved communication with other providers, their patients, as well as accessibility of information, were the most frequently reported perceived benefits of the DAP-EPS. The literature also stated benefits related to technological innovations including EMR (Farquhar, et al., 2005; Follen, et al., 2007; Miller & Sim, 2004). Our findings imply that physicians realize the potential
advantages of the DAP-EPS tool in improving existing challenges in care coordination and delivery of cancer care.

The theoretical model used in this study was successful in answering our research questions. In particular, it was successful in assessing the factors that influenced physicians’ attitudes towards adoption of the DAP-EPS and determining the relationships between individual, social, and organization levels. Although this theoretical framework was originally developed and adopted for assessing the attitude of healthcare providers towards the EHR, it worked in our study in assessing physicians’ attitudes in a different context. Adding other important elements such as subjective norms, the presence of physician champion and workflow compatibility may further improve the predictive capacity of the model.

6.2. Limitations of the Study

Despite the important information provided by our study, there are several limitations to be considered.

Our study focused on primary care physicians and did not assess the perspectives of other healthcare professionals, or cancer patients who would be the potential users of the DAP-EPS tool. In addition, we relied on self-reported responses, which may carry the risk of misinterpretation and raise the possibility of bias. Another limitation of our study was the absence of a complete list of email addresses within the College of Physicians and Surgeons of Ontario (CPSO) database. As our survey was Web-based, only those physicians, whose email addresses were available within the CPSO database, were invited to participate in the study. This limited our ability to reach the entire PCP population within the province of Ontario and capture their views on adoption of the DAP-EPS tool.

Furthermore, due to the low response rate, our sample size was small. Small sample size will increase type II errors. When type II error is large we fail to reject the null hypothesis when it needs to be rejected. Therefore, in a study with a small sample size we misidentify significant differences as not significant. In the context of regression, a small sample size produces estimates with large standard errors that may lead to classifying significant parameter estimates
as non-significant. Therefore, in a study with insufficient sample size we may fail to identify true associations between independent and dependent variables. The sample size for our study was 200. Despite our attempts we failed to reach the desired sample size, which caused our study to be underpowered. This may have caused significant associations in our bivariate analysis to be classified as non-significant, meaning they would not be included in the regression models. The consequences of these misclassifications might have resulted in inconsistencies between our findings and the literature.

Because of the low response rate, we cannot confidently generalize these results to all Primary Care Physicians in Ontario. However, we believe these results do help sketch a picture of many physicians practicing in Ontario.

Low response rates and lack of physician participation in research activities have been frequently reported in previous studies (Graffy, 2008; Grava-Gubins & Scott, 2008; Hummers-Pradier, et al., 2008; Rosemann & Szecsenyi, 2004). This lack of physician participation has been reported as a potential source of bias for practice-based studies that could threaten the validity of research results (Hummers-Pradier, et al., 2008). Various strategies such as a combination of shorter and electronic version of questionnaire and electronic modes of contact, and implementing more promotional approaches (communications and marketing) have been suggested to improve the rate of physician responses (Graffy, 2008).

Despite our efforts (e.g. follow ups, improvement of survey questionnaire, enhancing marketing, and in-person distribution of the survey in a number of local conferences) to enhance the response rate, we did not succeed. The literature also suggests monetary incentives as another strategy to increase physicians’ participation in surveys (Halpern, Ubel, Berlin, & Asch, 2002; VanGeest, Johnson, & Welch, 2007). However, financial compensation was not part of this study.

Another limitation of our study is that the characteristics of the physicians who participated in this study were not the same as the overall Ontario PCP population. Therefore, care should be exercised when interpreting the results and generalizing to other groups or settings.
Moreover, while developing the survey, we did not collect data regarding urban versus rural practice settings, and therefore could not determine any differences on this front in the adoption of the DAP-EPS tool.

The reliability and validity of our modified instrument could be another limitation. When items are removed from a previously validated instrument, the Cronbach alpha is expected to decrease (Dawn Iacobucci and Adam Duhachek (2003). Based on the evidence, merely comparing our study’s Cronbach alphas with the alphas of the original instrument may not be appropriate. Without using a proper statistical procedure, the comparison may lead to an incorrect conclusion. Dawn Iacobucci and Adam Duhachek (2003) stated that reporting 95% confidence intervals provides additional information that allows researchers and reviewers alike to more critically evaluate the reliability of a measure in question.

