UNDERSTANDING THE SPREAD OF EVIDENCE-INFORMED DECISION MAKING

UNDERSTANDING THE SPREAD OF EVIDENCE-INFORMED DECISION MAKING IN A GOVERNMENT HEALTH DEPARTMENT IN CANADA

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfillment of the Requirements for the Degree Master of Science in Nursing

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Abstract

Background. In order to deliver effective and efficient public health services, the best available research evidence should be considered when making public health decisions. The process of evidence-informed decision making (EIDM) involves searching for research evidence, appraising and synthesizing the high quality evidence, and adapting the evidence with consideration of local contextual factors and community preferences. For many public health departments achieving EIDM has been a challenge. **Methods.** This study aimed to learn how EIDM spread through interpersonal interactions within the health department of a provincial government in Canada. The health department was selected based on anecdotal evidence suggesting that ideas of EIDM had diffused within this department. Employees were invited to participate in an electronic survey about their interactions regarding EIDM. The data collected from this survey were analyzed using social network analysis methods. This helped to show how the interpersonal connections helped to spread the ideas of EIDM within the organization. **Results.** In this organization EIDM discussion occurred most often within the organizational divisions, whereas influence for EIDM often occurred both within and between divisions. The type of relationship that appeared most important in discussion of EIDM was colleague relationships, while supervisors were more important for encouraging use of EIDM. Furthermore, individuals in leadership positions within the organization were shown to have played an important role in the diffusion of EIDM. **Limitations and Conclusions.** Low participation resulted in a limited picture of the whole network of this organization. The use of social network analysis is a relatively novel approach for studying the diffusion of EIDM, and there are challenges to this approach that requires special consideration when working with organizations.

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Dedication

To Matthew and Alexander
My love and my light

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List of Abbreviations

CIHR- Canadian Institute for Health Research

EIDM- Evidence informed decision making

EMT- Extended Management Team

HiREB- Hamilton Integrated Research Ethics Board

KT- Knowledge translation

NCCMT- National Collaborating Centre for Methods and Tools

NCCHPP- National Collaborating Centre for Healthy Public Policy

PEI- Prince Edward Island

PHAC- Public Health Agency of Canada

PHPHC- Public Health & Primary Health Care

SARS- Severe Acute Respiratory Syndrome

TDM- Total Design Method

Declaration of Academic Achievement

The following is a declaration that this thesis is original research conducted by Stephanie Workentine, in partial fulfillment of a Master of Science in Nursing. Stephanie Workentine recognizes the contributions of her supervisor Dr. Maureen Dobbins, and her committee members Dr. Donna Ciliska, Dr. Noori Akhtar-Danesh, and Dr. Jennifer Yost in the design of this study, the interpretations of the findings, and for their feedback in the writing of this dissertation. Furthermore, Stephanie Workentine acknowledges Reza Yousefi-Nooraie for his input in the design of the social network analysis and his feedback on the interpretation of the findings.

Introduction

In all areas of healthcare, there is increasing pressure for health services to be informed by research evidence. The process of incorporating the best-available research evidence into the decision-making process for health programs, policy, and practice is known as evidence-informed decision making (EIDM) (Brownson, Fielding, & Maylahn, 2009; Dobbins et al., 2010).

In public health, policies, programs, and delivery of services take place in complex settings and contexts. One characteristic that contributes to the complexity of public health is the vast array of health priorities covered. The health areas encompassed by public heath range from communicable disease prevention and control through immunization and outbreak management, to the promotion of healthy lifestyle behaviours. In addition to the breadth of public health priorities, services are delivered by a variety of professionals in diverse community settings, which contributes to the complexity of the health care context. However, it is still important that essential public health services are based on high quality research evidence. Evidence-informed decision making in public health recognizes the vital role of evidence in public health practice, but acknowledges that factors beyond the evidence are influential in the complex decision making process (Ciliska, Thomas, & Buffett, 2008). Therefore, the goal of EIDM is for research evidence to be considered during the decision-making process.

Historically, decision-making in public health has been made without systematic planning and instead has been motivated by the short-term options and opportunities available (Brownson et al., 2009). However, the current socio-political climate of the public sector is one that both expects and values accountability and transparency. This has contributed to the expectation that research evidence be used to inform public health decision-making (Dobbins,

DeCorby, & Twiddy, 2004). Despite this expectation, achieving EIDM in reality is proving to be a difficult task for many public health departments.

While it is not yet clear how best to support health departments in becoming more evidence-informed, the literature suggests that strategies to support knowledge translation (KT) and EIDM need to focus on the organization rather than simply the individual (Bowen, Erickson, Martens, & Crockett, 2009; Kiefer et al., 2005). Knowledge translation (KT) has been defined as a "method for closing the gaps from knowledge to practice" (Straus, Tetroe, & Graham, 2009, p. 165). Organizational culture and the value placed on research evidence are influential factors in the success of KT efforts, and are associated with the use of research in decision-making (Dobbins, Cockerill, Barnsley, & Ciliska, 2001; Dobbins, Hanna, et al., 2009a; Peirson, Ciliska, Dobbins, & Mowat, 2012a). For KT to be sustainable, organizations need to develop a culture that values research and its use in decision making be the ultimate goal of influencing population health outcomes.

The culture of an organization is a social phenomenon. A social network perspective can provide understanding of the structure of a social system such as a public health organization. The spread of ideas and values occurs as a result of interpersonal interaction. Conceptualizing the spread of ideas can be theoretically understood with diffusion of innovations theory (Rogers, 2003). To concretely demonstrate diffusion, social network analysis techniques can be used to map the spread of ideas through social interactions. The use of a social network approach is supported by the literature which suggests that social networks are an important factor for enhancing EIDM in an organization (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004).

There are some exemplary settings in which organizations have made significant strides

towards achieving EIDM and where the ideas of EIDM have spread through the organization with relatively little support or assistance from external organizations. Through studying these organizations, it may be possible to identify important factors that could be used to identify other organizations that are in a similar state of readiness for EIDM and assist other organizations in the adoption of an evidence-informed model of practice and decision-making. The purpose of this research study is to explore how the ideas of EIDM spread through the health department of one provincial government in Canada that anecdotally appears to have experienced unplanned diffusion of EIDM.

Literature Review

A brief overview of selected theoretical and research literature related to social network analysis, KT, and diffusion of innovations in a public health and social network context will be discussed. The review of the literature will be structured as follows: first, a discussion of public health in Canada will establish the broader context in which this study will take place. This will lead to a description of a health department currently engaged in EIDM, which will be the organization explored in this study. A synopsis of the KT literature and EIDM will be discussed. To organize the presentation of what the literature suggests works for KT in public health in Canada, a framework by Lavis and colleagues (2003) will be used to structure the discussion. The literature review will continue with an overview of the principles of diffusion of innovations theory and use of the theory in research will be discussed. A review of the diffusion literature will be organized by the four main elements of diffusion theory and will connect the relevant concepts to social network analysis. This will demonstrate the connection between the main ideas guiding this research study.

Public Health in Canada

Public health has been defined as "a scientific and technical as well as a social and political endeavor that aims to improve the health and wellbeing of communities or populations" (Rychetnik, 2004, p. 538). The goal of Canada's public health system is to promote and support the health and wellness of the Canadian population with key priorities of health promotion, the prevention of illness and injuries, and preparing for and responding to public health emergencies (Public Health Agency of Canada, n.d.). Canada played an integral role in the beginning of an international public health movement during the first International Conference on Health Promotion in November 1986 (World Health Organization). The conference resulted in the creation of the Ottawa Charter for Health Promotion, which established the necessary prerequisites to achieve good health for all and the classification of health promotion actions that strive to achieve safe and healthy communities (World Health Organization, 1986).

The aim of public health services and programs is to enable Canadians to achieve better health, reduce strain on the health care system, and prevent premature death through the prevention of chronic diseases and injuries and protection from infectious diseases (Public Health Agency of Canada, 2013). Within the last decade Canada has faced major outbreaks, epidemics, and crises that have threatened the health of the public. Examples include outbreaks of severe acute respiratory syndrome (SARS), H1N1 influenza, West-Nile virus, illness as a result of food-borne contamination, and chronic disease epidemics such as obesity (Gotay et al., 2012; Naylor, Chantler, & Griffiths, 2004; Public Health Agency of Canada, 2008; 2010; Wojnarowicz, Olkowski, & Schwean-Lardner, 2007).

The coordination and delivery of public health services varies across Canadian provinces and territories and may be delivered provincially, regionally, or locally (Frank & Di Ruggiero,

2003). Most Canadian provinces operationalize public health services in large regions. For example British Columbia, Saskatchewan, Manitoba, New Brunswick, PEI, Newfoundland, Yukon and Northwest Territories are organized by regional health authorities; Nova Scotia by district health authorities; and Quebec by health and social service agencies (National Collaborating Centre for Healthy Public Policy (NCCHPP), 2011). Whereas a provincial health authority oversees public health operations and services that are organized by zones in Alberta and local public health units deliver public health services in Ontario (Government of Alberta, 2008; Government of Ontario, 2013; NCCHPP, 2011). The Public Health Agency of Canada (PHAC) was established as a national government agency responsible for public health in 2004 following the SARS outbreak in 2003 (PHAC, 2013). As a result of a 2004 think-tank on the future of public health in Canada, recommendations to improve the Canadian public health system included the need for national leadership, accountability for public health performance, and an evidence-based culture of learning (Frank, Di Ruggiero, & Moloughney, 2004).

The National Collaborating Centre for Methods and Tools. In 2004, PHAC formed six National Collaborating Centres for Public Health. The aim of the centres was to strengthen capacity in public health to synthesize relevant evidence and effectively apply this knowledge to public health practice, programs, and policies (Frank et al., 2004). One of the centres, the National Collaborating Centre for Methods and Tools (NCCMT) was established in 2006 at McMaster University in Hamilton, Ontario, with the purpose to promote and support EIDM in public health through the use of high quality evidence to support practice and policy (NCCMT, 2011). The NCCMT strives to collaborate with public health organizations in Canada to develop organizational capacity and individual skills to incorporate research evidence into public health practice through various products and services. Through maintaining an online registry of KT

methods and tools, the NCCMT aims to identify and evaluate existing methods and tools, make the tools available to those working in public health, identify gaps in methods and tools that need to be developed or further researched, and avoid unnecessary duplication of public health processes and products (NCCMT, 2011). The NCCMT supports sharing what works in KT in public health by working to build active and sustainable networks, and strengthen partnerships between practitioners, decision-makers, knowledge experts, policy makers, and researchers (NCCMT, 2011).

In addition to maintaining the registry of methods and tools, the NCCMT hosts workshops and networking events across Canada and offers multiple online learning opportunities to support EIDM. Tools designed by the NCCMT to support EIDM include a model for EIDM in public health and the steps in evidence-informed public health (Ciliska et al., 2008; NCCMT, 2012). In the model for EIDM in public health created by the NCCMT (2012), public health expertise is placed at the center of the model as ultimately decision makers draw on their explicit and tacit knowledge and expertise to weigh all the factors contributing to the process of making public health practice, program, and policy decisions. These factors include the best available research evidence, information about the local community health issues, the community and political preferences at the time of decision making, and the resources available for implementation.

Manitoba Health, Healthy Living and Seniors. An example of a health department that is engaged in thinking about EIDM is Manitoba Health, Healthy Living and Seniors. Since 2010, Manitoba Health has been involved in activities to support EIDM within the organization. One of the ways in which this occurred was by the Manitoba Health Public Health and Primary Health

Care Division contacting the NCCMT for additional EIDM assistance through employee training and sharing of resources.

Manitoba Health, Healthy Living and Seniors is a department of the Provincial Government of Manitoba that operates under the direction of the Minister of Health (Government of Manitoba, 2013a). The purpose of the provincial health ministry is to guide the planning and delivery of health care services for the citizens of Manitoba (Government of Manitoba, 2013a). Both legislation and emerging issues in health and health care are used by Manitoba Health, Healthy Living and Seniors to provide direction for the planning and delivery of health care services (Government of Manitoba, 2013a). Since 1997, delivery of health care services has been organized by Regional Health Authorities (Government of Manitoba, 2013b). Most direct services are delivered through Regional Health Authorities and other health care organizations, with the exception of the Selkirk Mental Health Centre and Cadham Provincial Laboratory and Northern Nursing Stations, which Manitoba Health, Healthy Living and Seniors manages directly (Government of Manitoba, 2013a). Manitoba Health, Healthy Living and Seniors administers the social programs provided by the provincial government, which includes a complex combination of insured health care services, services funded through other public institutions (e.g. community-based primary care and tertiary teaching hospitals), and those services that are private operations, but are still publically regulated (Government of Manitoba, 2013a).

Manitoba Health, Healthy Living and Seniors is organized into divisions that encompass the delivery of all publically funded health care services in the province. The divisions include Public Health and Primary Health Care, Administration and Finance, Health Workforce, Regional Policy and Programs, Provincial Policy and Programs, and Healthy Living and Seniors.

Each division is divided into branches that oversee the delivery of an area of healthcare. Within the branches, there are teams composed of a mix of health professionals and clerical/administrative staff that are responsible for the operation of the variety of programs Manitoba Health, Healthy Living and Seniors oversees.

Each organizational division has its' own areas of responsibility for the delivery of healthcare services in Manitoba. The division of Administration and Finance is responsible for the areas of management services, health information and finance, and the division of Health Workforce Secretariat is primarily responsible for areas of human resources. The division of Regional Policy and Programs is responsible for acute care services, whereas the division of Public Health and Primary Health Care is responsible for the public health and primary health care services in the province. The division of Provincial Policy and Programs oversees specialized provincial programs such as the Selkirk Mental Health Centre and the Cadham Provincial Lab. Finally, the division of Healthy Living and Seniors was originally a separate department of the government, but it was merged with the health department in January 2014. The division of Healthy Living and Seniors is responsible for the areas of health promotion and prevention services. Manitoba Health, Healthy Living and Seniors is also located in several physical locations and employees work in several locations across the province.

Manitoba Health, Healthy Living and Seniors employs a variety of health professionals and clerical/administrative staff. The roles of the professionals include managers, consultants, policy analysis, statistical analysts, public health inspectors, and epidemiologists. Manitoba Health, Healthy Living and Seniors also employs scientists at the Cadham provincial laboratory and front-line health professionals who provide care for provincial programs and services such as the Selkirk Mental Health Centre and Northern Nursing Stations. A librarian with the Centre for

Health Policy with University of Manitoba provides services to Manitoba Health, Healthy Living and Seniors through contractual agreement. Medical Officers of Health are also employed by Manitoba Health, Healthy Living and Seniors, but are located in the Regional Health Authority they serve. The Extended Management Team (EMT) includes management staff from each division and provides a forum for discussion of issues that cross the Department. The EMT includes the Deputy Minister, Assistant Deputy Ministers, Executive Directors, and Directors (Government of Manitoba Health, n.d.). This description of the internal organization structure as relevant to this research was developed through discussion with the project liaison from Manitoba Health, Healthy Living and Seniors.

According to the Manitoba Health, Healthy Living and Seniors Planning and Alignment Process Draft document (2010), the organization has a goal of developing an evidence-informed strategic action plan through collaboration with government departments, municipalities, regional health authorities, and other external partners. As a priority, EIDM has been incorporated into the current vision and mission of Manitoba Health, Healthy Living and Seniors. In addition to improving health status and reducing disparities, work related to using evidence connects to the priority of capacity building (Government of Manitoba, n.d.). It is evident that Manitoba Health, Healthy Living and Seniors has identified the connection between evidence-informed decisions and the outcome and goal of improved health status of Manitoba citizens. This is significant because it demonstrates the value of EIDM within the organization. In addition, Manitoba Health, Healthy Living and Seniors has been involved in a variety of KT initiatives and activities. For example, the *Need to Know* team, a CIHR funded collaborative research initiative between the Manitoba Centre for Health Policy at the University of Manitoba, Manitoba Health, Healthy Living and Seniors, and the Regional Health Authorities and Healthy

Living that fosters collaboration and KT in the province. Manitoba Health, Healthy Living and Seniors also provides funding to organizations and services that support KT and EIDM including the Canadian Agency for Drug and Technology in Health, the Evidence-Informed Research Portal, library services at the University of Manitoba, and the Manitoba Centre for Health Policy. In addition, Manitoba Health, Healthy Living and Seniors has a Health Information Management Branch that supports a repository of information relevant for the internal website, produces reports, and acts as a leader in the area of research. Manitoba Health, Healthy Living and Seniors' involvement with a variety of KT activities and organizations with a commitment to EIDM can also be identified as an indicator of the value the organization places on EIDM.

Since 2010, the NCCMT has worked with the Public Health and Primary Health Care division of Manitoba Health, Healthy Living and Seniors on several occasions to provide EIDM workshops among different teams. It was noted at a November 2011 meeting, that the concept of EIDM had expanded to other divisions within Manitoba Health. The adoption and spread of EIDM within the organization with relatively minimal support from external organizations, such as the NCCMT, is an important phenomenon to understand as it may help identify characteristics of organizations that are ready to adopt EIDM.

Public health departments in Canada are making progress towards using evidence to inform practice, program, and policy decisions. There is still work needed to optimize use of research evidence in public health. The literature review will continue to discuss the complex process of translating the research evidence into public health decision-making.

Knowledge Translation

There is a pressing need to improve the effective translation of research knowledge to healthcare practice. According to the World Health Organization (2004) "stronger emphasis

should be placed on translating knowledge into action to improve public health by bridging the gap between what is known and what is actually being done" (p. 15). It is recognized that on its own, new knowledge created from health research does not lead to effective implementation or an impact on health outcomes without effective application of knowledge (Graham, 2012). Successfully applying research-based knowledge to the issues faced in healthcare programs and services has the potential to improve health outcomes through more effective health services (Lavis, Robertson, Woodside, McLeod, & Abelson, 2003; Straus et al., 2009). As healthcare resources are limited and the cost of quality healthcare is a large burden on society, KT strives to increase effectiveness and efficiency of health services, but also to ensure the responsible use of limited healthcare resources (Lavis et al., 2003). KT aims to move beyond simply sharing knowledge, to applying and using knowledge to inform health care decisions (Straus et al., 2009). If knowledge is not effectively translated into practice, health care resources may not be used efficiently and effectively, and the provision of services based on out-of date information may not maximize the potential health outcome benefits; or worse may cause unnecessary harm (Straus et al., 2009). In addition, KT offers good "value for money" for the individual and collective investments made in health services and health research (Lavis et al., 2003, p. 221).

In the literature, there are a variety of terms related to KT, each with a distinct meaning, but in general the terms are closely related. More than a hundred terms have been identified through a collaborative online wiki for KT terms and definitions (McKibbon et al., 2013). Terms include, knowledge transfer, research dissemination, research use, research implementation, research uptake, implementation science, research utilization, evidence-based decision making, and innovation diffusion (Estabrooks, Thompson, Lovely, & Hofmeyer, 2006; McKibbon et al., 2013; Straus et al., 2009). In Canada, KT is embedded into the mandate of the primary federal

health research-funding agency, the Canadian Institute of Health Research (CIHR) (Graham, 2012). The definition provided by CIHR for KT is "a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system" (Graham, 2012, p.1). This definition emphasizes two major players in the knowledge translation and exchange process, researchers and knowledge users. Knowledge users are considered to be those who may use research results to inform health care practice, programs, and policies, which includes decision makers, administrators, policy makers and practitioners (Graham, 2012). The process of getting knowledge into practice can be viewed from two directions; push and pull, meaning translating knowledge from researchers to knowledge users, and knowledge users seeking and gathering research evidence to answer a practice question (Reardon, Lavis, & Gibson, 2006). The latter encompasses the process of EIDM that will be explored in this study. In addition to the push and pull models, Lavis and colleagues (2003) emphasize the need for collaboration between researchers and knowledge users in a "two-way exchange process" (p. 227). This model allows knowledge users to better understand and use research knowledge, and allows researchers to gain perspective on public health priorities, and the needs and relevance of research to public health practice (Reardon et al., 2006).