Overall the reliability of the domains within our modified instrument was lower than the original instrument. Therefore, the reliability of our modified instrument should be judged with caution. Moreover, the original instrument was developed and validated for a different context (assessing attitudes towards using an Electronic Medical Record), while we adopted the tool for assessing physicians’ attitude towards adoption of the DAP-EPS tool. It would have been more appropriate to develop and validate a new instrument for assessing attitude towards adoption of the DAP-EPS. However, development and validation of a new instrument was beyond the scope of my thesis.

Lastly, our study only reported the perceptions of physicians about technology adoption, rather than actual usage behavior. This is because the DAP-EPS was in the process of being built and not available to physicians at the time of this survey. Therefore, it is possible that post-implementation behavior may differ from pre-implementation self-reported perceptions or intentions to use the DAP-EPS. Our study respondents had very little actual exposure to the DAP-EPS tool. A limited number of screen shots from the DAP-EPS tool were the only resource available to them. This might have reduced the respondents’ ability to fully explore the functionality of the tool and comment on its usefulness.
This lack of exposure may have increased the variability of their responses and consequently reduced the power of the study in identifying significant factors associated with attitude towards the adoption of the DAP-EPS. Like the study of Morton et al., our study also showed that in a user-centered environment perceived usefulness is an important factor that affects physicians’ attitudes towards adoption of technology. Another similarity is that both our study and that of Morton et al were conducted in the pre-implementation stage.

There are also some differences between our study and Morton’s. They used structural equation modeling and path analysis while we used multivariate regression for analysis of our data. Although structural equation modeling and path analysis would have been more appropriate methods, the study sample size was too small to use such methodologies.

Morton et al. studied different groups of healthcare professionals including faculty, resident and flow physicians, while we primarily focused on primary care physicians. Morton et al. studied attitude towards adoption of an Electronic Healthcare Record (EHR) in an academic medical center, while we focused on a different e-Health application (i.e. DAP-EPS) in a different healthcare setting and context. Although there are differences between our study and theirs, we demonstrated that with minor modifications we could apply their model to assess the attitudes of a different group of healthcare professionals (Primary Care Physicians) towards adoption of the DAP-EPS, and determine the factors that influence their attitudes. This study has contributed to the literature, and demonstrated the applicability of the model in a different context. Thus, our study begins to expand the scope of the application of the framework developed by Morton et al. Despite the limitations, the results still offer valuable insights into predicting the attitudes towards adoption of PCP users. Moreover, the consistency of our results with other published studies and theories, including the TAM and its variations, boosts our confidence in our findings. This study not only provides more understanding about physicians’ perceived attitudes towards DAP-EPS adoption, but it also provides directions for future research.
6.3. Significance of the Study

Despite the limitations, our study contributes considerably to the understanding of technology adoption by Primary Care Physicians (PCPs) in the province of Ontario. There is an absence of research exploring the unique information technology implementation experiences of PCPs (Terry, Giles, Brown, & Stewart, 2009). Our study is unique in that it addresses factors related to a complex information system in the area of cancer diagnosis. In addition, the majority of previous studies have examined post-implementation stages where users had already been exposed and decided to adopt or reject the target system. Our study investigated Primary Care Physicians in their work-related context, and collected data from them prior to the implementation of the technology.

Moreover, this study is the first to employ a unified theoretical framework that is grounded in the theories of Technology Acceptance Model and Diffusion of Innovation to investigate the determinants of physicians’ attitudes towards adoption of an electronic tool in cancer diagnosis. The knowledge created through this study could potentially benefit future researchers by providing information on physicians’ perceptions of technology adoption. Finally, the present study provides avenues for promoting DAP-EPS adoption among physicians and supporting the diffusion of this technology in the cancer care system.

6.4. Implications of the Study

Based on the results, this study has implications for policy makers, implementers, and senior managers to encourage physicians to adopt the DAP-EPS tool.

1) Based on the main finding of this study that suggests perceived usefulness is a major predictor of physicians’ attitudes towards adoption of the DAP-EPS tool, it is recommended that the potential advantages and value of the DAP-EPS tool be directly communicated with the physicians to maximize their perceived usefulness of the tool. Furthermore, it is crucial to educate physicians about the benefits and possible advantages of the DAP-EPS in supporting their care for suspected cancer patients. By communicating the potential advantages and usefulness of the DAP-EPS in performing daily tasks, we can influence physicians’ attitudes and
increase the DAP-EPS adoption rate. Physicians may not realize the benefits of new technology and this lack of awareness may limit how useful they perceive it to be in their practice. Previous studies have confirmed the importance of communicating the reasons for adopting the new technology (Chismar & Wiley-Patton, 2003; Leatt, Shea, Studer, & Wang, 2006).

2) Another useful way to influence physicians’ perceptions of the usefulness of the DAP-EPS is to exhibit the value and advantages of the DAP-EPS to the physicians. This demonstration can be facilitated through appropriate hands-on training and/or providing a trial version of the DAP-EPS so that physicians can experience the usefulness of the tool. Emphasizing the usefulness of technology to physicians has been identified in the literature (Chismar & Wiley-Patton, 2003).

3) While our results do not find physician involvement in the development and implementation of the DAP-EPS to be a significant factor influencing their attitudes, the literature suggests the importance of physicians involvement in both the design and the implementation phases (Bernstein, McCreless, ocirc, eacute, & 2007). The literature recommends that the management and implementation teams encourage physician involvement in all stages of the project. They should ensure that physicians provide input about usability, usefulness, workflow processes, and potential modifications of the DAP-EPS tool. The discrepancy between our results and the literature could have been due to the small sample size.

4) Our study results revealed a significant correlation between ease-of-use and usefulness. Based on this finding it is recommended that the implementation team maximize the usability of the DAP-EPS to increase the usefulness of the tool. The DAP-EPS tool should be easy to navigate. Information should be organized and presented based on physicians’ needs, allowing them to quickly and effortlessly find the information or functionality they seek. The inability to seamlessly locate information and complete tasks within the DAP-EPS tool may frustrate physicians and decrease their rate of adoption. The significance of perceived ease-of-use is particularly important when considering various levels of physician technological knowledge and expertise. Thus, improving the usability of a target system is important to the continued successful diffusion of the tool.
5) Our findings revealed a significant correlation between management support and physicians’ attitudes towards adoption of the DAP-EPS. Based on this finding, continuous leadership from executives and managers is essential to the successful implementation of the DAP-EPS tool. Senior management should provide ample resources, and they should define and communicate the vision for change, and clearly discuss the goals and expectations. Communication should be about increasing efficiency and efficacy of cancer care delivery, improving patient safety, and enhancing quality of care. Existing studies have also suggested the importance of management support and its influential role in implementation processes (Jones & Moss, 2006; Leatt, et al., 2006). The effect of management support is more evident for those users who are part of larger healthcare institutions such as hospitals operated by senior management teams. These institutions have stronger organizational resources such as management expertise, experience with past process changes, financial resources, leadership, and information systems support staff. Solo practices that do not have these resources, may benefit from government appointed not-for-profit agencies that are responsible for the smooth implementation of e-Health initiatives at the provincial and federal levels. For example, the Canada Heath Infoway at the federal level and e-Health Ontario at the provincial level are responsible for oversight of the implementation of EHRs; these agencies can provide resources leadership and support to solo practices that lack larger organizational resources.

The key contribution of this study is testing the integrated model in a new context, i.e. a different health-care setting, professional user group, and e-health application. We addressed a gap in the literature by determining the factors that influence Primary Care Physicians’ (PCPs) attitudes towards adoption of a new electronic tool to support cancer diagnosis. This study is unique because it assesses PCPs’ attitudes towards adoption of such tool in the Province of Ontario. Furthermore, our study strengthens the empirical support for the theory describing the impact of social and organizational factors on physician attitudes towards technology adoption. The integrated framework used in this study appears to be an appropriate model for studying PCPs’ beliefs towards adoption of the DAP-EPS. This is despite the fact that Primary Care Physicians and their work related context differ from other types of technology users. Primary care physicians are part of a healthcare system that is a very complex social system. The integrated framework of TAM and DOI allowed us to examine the determinants of physicians’ attitudes
towards DAP-EPS adoption not only at the individual level but also at the group and organizational levels. Identifying factors affecting physicians’ attitudes will help the implementation team to take proactive action to increase the adoption rate of the DAP-EPS.
CHAPTER 7 - CONCLUSION

Cancer is a major health concern in Canada and around the word. Despite ongoing efforts for prevention and early detection, cancer incidence is expected to rise due to the growing and aging population. The cancer journey for patients is complex and involves many stages of tests and treatments. In general, cancer patients see multiple providers through the process of their treatment. Thus, care for these patients becomes increasingly complicated and requires effective care coordination to ensure timely and efficient delivery of care.