In the user pull model, EIDM incorporates the best available research evidence in the decision making process, while considering the specific situation and context (Brownson et al., 2009; Reardon et al., 2006). Therefore, EIDM is not based on research evidence alone (Dobbins, Hanna, et al., 2009a). Within the context of a public health organization and the broader environmental context, the needs, values, preferences, expertise, and resources are considered in judiciously weighing all the options to make the best decision possible regarding policies and

programs based on available research (Ciliska et al., 2008; Brownson et al., 2009; Dobbins et al., 2010). It is known that in public health, decisions often need to be made with consideration of the social and political climate and with consideration of societal expectations (Dobbins, Hanna, et al., 2009a). Brownson (2009) further clarifies the use of evidence-informed public health as following the same principals of applying the best available evidence to a program-planning framework. However, public health practice may also involve engaging in community assessments, community decision-making, evaluation of programs, and dissemination of key learning's to decision makers and community stakeholders (Brownson, 2009). In EIDM in public health it is important to emphasize that the definitions include two elements, the type of evidence and the consideration of the evidence with a clear reasoning process (Rychetnik, 2004). This involves the deliberate and explicit process of systematically collecting, appraising for quality, and analyzing, synthesizing, and interpreting the available evidence to be used in decision making (Ciliska et al., 2008; Dobbins et al., 2010; Rychetnik, 2004). The process of EIDM includes seven steps: 1) identifying questions from practice-based issues; 2) searching for relevant evidence; 3) appraising the quality of the evidence and using the highest quality evidence; 4) synthesize and interpreting the evidence within the local context and form recommendations; 5) adapting the evidence to the local context; 6) implementing and incorporating the evidence into practice, program or policy decisions; and 7) evaluating the effectiveness of the implementation efforts and the results of the decision (Ciliska et al., 2008; Ciliska, n.d.; Dobbins et al., 2010).

Barriers to knowledge translation and evidence-informed decision making. Over 250 barriers to KT and EIDM have been identified (Straus et al., 2009). At the level of the individual decision maker, commonly identified barriers include time constraints, resistance to change, and

limited competency and/or capacity to appraise and synthesize evidence. At an organizational level, barriers include a lack of access to relevant research, issues relating to knowledge management, competing priorities, leadership, and the socio-political environment. At the level of research systems, the volume of research produced, lack of infrastructure, and knowledge management are identified barriers to KT and EIDM (Bowen et al., 2009; Brownson et al., 2009; Dobbins, Robeson, et al., 2009b; Grimshaw, Eccles, Lavis, Hill, & Squires, 2012; Lavis et al., 2003; Straus et al., 2009; Straus, Tetroe, & Graham, 2011; Ward & Mowat, 2012).

What is known about knowledge translation in public health. In order to improve the KT process, Lavis and colleagues (2003) created a framework composed of five key questions when considering the process of moving research knowledge into practice. The questions include clarifying what the key messages are, who the target audience is, who the most appropriate messenger is, how the message should be disseminated, and what outcomes should be expected (Lavis et al., 2003). In addition to healthcare and services being evidence-informed, the strategies used in KT also need to be informed by evidence on their effectiveness. The five questions in Lavis' (2003) framework will be used to guide a discussion about what is known about KT in public health.

What is the message? Public health decisions need to be informed by a body of research knowledge (Lavis et al., 2003; Straus et al., 2009). It is well established that individual studies may have varying levels of effectiveness and the results of a single study can be misleading due to bias in research design (Grimshaw et al., 2012). Thus, systematic reviews rather than single studies should provide the foundations for the evidence to be transferred (Dobbins et al., 2004; Grimshaw et al., 2012; 2001; Lavis et al., 2003; Straus et al., 2009). It is also of vital importance that the best available evidence be used to inform public health decisions suggesting evidence be

assessed for methodological quality prior to its use (Ciliska et al., 2008; Dobbins et al., 2010).

Who is the Audience? In public health in Canada, the target audience for engagement in EIDM is decision makers at a provincial, regional or local level, as well as program managers and public health practitioners responsible for reviewing the evidence and implementing the findings into practice. In an active "producer push" model of KT from researchers to users, identifying the target audience is of critical importance (Lavis et al., 2003). Furthermore, an "exchange" model of KT is particularly useful and may lead to cultural shifts such as a "decision-relevant" culture among researchers and "research attuned" culture among decision makers (Lavis et al., 2003).

Who is the messenger? The credibility of the messenger to the target audience is critically important and will vary depending on the knowledge being transferred (Grimshaw et al., 2012; Lavis et al., 2003). However, in the KT process, the messenger is not always a direct person transferring new research knowledge. The development of research knowledge infrastructure is a proposed strategy to support effective and sustainable KT (Grimshaw et al., 2012). This may involve technological components, such as online searchable evidence databases which are also referred to in the literature as knowledge exchange portals, or organizational components such as knowledge brokers or training programs (Grimshaw et al., 2012; Quinn, Huckel-Schneider, & Campbell, 2014). This infrastructure is seen in public health in Canada with knowledge management tools such as HealthEvidence.org, which supports the transfer of public health knowledge by providing online access to a searchable registry of review-level evidence that has been assessed for relevance to public health and appraised for methodological quality (Dobbins, 2010). Organizations such as the NCCMT have a mandate to support EIDM in public health and provide products and services to support the development of

knowledge and capacity for EIDM (NCCMT, 2011). Furthermore, knowledge brokers have been studied as a KT strategy in public health, to act as a link between the research evidence and public health practitioners, and who strive to facilitate the process of EIDM (Dobbins, Robeson, et al., 2009b). These various KT activities provide multiple ways to address barriers to EIDM and strive to improve KT in public health in Canada through what Grimshaw et al. (2012) describe as knowledge infrastructure.

How will the message be delivered? There exists a wide body of evidence that passive KT strategies are relatively ineffective and rarely result in behavior change, whereas active strategies are more effective than passive strategies (Bero et al., 1998; Dobbins et al., 2010; Grimshaw et al., 2001; 2012; 2006; LaRocca, Yost, Dobbins, Ciliska, & Butt, 2012; Lavis et al., 2003). In a systematic review of KT strategies in public health, LaRocca and colleagues (2012) found no singular intervention was effective in all contexts. Multifaceted KT strategies led to changes in knowledge, but did not change practice behavior. Passive access to pre-processed evidence had minimal effect and knowledge brokering was not significantly effective overall, but had a significant positive effect on health departments, that at baseline rated themselves as not being evidence-based (Dobbins, Hanna, et al., 2009a; LaRocca et al., 2012). The literature suggests that public health KT strategies need to be customized to the specific context (Dobbins et al., 2004), which will often require an assessment of barriers and facilitators at the outset to effectively tailor the KT strategies (Grimshaw 2013). Lavis (2003) suggests that KT activities in Canada should include creating actionable messages for decision makers, improving decision-maker skills in EIDM, and the evaluation of KT activities to ensure effectiveness.

What is the expected impact or outcome? The goal of EIDM is for research evidence to be weighed in the balance when making public health decisions. For long term effective KT,

Bowen and colleagues (2009) propose that organizational changes in terms of culture, structure, and processes are required. They state that "a change in how business is done, and the environment business is conducted" is what is required to effectively overcome the challenges and barriers to achieving EIDM in public health (Bowen et al., 2009, p. 99). A study by Brownson and colleagues (2014) highlights the need to focus on enhancing an organizational climate and culture that is supportive towards evidence-informed public health. This change in organizational culture may be effectively achieved through social context, leading to the relevance of social network analysis in understanding adoption of EIDM throughout an organization. Furthermore, Ellen and colleagues (2013) identified organizational climate as one of the most important characteristics within a health care organization that supports the use of research in decision-making, in addition to the value organizational members place on application of research evidence.

Knowledge translation theory. In a review of KT theories, Estabrooks (2006) described many theories that are used in KT, emphasizing that there is not a single over-arching KT theory for all situations. Estabrooks (2006) asserts the importance of using theory to guide the design and implementation of KT research to support the development of effective and testable interventions. Examples of various KT theories include diffusion of innovations (Rogers, 2003), social capital theory (Lin & Erickson, 2008), and communities of practice theory (Wenger, 1998). As diffusion of innovations theory relates to KT and supports understanding how interpersonal interactions influence the spread of ideas, it will be used as the theoretical foundation for this research study. Diffusion of innovations is an important theory for understanding the relationship between communication and behavior change (Hornik, 2004). An important aspect of diffusion theory to this study is the element of interpersonal influence in

explaining the spread of ideas within and between groups, communities and social systems (Green et al., 2009). For it is within a social context that innovations are adopted and the social context has influence on the speed of adoption (Hornik, 2004). Recently the KT literature has begun to suggest that social networks impact the process of EIDM. It is recognized that knowledge dissemination and exchange is influenced by interpersonal connections and that social networks are a mechanism for knowledge transfer and application (Gagnon, 2011). This has lead to interest in use of a social network perspective to explore KT processes. Furthermore the social network is a mechanism through which diffusion can occur. This is why this review of the diffusion literature will discuss and relate the ideas to social network analysis. The review of the literature will continue with an exploration of diffusion of innovations theory, and how it supports use of social network analysis in research.

Diffusion of Innovations

Diffusions of innovations theory will be used to guide the study to understand and provide an explanation of how the ideas of EIDM spread through communication channels within the organization over time (Rogers, 2003). Diffusion is considered to be a type of social change, as the structure and function of a social system are altered as a result of innovation diffusion throughout the system (Rogers, 2003). Diffusion of innovations theory provides the theoretical underpinnings for research exploring how networks affect behavior change, because information about a new idea is spread through the interpersonal network of contacts (Valente, 2010; Valente & Pumpuang, 2007). Diffusion theory has also been used as a foundation for understanding organizational change and KT (Dobbins, Ciliska, Cockerill, Barnsley, & DiCenso, 2002; Estabrooks et al., 2006; Greenhalgh, Robert, Bate, Macfarlane, & Kyriakidou, 2005; Haider & Kreps, 2004; Iles & Sutherland, 2001).

Diffusion theory has a theoretical foundation tracing back to 1890 when the French sociologist Gabriel Tarde claimed that advances in society stemmed from the general imitation of selected original thinkers such as artists, creators, and scholars (Tarde, 1962; Green, Ottoson, García, & Hiatt, 2009). According to Tarde, ideas spread through human interactions, specifically, conversation and imitation (Tarde, 1962; Green et al., 2009; Greenhalgh et al., 2004). Everett Rogers developed his theory on the diffusion of innovations during his graduate studies in rural sociology in the 1950's (Green et al., 2009). Rogers' theory built on the foundation of research by Ryan and Goss (1943) that explained key central concepts in diffusion theory such as the S-shaped rate of adoption curve and the categories of adopters. The S-shaped curve demonstrates how the rate of adoption of new ideas is often initially slow, followed by a rapid increase before the eventual leveling off as the majority of people within the social system adopt the innovation (Rogers, 2003). Rogers believed diffusion of innovations was a "universal micro-process of social change" (Rogers, 2004, p. 16) and sought to extend the theory beyond adoption of rural farming innovations, to a general diffusion model which he published in 1962 in his book *Diffusion of Innovations* (Greenhalgh et al., 2004; Rogers, 2004).

Diffusion theory is relevant to understanding the spread of ideas within the context of organizations, KT, and public health. In a comprehensive systematic review of diffusion of innovations in service organizations Greenhalgh and colleagues (2004) discussed the various disciplines that utilize diffusion of innovation and how it is conceptualized for each discipline. In reviewing the organization and management literature, Greenhalgh and colleagues discuss the influence of organizational process, context, and culture. In an organizational context, adoption of an innovation is defined as the assimilation or routinization of the innovation, in which diffusion is influenced by people within the organization and their interpersonal relationships

(Greenhalgh et al., 2004). From a KT context, diffusion of innovations is conceptualized as filling a "knowledge gap" for practitioners, decision makers, and policy makers where the innovation is defined as practices and policies based on high quality research evidence (Greenhalgh et al., 2004, p.587).

Diffusion scholars have varying perspectives regarding how to define diffusion. Some scholars include both planned and unplanned spread of new ideas (Rogers, 2003). While other scholars restrict the term to only spontaneous and uncontrolled spread, in contrast to dissemination where conscious and directed efforts are involved to encourage the spread of new ideas (Green et al., 2009). Greenhalgh and colleagues (2004) describe the existence of a continuum between "pure" diffusion where the spread of innovations is "unplanned, informal, decentralized and largely horizontal and mediated by peers" and "active dissemination" which involves formal planning to spread new information, often through centralized structures that may involve vertical hierarchies (Greenhalgh et al., 2004, p. 601).

Elements of diffusion. The four main elements of diffusion of innovations include the innovation itself, communication channels through which information about the innovation is shared, the time for diffusion to occur, and the members of the social system in which the innovation is to spread (Rogers, 2003). These four elements of diffusion will be used to structure the literature review and discuss the connection between diffusion theory and social network analysis.

The Innovation. In the first element of the theory, the innovation may be defined as a new idea, practice, or object that may be adopted by members of a social system (Rogers, 2003). Innovations may be technological in nature (i.e., application of computers or mobile phones), behavior oriented (i.e., preventive innovations in public health), or administrative innovations

(i.e., policies within in organizations) (Damanpour, 1991; Green et al., 2009; Greenhalgh et al., 2004; Rogers, 2003). An innovation may be understood in terms of its characteristics or perceived attributes that influence the rate at which the innovation may be adopted. Rogers (2003) outlines five characteristics of innovation: 1) relative advantage or the perceived advantage the innovation provides to the potential adopter; 2) compatibility or how consistent the innovation is with previous experiences, existing values and the needs of potential adopters; 3) complexity or how difficult to adopt the innovation is perceived to be; 4) trialabilty or the ability to experiment with an innovation before committing to full adoption; and 5) observability or the degree to which adoption of an innovation is visible by other members within the social system. These characteristics can encourage adoption. For example, when the characteristics are positive, the innovation seems advantageous leading to both a greater likelihood of adoption and more rapid adoption. Within a social context, the attribute of observability tends to result in clusters of adoption as a result of peer networks (Rogers, 2003).

In a public health context, diffusion is often used to facilitate the spread of health messages within a community through interpersonal and mass communication channels for the purpose of health education, social marketing, and health promotion (Green et al., 2009; Haider & Kreps, 2004; Rogers, 2002). In terms of health promotion, Greenhalgh and colleagues (2004) describe diffusion of innovations as being conceptualized by "reach" or "uptake" behaviours targeted by health promotion campaigns, where the innovation tends to be knowledge or information that may result in positive health behaviors and lifestyle choices (Greenhalgh et al., 2004). These are referred to as preventive innovations.

It is understood that some innovations are taken up to a lesser degree than others, depending on how advantageous the innovation is to the group of potential adopters. One

example is preventive innovations where the innovations have low relative advantage. Because preventative innovations operate under the premise of long-term benefit, there may be a delay in reward for adopting the new behavior. Furthermore, the benefits of a preventative innovation may be intangible, and this can act as a barrier to the success of the diffusion process (Rogers, 2002). The context of behavior change in a public health setting relevant to diffusion of innovations may be classified as initiation of a desirable behavior, cessation or discontinuance of an undesirable behavior, prevention, or sustained behavior change (Haider & Kreps, 2004). The adoption of innovations may have consequences that can be classified as desirable or undesirable, direct or indirect, anticipated or unanticipated (Haider & Kreps, 2004). In terms of supporting diffusion of innovations that serve to prevent premature disease or disability, utilizing peer networks is a strategy to support diffusion and adoption of preventive innovations (Rogers, 2002). For example, evidence suggests peer friendship networks influence health behaviors such as smoking (C. Alexander, Piazza, Mekos, & Valente, 2001). For this reason, prevention of smoking behaviours among adolescents should likely utilize a network perspective. Thus, depending on the goal of an innovation, some believe different strategies will be needed to support adoption. In the literature use of peer networks has been show to be effective for preventive innovations. Research by Valente and Fosados (2006) found interpersonal communication was successful in increasing safer sexual behaviours. This suggests interventions using a network perspective to promote adoption through social influence may be beneficial when the perceived short-term benefit of innovation adoption is relatively low.

Communication Channels. Communication channels are the means by which new information is shared within a network and are categorized as mass media channels or interpersonal channels (Rogers, 2003). Interpersonal communication channels are the key

variable that connects diffusion theory to a social network perspective, which analyses the social structure and social influences. Social networks play an important role in diffusion within networks where patterns of friendship, communication, support and advice tend to exist (Greenhalgh et al., 2004). Utilizing a network perspective in diffusion research recognizes both the micro and macro levels of a network that influence the diffusion process (Valente, 2005). The micro-level influences of interpersonal interaction represent direct network exposure, whereas the macro-level influences include the broad contextual factors that contribute to diffusion (Valente, 2005). Both the micro and macro levels are part of the social network influences and are both "elements of the diffusion paradigm" (Valente, 2005, p. 113). Homophily and conversely, heterophilia, are important concepts to both social network analysis and diffusion research, which impacts both information flow and social influence.

Homophily and tie strength. Homophily exists when there are similarities among individuals connected in a network (Valente, 2010). Gabriele Tarde states in The Laws of Imitation "social relations… are much closer between individuals who resemble each other in occupation and education, even if they are competitors" (Tarde, 1962, p. 64). New ideas may spread rapidly through dense and homophilous networks, however as the network members are similar there tends to be fewer new ideas as members are exposed to the same information (Rogers, 2003). In his seminal 1973 article, Granovetter described the important role that weak ties play in the diffusion process. Before Granovetter's research in the 1970's, most network models focused on strong ties among small, well-defined groups. However Granovetter's perspective linked the micro and macro levels of social structure through exploring the strength weak ties provide within a social network. In homophilous networks, information redundancy can occur quickly, and therefore new ideas or innovations tend to enter a social system through

the ties that are less connected. This exploration of the relations between groups changed the perspective of social network analysis (Granovetter, 1973). The weak connections within a network provide a channel for gaining new information by bridging between distally connected groups, and permitting the flow of new information into a homophilous network (Rogers, 2003; Valente, 2010). Granovetter (1983) describes weak ties as the acquaintances included in an individual's broader low-density network, in contrast to close friends contained within a tight and densely knit network. Granovetter argues, "social systems lacking in weak ties will be fragmented and incoherent" (1983, p. 202). The strength of weak ties is not in terms of influence, but in information diffusion, as "weak ties are strong in information" (Valente, 2010, p. 182). Without these bridges, there would be restricted flow of new information into a network (Rogers, 2003).

This relates to the ideas of Burt (1997; 2004) who developed the concept of structural holes. Burt (1997) found weak ties that filled a hole in the network and connected otherwise disconnected groups had a potentially powerful position. In the context of this study, a network member who fills a structural hole within the communication network of the organization has the potential to influence the diffusion of ideas. According to Burt (2004) people who occupy a position of a structural hole are connected across groups. The connections between different groups allow for greater understanding of alternative "ways of thinking and behaving" (p. 349). The people who occupy a position between groups may be more likely to have new good ideas. Burt (2004) studied the hypothesis that brokerage increases the risk of having good ideas and that being in a structural hole at the intersection of social worlds exposes one to new ideas. Burt concludes that good ideas emerge from the intersection of social world by a structural hole, but the ideas spread separately through segregated networks. This suggests the spread of ideas is

optimized through homophilous environments, and new ideas emerge through the hole, which supports Roger's theory of diffusion.

Although weak ties play an important role in supporting the flow of information through a network, the stronger connections within a network have significantly greater influence on adoption of innovations (Rogers, 2003). The diffusion and social network literature discuss the strength of strong and weak ties. Both ties are influential and essential to diffusion as they access different types of informational resources: strong, rich redundant information in homophilous ties, and new and innovative information in weak ties (Tenkasi & Chesmore, 2003). In social network research, Jippes and colleagues (2010) found that utilizing a social network approach was more effective than a formal training intervention in supporting adoption of an educational innovation among medical specialists. This suggests social network analysis can be effectively used as an intervention to support adoption in some settings.

Time. The dimension of time within diffusion theory involves the process potential adopters undergo in the decision to adopt or reject an innovation. The decision process is not instantaneous and involves five stages: 1) knowledge, where a potential adopter is exposed to the innovation and understands its function, which may be through interpersonal or mass communication channels; 2) persuasion, where a favorable or unfavorable attitude towards the innovation is formed and often highly influenced by the interpersonal and social connections; 3) decision, where a unit of adoption engages in activities that lead to adoption or rejection of the innovation; 4) implementation, where the innovation is put into practice; and 5) confirmation, where adoption of the innovation is reinforced or exposure to conflicting messages occurs which leads to discontinuance (Rogers, 2003). It is typical for diffusion to take a long time and the slow

pace of diffusion may be related to factors of the network structure that may inhibit diffusion (Valente, 2010).

In diffusion theory, the element of time is influenced by the level of innovativeness of potential adopters. Individuals can be classified into five categories of adopters based on their level of innovativeness: innovators, early adopters, early majority, late majority, and laggards (Rogers, 2003). The characteristics of the individuals within the adopter categories influence the social network structure. For example, individuals who are well integrated into a social system tend to adopt behaviors earlier than less integrated individuals (Valente, 2010). According to Valente (2010) not all adopters have equal influence on the behavior of others within the network. Innovators and early adopters tend to be on the outer edges of the social network with the inclination towards innovation because they are different from other network members. Whereas opinion leaders have greater capacity to influence others, they often occupy more central positions in a social network, and tend to adopt innovations sooner than the majority (Rogers, 2003; Valente, 2010; Valente & Pumpuang, 2007). As opinion leaders play a critical role in the success of diffusion within a network perspective, the concept will be further discussed in relation to the opinion leader's role in the social system.