Care coordination and exchange of clinical information across various levels of care are reported to be major challenges of the healthcare system. Existing evidence indicates that healthcare providers have difficulty accessing timely clinical information when patient care is transferred between providers. Lack of timely access to patient information often results in long wait times, inadequate patient monitoring, redundant care, and medical errors. In recognizing these challenges, one of the most practical models for care coordination is the one that relies on the timely availability of complete medical information. For example, one of the most promising areas that could facilitate the efficiency and effectiveness of care coordination is the application of information technology in healthcare. E-Health innovations have been reported to have the potential to optimize the delivery of care by enhancing the communication channels between healthcare providers, and reducing wait times. However, diffusion of these technologies to the healthcare system remains a major challenge. One of the most important factors for successful implementation of information technology is users’ adoption and use of that technology. Healthcare professionals have considerable influence on adoption of these technological innovations in various clinical settings.

The aim of our study was to assess primary care physicians’ attitudes towards adoption of the Diagnostic Assessment Program-Electronic Pathway Solution (DAP-EPS) tool. The DAP-EPS is a web-based application that can improve the delivery of cancer care in the diagnostic phase. The implementation of the DAP-EPS is a provincial initiative supported by Cancer Care Ontario in
collaboration with the Ontario division of the Canadian Cancer Society. We conducted an online survey to collect data from a sample of Primary Care Physicians practicing in the province of Ontario. In order to guide our study, we used an integrated theoretical framework that combined the theories of Technology Acceptance Model and Diffusion of Innovation.

The data demonstrated that if the DAP-EPS is perceived by physicians as beneficial in helping them perform clinical activities they will have a positive attitude towards adoption of the tool. The results of our study suggest that the perceived usefulness is the most significant factor affecting physicians’ attitudes towards adoption of the tool. Furthermore, the results of our analyses reveal that perceived usefulness is more important than perceived ease-of-use within the PCP context. By perceived usefulness, we mean the extent to which PCPs believe that using the DAP-EPS tool will enhance their clinical work performance, and perceived ease-of-use, the extent to which PCPs believe that using the DAP-EPS will be free of effort (Yi, et al., 2006).

Implications of the findings suggest that training sessions need to emphasize the usefulness of the DAP-EPS. Any increase in ease-of-use features of the DAP-EPS would directly influence the perceived usefulness of the tool, which in turn influences physicians’ attitudes and DAP-EPS adoption. Assessing adoption of the DAP-EPS among PCPs offers a considerable contribution to the existing research in the area of technology adoption among primary care physicians.

7.1. Future Research Recommendations

Future research studies should concentrate on conducting prospective studies to understand the determinants of successful implementation, thereby ensuring the sustainability of the DAP-EPS tool. The following is a list of recommendations for further research:

1) Future qualitative studies such as ethnography and observational studies, interviews, and focus groups will increase our understanding of primary care physicians’ needs and requirements for technology in their clinical settings.
2) Studying other healthcare settings or professional groups involved in cancer care delivery, such as specialists or oncologists, may provide different perspectives on users’ attitudes towards
adoption of the DAP-EPS. Furthermore, evaluation and comparison of physicians across jurisdictions can provide more valuable information.

3) Studying patient populations and understanding their needs and perspectives will inform strategies to encourage higher adoption rate of the DAP-EPS tool.

4) Conducting pre-implementation task analyses and usability studies could provide a more insightful understanding of the DAP-EPS tool, its ease-of-use, and its overall impact on physicians’ productivity and workflow.

5) Post-implementation studies on actual use of the DAP-EPS tool could determine if the pre-implementation assessment accurately predicted physicians’ behavioral intention to use the DAP-EPS. Post-implementation satisfaction studies could examine physicians’ perceptions of the DAP-EPS functionality, usefulness, and perhaps the quality of technical support.

6) Future studies should look at the physicians’ “hands-on” experience with the DAP-EPS tool. Factors related to ease-of-use and usefulness may be different in a study where physicians had actual experience with the tool.

7) Ongoing evaluation in all phases of the design and implementation will be necessary to determine the impact of the DAP-EPS tool on physicians or other users and overall effects on patient care.

8) Future research should include a longitudinal component to examine barriers and adoption intentions of physicians and determine how they change over time.
REFERENCES


Retrieved March 28, 2011, from


Campbell, N.C., MacLeod, U., & Weller, D. (2002). Primary care oncology: essential if high quality cancer care is to be achieved for all. *Family Practice, 19*(6), 577-578.


Glossary of Terms

This section provides definitions of terms and concepts used throughout the report.