The rate of adoption is another way time is incorporated into diffusion theory. It involves the relative speed an innovation spreads and is adopted by members within the social network (Rogers, 2003). For over forty years diffusion scholars have sought to explore the differences between early and later adopters of innovations, how the perceived attributes of an innovation influence the rate of adoption, how interpersonal networks become activated, and why the S-shaped diffusion curve undergoes a rapid increase between 10-20% adoption among a social system resulting in a critical mass (Rogers, 2003). Diffusion research seeks to understand why

some members of a population adopt new ideas, while others do not, and the factors associated with adoption and spread (Valente, 2010). The S-shaped adoption curve, and the rapid acceleration of adoption that is observed are influenced by the concepts related to social networks including thresholds and critical mass.

Thresholds. Within a network individuals may have a certain threshold of adoption that needs to be reached within the community before community members are willing to take the risk of adopting an innovation (Valente, 2010). Thresholds are situation specific and are reached when the benefits of adopting outweigh the risks, based on how may other people within the network have already adopted (Granovetter, 1978). Early-adopters of an innovation may be considered to be of a lower-threshold than their peers, and when they are distributed throughout a network they support diffusion (Valente, 2010). However, if opinion leaders have a relatively high threshold for a particular innovation, this may hinder the diffusion process (Valente, 2010).

Critical Mass. Rogers (2003) describes critical mass as being the point where enough adoption has occurred within a social network, that the rate of adoption of the innovation will continue to be self-sustaining. The theory of critical mass is originally from physics representing the amount of radioactive material required for a nuclear fission reaction to occur, resulting in an explosion. Critical mass has also been related to sociology by Oliver, Marwell, and Teixeria (1985) with the idea that collective action requires a certain amount of social participation before it "explodes", resulting in a wide spread social movement (p. 523). A similar idea developed by Thomas Schelling (1978), who coined the term "the tipping point", where adoption reaches a point of ongoing momentum once a certain level is reached. This ongoing momentum may be difficult to reverse and therefor be self-sustaining (Valente, 2010). In understanding diffusion, critical mass is particularly significant in the adoption of technological innovations that are

interactive and therefore social in nature, such as the telephone, email, computer conferencing (Markus, 1987). Because these innovations require others to be using them in order for the innovation to be beneficial, they can be prone to a slow start (Markus, 1987; Rogers, 2003). However, as more people adopt the innovation, according to Markus (1987) the idea of "reciprocal interdependence" occurs where early adopters make the innovation more advantageous to new adopters and new adoption by other individuals later also serves to increase the benefit to previous adopters (p. 491). This is relevant to both diffusion and social networks because the behaviour of members connected in a network influence each other's behaviours over time.

Social System. Social systems are considered to be any formal or informal group of individuals connected through social ties. In a network perspective, a social system is structured by relationships and may be very different than the formal or externally visible structures (Valente, 2010). According to Hawe and colleagues (2004), studying a network's structure is the heart of social network analysis. In diffusion theory, social structure also includes the norms and communication patterns of the social system (Rogers, 2003). Network structure and measures of position, the small world phenomenon, and the position of opinion leaders connect the diffusion and social network literature.

Social structure and position within networks. In social network analysis both individual and network-level data help to explain the distribution and spread of ideas, opinions, attitudes, or behaviors. Individuals are influenced by both their direct connections, but also by the pattern of connections within the whole network (Valente, 2010). The spread of ideas is influenced by properties of the network structure and the adoption of a new ideas or behaviors is strongly influenced by the ideas or behavior of other members of their social network (Jippes et al., 2010;

Valente, 2010). For example, a recent study by Masica and Cicchetti (2011) found physicians who were better integrated into the social network structure of six Italian National Health service hospitals, were more likely to self report adoption of evidence based medicine. When studying adoption of behaviors, it is important to note that the relationship between networks and diffusion can be understood from two opposing perspectives: that the network influenced the adoption of the behavior through social influence or, secondly, that the specific relationships were formed based on the presence of the behavior, thus creating the network by selection (Valente, 2010). In a classic diffusion study that highlights the impact of a social network, Coleman, Katz, and Menzel (1966) explored the adoption of a new antibiotic, Gammanym among physician prescribing practices. They found that the more links and contacts a physician had, and the stronger those connections were, the sooner they were likely to adopt Gammanym. Whereas those physicians who were more isolated in terms of their peer networks tended to adopt use of Gammanym later (Coleman et al., 1966).

Small world and scale-free networks. The small world phenomenon is a macro level network characteristic (Valente, 2010). It relates to network structures in which most people have relatively few connections, but the distance between two nodes is shorter than expected by chance, as a result of "high local clustering and short global separation" (Watts, 1999, p. 439). Stanley Milgram (1967) developed the concept of small world networks. It is a result of networks that tend to involve clustering and connectivity (Hawe et al., 2004). Small world graphs are often composed of a sparse but highly clustered network with few dominant actors, that have broader social contacts across social realms (Hawe et al., 2004; Milgram, 1967). This was demonstrated through the pivotal experiment conducted by Milgram where he asked randomly selected people in Omaha, Nebraska to pass along a package to an acquaintance or

friend who could assist in delivering a package to a randomly selected person in Boston, Massachusetts. What he found was the majority of the deliveries occurred within four to seven steps (Milgram, 1967).

Another characteristic that can be observed in network structure is what Barabasi termed scale-free properties (Barabasi, 2009). This occurs when network members show a preference to linking to the most highly connected members of a network (Lloyd & May, 2001). This has implications for the spread of disease and has been observed in the transmission of the HIV virus during the early stages of the AIDS epidemic and the growth of the internet (Lloyd & May, 2001; Luke & Harris, 2007; Valente, 2010). In terms of number of connections representing value within a network, Valente (2010) describes this phenomenon as "the rich getting richer" (p. 12). This has been demonstrated in the social network research by Parchman, Schoglio and Schumm (2011), who studied the network properties of health care delivery in the American Department of Veterans Affairs to understand the implication of network properties for implanting evidence-based guidelines. The study determined that the network of physicians was clustered with highly connected nodes that served as 'hubs', revealing scale-free characteristics of the network (Parchman et al., 2011). The study suggests that the hubs may serve to accelerate the dissemination and implementation and adoption of evidence-based practice and further adoption may accelerate if the identified hubs within the structure are targeted with further interventions (Parchman et al., 2011).

Opinion leadership. Opinion leaders are defined as those with the ability to influence the behaviors, attitudes, beliefs, motivations and opinions of others (Valente & Pumpuang, 2007). By the nature of their position in a social network, opinion leaders need to reflect the social norms of the community in order to maintain their influential role (Valente, 2010; Valente &

Pumpuang, 2007). Opinion leaders tend have greater external communications and extensive interpersonal networks in order to learn of new information and effectively share new ideas to others (Rogers, 2003). They also tend to be more innovative which results in them being early adopters of innovations, but most often not the earliest in order to remain connected to the values of the social system (Valente, 2010; Valente & Pumpuang, 2007) They may "monitor the climate of opinion and exercise their influence when the advantages of the new ideas are apparent or when it is clear that norms will change" (Valente & Pumpuang, 2007, p. 882). Alternatively, opinion leaders may resist adoption if an innovation appears incompatible with the current system, because deviating too far from the network norms and values could result in the loss of a prestigious position within the network (Valente 2010). This was demonstrated by Becker (1970) who found chief administration in local health departments in the states of Michigan, Illinois and New York adopted measles immunization programs, but delayed adoption of diabetes screening. At the time measles immunization was consistent with current public health activities, whereas diabetes screening represented a significant departure from public health activities (Becker, 1970). Becker described the diabetes-screening program as being of "low-adoptive potential" (p. 272). Opinion leaders play a critical role in the diffusion on innovations among social networks, and forming the culture or climate of a social system.

Attributes of opinion leaders. In diffusion and social network research, it can be desirable to study the associated attributes of influential network members to increase the understanding of network functioning. Because of the critical role opinion leaders play in the diffusion process within social networks, it is important to understand the characteristics and attributes of opinion leaders. However, because social network analysis views individuals in their social context, the attributes of opinion leaders should be considered in relation to others within the network. This is

represented by the concept of homophily which suggests that the similarity of individuals influences their social relations, or in other words "contact between similar people occurs at a higher rate than among dissimilar people" (McPherson, Smith-Lovin, & Cook, 2001, p. 416). In the social network literature, the characteristics studied have centered around the demographic characteristics of gender, ethnicity, age, religion, social class, level of education, occupation, but have also included characteristics of intelligence, attitudes, aspirations, values and beliefs, and behaviour (McPherson et al., 2001). In addition, researchers have studied the similarity of attributes in various types of relationships such as marriage, friendship, career support, contact, and presence at the same location (McPherson et al., 2001). An influential study that is an example of network ties and individual attributes is the General Social Survey study, in which Burt (1984) proposed adding network questions to the large scale US telephone survey. Two types of network questions were added, name generators by asking, "to whom do you go to with important personal matters" and name interpreters, which ask the respondent to disclose personal characteristics of their contact (Burt 1984, p. 331). In the 1985 General Social Survey, the personal characteristic variables assessed were sex, race, education, contact frequency, length of acquaintance, kinship or role relation, topics of conversation, age, religion, political affiliation, and income (Burt, 1984; Marsden, 1987). The study found that an individual's close social network was often homogeneous in terms of ethnicity, age, and education level (Marsden, 1987). In the Coleman, Katz and Menzel (1966) medical innovations study explored age, the number of medical journal subscriptions, attachment to medical institutions outside the community, and attitudinal characteristics and friendship. The opinion leaders were identified using sociometric methods as the individuals named most often by their colleagues as a discussion partner, a person they turn to for advice, or a person they consider to be a friend. Coleman and colleagues found

early adopters of the innovation were influenced more by people they discussed professional matters with, and people they turned to for advice; whereas later adopters were influenced most by doctors they considered to be friends (Coleman et al., 1966; Coleman, Katz, & Menzel, 1957; Rogers, 2003). The variable with the strongest association with friendship ties was professional affiliation, such as belonging to the same hospital, clinic, or office area (Coleman et al., 1966; Rogers, 2003). This suggests friendship, professional similarity, professional proximity and proximity of location are important social network variables to consider.

In a network study of medical officer's adoption of two public health programs, Becker (1970) found physicians who were opinion leaders were earlier adopters of the innovation and were found to be more cosmopolitan. Cosmopolitanism was measured by a 19-question scale, which assessed the physicians' professional goals, approval of colleagues, and how the doctor looks to their community for information. The survey generated a score that assessed the degree to which the physician looked elsewhere for information and approval to represent cosmopolitanism, versus localite doctors who focused on their local department and community for information and approval (Becker, 1970). In the diffusion literature, Roger (2003) characterizes opinion leaders as having more exposure to communication channels, being more cosmopolite, having greater contact with change agents, showing greater social participation, having a higher socioeconomic status and generally being more innovative. The health care literature also indicates opinion leaders among physician in the area of guideline implementation, are sought out by their colleagues because of characteristics of their position, personality, knowledge, expertise, influence, their understanding of local practice, and their interpersonal and communication skills (Borbas, Morris, McLaughlin, Asinger, & Gobel, 2000; Stross & Bole, 1980; Wenrich, Manito, Morris, & Reilly, 1971). Additional personal characteristics associated

with medical opinion leaders for improving quality of care include a physician's personal commitment, professional credibility, quality improvement behaviours and skills, professional behaviours and skills, and linkages with healthcare institutions (Holmboe et al., 2003).

In an organization and workplace context, the literature suggests employee attitudes and perceptions about an organization are formed primarily from relationships and the available social information (Salancik & Pfeffer, 1978). Ibarra and Andres (1993) asserted that in organizations, two network processes influenced the attitudes of employees: the employee's position within the organization or the informal hierarchy, and the localized social influence of the attitudes among employees close by social proximity. They found employee perception of the organizational conditions was influenced by central network members and social connections based on proximity, however social influence was strongly associated with network centrality, rather than social proximity (Ibarra & Andrews, 1993). This implies that socially central network members such as opinion leaders have a greater influence on employee perceptions, than social connections based primarily on proximity, such as being on the same team or working in the same physical location.

The literature describes many personal and demographic characteristics of influential network members. Key variables that have emerged in the social network, diffusion, and health care literature include the type of relationship, whether it is based on friendship, location, position, advice or discussion of professional matters. Other key variables include level of education, professional position, expertise, influence, and cosmopolitanism or connections to and knowledge of areas beyond local practice. The proximity of physical location, such as healthcare setting (i.e. hospital, office location), and professional proximity (i.e. as area of practice, division) are also variables that may influence the formation of social connections.

Use of social network analysis in KT and health care research. Although the foundations of social network analysis stem from sociology, the approach has been applied to health care, public health, and KT research. In public health, social network analysis has often been used to study disease transmission, such as the spread of infectious diseases such as HIV/AIDs and sexually transmitted infections (Luke & Harris, 2007). However, social networks also facilitate the communication of information through information transmission networks (Luke & Harris, 2007). A recent social network study in public health KT research by Yousefi-Nooraie, Dobbins, Brouwers, and Wakefield (2012) used social network analysis to study the information seeking behaviours among employees of a Canadian public health department. This study sought to understand how public health professionals turn to their peers when they needed to answer a practice question. The results of this study suggest that the identification of central members can be used to support information flow through the health department. Additionally, understanding the network structure can be used to inform KT interventions, identify potential knowledge brokers, and use a community of practice model that uses peer support to influence changes to practice (Yousefi-Nooraie et al., 2012).

In another recent network study relevant to knowledge translation in health care, Gainforth and colleagues (2014) studied the adoption of evidence-based physical activity guidelines among employees of a community organization that supports people after a spinal cord injury. The network structure showed evidence of a core-peripheral structure with people at the core showing greater knowledge of evidence-based guidelines, and behaviours that suggest physical activity promotion. Greater adoption of the guidelines was observed in central members measured by in-degree, which provides some support for diffusion of innovations, as network members within the network core as apposed to the periphery have more opportunities to share

information and support adoption of evidence-based practices. The authors concluded that a position within the network core was associated with interpersonal communication that supports greater knowledge mobilization (Gainforth et al., 2014).

Network analysis is a way to better understand how a social structure functions, and identify the key network players, influential network members, and network properties that influence diffusion and adoption of innovations. In conclusion, diffusion of innovations theory supports the use of a social network approach in research that aims to understand the role interpersonal interactions play in supporting knowledge translation in health departments in Canada. Use of a social network approach may assist in identifying opinion leaders and understanding the relational variables that support diffusion in a healthcare organization.

Methods

Purpose Statement

It is highly important to find effective strategies to enhance knowledge translation (KT) in the Canadian public health sector. Organizations may require different types and intensities of interventions in order to adopt evidence-informed decision making (EIDM). Ideally, organizations would foster a culture that values research evidence in their decision making for practice and policy. Understanding how organizations adopt EIDM with minimal intervention is a first step in understanding important factors to assess, encourage, and optimize when supporting EIDM interventions. Using a social network perspective can help build understanding of the interpersonal communication and interactions that can explain how ideas diffuse among an organization.

Anecdotal information suggests that EIDM has spread to various divisions in Manitoba Health, Healthy Living and Seniors following a workshop with NCCMT in 2010. This spread is an example of diffusion. At this time it is not known to what extent the ideas of EIDM have diffused, or how and why this unplanned diffusion occurred. Because the diffusion of EIDM is desirable, this unique context provides the opportunity for valuable KT research to occur. In Manitoba Health, Healthy Living and Seniors, it appears the ideas of EIDM diffused with minimal intervention, while other public health organizations have required significant investment of resources, formal planning and external support to incorporate EIDM into the organization's culture. Investigating this phenomenon will contribute to the body of KT knowledge.

The purpose of this study is to understand the extent to which the concept of EIDM has spread throughout the Manitoba Health, Healthy Living and Seniors divisions and how

interpersonal interactions contributed to this spread. This is an initial exploratory study where the findings may be used to inform future investigation of this phenomenon.

Research Questions

1. To what extent are EIDM practices reported throughout the organization, Manitoba Health, Healthy Living and Seniors?
2. How has interpersonal interaction facilitated the spread of EIDM throughout the organization?
3. Have public health professionals from the Public Health and Primary Health Care division who attended the original 2010 NCCMT workshop influenced the spread of EIDM to other divisions and the executive management team?
4. What are the roles, relationships, and attributes of the network members who have had the greatest influence on use of EIDM by others?
5. Did education or training in EIDM other than the 2010 workshop contribute to the diffusion of EIDM?
6. Are there influential network members in EIDM but who have no formal training in EIDM?
7. Did factors related to the organizational structure contribute to the diffusion of EIDM?

Social Network Analysis Research Design

In order to explore the diffusion of EIDM, and how social interactions may have facilitated the spread, a social network analysis was conducted. When using this approach the connections or relationships between individuals is the focus of the analysis, which allows for the spread of ideas among members of the organization to be mapped through interpersonal

communications.

Social network analysis tries to explain how similar behavior among members of a network is not solely due to similar characteristics. Instead, their actions are shaped by social influences, which may explain the similar behaviours or outcomes (Marin & Wellman, 2011). Historically, in order to understand a phenomenon, researchers have assessed the individual level characteristics that influence an outcome of interest (Hannerman & Riddle, 2005; Marin & Wellman, 2011). For example, a person's attitudes, beliefs, and behaviors are influenced by a combination of their individual attributes such as sex, age, ethnicity, level of education, income, and occupation. Social network analysis seeks to understand how interpersonal interactions and relationships influence behavior, in addition to such individual attributes (Hannerman & Riddle, 2005; Valente, 2010). Thus, more can be learned in studying the variable of interpersonal interaction than by studying individual attributes alone.

In social network analysis research, studies may focus on the whole-network, or on the network that surrounds specific individuals (Marsden, 2005; Valente, 2010). The purpose of whole network studies is to examine interrelated individuals that are "bounded social collectives" (Marsden, 2005, p. 8). It is important to note the network is bounded for the purpose of analysis, when in reality network boundaries may be flexible, dynamic or ambiguous (Marsden, 2005). One of the major advantages to this whole-network perspective is it can provide a complete map of the communication networks and explain how information or behaviours spread through the network (Valente, 2010).

In contrast to a whole network approach, egocentric network designs focus on the networks of relationships that surround a set of focal actors or objects (Marsden, 2005). Although whole network and egocentric designs are often distinct, the concepts of the networks

and relationships are related (Marsden, 2005). Individual ego networks have been described as the building blocks of sociometric data, as complete networks are composed of a collection of ego networks (Valente, 2010). According to Valente (2010), holding a network perspective supports the idea that the attitudes, beliefs, values, ideas and behaviours of one's network influences the individual, or "ego". In this type of network perspective, the personal network exposure for the ego's network is the proportion of ties that hold a particular belief or engage in a particular behaviour (Valente, 2010). In network studies with an ego network perspective, typically data is collected on the focal individual, the ego, and their network contacts which are called alters (Valente, 2010). Questions designed for ego network studies often ask about general ties and relationships, such as the seminal study where Marsden and colleagues asked with whom the individual discusses important matters (Borgatti et al., 2002; Hannerman & Riddle, 2005; Marsden, 1987). In this study analysis techniques from both sociocentric and egocentric network analysis will be used.

Studying social networks often involves mapping the network structure, which allows for a holistic perspective on a set of related individuals (Hannerman & Riddle, 2005). The relation between two network members is not considered in isolation; instead it is the pattern of relationships between members of the network that is studied in social network analysis (Marin & Wellman, 2011). The ability to visualize the social structure through mapping the network graphically is one of the greatest benefits of social network analysis. This technique of eliciting graphical representation of connections was developed in 1932 by Jacob Moreno, which he called sociometry (Borgatti, Mehra, Brass, & Labianca, 2009; Moreno, 1934). Sociograms are graphs created to visually represent networks using network analysis software. The graphs depict network members as nodes and display how they are connected to other network members. In the

literature, individual people within a network are described as network members, nodes, or actors and the connection or relationship to other individuals are described as relations, ties, links, lines, or edges (Hannerman & Riddle, 2005; Hawe et al., 2004; Marin & Wellman, 2011).

Reliability and validity of network data. Challenges exist in the collection of network data in order to form a complete picture of a network. As network data collection is similar to data collected in traditional health research through the use of interview and self-completed questionnaires, it is subject to the same issues of reliability and validity as traditional attribute focused data collection (Hawe et al., 2004). According to Marsden (2005), the findings of a network study rely heavily on the presumed validity of the self-reported relationships and characteristics. In a review of network measurement methods, Marsden (1990) describes how people are better at recalling regular or routine interactions than those that occurred at a specific time. According to Marsden (1990), the correlation between responses and observations in social network analysis has historically been quite high. It has also been argued that how a participant interprets a relationship is an important part of social network data (Marsden, 1990).

Recall bias and simple forgetting have been identified concerns in the social network literature. When using name generator questions that ask participants to identify interpersonal contact with a specific relationship, research indicates that only a fraction of the people who have the specified relationship with the participant are reported (Brewer, 2000). Techniques that have been found to improve reporting include recognition through techniques such as rosters, use of non-specific probes in interviews, and the use of multiple name generator questions (Brewer, 2000). Nonetheless, participants tend to report names in order of significance, such as by more frequent contact or higher social status, which suggests that even if not all contacts are reported, the most prominent connections most often are (Brewer, 1995). Regarding accuracy of reporting

of relationships, research indicates participants make more accurate reports about regular or long-lasting patters of interactions, and close rather than distant contacts (L. C. Freeman, 1992; L. C. Freeman, Romney, & Freeman, 1987; Romney, Weller, & Batchelder, 1986). The literature on name interpreter data found participants were able to report with reasonable accuracy the requested characteristics for their contacts, but research suggests participants found reporting characteristic on a series of contacts to be tedious (Marsden, 1990; White & Watkins, 2000). For this reason name generator questions in social network research studies have often limited the request of contacts to between three to five names (Burt, 1984; Coleman et al., 1966; Marsden, 2005; White & Watkins, 2000). These are important considerations in planning social network research, as the literature suggests in network analysis participants tend to be accurate in reporting relationships that they find most significant, and interactions that occur most regularly.

Therefore, social network analysis provides a unique perspective in which to study diffusion. Social network analysis may assist in better understanding the spread of ideas through social interaction, and will provide insight into how unplanned diffusion occurred within a healthcare organization. Understanding the characteristics of the network that facilitated diffusion, and characteristics of influential individuals will advance the understanding of key factors which may support effective knowledge translation in public health in Canada.

Population and Sampling

The population for this study was employees from the Manitoba Health, Healthy Living and Seniors division of the Manitoba Ministry of Health. This organization was chosen for the study because of anecdotal information suggesting that diffusion of EIDM had occurred following an EIDM workshop delivered in 2010. Since 2010, Manitoba Health has been involved in activities to support EIDM within the organization.

To produce an accurate picture of the whole network, it is optimal for all network members to be included in the sample. However, with thousands of employees in Manitoba Health, Healthy Living and Seniors it was not possible or practical to include the entire organization. In addition, it was important to ensure EIDM was relevant to the selected sample, as not all roles within the organization are expected to be involved in the process of searching for and applying research evidence to decision making. Therefore, using purposive sampling, only specific roles were included in the study.

Inclusion criteria. This study included the Extended Management Team (EMT) (which includes the Deputy Minister, Assistant Deputy Ministers, Executive Directors, Directors, Medical Officer's of Health, and Managers) and employees working as Consultants/Policy Analysts, Statistical Analysts, Epidemiologists/Scientists, and Public Health Inspectors as they utilize evidence in their daily work. The above roles were selected for this study because the EMT, managers, and consultants provide a snapshot of the extent of diffusion through the leadership roles within the organization, while the analysts, epidemiologists, and public health inspectors provide the perspective of the health department staff for whom EIDM was relevant to their role. Due to the potential influence on the diffusion process, the study aimed to ensure the inclusion of the 30-40 employees who were involved in an initial workshop with NCCMT in 2010 and who were still working in Manitoba Health, Healthy Living and Seniors. It was determined that members of this group would be captured in the sample as described.

Exclusion criteria. Employees who were excluded from the study included clerical and administrative support staff, as well as front-line employees that are in service provision roles such as health professionals working at the Mental Health Centre and Northern Nursing Stations. In previous social network research in public health in Canada, Yousefi-Nooraie and colleagues

(2012) showed that managers, consultants, and analysts had higher response rates in the study than front-line staff, likely due to the relevance of EIDM to their role. The inclusion and exclusion criteria for the survey were identified in collaboration with the project liaison with Manitoba Health, Healthy Living and Seniors.

Sample Size. Consistent with a sociocentric social network analysis approach, all employees who met the inclusion criteria above were invited to participate in the study, resulting in 190 potential participants. This number of potential participants was provided by a contact with Manitoba Health, Healthy Living and Seniors who acted as a project liaison with the organization and the student for the purpose of this research. All participants who consented to complete the survey and who met the inclusion criteria were included in the study. Participants who indicated they did not want to participate in the study or certain survey questions were excluded from the analysis.

Survey Methods

In designing the survey in collaboration with Manitoba Health, Healthy Living and Seniors, the principles of the Total Design Method (TDM) were considered (Batinic, Reips, & Bosnjak, 2002; Dillman, 1991). This approach to the design and administration of surveys has been used to increase the response rate by considering the visual and organizational aspects of questionnaire development and survey implementation. The aim of the TDM is to reduce the perceived "costs" to participants, so the perceived benefits or rewards for completing the survey outweigh the time and inconvenience of participation. For example, designing the questionnaire to appear easy and less time-consuming to complete, ensuring the questionnaire is interesting, and striving to increase participant trust of the questionnaire by sponsorship by well-known credible institutions (Dillman, 1991). According to research by Dillman (1991), paying close

attention to the details of survey design and implementation can increase response rates typically between 60-80%.

In the TDM, Dillman (1991) describes the importance of the order of the questions to ensure interesting questions directly related to the description provided in the invitation to participate appear first. Additionally, attention to the visual and graphic design of the questionnaire is recommended. These principles were followed by involving input from the project liaison with Manitoba Health, Healthy Living and Seniors to ensure the wording of the survey questions, the order of questions, and the visual design of the survey appealed to Manitoba Health, Healthy Living and Seniors employees. Credibility and trust was developed through endorsement by the Manitoba Health, Healthy Living and Seniors liaison, by specifying that the survey was graduate research from McMaster University, and that the study was conducted in collaboration with the NCCMT.

There are additional details Dillman (2002) suggests are important to consider for the design of web-surveys. These include clearly introducing the questionnaire on the welcome screen, presenting each question in format similar to paper questionnaires, allowing participants to scroll through the questions, allowing participants to skip questions, restraining the use of color to promote read-ability and consistency, providing instructions for necessary computer actions at the point when they are needed, avoiding drop-down boxes, and finally including a depiction of how far along participants are in completing the questionnaire (Batinic et al., 2002; Kaplowitz, Hadlock, & Levine, 2004; Schaefer & Dillman, 1998). The McMaster School of Nursing Research Services developed the electronic survey in Lime Survey ("LimeSurvey," n.d.). The principles of Dillman (2002) were incorporated into the survey design as much as possible within the capabilities and available options of the survey program.

In addition to the design of the survey questions, TDM was used to guide the follow-up to the survey administration as a way to increase response rates. Using this approach with mail surveys Dillman recommends a postcard follow-up one week after original mailing and a replacement questionnaire and cover letter to be sent to non-respondents one month later (Batinic et al., 2002; Dillman, 1991; Schaefer & Dillman, 1998). However, in electronic surveys such as in this study, those who received an email questionnaire without prior email notification were less likely to respond, therefore pre-notice prior to survey delivery has a strong impact on response rate (Batinic et al., 2002; Kaplowitz et al., 2004; Rogers, 2003; Schaefer & Dillman, 1998; Valente, 2010). Dillman indicates that follow-up reminders have a similar effect in increasing response rate (Batinic et al., 2002; Marsden, 2005; Schaefer & Dillman, 1998). However, for this study, modifying Dillman's (1991) mail survey recommendations, it was initially proposed that a pre-notice of the survey would be provided one week in advance of actual survey delivery, followed by an invitation to participation and two email reminders. However, in working with Manitoba Health, Healthy Living and Seniors to plan survey implementation, it was deemed that requesting the EMT to forward four emails to eligible participants would be too time intensive and put too much onus on the management. Therefore to continue to work in partnership with Manitoba Health, Healthy Living and Seniors the number of emails to be sent by the EMT was reduced to one invitation to participate and one reminder email. However, participation in the survey was lower than expected so two additional email reminders were sent to further encourage participation in the survey.

Recruitment. The invitation to participate in the project was made via email and sent from the Acting Assistant Deputy Minister's office to the office of the other Assistant Deputy Ministers for distribution to the eligible employees. This was a slight change to the original plan

for the email to be sent from the EMT who would distribute the invitations, however this was related to necessary processes on the part of Manitoba Health, Healthy Living and Seniors. The email invitation and attached letter of information included information on the purpose of the study, the methods, ethical implications, including voluntary participation and the risks and benefits to participating in the study, the importance of their contribution, who would see the data, and how confidentiality and anonymity would be handled and a description of how to withdraw completely from all analysis (See Appendix B and C).

One week later the reminder email was sent, at which time participation in the survey was very low (n=7). Therefore permission from the Hamilton Integrated Research Ethics Board (HiREB) was requested to send one additional email reminder, and approval was granted. The following week survey participation was still lower than expected (n=14). Permission from the research ethics board was requested to send one additional email reminder to share the information about adding a small incentive of 4 x $25 gift certificates to Indigo/Chapters randomly selected survey participants to further encourage participation. At this time it was realized that not all managers were clear on the process of sending the email on to eligible staff. Therefore, in discussion with the project liaison with Manitoba Health, Healthy Living and Seniors, the instruction to share the email with the appropriate staff was added at the very top of the email invitation in bold typeface. However, after the email was sent, it became known that the administrative assistant who sent the email on behalf of the Acting ADM's office deleted this instruction before sending the final reminder email. Because of this it was requested the email be re-sent, however this request was not accepted.

Data Collection

Collection of network data. In this study, network data were collected, as networks are known to have an influence on diffusion and network properties influence how ideas, attitudes, opinions and behaviors spread (Ibarra & Andrews, 1993; Lazega & Van Duijn, 1997; Rogers, 2003; Salancik & Pfeffer, 1978; Valente, 2010; Yousefi-Nooraie et al., 2012). In order to assess the extent EIDM had spread across all areas of the organization, information on participants' contacts with whom they have discussed, encouraged, or been influenced to adopt EIDM practices in their public health practice was requested.

EIDM adoption: For the purpose of this study, two questions were used as indicators of EIDM adoption. First, question 3) Have you used any resources to support EIDM in your work?, as use of resources to support EIDM demonstrates a commitment to learning EIDM skills. Second, question 6) In the past 6 months, have you conducted a search to find research evidence (or had someone conduct a search on their behalf, or assisted someone in conducting a search for evidence). The decision to use the behaviour of searching for evidence to indicate adoption of EIDM was chosen because a search for evidence is described in the literature as a skill required for EIDM and it would be a first step in thinking about the need to integrate research evidence in decision-making (Brownson, 2009; Kiefer, 2005; Ciliska, n.d.). Additionally, searching for evidence is a tangible activity that can be recalled and reported.

Use of resources to support EIDM indicates the participant has completed some measure of formal learning or training in EIDM. Examples of tools to support EIDM include:

- Completing an online EIDM module (by NCCMT or other organizations)
- Using the NCCMT STEPS of Evidence-Informed Public Health (NCCMT, 2012)

- Utilizing library services through the University of Manitoba, which includes the services of a librarian who works with Manitoba Health, Healthy Living and Seniors and regional health authority staff, and a library website
- Using the Manitoba Centre for Health Policy (MCHP) through the University of Manitoba, which has involved knowledge translation workshops for Manitoba Health, Healthy Living and Seniors
- Accessing other resources to support EIDM such as the Canadian Agency for Drugs and Technology in Health (CADTH) for evidence related to technology and common drug review
- Accessing information through the Canadian Institute of Health Information (CIHI) which provides access to Canadian health data
- Utilizing various evidence portals such as the Evidence Informed Health Research Portal (EIHR) which is funded by CIHR and a collaboration with the McMaster Health Forum, and provides webinars and access to a repository of policy-relevant documents addressing 'healthcare renewal' in Canada
- Using www.healthevidence.org, a registry of critically appraised systematic reviews in public health

This list of EIDM resources was provided by the project liaison with Manitoba Health, Healthy Living and Seniors as examples of resources used by Manitoba Health, Healthy Living and Seniors employees.

Survey questions. Participants completed a 10 question electronic survey that was expected to take approximately 20-25 minutes. The survey asked participants about Manitoba Health, Healthy Living and Seniors employees with whom they have discussed EIDM, if they

have used resources to support EIDM, how they use EIDM resources in their work, who influenced or encouraged their use of EIDM resources and how they would characterize their relationship, who they encouraged to use EIDM resources and how they would characterize their relationship, and if they have conducted a search of the literature in the past six months. Additionally, in order to distinguish between direct involvement in an NCCMT workshop and the interpersonal influence of diffusion, participants were asked if and when they participated in workshops conducted by NCCMT, what division they were working in March 2010, and what divisions they have worked in since if they are no longer in same division. Please see Appendix A for a full version of the survey questions.

Relational data. The social network questions in the survey can be further classified as the collection of name generator data and name interpreter data (Ibarra & Andrews, 1993; Marsden, 2005). Name generator questions such as question 1) "Who within Manitoba Health, Healthy Living and Seniors have you discussed EIDM with?" and question 2) "Who within Manitoba Health, Healthy Living and Seniors encouraged, influenced or supported you to use EIDM resources?" identify potentially influential individuals. The name interpreter data collected in connection with this question focused on the most important variables associated with social influence identified in the literature. Name interpreter questions included the type of relationship the survey participant had with the alter they named. The types of relationships included whether the alter was considered to be in a position of influence such as being a leader or supervisor; whether the alter was someone the participant is the supervisor to; whether the alter was a colleague or peer, suggesting the person is at the same level of power within the organization as the participant; or whether the alter was a friend which suggests a relational tie greater and more intimate that a simple work related relationship. The literature suggests the type

of relationship is important in understanding employees attitudes and perceptions, the flow of information, and information seeking behaviours (Ibarra & Andrews, 1993; Lazega & Van Duijn, 1997; Marsden, 2005; Salancik & Pfeffer, 1978; Yousefi-Nooraie et al., 2012).

For the Manitoba Health, Healthy Living and Seniors employees identified in the name generator questions, the division and role was asked, in order to identify their location and role within the organization. Formal positions and department affiliations are considered to be the traditionally emphasized sources of influence beyond a social network context (Coleman et al., 1966; Ibarra & Andrews, 1993; Marsden, 1987; Yousefi-Nooraie et al., 2012). These variables can be used to verify the extent of EIDM diffusion in the organization and to assess if a relationship exists between network centrality and formal organizational structures.

In addition to assessing the influential network members, to understand the extent the ideas of EIDM have spread through the organization, relational data was collected from participants by asking, question 5) "Who have you encouraged, supported or influenced to use EIDM resources?" The responses provide additional data on the spread of EIDM throughout the organization. As many members of the sample may oversee various teams and groups within their division, they may have recommended entire groups use a specific resource. Therefore, the option was provided for participants to select from a list of teams in addition to providing individual names of people they may have influenced. For the analysis, question 2 and question 5 were merged to form one sociogram that depicts a network based on connections of influence.

For the question 5) "Who have you encouraged, supported or influenced to use EIDM resources?" use of EIDM resources was selected to suggest the spread of EIDM. Use of EIDM resources was chosen as the type of behaviour for this question because encouraging use of EIDM resources is a behaviour that should be relevant to all employees included in this study

sample. Whereas being in a position to recommend a person or team conduct a search for evidence may be a request that is made by those in a leadership position directed to individuals in certain roles, such as policy analysts. Also, recommending an EIDM resource acknowledges the importance of consistent training and support in the EIDM process. As with the previous network name generator question, the nature of the relationship, division, and job title was requested.

The option of including a roster of names of the included participants was explored. This technique is supported in the literature as improving social network response rates and accuracy of responses (Marsden, 2005; McPherson et al., 2001). However, the organization of an accurate roster of all included employees, and permission to access the personal information was not feasible. In addition it was the preference of Manitoba Health, Healthy Living and Seniors to leave the name generator questions open-ended rather than include a roster list. Yousefi-Nooraie and colleagues (2012) used an open-ended name generator technique in their social network study, and found that almost all participants provided at most four names. With the tendency for survey participants to provide relatively few names, the first names that come to mind are likely of greatest interest. Furthermore, as Brewer (2000) indicated, participants tend to report the names in order of significance. Therefore, for this study, open-ended name generator questions would most likely result in the identification of persons of greatest influence in supporting EIDM diffusion.

For each name generator question, five cells were provided for participants to list their contacts. This number is based on trends in the literature that show other social network studies have often limited responses to three names, and often participants do not list more than four

names when the opportunity to list more names is provided (Coleman et al., 1966; Marsden, 1987; Mascia & Cicchetti, 2011; Yousefi-Nooraie et al., 2012).

*Attribute data***:** Along with the collection of social ties or connections, demographic data or individual attributes were also collected. This allows for analysis of the characteristics of key members or characteristics of members within identified clusters that may influence diffusion. The literature suggests data about level of education, role or position within the organization, and division or area of work within the organization connect to the concept of homophily within an organizational context (Borgatti, Everett, & Freeman, 2002; McPherson et al., 2001). The years of work in the department of Health or Healthy Living & Seniors was included because it represents the level of experience and seniority within the organization, which the literature indicates may be important in an organizational context (Borgatti & Molina, 2003; Mascia & Cicchetti, 2011).

Pilot testing survey questions. The survey questions were pilot tested with seven public health employees in three different health departments in Ontario. The roles of pilot tester participants included manager, public health nurse, consultant, library coordinator, program evaluator, and competency development specialist. The estimated time for completion of the survey ranged from approximately 10 to 30 minutes, with the most common times being 20-25 minutes.

Feedback was incorporated into the survey prior to administration in Manitoba Health, Healthy Living and Seniors. The feedback provided included providing examples of discussion or encouragement of EIDM with an entire group, such as at a meeting, or encouraging an entire team to complete an EIDM module. Additionally one pilot tester clarified that describing the characteristics as "your supervisor" or "your colleague (at the same level)" did not accurately

reflect all options for colleague relationships. The rationale for this comment was that a person might be encouraged or influenced by a supervisor who works in a different area of the organization, and therefor may not necessarily be the participant's direct supervisor. An example of this could be a former supervisor or a leader in a different division that has been particularly influential to people beyond those they are responsible to supervise. This may have occurred as a result of restructuring or mobility within the organization as people move to different areas of the organization. Also, the pilot tester commented that not all employees a participant considered to be a colleague would be at the exact same level within the organization structure. Therefore, "your supervisor" was changed to "a supervisor" and "your colleague (at the same level)" was changed to "colleague" and an "other _____" option was added. For question 9) an option "Not applicable, I did not work at Manitoba Health in 2010" and question 10) "I work in the same division as is 2010" were added based on pilot tester comments. The option of "I worked in the department of Healthy Living & Seniors" was added to reflect the new organizational structure.

Two pilot testers commented on the question of gender with two check boxes not being the most inclusive for transgendered individuals. The question wording "Which gender do you best identify with?" was an option that was considered. However, given gender was not anticipated to have a significant influence on the results, the variable was omitted.

Other feedback from pilot testers included organizational structure listed in the survey by branches and division did not reflect the organizational structure in their health department. Although for the purpose of pilot testing "Manitoba Health" was changed to "your health department" to try to make the tool generic for other public health professionals, the roles and divisions listed in the survey were still different than the structure at local public health units.

Data Management. The data from the online survey was exported to Microsoft excel, to allow for the organization and storage of attribute data. Network analysis was conducted in UCINET software (Borgatti, 2002; Borgatti et al., 2002). All social network responses were coded as binary data, indicating that a tie either existed or not.

One of the challenges with social network research is that anonymity in data collection is not possible (Borgatti & Molina, 2003; Valente, 2010). To protect the study participants, survey responses were kept confidential, and only the graduate student for this project was permitted to see the original data. Individual identification numbers were generated and used in the analysis to preserve confidentiality and the names were transformed into identification numbers as soon as possible after the data was received. The electronic file of the identity key with participants names was saved to a laptop computer in a password protected encrypted file, using TrueCrypt software. The identity key was saved in a separate location from the rest of the study data on the computer hard-drive. In addition the identity key was backed-up using Crash Plan, a secure, encrypted off-sight back-up service. Data without identifiers was also stored in a password protected encrypted file on the hard-drive of a laptop computer, and backed-up using the same secure off-site service.

Data Analysis

To visualize the extent EIDM has diffused through divisions within the organization, sociograms were created in NetDraw (Borgatti, 2002; Hannerman & Riddle, 2005). This type of graphing permits the visual portrayal of the communication structure of a network and is one of the most attractive features of a social network analysis (Valente, 2010). This allows for mapping the spread of ideas through the creation of a network structure. Individuals were transformed into nodes and the connections or relationships transformed into ties (also known as links, edges).