Care Coordination

Lack of clarity about what ‘care coordination’ actually encompasses hinders the improvement of cancer care coordination. Although the term ‘care coordination’ is frequently used in health services literature, it is hardly ever defined (McDonald et al. 2007), or the term is used interchangeably with other phrases such as continuity of care, integrated care (Yates 2004), transition of care, continuum of care, and integration of services and seamless care (Haggerty, et al., 2003). Confusion about the definition of care coordination makes studying this topic particularly challenging. As a result, for the purpose of this research study, we used the definition of ‘care coordination’ proposed by McDonald et al. (2007), which was developed based on a systematic review that found more than 40 distinct definitions for care coordination. McDonald defined care coordination as “the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient’s care to facilitate the appropriate delivery of healthcare services. Organizing care involves the marshalling of personnel and other resources needed to carry out all required patient care activities, and is often managed by the exchange of information among participants responsible for different aspects of care” (McDonald, et al., 2007).

E-Health

Currently, there are several overlapping or distinct definitions for e-Health in the existing literature, but there is no single standard definition that is universally accepted and applied by healthcare organizations and academic institutes. A systematic review by Oh et al. (2005) brought together numerous e-Health definitions from various sources (published, suggested or proposed). The study reported on 51 definitions for the term e-Health. The precise meaning of e-Health varies with the context in which the term is used. However, the term e-Health has been widely used and is fairly well understood by many academic institutions, professional,
government and funding organizations (Oh, et al., 2005). E-Health includes various aspects associated with medical informatics. A broad range of initiatives covered under the umbrella of the term e-Health are telemedicine, electronic medical records (EMR) or electronic Health Records (EHR), Health informatics or Medical informatics, and Evidence-based Decision Support Systems (EDSS), to name a few (Lievens & Jordanova, 2007).

For the purpose of this thesis report, we used the most commonly cited definition (Oh, et al., 2005) of e-Health by Eysenbach (2001). He defined e-Health as “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 healthcare locally, regionally, and worldwide by using information and communication technology”.

Health Informatics

In spite of numerous attempts to define Health Informatics (HI), no single common definition exists. Health informatics also has been referred to as health information technology, health information management, healthcare informatics, and medical informatics (Bath, 2008). Health Informatics intersects with information science, computer science, and healthcare. It deals with the resources, devices, and methods required to enhance and optimize the acquisition, storage, retrieval, and use of information in healthcare and clinical settings. Health informatics tools and techniques include computers as well as clinical guidelines, formal medical terminologies, and information and communication systems. Informatics has also applications in the areas of nursing, clinical care, dentistry, pharmacy, public health, occupational therapy, medical and biomedical research. The subsets of HI include (although not exhaustive) nursing informatics, biomedical informatics, primary care informatics, and nursing informatics.

For the purpose of this research, we used the following definition for the term HI by Bath (2008) “the structures and processes, as well as the outcomes involved in the use of information and information and communications technologies (ICT) in healthcare”.

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Electronic Health Records (EHR)

Various terminologies have emerged in the published literature; the most common include Computerized Patient Records (CPR), Electronic Patient Records (EPR), Electronic Medical Records (EMR) and, most recently, Electronic Health Records (EHR). Despite the difference in their definitions, these terminologies have been used interchangeably by researchers, government, and industry. For instance, the terms EMR and EHR explain entirely different concepts.

According to Healthcare Information and Management Systems Society (HIMSS), EMR is a “legal record created in hospitals and ambulatory environments that is the source of data for the EHR (Garets & Davis, 2006, p 2). The EHR, on the other hand, is the aggregated electronic health record of an individual that is created and gathered collectively across more than one healthcare organization or practice. EHR represents the ability to share the health record of a patient among different stakeholders (patients, healthcare providers, employers, payers/insurers, and the government) over an electronic network (Garets & Davis, 2006).

Technology Adoption

There is no clear definition of technology adoption, in large part due to the tremendous variability in types of technology and circumstances under which people adopt them. For the purpose of this research project, we used the following terms and definitions adopted from a study by Davis et al. (1989) that examined the user acceptance of computer technology:

**Attitude:** Individual's positive or negative feeling about performing the target behavior (e.g., using a system).

**Adoption:** The actual acceptance and use of an ICT application.

**Implementation:** The processes involved in dissemination of the new technology by getting new software and/or hardware operating properly in its environment. That is including installation, configuration, and running, testing, making required changes, and providing the necessary trainings. When referring to the published literature in this thesis report, the corresponding terminologies found in each particular article will be used to refer to the defined terminologies above.
Dear Colleague,

To improve coordination of care, reduce wait times and to improve patient experience, Cancer Care Ontario (CCO) has supported the development of Diagnostic Assessment Programs (DAP), a single point of access for diagnostic services that concentrate and coordinate care and provide information and support to patients throughout the process. In order to assist Primary Care Providers (PCPs), patients and specialists share information and understand the diagnostic process, CCO, in partnership with Canadian Cancer Society (CCS) is developing Diagnostic Assessment Programs-Electronic Pathway Solution (DAP-EPS).