Creation of matrices allowed for the computation of network properties. In UCINET, matrices were created to display the relational data and were used to record the relationship between two types of nodes (Hannerman & Riddle, 2005; Valente, 2010). The matrices allow for the computations of measures of in-degree and out-degree, described in further detail below as individual level measures. High measures of in-degree centrality were used to identify people who could be considered to be opinion leaders in the area of EIDM (Valente, 2010). It is important to note that when using UCINET and NetDraw software, only participant identification numbers were used. No participant names were used in the software programs.

Network data was merged with the attribute data set to permit comparison with attribute variables. Characteristics of individuals with high degree centrality were analyzed. Descriptive statistics for attribute variables were calculated, including frequency and percentage for categorical variables, and mean and standard deviation for continuous variables.

Two networks were created, an information sharing network and an influence network. The results from question 1) "Who within Manitoba Health, Healthy Living and Seniors have you discussed EIDM with?" was used to develop an information sharing network which demonstrated how the informal flow of information occurred in the organization. An influence network based on the merged results of question 2) "Who encouraged, influenced or supported you to use EIDM resources?" and question 5) "Who have you encouraged, supported or influenced to adopt EIDM?" was created and represents diffusion throughout the organization.

Network measures of centrality. Social network analysis can assist in identifying opinion leaders through determining the central network members.

Degree Centrality. The number of ties of an individual actor or node is represented by the measure of degree centrality. The individuals with more connections often have more influence

and power. According to Hannerman and Riddle (2005), if network data is directional in nature it means a connection may not necessarily be reciprocated. Thus, individuals who receive more connections are considered to have high in-degree centrality, as there are many ties directed inward to the individual and this can be interpreted as a position of prominence or prestige (Hannerman & Riddle, 2005). Positions within the network structure, such as centrality measures, are important to understand because when adoption shifts from peripheral network members to the centre of the network, diffusion will accelerate, often leading to wide-spread adoption. Thus, opinion leaders play an important role in the diffusion of ideas through networks and are often identified as being in a central position within the network. According to Valente (2010), opinion leadership is often measured by in-degree centrality. Therefore individuals with high in-degree centrality for question 2) "who within Manitoba Health influence, supported or encouraged you to use EIDM resources" may be considered as potential opinion leaders in the area of EIDM

Betweeness centrality. The measure of degree centrality has limitations in describing the significance of a network member's position because it only considers the immediate ties (Chan & Liebowitz, 2006; Hannerman & Riddle, 2005). Whereas betweeness centrality measures to what extent a network member lies between other members and therefore can play an important "broker" or "gatekeeper" role in terms of the flow of information through a network (Chan & Liebowitz, 2006; Hannerman & Riddle, 2005). Betweeness centrality represents the proportion of times an actor is between other actors for sending information or the "frequency a person lies on the shortest path connecting everyone else in the network" can be an important measure of centrality and power within a network (Valente, 2010, p. 87). Individuals with high betweeness may have a strategic position within the network. (Hannerman & Riddle, 2005; Valente, 2010)

General statistical analyses. Network size, participation rates, and percentage of overall Manitoba Health employees were calculated. Descriptive statistics including means, frequencies and standard deviations for the attribute data were calculated.

To analyze the adoption of EIDM, the frequency and percentage of participants who reported behaviour indicating EIDM adoption in question 6) "In the past 6 months have you conducted a literature review, or had someone conduct a literature review on your behalf?" and the reported use of resources to support EIDM in question 3) "Have you used resources to support EIDM?" and question 4) "How do you use EIDM resources in your work" were calculated.

For the following questions, 7) "Have you participated in workshops with NCCMT?"; 9) "In which division did you work in in March 2010?"; 10) "What divisions have you worked in since 2010 if you are no longer in the same division" and "When did you move to this division?" the intention was to understand the relationship between participation in EIDM workshops and the movement between divisions. The data from these questions were used to calculate frequencies and percentages. Attribute comparisons were made between those who participated in workshops and adopted EIDM, compared to individuals who adopted via interpersonal influence. The finding will suggest if movement of individuals between divisions was a factor that may have contributed to the diffusion of EIDM.

Quadratic Assignment Procedure (QAP) Regression. In social network research, the outcomes measured are relationships. Consequently, observations are not independent, so traditional inferential statistics will not yield accurate results for network measures (Hannerman & Riddle, 2005; Krackhardt, 1988). Quadratic assignment procedure (QAP) regression can help explain the patterns in relationships. As the relational variables are not independent, in order to

determine statistical significance of the findings, the QAP regression runs thousands of random permutations of the rows and columns in order to determine the measure of statistical significance (Hannerman & Riddle, 2005; Krackhardt, 1988). By permuting the rows and columns of the matrices, QAP is able to determine all possible correlations within the matrices. The procedure therefore builds a row/column interdependence that is assumed in network data into the calculation of the test statistic (Krackhardt, 1988; Marsden, 2005). Krackhardt (1998) concludes that QAP provides unbiased tests of significance for multiple regression coefficients. The lack of independence of network data can bias the significance test of relationships between networks, and is more likely to overestimate significance if traditional statistical methods are used (Hannerman & Riddle, 2005; Krackhardt, 1988; 1994).

To perform a QAP regression, network members with missing data were counted as a non-tie and network members who were isolates were excluded from the analysis. To conduct a QAP regression it is important that the matrices are structured with the same nodes, in the exact same order. The relational data was imported as non-symmetric, or directional ties. This was important to consider, because with the limited response to the survey there was not always sufficient data to determine if ties were mutual. In addition, the relational questions ask for information about a type of relationship, which includes an element of a power hierarchy. For example, naming someone as a supervisor or an employee one supervises is a directional relationship with the supervisor being in the position of power. A matrix was created by transforming two-mode data with individuals recorded in rows and variables in columns, to one-mode relational data that compared the presence of a connection between the participants on a variable of interest. Therefore all one-mode matrices featured the same people, but the matrix represented a different relation. One-mode data involves a single set of individuals linked by one

set of relationships (Hannerman & Riddle, 2005; Marsden, 2005). Waserman and Faust (Davis, Gardner, & Gardner, 2009; Wasserman & Faust, 1994) developed the term two-mode data, that compares the connection of two sets of objects. Most often two-mode data is an example of nesting of social structures within larger social structures, such as within organizations (Hannerman & Riddle, 2005). An example of two mode data is membership on committees or divisions. In the social network literature two-mode data is presented in a classic study that compares women's presence at social events in the American South in the 1940's (Davis et al., 2009; Hannerman & Riddle, 2005). Two mode data depicts the macro-level structure of the network, which can be compared to the micro-level interactions of individual members (Hannerman & Riddle, 2005).

For the QAP regression, the dependent variable of interest was the existence of a tie between pairs. QAP regressions were conducted comparing the presence of a tie between pairs and similarity of division (e.g. Administration and Finance, Health Workforce Secretariat, Regional Policy & Programs, Public Health and Primary Health Care, and Provincial Policy & Programs) and similarity of roles (Assistant Deputy Minister, Executive Director, Director, Medical Officer of Health, Manager, Consultant, Policy Analyst, Statistical Analyst, Epidemiologist, etc.) which represent variables relevant to the organizational structure. The dependent variable of being a survey participant was also explored, to see if there was a significant relationship observed for EIDM ties based on the similar affiliation of choosing to participate in this survey on EIDM or "same participation". Because all employees invited to participate in the survey had the choice to participate or not, there may be something about those who chose to participate which could influence their ties related to EIDM. For example it is possible that those who chose to participate may all be tied to each other through discussion of

EIDM. Using 2000 random permutations, the QAP regression was calculated, meaning the rows and columns were randomly switched approximately 2000 times in order to determine if the result was statistically significant.

Relationship between centrality and participant attributes. To determine if the attributes of the invited participants influence their centrality score, a multiple linear regression analysis was proposed. The dependent variables of interest included the degree and betweeness centrality scores. The independent variables that were investigated included years worked, having graduate level education, being in a leadership role, having attended an NCCMT workshop, and having used NCCMT resources. For this analysis the dependent variables and one independent variable, years worked, were continuous variables and all other variables were dichotomous variables (having graduate level education, being in a leadership role as defined by roles in the EMT, having attended an NCCMT workshop, or having used NCCMT resources).

First univariate analysis was conducted in SPSS. To assess if the outcome variable of interest, was normally distributed, the distribution of degree and betweeness centrality score for the discussion network, and the in-degree and betweeness centrality scores for the influence network were graphed. The means and standard deviations of the continuous variables were assessed, and the distribution of the continuous variable of years of work was graphed in a scatter plot. To determine if a linear relationship existed between the continuous variables of centrality scores and years of work, a correlation analysis was conducted. Because the data for centrality scores did not appear to be normally distributed, spearman's correlation was used to test hypotheses about the existence of a linear relationship between centrality score and the dependent variables of years worked, graduate level of education and leadership role, attendance at an NCCMT workshop and use of NCCMT resources.

For each of the dichotomous variables, a Mann-Whitney test was conducted to assess if centrality was different based on each of these variables. The Mann-Whitney test is a non-parametric test between groups that is useful when the data is not normally distributed. The Mann-Whitney test ranks the test variable, and compared the mean rank between two groups. The Man-Whitney test was conducted for the test variables of degree and betweeness centrality for the discussion network, and the variables of in-degree and betweeness centrality for the influence network. For each test variable, the differences between the dichotomous variables were compared, to see if there was a difference in the centrality scores between the groups. If the Mann-Whitney test demonstrates the variables have a significant relationship with centrality score, a linear regression analysis will be conducted for each variable, and only variables that show a statistically significant relationship with a p value of <0.05 will be combined in multiple linear regression analysis.

Ego network analysis. For this study understanding the effect of diffusion through the whole network within an organization was ideal, however collecting enough data to accurately represent a whole network was not possible. Because the planned sociocentric network resulted in such a limited picture of the whole network, the individual networks can be viewed from the perspective of each person. The ego-network data was re-formatted and re-structured in Microsoft excel to a format suitable for ego-network analysis, where egos and alters and their attributes and relationships are contained in a single dataset. Microsoft excel was used to calculate percentages and data was imported into SPSS for analysis of descriptive statistics. A descriptive analysis was conducted to analyze the percentage of egos that reported each type of relationship with the ties they named as their alters in each network question, the percentage of

alter attributes described in each network, and the percentage of overlap between the three networks.

Ethical Considerations

Research ethics approval was sought from the Hamilton Integrated Research Ethics Board (HiREB), directly to the Faculty of Health Science Student Research Committee. No research is risk free, however, by keeping responses confidential the risk to participants is minimal. The primary risk of participating is the risk of individuals within the organization being able to guess the identity of specific teams, departments or individuals within the social network maps. However, as all responses are confidential and none of the original data will be shared with the organization, the risk of participating is minimal. To ensure risks to participants were minimized, additional steps were taken to ensure that no identifying information would be shared with the findings reported to the organization that could put participants at risk of being identified. The strategies discussed below are based on the suggestions of Borgatti (Borgatti & Molina, 2003; 2005) for ethical guidelines when conducting network research with organizations.

First, the process of transforming the participant's names and the names of network contacts were transformed into identification numbers as soon as possible in Microsoft Excel. The anonymized data was used in all analysis. Furthermore, when sharing the sociograms with Manitoba Health, Healthy Living and Seniors and in all scholarly publications, the names of the divisions and identifiable roles will not be included, so specific individuals or groups within the organization will not be recognizable. To protect participants, the management of Manitoba Health, Healthy Living and Seniors will not be provided any of the original data, and they will not know who choose to participate in the study and who did not.

It is worth noting that on the social network maps, members of the organization who knew each other well may be able to guess the identity of individuals who occupied important or influential locations within the network. However, it would not be feasible to guess specific participants who were not using evidence in a way that would reflect negatively on participants. As the sociograms express the positive relational ties of participants' perspectives on who had been influential in discussing and encouraging EIDM, the potential for negative consequences was minimal. Also, by using strict data anonymizing procedures and storage, the potential risks to participants was significantly reduced.

In the invitation voluntary participation was highlighted, as was how to withdraw from the study at any time by contacting the student investigator. The consent form specified that the management within Manitoba Health, Healthy Living and Seniors will not know whether an individual chose to participate or not. The consent form also emphasized that Manitoba Health, Healthy Living and Seniors will not see the individual names reported, and the graphs will not display names or any identifying information. Rather, the findings of interest are the general trends in relations and interactions and how that creates the social structure and influences the spread of ideas.

One of the ethical issues encountered in this type of network research is how to deal with the names of network members who have not consented to participate in the study. For this study if an employee did not participate in the survey but was named by other participants, they were included as a node in the analysis. This decision was based on recommendations in the social network literature that emphasize that participants are reporting on their perception of a relationship with another, which is within the rights of the survey participants to do (Borgatti & Molina, 2003; 2005; Valente, 2010). In this study, to strive to protect the rights of potential

participants, all participants were given the option of withdrawing of the study completely by consenting not to participate, or emailing the student investigator directly to withdraw from the study. For this to occur the participant had to provide their name in order for them to be excluded from all analyses. For each survey question, participants were also provided the option of "prefer not to answer". When participants selected that they preferred not to answer one of the network questions, they were excluded from all analysis for that question, including if other colleagues named them as an influential EIDM contact.

For participants, the benefits of participating in this study included increasing the understanding of how EIDM spread within Manitoba Health, and contributing to the broader understanding of the spread of EIDM in a government organization. The findings of this study may help assist with identifying organizational factors that contribute to readiness to adopt EIDM.

Results

A total of 17 of approximately 190 eligible (9%) employees participated in the electronic study, with 16 completing the survey. Zero participants withdrew from the study by emailing the investigator. One participant began the survey but did not complete the survey, and therefore was excluded from all analysis. Of the 16 participants who completed the survey, 100% (n=16) completed the attribute questions, and 62.5% (n=10) completed all survey questions. Respondents represented 5 of the 6 organizational divisions invited to participate. The issues associated with low participation and the limitations and implications for the study findings will be mentioned in the results when relevant, and thoroughly examined in the discussion.

Characteristics of Survey Participants

A summary of the characteristics of the survey participants can be seen in Table 1 (below). A table with all the attribute information included in the survey can be found in Appendix E. The reported years of work at Manitoba Health, Healthy Living and Seniors spanned a wide range from less than one year to 27 years, with an average of 7.7 years worked. The majority of participants reported completing a master's degree (56.3%, n=9). The division with the most amount of participation in the survey was the division of Administration and Finance (33.3%, n=5), followed by Regional Policy and Program, Public Health and Primary Health Care, and Provincial Policy and Programs (20%, all n=3). The most commonly reported role was Policy Analyst/Consultant (56.3%, n=9). All but one of the participants were located in the same office building.

Table 1. Characteristics of participants

Years of work at Manitoba Health, Healthy Living and Seniors	**(N=16)** Mean 7.7 Min=0.75, Max=27
Highest degree earned	**Number (Percent) (N=16)**
Diploma	2 (12.5)
Baccalaureate	3 (18.8)
Masters	9 (56.3)
Doctorate	2 (12.5)
Role	**Number (Percent) (N=16)**
Assistant Deputy Minister	0 (0.0)
Director	1 (6.3)
Epidemiologist/Scientist	0 (0.0)
Executive Director	2 (12.5)
Manager	2 (12.5)
Medical Officer of Health	0 (0.0)
Policy Analyst/Consultant	9 (56.3)
Public Health Inspector	0 (0.0)
Statistical Analyst	0 (0.0)
Other	0 (0.0)
Division *Branch**	**Number (Percent) (n= 15)**
Administration and Finance	5 (33.3)
Health Information Management	3 (20.0)
Management Services	2 (13.3)
Health Workforce Secretariat	0 (0.0)
Regional Policy and Programs	3 (20)
Acute, Tertiary and Specialty Care	1 (6.7)
Continuing Care	1 (6.7)
Public Health and Primary Health Care	3 (20.0)
Primary Health Care	3 (20.0)
Provincial Policy and Programs	3(20.0)
Provincial Drug Program	1 (6.7)
Capital Planning	1(6.7)
Selkirk Mental Health Centre	1 (6.7)
Healthy Living and Seniors	1 (6.7)
Healthy Living and Populations	1 (6.7)
Location	**Number (Percent) (N= 16)**
300 Carlton Street	15 (93.8)
Other	1 (6.3)

**Only branches with participants are listed. See Appendix E for table with all branches included*

Response Rates by Survey Question

Participants had the choice to answer any or all of the survey questions. They had the option to answer the question, leave the question blank or to select an option that they preferred not to respond for every survey question. All but two of the questions had a response/completion rate between 87.5% and 100%. The two questions with lower response rates were question 5 "Who within Manitoba Health have you encouraged, supported or influenced to use EIDM resources?" and question 8b "Have you participated in other education or training on EIDM?" with 6 participants (37.5%) choosing not to respond to either question. A full description of the completion rates by survey question can be seen in Table 2.

Table 2. Completion rate by survey question

Question	Number of participants who completed Number (Percent) N=16	Non-response (blank) Number (Percent)	Prefer not to answer Number (Percent)
1	15 (93.8)	0 (0.0)	1 (6.3)
2	14 (87.5)	1(6.3)	1 (6.3)
3	15 (93.8)	0 (0.0)	1 (6.3)
4	15 (93.8)	0 (0.0)	1 (6.3)
5	10 (62.5)	2 (12.5)	4 (25.0)
6	16 (100.0)	0 (0.0)	0 (0.0)
7	15 (93.8)	0 (0.0)	1 (6.3)
8a)	13 (81.3)	1 (6.3)	2 (12.5)
8b)	10 (62.5)	5 (31.3)	1 (6.3)
9	16 (100.0)	0 (0.0)	0 (0.0)
10a)	14 (87.5)	2 (12.5)	0 (0.0)
10b)	16 (100.0)	0 (0.0)	0 (0.0)

To summarize the results and findings from the electronic survey, the results are organized as a presentation of findings about EIDM adoption, resources and training; and responses to the name generator questions (social network questions). First the findings about

EIDM adoption, resources and training will be discussed. This will provide an overview of the EIDM behaviours of participants before delving into the social network questions.

EIDM Adoption, Use of Resources and Training

Measures of EIDM adoption. EIDM adoption was measured using two questions that measured the following behaviours: searching the literature and use of EIDM resources. For question 6, "In the past 6 months, have you conducted a search to find research evidence, (or have you had someone conduct a search on your behalf, or assisted someone in searching the literature?" all participants completed the question, with 14 (87.5%) saying they had conducted a search of the literature within the past 6 months, and 2 (12.5%) saying they did not. For question 3, "Have you used any resources to support EIDM in your work?" and question 4, "How have you used EIDM resources in your work?" 15 participants completed the question; and one respondent choose not to respond and therefore was excluded from analysis of these questions. All 15 participants reported using EIDM resources in the past 6 months? Table 3 below presents the data on EIDM adoption.

Use of EIDM resources. Use of EIDM resources was measured in question 3b) "What EIDM resources have you used?" All 15 participants selected between 2 and 6 of the listed EIDM resources, with a mean of 4 resources selected, and about one-third of participants (n= 5, 33.33%) selected 5 EIDM resources. Of the 15 participants, 46.7% (n=7) reported using NCCMT resources, 86.67% of participants (n=13) reported using resources from the Canadian Institute for Health Information (CIHI) and 93.75% (n=14) reported using the Manitoba Centre for Health Policy. In addition 5 participants listed using additional EIDM resources including Academix journal review, Evidence-Informed Healthcare Renewal (EIHR) Portal, British Medical Journal (BMJ), Institute for Healthcare Improvement (IHI) conference materials and

resources, ASQ (formerly the American Society for Quality), Medscape, literature reviews, and Google and Google Scholar article searches.

Table 3. EIDM adoption and use of EIDM resources

Measures of EIDM adoption	
Question 3a) Have you used any EIDM resources?	**Number (Percent) (N=16)**
Yes	15 (93.8)
No	0 (0.0)
Prefer not to respond	1 (6.3)
Question 6a) Have you conducted a search of the literature	**Number (Percent) (N=16)**
Yes	14 (87.5)
No	2 (12.5)
Prefer not to respond	0 (0.0)
Use of EIDM resources	
Question 3b) What EIDM resources have you used	**Number (Percent) (n= 15)**
NCCMT resources	7 (46.7)
Library Services	11 (73.3)
CADTH (Canadian Agency for Drugs and Technology in Health)	9 (60 .0)
CIHI (Canadian Institute for Health Information)	13 (86.7)
Manitoba Centre for Health Policy	14 (93.8)
Evidence Portals	7 (87.5)
Other	5 (33.3)
Prefer not to respond	0 (0.0)
Blank	1 (6.25% of total 16)
Question 4) How have you used EIDM resources	**Number (Percent) (n= 15)**
For policy, programs or standards development	12 (80.0)
Defining a problem	12 (80.0)
To develop and analyze options	14 (93.3)
To identify needs, gaps or issues	13 (86.7)
To identify outcomes or indicators for monitoring and evaluation	11 (73.3)
Other	2 (13.3)
Prefer not to respond	1 (6.25% of 16)

In response to question 4) "How have you used EIDM resources in your work?" of the 15 participants that completed the question, 7 participants (46.6%) selected all five responses for how EIDM resources could be used. The most common response was EIDM resources were used

"to develop and analyze options" with 14 participants (93.3%) indicating this, followed by 13 responses (86.67%) for "to identify needs, gaps or issues" and 80% (n=12) indicating they used EIDM resources "for policy, programs or standards development" and "defining a problem." In addition, two participants used the "other" response option to describe using EIDM resources to "identify industry best practices and standards" and to "identify other jurisdictional approaches, for case studies to use as examples." Further information on the respondents' use of EIDM resources is reported in Table 3, and information on how many EIDM resources were selected by survey question is presented in Table 4.

Table 4. Number of survey responses selected by participants (in select all that apply)

Question 3b) Number of resources selected	**Number of participants that selected each number of resources Number (percent) (n= 15)**
Selection of 2 EIDM resources	2 (13.3)
Selection of 3 EIDM resources	3 (20.0)
Selection of 4 EIDM resources	3 (20.0)
Selection of 5 EIDM resources	5 (33.3)
Selection of 6 EIDM resources	1 (6.7)
Question 4) Number of responses to "How have you used EIDM resources in your work?"	**Number participants that selected the number of responses Number (percent) (n= 15)**
Selection of 5 responses	7 (46.6)
Selection of 4 responses	4 (26.7)
Selection of 3 responses	1 (6.7)
Selection of 2 responses	1 (6.7)
Selection of 1 response	1 (6.7)

EIDM training. Participants' previous training in EIDM either within or external to Manitoba Health, Healthy Living and Seniors was assessed in questions 7 and 8. For question 7, "Have you participated in workshops with NCCMT?" 15 participants completed the question, while 1 selected 'prefer not to respond', and was excluded from analysis of this question. The

majority of respondents (60%, n= 9) reported not attending a workshop with NCCMT. For the 6 participants (40%) reporting they had attended an NCCMT workshop, only 1 survey participant was from the original 2010-workshop group. Three participants (20%) attended a workshop in 2012, and five (33%) participated in a workshop in 2013.

When responses to question 7 about NCCMT workshop attendance is compared to question 3 about use of EIDM resources, of the six participants who reported attending a workshop in question 7, all six participants also reported using EIDM resources in question 3, and all six participants specifically reported using NCCMT EIDM resources. In addition, one survey participant reported using NCCMT resources in question 3 who had not attended any NCCMT workshops.

For question 8 "Have you participated in other education or training on EIDM?" Thirteen participants provided data for training within Manitoba Health, Healthy Living and Seniors. Two selected not to respond and one participant left the question blank. Of the 13 respondents, 46.15% (n=6) indicated they received other EIDM training within Manitoba Health, Healthy Living and Seniors, whereas 53.84% (n=7) reported not received other training. Only 10 participants provided data regarding training outside Manitoba Health, Healthy Living and Seniors as 5 respondents left the question blank, and one selected prefer not to respond. Of the 10 responses, 50% of participants (n=5) indicated they participated in other EIDM training outside Manitoba Health, Healthy Living and Seniors, and 50% (n=5) indicated they had not received any external EIDM training. Further information on EIDM training is presented in Table 5 below.

Table 5. EIDM education and training

Question 7) Have you participated in workshops with NCCMT? If so, when?	**Number (Percent) (n= 15)**
Have not attended a workshop	9 (60.0)
March 2010	1 (6.7)
November 2011	1 (6.7)
May/June 2012	3 (20.0)
October 2013	5 (33.0)
Attended more than one workshop	2 (13.3)
Prefer not to respond	1 (6.25% of total 16)

Question 8) Have you participated in other education or training on EIDM?

Within Manitoba Health? (n= 13)		**Outside Manitoba Health (n=10)**	
Yes	6 (46.2)	Yes	5 (50.0)
No	7 (53.8)	No	5 (50.0)
Prefer not to respond	2 (12.5% of total 16)	Prefer not to respond	1 (6.3% of total 16)
Blank	1 (6.3% of total 16)	Blank	5 (31.3% of total 16)

Movement between divisions and organizational re-structuring. To assess if organizational re-structuring may have been a factor that contributed to diffusion of EIDM, it was necessary to gain some perspective on whether employees had moved divisions. This was assessed in questions 9 and 10. For question 9 "In which division did you work in March 2010?" all survey participants (100%, n=16) answered the question. Twenty-five percent (n=4) did not work at Manitoba Health, Healthy Living and Seniors in 2010. In 2010, 25% of the survey respondents for this question (n=4) were working in the division of Public Health and Primary Health Care in March 2010, and two of those participants moved to other divisions since 2010.

For question 10 "In which other divisions have you worked since 2010?" 3 participants (18.75%) worked in the same division, while 8 (50%) moved divisions, and 2 (12.5%) moved more than once. The majority of participants who moved divisions, moved in 2013 (n=6, 37.5% of total 16). Further information about movement between divisions is presented below in table

6. This will be incorporated into a reflection on the characteristics of the employees who were determined to be influential in discussing and encouraging EIDM.

Table 6. Internal movement and re-structuring

Question 9. In which division did you work in March 2010?	**Number (percent) (N=16)**
Administration and Finance	1 (6.3)
Health Workforce Secretariat	1 (6.3)
Regional Policy and Services	2 (12.5)
Public Health and Primary Health Care	4 (25.0)
Office of the Chief Provincial Public Health Officer	0 (0.0)
Provincial Policy and Services	2 (12.5)
The department Healthy Living, Youth and Seniors	1 (6.3)
Did not work at MH in 2010	4 (25.0)
Question 10. In which other divisions have you worked since 2010?	
Did not work at Manitoba Health in 2010	4 (25.0)
Work in the same division	3 (18.6)
Moved divisions	8 (50.0)
Number moved division more than once	2 (12.5)
Time of movement between divisions	
2010	0 (0.0)
2011	1 (6.3)
2012	1 (6.3)
2013	6 (37.5)
Divisions worked since 2010	
Worked in the same division since 2010	3 (18.6)
Healthy Living and Seniors	6 (37.5)
Health Workforce Secretariat	1 (6.3)
Regional Policy and Programs	2 (12.5)
Public Health and Primary Health Care	1 (6.3)
Provincial Policy and Programs	1 (6.3)

Network Data

Responses to name generator questions. For the name generator questions 1, 2 and 5, between 8 to 13 participants provided names of contacts within Manitoba Health, Healthy Living and Seniors with whom they have had contact regarding EIDM. Participation rates decreased in each name generator question with 93.75% (n=15) participating in the first question, 87.5% (n=14) participating in the second, and 62.5% (n=10) participating in the third.

For question 1, "Who within Manitoba Health, Healthy Living and Seniors have you discussed EIDM with?" 13 participants (86.67%) provided at least one name, and 6 participants (40%) provided 5 names. For question 2, "Who within Manitoba Health, Healthy Living and Seniors encouraged, influenced or supported you to use EIDM resources in your work?" 12 participants (80%) provided at least one name, and 3 participants (20%) provided 5 names. For question 5 "Who within Manitoba Health, Healthy Living and Seniors have you encouraged, supported or influenced to use EIDM resources?" participation was lower, with 4 participants (25%) selecting not to respond. Of the 12 participants responding to question 5, 8 participants (66.67%) provided at least one name and 2 (16.67%) provided 5 names. Participants with no reported ties are also known as isolates. There were 2 isolates for each network question.

Table 7. Participation rates and number of names provided during name generator questions

	Question 1) Who have you discussed EIDM with? **Number (percent) (N=16)**	**Question 2)** Who encouraged, influenced or supported you to use EIDM resources in your work? **Number (percent) (N=16)**	**Question 5)** Who have you encouraged, supported or influenced to use EIDM resources? **Number (percent) (N=16)**
Participation by question	15 (93.8)	14 (87.5)	10 (62.5)
Prefer not to respond	1 (6.3)	1 (6.3)	4 (25.0)
No response	0 (0.0)	1 (6.3)	2 (12.5)
Number names provided for name generator questions			
	Question 1 (n=15)	**Question 2** (n=15)	**Question 5** (n=12)
No one	2 (13.3)	2 (13.3)	2 (16.7)
At least 1 name provided	13 (86.7)	12 (80.0)	8 (66.7)
At least 2 names provided	10 (66.7)	10 (66.7)	7 (58.3)
At least 3 names provided	9 (60.0)	7 (46.7)	6 (50.0)
At least 4 names provided	7 (46.7)	4 (26.7)	4 (33.3)
At least 5 names provided	6 (40.0)	3 (20.0)	2 (16.7)

Characteristics of people named as ties. For question 1, the individuals named as a tie for discussing EIDM were most often from the divisions of Regional Policy and Programs (n=12), followed by Administration and Finance (n=9) and Provincial Policy and Programs (n=8), and in the role of policy analyst/consultant (n=19), followed by executive director (n=8). When describing the role of a tie, the category of "other" was selected for 4 ties that were described as being a medical advisor, a surgical consultant/mentor, redevelopment coordinator, and infection control nurse. The most commonly reported relationship for EIDM discussion ties was colleague (n=30) and supervisor (n=10). One tie was listed as the relationship of "other" and was described as a mentor/strategy leader.

In contrast, when asked to name individuals who encouraged EIDM in question 2, the named ties most often came from the division of Administration and Finance (n=7), followed by Provincial Policy and Programs (n=6). However the most commonly reported roles and types of relationships were the same as for question one, with roles of Policy Analyst/Consultant (n=8) and Executive Director (n=7), and relationships of colleague (n=19) and supervisor (n=11). In question 2, there were 6 ties that were listed as the role of "other" and were described as a librarian, an infection control nurse, a retired deputy minister, a medical director, a provincial lead in clinical access and improvement, and an employee seconded from Manitoba eheath. The "other" category for relationships included ties described as being an employee from another division, a former supervisor, a mentor, and a librarian.

For question 5, which asked who survey participants have encouraged to use EIDM, the division of the people named most often was Public Health and Primary Health Care (n=7), followed by Healthy Living and Seniors (n=6). The commonly reported roles are similar to the other two questions, policy analyst/consultant (n=13) and executive director (n=3), and the role of colleague (n=22) was most often reported, however this was followed by the role of employee (n=4).

Social Network Analysis

The names provided in the three name generator questions were used to create matrices and sociograms. In the sociograms the actors are portrayed as nodes, and the ties as lines. Attribute datasets containing information on the division and role of participants and their contacts was imported for each network. To create the network image, nodes were grouped together by division. To further visually interpret the data, the divisions were categorized by shape and role was differentiated by color. To distinguish between participants and their

contacts, participant nodes are larger in size. The legend for the sociograms is provided in table form, in Table 8 below. Separate sociograms were created for the responses from questions 1, 2 and 5 and these maps are presented in Figures 1, 2 and 3. The responses from questions 2 and 5 were merged to form an influence network to show the flow of influence for EIDM. This network will include ties for those that encouraged survey participants, and the ties to the people the survey participants encourage. This network is presented in Figure 4. The ties from all three questions were merged to form one large network map that displays all the ties related to EIDM that were reported in the survey, and is presented in Figure 5.

Table 8. Legend for sociograms in Figures 1-5

Division		**Role**		**Size of node**	
Square	*Administration and Finance*	Green	*Assistant Deputy Minister*	Large	*Survey Participant*
Circle in a box	*Health Workforce Secretariat*	Orange	*Director*	Small	*Node tied to survey participant*
Triangle	*Regional Policy and Programs*	Black	*Epidemiologist/Scientist*		
Circle	*Public Health and Primary Health Care*	Red	*Executive Director*		
Diamond	*Provincial Policy and Programs*	Yellow	*Manager*		
Downward triangle	*Healthy Living and Seniors*	Blue	*Policy Analyst/Consultant*		
Plus sign	*Other*	Teal	*Other*		

Figure 1. Information sharing network. Responses from question 1) Who within Manitoba Health, Healthy Living and Seniors have you discussed EIDM with?

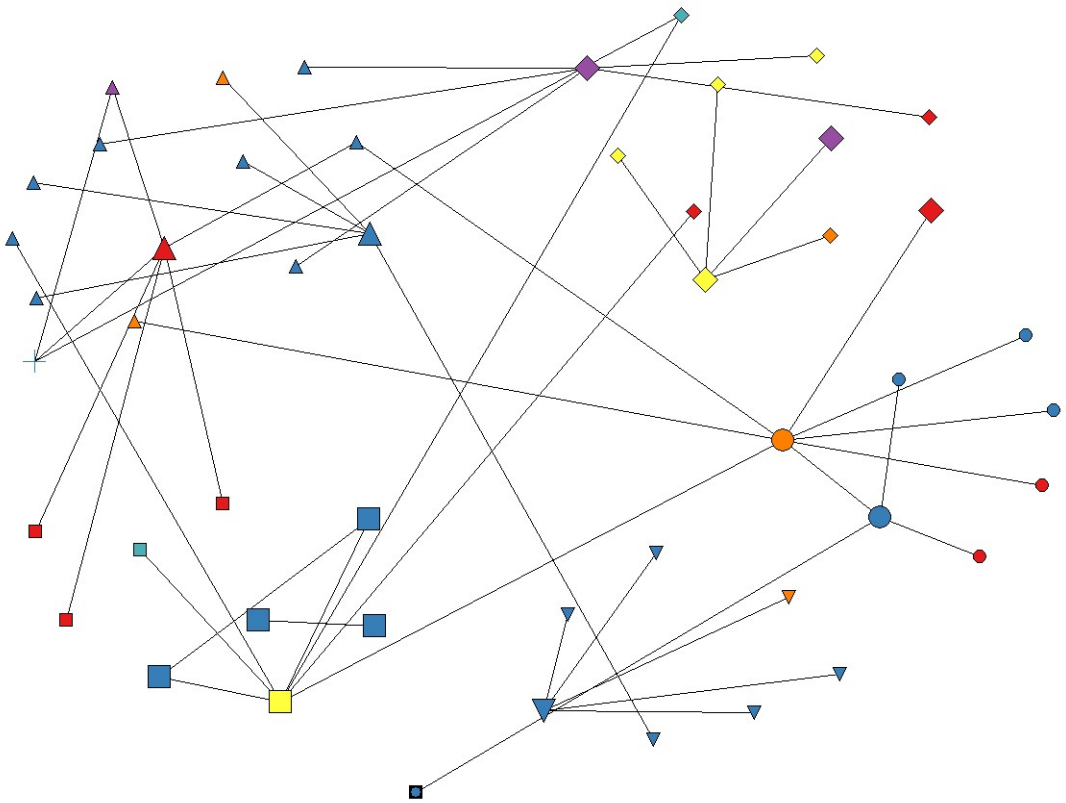


Figure 1 above represents responses to question 1, which assesses ties related to discussion of EIDM. The sociogram exhibits how when the nodes are grouped by division, there appears to be some clustering by division. However, the sociogram also portrays how some information sharing ties span divisional boundaries. In Figure 1 the ties do not indicate directionality in order to portray the existence of an equitable relationship for discussing EIDM. Whereas to show the flow of influence for question 2, which asks who encouraged the participant to use EIDM resources, the direction of the tie was reversed to show that the actors who were named were the ones who provided the encouragement to use EIDM resources. Figure 2 also exhibits characteristics of clustering by division and the existence of cross-divisional ties. Please see Figure 2 below.

Figure 2. Influence network for in-degree. Responses from question 2) Who within Manitoba Health, Healthy Living and Seniors encouraged, influenced or supported you to use EIDM resources in your work?

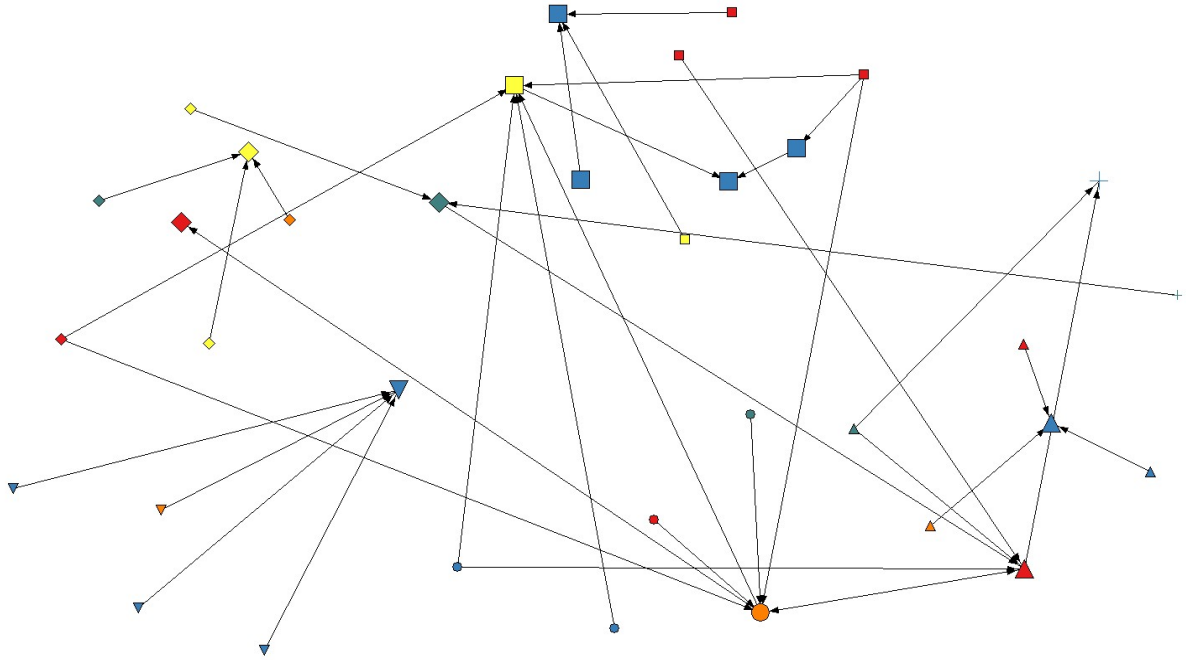


Figure 3. Influence network for out-degree. Responses from question 5) Who within Manitoba Health, Healthy Living and Seniors have you encouraged, supported or influenced to use EIDM resources?

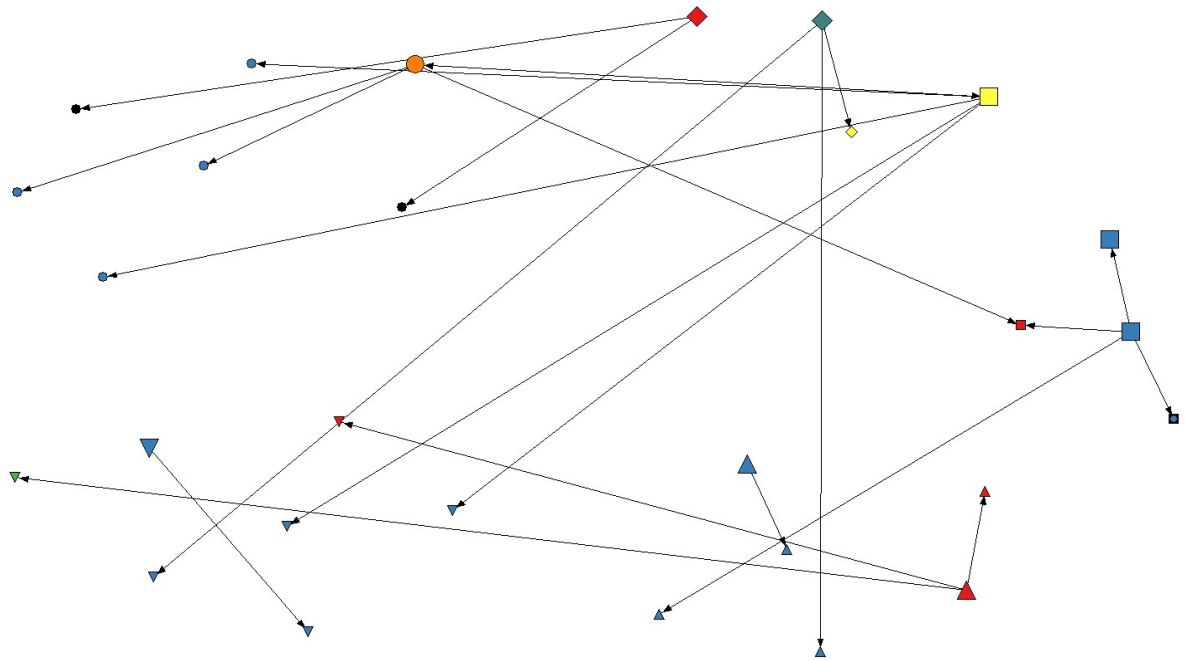


Figure 3 above shows the ties from the survey participants to the actors they named as people they encouraged to use EIDM resources. There appears to be proportionally a relatively large amount of cross-divisional ties for the actors who the participants have encouraged to use EIDM. To show the flow of influence for EIDM an influence network sociogram was also created with data combined from question 2 and 5 and is displayed in Figure 4 below. This sociogram appears to have both cross divisional ties, but also evidence of clustering by division as was observed in the networks for each individual question assessing encouragement and influence for EIDM.