The University Health Network is working with CCO to conduct a readiness assessment survey about the DAP-EPS, and we would like to invite you to participate in this research study. As a Family Physician practicing in the province of Ontario, we would like to find out about your perceptions towards using DAP-EPS in the clinical setting and to determine what factors might influence your attitude about the DAP-EPS use and its perceived usefulness.

Your input is very important to improving the DAP-EPS tool. If you wish to participate please complete the attached survey and deposit it at the registration desk. The survey should not take more than 10 minutes to complete and all responses will remain anonymous. Your participation is voluntary. Please note that by completing and submitting the survey, you will be indicating your consent for participation in this study.

If you have any questions please do not hesitate to contact one of us.

Thank you,
Sincerely,

Sara Urowitz, MA, MSW (RSW), PhD
sara.urowitz@rmp.uhn.on.ca
Manager, Educational Informatics
ELLICSR – Cancer Survivorship Centre
Toronto General Hospital / University Health Network

David Wiljer, PhD
david.wiljer@rmp.uhn.on.ca
Director, Knowledge Management and Innovation, Oncology Education / Radiation Medicine Program
Princess Margaret Hospital / University Health Network

Marjan Moeinedin
marjan.moeinedin@utoronto.ca
Graduate Student, Department of Health Policy, Management and Evaluation
Faculty of Medicine, University of Toronto

You may also complete the survey online: www.surveymonkey.com/s/DAPEPSsurve
Electronic Pathway Survey

1

To improve coordination of care, reduce wait times and to improve patient experience, Cancer Care Ontario (CCO) has supported the development of Diagnostic Assessment Programs (DAP), a single point of access for diagnostic services that concentrate and coordinate care and provide information and support to patients throughout the process.

In order to assist Primary Care Providers (PCPs), patients and specialists share information and understand the diagnostic process, CCO, in partnership with the Canadian Cancer Society (CCS), is developing Diagnostic Assessment Programs-Electronic Pathway Solution (DAP-EPS).

Your input is very important to improving the DAP-EPS tool. The survey should not take more than 10 minutes to complete and all responses will remain anonymous. Your participation is voluntary. Please note that by completing and submitting the survey, you will be indicating your consent for participation in the study.

Thank you!

2 Demographics (Part A)

1 Are you a family physician?
   □ Yes □ No

3 Demographics (Part B)

1 Sex (Please select one)
   □ Female □ Male

2 Age (Please select one)
   □ Under 30 years □ 50 – 59 years
   □ 30 – 39 years □ 60 years and older
   □ 40 – 49 years

3 How long have you been working in the health care field as a physician (Please select one)
   □ Less than 2 years □ 11 - 15 years
   □ 2 - 5 years □ More than 15 years
   □ 6 - 10 years

4 Which of the following practice settings BEST describes where you practice medicine?
   (Please select one)
   □ Private office / Clinic (excluding free-standing walk-in clinics)
   □ Free-standing walk-in clinics
   □ Academic family medicine teaching unit
   □ Community health center
   □ Other (please specify): ____________________________________________________
Electronic Pathway Survey

5 Please indicate which of the following best describe how your MAIN practice is organized? (Please select one)
- Solo practice
- Family Health Team
- Family physician group medical practice
- Family physician / specialist group medical practice
- Other (please specify): ____________________________

6 Approximately how many patients are in your own personal practice?
- 0 to 499
- 1500 to 1999
- 500 to 999
- 2000 to 2999
- 1000 to 1499
- 3000+

7 Approximately how many patients with suspected cancer did you see in the past year?
- None
- 10 - 20
- 1 to 4
- > 20
- 5 to 9

4 Please read before proceeding to the following questions:

To improve coordination of care, reduce wait times and to improve patient experience, Cancer Care Ontario has supported the development of Diagnostic Assessment Programs (DAP), single points of access for diagnostic services that concentrate and coordinate care and provide information and support to patients throughout the process similar in nature to the Breast Assessment Program.

CCO, in partnership with the Canadian Cancer Society (CCS), is also in the process of developing the Electronic Pathway Solution (EPS) designed to assist Primary Care Providers (PCPs), patients and specialists share information and understand the diagnostic process.

The DAP-Electronic Pathway Solution (DAP-EPS) will be a web-based application that includes the following:
- Connects PCPs and patients into Regional Diagnostic Assessment Programs;
- Provides access to diagnostic services and information;
- Provides access to pathways;
- Provides access to decision support tools;
- Provides content management and patient education;
- Provides referral tools; and
- Provides access to test results and scheduling.

Please refer to the screenshots and brief descriptions of the EPS.

1 I have access to the Internet in the office
- Yes
- No

Found at the end
Electronic Pathway Survey

2 I use electronic medical records in my primary practice setting
   □ Yes □ No

3 Do you use a computer or handheld device to access the following?
   (Please select all that apply)
   □ Patient’s medical information
   □ Your email
   □ Health/clinical resources or journals
   □ Other web-based tools designed for patient management
   □ Other (please specify): ____________________________________________

4 What training or experience with computers have you had?
   (Please select all that apply)
   □ Formal medical school training
   □ Formal residency or fellowship training
   □ None
   □ Self-guided learning
   □ Formal workshops or conferences

5 Overall, how sophisticated a computer user do you consider yourself?
   (Please select one)
   □ Novice - beginner with limited skills and privileges
   □ Advanced beginner; but no significant expertise
   □ General - starting to become well-rounded, knowledgeable
   □ Advanced - experienced and able to assist others

6 Please rate the following: Physician Involvement

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>My involvement during the EPS implementation and setup phase will make the EPS more useful to me.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Being involved during the EPS implementation and setup phase will improve my adoption and use of the tool.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

7 Please rate the following: Adequate Training

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>My practice has the necessary technology, training, and support resources needed to implement a new clinical information system.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Most physicians and clinical staff in my practice are willing to learn how to use an EPS system.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
**Electronic Pathway Survey**

Training will make it easier for me to use the EPS.

---

### 8 Please rate the following: Physician Autonomy

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using the EPS will standardize the physicians’ clinical practices and decision-making with regard to cancer diagnosis.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using the EPS may threaten the physicians’ personal and professional privacy.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using the EPS may result in legal or ethical problems for the physician.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using the EPS may limit the physicians’ autonomy in making clinical decisions or judgments.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

---

### 9 Please rate the following: Doctor - Patient Relationship

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using the EPS will likely reduce the patient’s confidence in the physician if used as a diagnostic and referral aid.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using the EPS will likely threaten the physician’s credibility with his/her patients.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Using the EPS will likely reduce the patient’s satisfaction with the quality of care.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Overall, using the EPS will likely interfere with the effectiveness of the doctor patient interaction.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

---

### 10 Please rate the following: Perceived Ease of Use

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning to use this new technology will be easy for me.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I expect to become skilled at using the EPS.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Overall, I expect the EPS will be easy for physicians to use.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
# Electronic Pathway Survey

## 11 Please rate the following: Perceived Usefulness

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using the EPS will improve the quality of my patient care.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the EPS will give me greater control over my work schedule.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Using the EPS will allow me to accomplish tasks more quickly.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Using the EPS will enhance the overall effectiveness in my job.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Overall, the EPS will improve the coordination of care.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 12 Please rate the following: Attitude about EPS Usage in Clinical Settings

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>The EPS technology will support the physician in providing better patient care.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>I will encourage the use of the EPS among my colleagues.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am satisfied with using the conventional patient referral process in my job.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 13 Please rate the following: Management/Physician Leadership Support

Note: if your practice is private and not part of any organization or group practice, please skip this question.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Disagree/Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>The EPS project will be important to my senior management team.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>My senior management will ensure the effective implementation of the EPS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My senior management will involve me in the implementation of the EPS.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Training and support will be provided for effective use of the EPS.</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

## 14 I have the ability to influence my group to use this tool (Please select one)
- Yes
- No
- Unsure

## 15 Regarding EPS training, how do you learn best? (Please select all that apply)
- Group setting
- Self-directed
- Face to face
- Web-based
- Other (please specify):
Electronic Pathway Survey

16. Please select perceived barrier/s regarding the use of the EPS tool from the following list (Please select all that apply)

- Financial costs
- High initial physician time
- Difficulty with technology
- Challenges with workflow redesign
- Inadequate technical support
- Ease of use

17. Please select perceived benefit/s regarding the use of the EPS tool from the following list (Please select all that apply)

- Coordination of care
- Timeliness of the information
- Accessibility of the information
- Physician-physician communication
- Patient-physician communication
- Efficiency and quality of care
- Standardization of care

Thank you for your participation and we greatly appreciate the time you spent completing this survey!