Figure 4. Influence network. Combined responses from question 2 and 5: Who within Manitoba Health, Healthy Living and Seniors encouraged, influenced or supported you to use EIDM resources in your work, and who within Manitoba Health have you encouraged, supported or influenced to use EIDM resources?

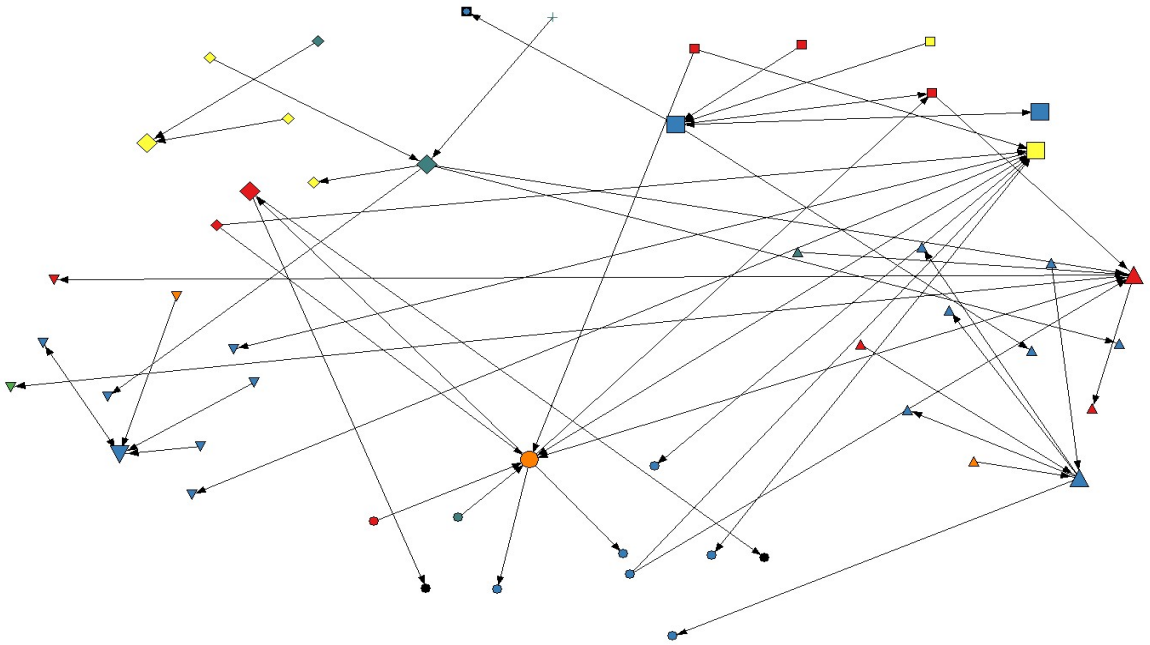
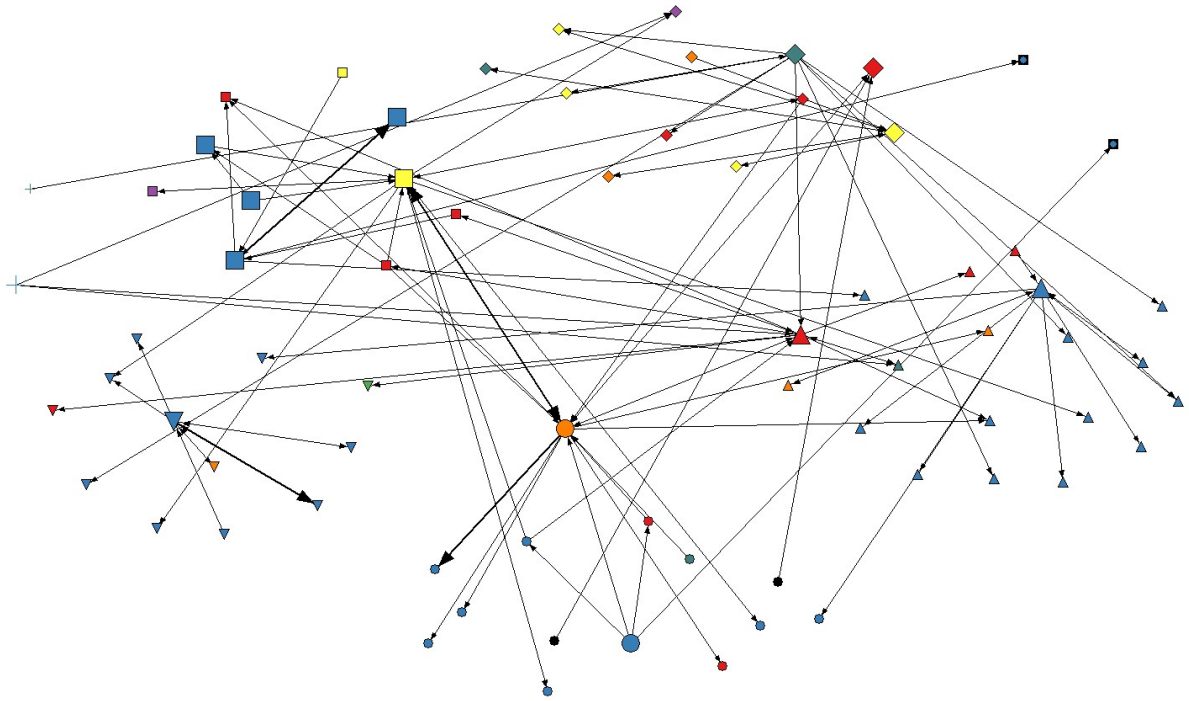


Figure 5. General EIDM network Combined responses from question 1, 2 and 5.



In order to show all reported ties related to EIDM within the organization the data from question 1, 2 and 5 were combined to create Figure 5. This shows the connections between all the nodes that have an EIDM related tie. As the same person may be named in different name generator questions, tie strength was portrayed in this network image by darker ties and arrows for contacts that were named multiple times. Furthermore, when the variable of tie strength is added there appears to be a relatively small number of ties that were named more than once in the survey questions.

Individual network measures. Centrality measures of degree and betweeness centrality were calculated to determine potentially influential members of the network based on position.

Information sharing network. For question 1 about EIDM discussion, degree and betweeness centrality were calculated for each node or actor. The centrality scores for a collection of actors with the highest scores are reported in Table 9, which has the actors in rank

order by degree centrality. Actors with the highest scores were all survey participants who had provided 5 named ties. The three actors with the highest degree centrality scores (8, 7, 6 respectively) also had the highest betweeness centrality scores (174.5, 114.4, 80.5 respectively). Among those with the highest centrality scores one was a director, one a manager, and one an executive director; all of which represent leadership roles on the EMT within Manitoba Health, Healthy Living and Seniors. Each of these central actors reported working in a different organizational division, Public Health and Primary Health Care, Administration and Finance, and Regional Policy and Programs. It is interesting to note that there were a few survey participants who had higher betweeness centrality than degree centrality and this is noted in Table 10 with an asterisk. Two Policy Analysts/Consultants who were both survey participants had degree centrality scores of 4 and 3 respectively, which represent the number of named ties each actor provided. Therefore, their higher betweeness centrality is most likely attributable to being connected to other actors who were well connected within the network.

Table 9. Question 1) Network Members with the highest degree and betweeness centrality

ID	Degree	Betweeness	Participant	Division	Role	No. of names provided
109	8.0	174.5	Yes	Public Health and Primary Health Care	Director	5
102	7.0	114.5	Yes	Administration and Finance	Manager	5
108	6.0	80.5	Yes	Regional Policy and Programs	Executive Director	5
112	5.0	10.0	Yes	Regional Policy and Programs	Policy Analyst/Consultant	5
113	5.0	10.0	Yes	Healthy Living and Seniors	Policy Analyst/Consultant	5
110	5.0	10.0	Yes	Provincial Policy and Programs	Other: Listed as a planner	5
111	4.0	63.0*	Yes	Public Health and Primary Health Care	Policy Analyst/Consultant	4
101	4.0	6.0	Yes	Provincial Policy and Programs	Manager	4
115	3.0	23.5*	Yes	Not listed	Policy Analyst/Consultant	3
131	2.0	29.0*	No	Provincial Policy and Programs	Statistical Analyst	N/A
140	2.0	0.0	No	Regional Policy and Programs	Other: Mentor	N/A

*Ordered by degree. * Indicates those with higher betweeness than degree centrality.*
Selected from total nodes, N=49

Influence network. To create the influence network with responses from question 2 and question 5 that asked participants who encouraged, influenced, or supported use of EIDM resources, the direction of the tie for question 2 was reversed in order to show the flow of EIDM influence. Therefore in this network the flow of influence or encouragement goes from the actors named by survey participants in question 2, to the participant, and from the participant to the

actors named by survey participants in question 5. In this network with the combined responses, out-degree represents the amount of influence or encouragement of EIDM. It is important to note that these measures are biased based on participants' responses, as the number of names the participant provided influenced the scores. The centrality scores are reported in Table 10 and they are ordered by out-degree because in this situation out-degree represents the direction of influence between the actors in the dyad. Survey participants once again exhibited the highest centrality scores. The actors with the highest out-degree and betweeness centrality were the same actors identified in question one. In this network three new actors were identified as having relatively higher betweeness centrality than degree centrality scores. One was an Executive Director from the division of Provincial Policy and Programs and two were Policy Analyst/Consultants, from the division of Public Health and Primary Health Care and Healthy Living and Seniors. Similar to the scores calculated from question 1, degree centrality is influenced most by the number of names provided by survey participants, and betweeness centrality is influenced by how the actors are connected to others within the network. All three of the actors with the highest centrality scores also reported adopting EIDM by searching for research and using EIDM resources. These actors also reported having received EIDM training from NCCMT and reported using NCCMT EIDM resources in their work.

Table 10. Question 2 and 5 combined) Network Members with the highest degree and betweeness centrality

ID	Out-Degree	In-Degree	Betweeness	Yes	Division	Role	No. of names provided Q2	Q5
109	6.0	6.0	181.0	Yes	Public Health and Primary Health Care	Director	5	4
102	5.0	5.0	81.5	Yes	Administration and Finance	Manager	5	5
108	4.0	5.0	157.5	Yes	Regional Policy and Programs	Executive Director	5	3
105	4.0	3.0	56.0	Yes	Administration and Finance	Policy Analyst/Consultant	3	4
112	4.0	3.0	12.0	Yes	Regional Policy and Programs	Policy Analyst/Consultant	3	5
110	4.0	2.0	38.0*	Yes	Public Health and Primary Health Care	Policy Analyst/Consultant	2	3
114	2.0	1.0	36.0*	Yes	Provincial Policy and Programs	Executive Director	1	2
125	2.0	0.0	0.0	No	Provincial Policy and Programs	Manager	N/A	
129	2.0	0.0	0.0	No	Public Health and Primary Health Care	Policy Analyst/Consultant	N/A	
113	1.0	4.0	3.0*	Yes	Healthy Living and Seniors	Policy Analyst/Consultant	4	1
150	1.0	2.0	60.0*	No	Administration and Finance	Executive Director	N/A	

*Ordered by out degree. * Indicates those with higher betweeness than out-degree centrality*
Selected from total nodes, N=50

Diffusion and discussion among branches and teams. For questions 1 and 5, survey participants had the option of selecting whether EIDM had been discussed or encouraged within a whole branch or team. Three survey participants indicated EIDM was discussed and encouraged within the branch in which they worked and the three participants provided the same information for both questions. One participant also listed two additional branches within the division in which they worked. The roles of the respondents who selected a whole branch or team included an executive director, a director, and a policy analyst/consultant. The branches that were named where EIDM had been discussed and encouraged included the Acute, Tertiary and Specialty Care branch within the division of Regional Policy and Programs; and the Public Health branch, Primary Health Care branch, and the branch of the Aboriginal and Northern Health Office within the division of Public Health and Primary Health Care. Two different survey respondents in different roles named the branch of Primary Health Care answered, which suggests that it was likely that EIDM was an idea that the branch as whole may have been adopting. Two of the three respondents who listed teams were actors with the three highest centrality scores, and the other respondent only listed the team and no individual members for question 5. Furthermore the three respondents who listed teams as actors were also individuals who attended NCCMT workshops and used NCCMT EIDM resources. This information suggests there are a few divisions and branches that may have been discussing and encouraging use of EIDM at the branch level, and this may have been partly in response to a few key individuals. These key individuals were also identified by others as encouraging EIDM, and could be considered to be opinion leaders for EIDM. However, for the most part people who participated in the survey did not list discussing or encouraging EIDM at the branch or team

level. It should also be noted that only 2 out of 6 divisions and 4 out of 34 branches were represented in the responses to questions about diffusion to whole branches.

Descriptive summary of characteristics of influential network members. Based on the data analysis a small number of identified actors appeared to be in positions of influence as identified by measures of centrality. Because their position in the network seemed to be influential for discussing EIDM and encouraging others to use EIDM resources, these individuals may be considered as being opinion leaders for EIDM. The three influential actors all reported using EIDM resources and conducting a search of the literature in the past 6 months, which are measures of EIDM adoption in this study. They were all in a position of leadership on the EMT, but occupied different roles. They were all from different divisions within Manitoba Health, Healthy Living and Seniors. In addition, since 2010 they have all worked in different divisions than they do now, and two of them worked in the division of Healthy Living and Seniors since 2010. They are diverse in their years of work at Manitoba Health, Healthy Living and Seniors with their years of work ranging from 2 and 17 years. Regarding EIDM training, they all reported having other EIDM training within Manitoba Health, Healthy Living and Seniors, and one actor reported having attended training outside of the organization. Two of the three influential actors reported having attended NCCMT workshops and all three reported using NCCMT resources. Other actors who named these influential network members as a tie characterized their relationship as that of a colleague and/or supervisor. Furthermore, these influential network members also report some ties to each other.

QAP regression analysis. To explore factors that influenced formation of a tie, a QAP regression was conducted. For the information-sharing network from the responses to question 1,

the independent variable was ties named in question 1 and the dependent variables included being in the same division and having the same role.

The results for both question 1, and question 2 and 5 combined, the R square was very small (0.081, 0.004 respectively), suggesting that this analysis only explains 8% of the variability for forming a tie for EIDM information sharing, and 0.4% of the variability of forming an influential tie. However, for both question 1 and question 2 and 5 combined, the R-square values were highly significant ($p=0.001$, $p= 0.006$ respectively).

The variables that significantly predicted a tie for both EIDM information sharing and EIDM influence was being in the same division. For the information-sharing network, being in the same division resulted in a very small statistically significant regression coefficient of 0.12 ($p<0.001$). For the influence network being in the same division resulted in a very small statistically significant regression coefficient of 0.002 ($p=0.029$). Having the same role was not a significant predictor of forming information sharing or EIDM influence ties, as the results were not statistically significant. The employees who participated in the survey were significantly less likely to have a tie for information sharing with other employees who chose to participate in the survey, with a very small regression coefficient of -0.069 ($p<0.001$), and more likely to have a tie related to EIDM influence with a very small significant regression coefficient of 0.001 ($p<0.001$).

These findings confirm that actors were significantly more likely to discuss EIDM or encourage others to use EIDM resources with other employees within their same division. This statistical analysis is a way to confirm the observations made of the sociograms that there appears to be a significant amount of ties that clustered by division for both the information

sharing and influence networks. The results of this QAP regression can be seen in Table 11 below.

Table 11. Results from QAP regression with same division, role and participation

	Information sharing network (Question 1) (N=49)	**Influence network (Questions 2 and 5 combined)** (N=50)
Model fit statistics		
R square	0.081(p=0.001)	0.003 (p=0.006)
Adjusted R square	0.080	0.002
Intercept	0.056	0.001
Unstandardized regression coefficients		
Same Division	0.116 (p<0.001)	0.002 (p=0.029)
Same Role	0.006 (p= 0.303)	-0.001 (p= 0.072)
Same Participation	-0.069 (p<0.001)	0.001 (p<0.001)

Relationship between centrality and participant attributes. To assess if centrality scores were normally distributed, bar charts were created. As the data does not appear to be normally distributed, a Spearman's correlation was used. The mean and standard deviation of the continuous variables of centrality scores and years of work are reported in Table 12. To visually assess the relationship between years of experience and centrality score, a scatterplot graph was created. The graphs show that degree centrality may increase with years of work, but there does not appear to be a strong linear relationship. Based on the results of the spearman's correlation, there appears to a positive, non-significant positive correlation between years of work and all types of centrality score. The results of the Spearman's correlation are reported in Table 13.

Table 12. Mean and standard deviation for continuous variables

Discussion Network (n=13)	**Mean (SD)**	**Influence Network** (n=10)	**Mean (SD)**
Degree Centrality	3.9 (2.4)	In-degree Centrality	2.9 (2.0)
Betweeness Centrality	36.0 (55.8)	Betweeness Centrality	50.9 (67.7)
Years of work	8.2 (6.9)	Years of work	9.4 (7.3)

Table 13. Spearman's Rho correlation for discussion network and influence network

Centrality measure and years worked	Spearman's Rho (p value)
Degree Centrality and years worked (n= 13)	10.2 (p= 0.532)
Betweeness Centrality and years worked (n= 13)	0.3 (p= 0.344)
In-degree centrality and years worked (n=10)	0.2 (p= 0.522)
Betweeness centrality and years worked (n=10)	0.1 (p= 0.835)

The following variables were assessed in the Man-Whitney test to assess if the variables of whether the participants had a graduate level education, whether participants were in a leadership role, whether participants had attended NCCMT workshops, and whether participants had used NCCMT resources had an effect on centrality scores. Based on the results of the Man-Whitney test, it appears that none of these variables were significantly associated with centrality. Therefore none of the variables were able to be included in the linear regression analysis. The results of the Mann-Whitney test for the centrality scores from the discussion network and influence network are reported in Table 14. This suggests that there were likely other variables not assessed that influenced centrality.

Table 14. Mann-Whitney test for discussion network and influence network.

Mann-Whitney test for Discussion Network centrality scores and participant attributes	**Degree Centrality**	**Betweeness Centrality**
Graduate education (n=10) *Mean rank*	6.7	6.9
Less than graduate education (n=3) *Mean rank*	8.2	7.3
Mann-Whitney U	11.5 (p=0.549)	14.0 (p=0.861)
Leadership Role (n=5) *Mean rank*	8.9	9.0
Not in leadership role (n=8) *Mean rank*	5.8	5.8
Mann-Whitney U	10.5 (p=0.158)	10.0 (p=0.130)
Attendance at NCCMT workshops (n=6) *Mean rank*	7.8	8.2
No workshop attendance (n=7) *Mean rank*	6.3	6.0
Mann-Whitney U	16.0 (p=0.469)	14.0 (p=0.301)
Use of NCCMT Resources (n=6) *Mean rank*	7.8	8.2
No use of NCCMT resources (n=7) *Mean rank*	6.3	6.0
Mann-Whitney U	16.0 (p=0.469)	14.0 (p=0.301)
Mann-Whitney test for Influence Network centrality scores and participant attributes	**In-degree Centrality**	**Betweeness Centrality**
Graduate education (n=7) *Mean rank*	5.4	6.3
Less than graduate education (n=3) *Mean rank*	5.8	3.7
Mann-Whitney U	9.5 (p=0.818)	5.0 (p=0.204)
Leadership Role (n=5) *Mean rank*	6.8	7.0
Not in leadership role (n=5) *Mean rank*	4.2	4.0
Mann-Whitney U	6.0 (p=0.171)	5.0 (p=0.113)
Attendance at NCCMT workshops (n=5) *Mean rank*	5.8	6.0
No workshop attendance (n=5) *Mean rank*	5.2	5.0
Mann-Whitney U	11.0 (p=0.752)	10.0 (p=0.597)
Use of NCCMT Resources (n=5) *Mean rank*	5.8	6.0
No use of NCCMT resources (n=5) *Mean rank*	5.2	5.0
Mann-Whitney U	11.0 (p=0.752)	10.0 (p=0.597)

Descriptive analysis of ego-networks. The percentage of each type of relationship reported by egos for each of the network questions was calculated. Based on the results of this analysis, it appears that approximately 73% of egos discuss EIDM with their colleagues and 40% of egos discuss EIDM with their supervisors. However, only 13% of egos report discussing EIDM with alters whom they consider to be friends, or an employee they supervise.