Please leave completed surveys at the REGISTRATION DESK
The Electronic Pathway Solution (EPS) enables family doctors to refer and track their patients’ progression in the DAP and provides specialists with immediate access to patient diagnostic information.

The EPS will provide family doctors with access to cancer centers, specialists, test results, etc.
Evidence-based pathways and algorithms provide decision support and assistance for family doctors engaging in the diagnostic process.

Electronic navigation assists patients plan and understand their diagnostic journey.
Information, test results, patient status, location on cancer journey and diagnostic results are all supported and shared through the EPS.
Introduction Letter

Dear Colleague:

To improve coordination of care, reduce wait times and to improve patient experience, Cancer Care Ontario (CCO) has supported the development of Diagnostic Assessment Programs (DAPs), single points of access for diagnostic services that concentrate and coordinate care and provide information and support to patients throughout the process. In order to assist Primary Care Providers (PCPs), patients and specialists share information and understand the diagnostic process, CCO is developing Diagnostic Assessment Programs-Electronic Pathway Solution (DAPs-EPS).

The University Health Network is working with CCO to conduct a readiness assessment survey about the DAPs-EPS, and we would like to invite you to participate in this research study.

As a family Physician practicing in the province of Ontario, we would like to find out about your perceptions towards using DAPs-EPS in the clinical setting and to determine what factors might influence your attitude about the DAPs-EPS use and its perceived usefulness.

Your input is very important to improving the DAPs-EPS tool. If you wish to participate please use the link below to connect you with the survey: (insert link here)

The survey should not take more than 10 minutes to complete and all responses will remain anonymous. Your participation is voluntary. Please note that by completing and submitting the survey, you will be indicating your consent for participation in this study. This survey is being administered using Survey Monkey, which is a US based provider, and as such, any information stored is subject to the PATRIOT Act and may be accessed without your prior consent for matters of U.S. national security.

If you have any questions please do not hesitate to contact one of us.

Thank you,
Sincerely,

David Wiljer, PhD
David.wiljer@rmp.uhn.on.ca
Director, Knowledge Management and Innovation, Oncology Education / Radiation Medicine Program, Princess Margaret Hospital/University Health Network, Assistant Professor, Department of Radiation Oncology, University of Toronto

Sara Urowitz, MA, MSW (RSW), PhD
Sara.urowitz@rmp.uhn.on.ca
Manager, Educational Informatics, ELLICSR – Cancer Survivorship Centre, Toronto General Hospital

Marjan Moeinedin
Marjan.moeinedin@utoronto.ca
Graduate Student, Department of HPME, Faculty of Medicine, University of Toronto
Reminder Letter

Dear Colleague:

As a family Physician practicing in the province of Ontario, we are contacting you to find out about your perceptions towards using an Electronic Pathway Solution in the clinical setting and to determine what factors might influence your attitude towards EPS use and its perceived usefulness. Recently we sent a request for you to complete a survey about the EPS. If you have already completed it please disregard this message.

To improve coordination of care, reduce wait times and to improve patient experience, Cancer Care Ontario (CCO) has supported the development of Diagnostic Assessment Programs (DAPs), single points of access for diagnostic services that concentrate and coordinate care and provide information and support to patients throughout the process. In order to assist Primary Care Providers (PCPs), patients and specialists share information and understand the diagnostic process, CCO is developing Diagnostic Assessment Programs - Electronic Pathway Solution (DAPs-EPS).

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If you have any questions please do not hesitate to contact one of us.

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Sincerely,

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david.wiljer@rmp.uhn.on.ca  
Director, Knowledge Management and Innovation, Oncology Education / Radiation Medicine Program, Princess Margaret Hospital/ University Health Network, Assistant Professor, Department of Radiation Oncology, University of Toronto

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sara.urowitz@rmp.uhn.on.ca  
(RSW), PhD  
Manager, Educational Informatics  
ELLICSR – Cancer Survivorship Centre, Toronto General Hospital

Marjan Moeinedin  
marjan.moeinedin@utoronto.ca  
Graduate Student, Department of HPME, Faculty of Medicine, University of Toronto
APPENDIX - C

Diagnostic checking plots

Fit Diagnostics for Attitude_Useage
Diagnostic checking plots

Residual by Regressors for Attitude_Useage

- Residual vs. Physician_Autonomy
- Residual vs. Ease of Use
- Residual vs. Usefulness

- Residual vs. Management_Support
- Residual vs. age_under39
- Residual vs. age40_49
Diagnostic checking plots

Residual by Regressors for Attitude_Useage

- Residual by age50_59
- Residual by emr_use
- Residual by Family Health Team
- Residual by Solo practice