Approximately 47% of egos are encouraged to use EIDM resources by people they consider to be colleagues, while 40% are encouraged by their supervisor. No egos reported receiving encouragement from employees they supervise and only 6.7% reported receiving encouragement from an alter they considered to be a friend. Whereas when the ego was providing the encouragement to use EIDM resources, approximately 58% provided encouragement to alters they considered to be colleagues, and 17% to employees they supervised. Approximately 17% of egos reported providing encouragement for EIDM to alters who were their supervisor and alters they considered to be friends. The results of this relational analysis are reported in table 16 below.

Table 16. Ego network analysis of the percentage of the type of relationships reported for each network question

Characteristics of ego's relationship with alter	Frequency (Percent)
Ego discusses EIDM with an alter who is their supervisor (n=15)	6 (40.0)
Ego discusses EIDM with an alter who is an employee they supervise (n=15)	2 (13.3)
Ego discusses EIDM with an alter who they consider to be a colleague (n=15)	11 (73.3)
Ego discusses EIDM with an alter who they consider to be a friend (n=15)	2 (13.3)
Ego receives encouragement for EIDM from an alter who is their supervisor (n=15)	6 (40.0)
Ego receives encouragement for EIDM with an alter who is an employee they supervise (n=15)	0 (0.0)
Ego receives encouragement for EIDM with an alter who they consider to be a colleague (n=15)	7 (46.7)
Ego receives encouragement for EIDM with an alter who they consider to be a friend (n=15)	1 (6.7)
Ego provides encouragement for EIDM to an alter who is their supervisor (n=12)	2 (16.7)
Ego provides encouragement for EIDM to an alter who is an employee they supervise (n=12)	2 (16.7)
Ego provides encouragement for EIDM to an alter who they consider to be a colleague (n=12)	7 (58.3)
Ego provides encouragement for EIDM to an alter who they consider to be a friend (n=12)	2 (16.7)

When the proportion of alters that have certain attributes are calculated for each network question it was found that 80% of egos reported discussing EIDM with alters who were in leadership roles within the organization on the EMT. Furthermore, discussion ties were more likely to occur with alters who worked within the same organizational division as approximately 73% of discussion ties between egos and alters were with members of the same division. For receiving encouragement to use EIDM resources, approximately 67% were encouraged by alters who were in a leadership role, and 60% were encouraged by alters who worked within the same division. Whereas approximately 50% of egos who participated in the question about providing EIDM encouragement reported encouraging alters who were in leadership roles on the EMT, 50% encouraged alters who worked in the same organizational division. Therefore it appears discussion ties are primarily intra-divisional, while encouragement ties for EIDM may occur more often between divisions than discussion ties. In addition network members who were in leadership roles appeared to have played an important role in encouragement for EIDM.

There was minimal overlap of ties in the three network questions. The most overlap was observed in ties for discussion and receiving encouragement to use EIDM with approximately 26% of ties in both networks, therefore approximately one quarter of people named as discussion partners were also named as having encouraged EIDM. There was only 6% of overlap between the ties for discussion of EIDM and providing encouragement for EIDM, and 6.5% overlap in networks sending and receiving encouragement for EIDM. This suggests that only 6% of those within the network who provided encouragement for EIDM were named as discussion partners, or someone egos encouraged or influenced for EIDM. The results of the percentage of alter attributes for each network question is reported in Table 17, and the percentage of overlap between the network questions are reported in Table 18.

Table 17. Ego network analysis of the percentage of alter attributes for each network question

Characteristics of alter attributes	Frequency (Percent)
Ego discusses EIDM with an alter who is in a leadership role on the EMT (n=15)	12 (80.0)
Ego discusses EIDM with an alter who works in the same division (n=15)	11 (73.3)
Ego receives encouragement for EIDM from an alter who is in a leadership role on the EMT (n=15)	10 (66.7)
Ego receives encouragement for EIDM with an alter who works in the same division (n=15)	9 (60.0)
Ego provides encouragement for EIDM to an alter who is in a leadership role on the EMT (n=12)	6 (50.0)
Ego provides encouragement for EIDM to an alter who works in the same division (n=12)	6 (50.0)

Table 18. Proportion of overlap between the three networks

	Frequency (Percent)
Ties for both discussion and receiving encouragement for EIDM (n=54)	14 (26.0)
Ties for both discussion and providing encouragement for EIDM (n=66)	4 (6.0)
Ties for both sending and receiving encouragement for EIDM (n=62)	4 (6.5)

Discussion

The purpose of this research was to conduct an initial exploratory study to better understand how interpersonal interactions contributed to the spread of EIDM and to determine the extent that the ideas of EIDM have diffused throughout the organization Manitoba Health, Healthy Living and Seniors. Despite low participation in the survey as a whole, overall the survey questions had relatively high completion rates by participants. The exception being question 5, "Who within Manitoba Health have you encouraged, supported or influenced to use EIDM resources?" in which 25% of participants selected not to participate. The declining participation may be due to a variety of factors including the length of time and attention required to complete the survey and the relative effort required for participants to answer name generator questions as well as the sensitive nature of the questions (De Lange, Agneessens, & Waege, 2004; Marsden, 2005; Valente, 2005). Question 5 was the third name generator question on the survey, and it is possible participant fatigue from answering multiple name generator questions was a factor in the lower participation for this question. Furthermore, this question may be considered to be more sensitive in nature as it asks participants to disclose if they have influenced people in their network. Therefore, instead of saying they had influenced no one to use EIDM resources, some participants may have preferred to be excluded altogether from the analysis of this question.

However, despite the overall low participation this study has discovered information about a small group of employees that appear to have an interest in EIDM, are aware of EIDM, and use a variety of EIDM resources in their work. Approximately half of the participants have moved organizational divisions since 2010, and approximately 13% moved divisions more than once during that time. Many participants have no formal training in EIDM, with over half of

participants reporting never having attended a workshop with NCCMT or other EIDM training within or outside Manitoba Health, Healthy Living and Seniors. Approximately half of the participants are in leadership roles in the organization as defined by roles on the EMT, with the other half of participants representing employees primarily in the role of policy analysts/consultants. Almost all of the survey participants reported behaviours that indicate adoption of EIDM and most participants reported using EIDM resources in their work to develop and analyze options and identify needs, gaps or issues. These behaviours all suggest the networks described by the participants in this study are a picture of a sub-set of the whole organization that is interested in EIDM and has taken steps to adopt EIDM in their work. The original research questions will now be reviewed in the context of this study's findings.

Research Questions.

1. To what extent are EIDM practices reported throughout the organization, Manitoba Health, Healthy Living and Seniors?

This study measured EIDM practices of searching the literature and use of EIDM resources as measures of adoption of EIDM. The extent that EIDM practices are reported throughout Manitoba Health, Healthy Living and Seniors represents diffusion of EIDM. Among survey participants approximately 88% reported adopting EIDM as measured by conducting a literature search recently, and 94% reported using EIDM resources. This study found that all the organizational divisions were represented at some point in the different network maps, which suggests the behaviours or practices that indicate adoption of EIDM have to a small extent reached every division. Four out of six divisions were adequately represented in the networks of the survey participants and the contacts they named, which can be seen in Figure 5. The survey results also show that EIDM has been discussed at branches within the divisions of

Administration and Finance, Regional Policy and Programs, Provincial Policy and Programs and Public Health and Primary Health Care. This suggests the ideas of EIDM have been shared to whole branches or teams within four of six divisions in the organization. The Health Workforce Secretariat was the only division without representation in the survey, and there was little response from the division of Healthy Living and Seniors that recently merged with the health department.

This study aimed to understand the diffusion of EIDM, however the diffusion literature highlights many challenges with collecting sufficient data to represent accurate diffusion of innovations (Meyer, 2004). The results from the two questions measuring EIDM adoption suggests that those who selected to complete the survey appear to be employees who were familiar with EIDM, which could have influenced their choice to participate. The high percentage of survey respondents who reported searching the literature and using EIDM resources emphasizes that the survey respondents reported behaviours that indicate adoption of EIDM. However it is likely that survey participants represent members of the organization who were already interested in, and possibly in favor of EIDM. Those who participated in the survey appear to be engaged in EIDM, possibly more so than non-respondents, and therefore, the results presented here may overestimate adoption of EIDM behaviours across the whole organization. Also, the assessment of the extent of the diffusion of EIDM is limited by the accuracy of the measures and the participant responses. For example, the selection of EIDM resources was developed in collaboration with the Manitoba Health, Healthy Living and Seniors so the survey would be applicable and relevant to the participants. However, some of the EIDM resources may provide access to evidence for use in decision making rather than supporting the formal process of EIDM. Furthermore, any measure of the extent of diffusion is simply an indication of the

current level of adoption. Because diffusion is a process that occurs over time (Rogers, 2003), it is possible that the ideas of EIDM may continue to spread to new employees in the organization as time progresses.

The state of diffusion and adoption of EIDM through an organization is specific to the organizational context. The literature suggests that efforts need to be made at a local health department level to enhance an organizational culture and climate that is supportive of evidence-based public health (Brownson et al., 2014). Furthermore, research by Brownson and colleagues (2014) indicates that to effectively enhance evidence-based public health, it is not likely that there will be a "one-size fits all approach" that will be effective for all public health department contexts (p. 54). In the nursing literature, when diffusion of nursing best-practice guidelines was promoted through practice champions, tailoring the implementation strategies to the organizational context was associated with successful diffusion and implementation (Ploeg et al., 2010). However, Brownson and colleagues (2014) suggest that in order to achieve an organizational culture and climate supportive of evidence-based public health necessary factors include having a social network supportive of evidence-based public health, committed leadership, and a critical mass of interested employees. The findings of the current study indicate there may be a group of employees interested in EIDM within Manitoba Health, Healthy Living and Seniors, which may have played a role in EIDM diffusion, however due to the limitations of the collected data the full extent of diffusion is not known.

2. How has interpersonal interaction facilitated the spread of EIDM throughout the organization?

This study measured how the ideas of EIDM appear to have spread through the interpersonal interactions of discussing EIDM and encouragement to use EIDM resources. Based

on the results of the QAP regression, this study found that employees are significantly more likely to develop ties related to EIDM with other employees within their own division in both the information sharing and influence networks. This finding may be somewhat expected, as it seems highly likely that those who work together in the same division are more likely to develop connections due to professional and physical proximity. Moreover, in the ego network analysis it appeared that most of the discussion ties were intra-divisional, while encouragement for EIDM occurred both between divisions and within divisions, which suggests the presence of influential discussion and influence ties within divisional boundaries. This finding is echoed by Yousefi-Nooraie and colleagues (Yousefi-Nooraie et al., 2012) who, in a similar study, found that the communication networks within a Canadian health department were often segregated by organizational division. The social network literature also identifies that local networks can influence behaviour. A study investigating the effect a physician's network had on their prescribing behaviour found that physicians who worked together tended to have similar prescribing behaviour (Fattore, Frosini, Salvatore, & Tozzi, 2009). Fattore and colleagues (2009) concluded this finding demonstrated the network effect of social influence. This finding of the localized nature of networks based on physical proximity is supported in several other social network studies (Coleman et al., 1966; West et al., 1999; West & Barron, 2005; Yousefi-Nooraie, Dobbins, & Marin, 2014)

In the current study, the assessment of the sociograms appear to show that the respondents to the survey seem more likely to report receiving encouragement from a supervisor and providing encouragement to an employee they supervise. Furthermore, 40% of participants reported discussing EIDM with their supervisor and 40% reported receiving encouragement for EIDM by their supervisor. However, overall, respondents appear most likely to discuss or

encourage use of EIDM with other employees they consider to be colleagues with 74% of participants reporting discussing EIDM with fellow colleagues. The importance of supervisory and/or leadership roles are confirmed in the social network research literature. Yousefi-Nooraie and colleagues (2012) found that individuals who occupied a central position within the network of a public health organization were more likely to be members of a supervisory/administrative division. Moreover, in an analysis of network data from professional consultants and mangers in a public health department, mangers were determined to be in a central position in the information-seeking networks (Yousefi-Nooraie et al., 2014).

Because of the low participation rates in the study, the options for viewing the EIDM networks from an ego-network perspective was explored, as ego-networks are a way to understand how the personal networks of individual actors influences their behaviours (Valente, 2010). Although many network studies utilize this perspective (Burt, 1984; B. H. Erickson, 2004; Marsden, 1987; Wellman, 1979), that was not the analysis strategy that was originally planned. The findings of this descriptive ego-network analysis indicates that most survey participants listed ties to people in leadership roles on the EMT, with 80% of participants saying they discussed EIDM with someone in a leadership position and 67% were influenced by a person in a leadership position. The discussion and encouragement of EIDM was also reported to have occurred within whole branches within the organization, and it appears that the actors with the highest centrality scores who may be considered opinion leaders for EIDM were the same actors who reported discussing and encouraging EIDM at the branch level. The literature also reflects the important role committed leadership plays in supporting climates conducive to EIDM (Brownson et al., 2014; Dodson, Baker, & Brownson, 2010; Peirson, Ciliska, Dobbins, & Mowat, 2012b; Stetler, Ritchie, Rycroft-Malone, Schultz, & Charns, 2009).

3. Have public health professionals from the Public Health and Primary Health Care division who attended the original 2010 NCCMT workshop influenced the spread of EIDM to other divisions and the executive management team?

Unfortunately there was not enough participation from the original 2010 NCCMT workshop group to draw any firm conclusions about the role this group may have played in the diffusion of EIDM. However, the participants' interest in EIDM and the identification of influential network members who were not from the original workshop group suggests there are likely a variety of factors that have influenced the diffusion of EIDM in this organization outside of this original workshop group. Despite the fact the sampling strategy was designed in collaboration with Manitoba Health, Healthy Living and Seniors to include participants from the original 2010 workshop group, the low response from this group has led to inconclusive information about the role the 2010 workshop group has played in the EIDM diffusion process.

4. What are the roles, relationships, and attributes of the network members who have had the greatest influence on use of EIDM by others?

The participants who were identified as having the highest centrality scores may be considered opinion leaders for the diffusion of EIDM. In this study the three members who consistently had the highest centrality scores from a variety of measures held leadership roles on the EMT, but they each came from different divisions within the organization and had all moved divisions 1-2 times since March 2010. In addition, they all had formal EIDM training within Manitoba Healthy, Healthy Living and Seniors and all reported using NCCMT resources, while two out of three reported having attended an NCCMT workshop. Also the same central members were identified in both the information-sharing network and influence network, suggesting their

central position appears to be consistent between the networks of EIDM information sharing and influence.

It is important to note that the findings discussed about the central members in the network should be interpreted with caution. Although these participants have been identified as holding central positions, the identification of those who are most centrally located in the EIDM networks is very limited by the data obtained. In whole networks with more comprehensive and complete data, betweeness centrality may represent being in a strategic position of frequently lying on a path between other nodes in the network (Valente, 2010). However, Valente (2010) describes how when response rate is low and more data is missing from the network, that simple measures such as degrees and closeness are relatively robust, whereas measures that evaluate the structure of the network are more vulnerable when data is missing; in-degree has been shown to be much more robust than betweeness centrality (Costenbader & Valente, 2003; Valente, 2010). Because this data is limited by the low response rate, it is difficult to form any strong conclusions at this time based on the calculations of degree and betweeness centrality, because it is not known if these same members would occupy a central position in a more complete picture of the network.

In this study, the relationships of supervisor and colleague were the most frequently reported relationships for ties related to EIDM and the majority of participants reported ties to employees in leadership and management roles. This finding that those in supervisory or leadership positions were important in supporting EIDM is consistent with the network literature. When exploring information-seeking ties in public health, Yousefi-Nooraie and colleagues (2014) identified that being in a position of superiority by working in an administrative division within the health department were factors that contributed to the formation of information-

seeking ties. However the particular organizational context is important for understanding the role a hierarchy plays in the formation of network ties. West, Barron, Dowsett and Newton (1999) compared the networks of nursing managers and physicians and found the networks of nurse managers to be more concerned with the vertical hierarchy than that of physicians where communication was more horizontal in nature and considered to be more egalitarian. The researchers concluded that professional differences were associated with differences in the professional networks between the two professions (West et. al., 1999). Therefore, the literature suggests leadership and/or hierarchical roles effect the development of influential ties within a network, but the extent of influence hierarchical roles may depend on the specific context. Likewise, the knowledge translation literature frequently acknowledges the importance of committed leadership to support a culture conducive to the effective implementation of EIDM (Brownson et al., 2014; Dodson et al., 2010; Peirson, Ciliska, Dobbins, & Mowat, 2012b; Stetler et al., 2009; Ward & Mowat, 2012).

In this study, there was not a statistically significant relationship between being in the same role and the existence of a tie for EIDM information sharing or influence, based on the results of the QAP correlation. Based on the idea of homophily we would expect people of similar positions to be more likely to have a tie to each other (McPherson et al., 2001). In the literature, being in the same organizational role appeared to be a significant factor in the formation of a tie as suggested by Yousefi-Nooraie and colleagues (2014). Managers were more likely to turn to other managers for advice than professional consultants (Yousefi-Nooraie et. al., 2014). Likewise, in a study by West and Baron (2005) the discussion partners named by doctors, nurses, and health care managers were most often in the same role, so doctors tended to turn to doctors and nurses turned to nurses. In the current study the reason this phenomenon of

homophily by role was not observed might be due to the limited sample size, or the context of the professional environment within a government health department. It is possible that in this healthcare setting similarity of role may not be as important a factor in determining the formation of information sharing or influence ties as it is within a front-line public health or hospital setting

In the current study, friendship ties also did not appear to play a noteworthy role in the EIDM information sharing and influence networks, despite friendship appearing as an influential relationship in the literature. In contrast to the findings of this study, when exploring physician behaviours of adopting electronic health records, Zheng and colleagues (2010) found that physicians were influenced to a greater extent by their friendship ties, than those who were considered professional peers. Moreover, Yousefi-Nooraie and colleagues (2014) identified friendship as a significant predictor of information seeking ties and managers were also identified as having larger friendship networks (Yousefi-Nooraie et al., 2012). Furthermore, in the diffusion literature, the study by Coleman and colleagues (1957) found ties of a professional nature including those whom physicians turned to for advice were more influential with early adopters of the innovation, where friendship was of greater significance for those who adopted later (Coleman et al., 1957; 1966; Rogers, 2003). Therefore, despite support in the literature for the importance of friendship ties, this did not appear to be an important type of relationship in ties related to EIDM in this specific context. A possible reason for this could be that friendship ties may not have been as important in the diffusion of EIDM within this organization. However it could also be due to how the social network questions were asked on the survey. Some social network studies ask specifically about friendship ties directly, where in this study the social network questions specifically asked about ties related to EIDM, and then asked participants the nature of the relationship, which could be defined as a friendship.

5. Did education or training in EIDM other than the 2010 workshop contribute to the diffusion of EIDM?

In this study it appears EIDM diffusion and adoption has occurred throughout the divisions of the organization, however based on the very limited participation by members of the 2010 workshop group, it is difficult to know the role the original workshop group played in the diffusion process. Based on the small sample of employees that appear interested in EIDM, it appears 56% of survey participants received some type of formal EIDM training within Manitoba Health, Healthy Living and Seniors, and 38% received training from NCCMT. However, only 1 survey participant was from the original workshop group, therefore the data is not sufficient to draw conclusions at this time. Although, it is notable that the identified opinion leaders all reported using NCCMT resources, and two out of three reported attending an NCCMT workshop. The information from the survey suggests that use of NCCMT resources and attendance at workshops may have encouraged EIDM in some employees, but that there are likely other EIDM resources and external organizations that have encouraged the diffusion of EIDM within Manitoba Health, Healthy Living and Seniors.

Training in EIDM is an important variable for understanding EIDM knowledge, skills and behaviours. The literature suggests workshops and training in EIDM show a significant increase in EIDM knowledge immediately following the training in groups of public health professionals (Forsetlund et al., 2003; Yost, Ciliska, & Dobbins, 2014), and clinical professionals (Awonuga et al., 2000; Shuval et al., 2007; R. S. Taylor, Reeves, Ewings, & Taylor, 2004). Furthermore, an intensive one week workshop on EIDM has been shown to be effective at retention of EIDM knowledge and skills over a six month time period (Yost et al., 2014). However in this study by Yost and colleagues (2014), EIDM behaviors increased, but not to a

statistically significant extent following the training. Moreover, the study found a weak non-significant correlation between EIDM knowledge and skills and EIDM behaviours (Yost et al., 2014). Regarding the relationship between EIDM training and social influence, in a social network analysis study, Yousefi-Nooraie and colleagues (2014) found a relationship between the extent of evidence-based practice measured by an assessment tool, and being recognized as both an information source and an expert by peers. Therefore, it is possible that those with more training and expertise in EIDM may be more likely to influence the diffusion and adoption of EIDM among their colleagues. However, based on the limited participation in the study it is not known how education and training in EIDM affected employees who chose not to participate, so consequently the findings are limited by the sample of participants.

6. Are there influential network members in EIDM but who have had no formal training?

The survey results show that identified opinion leaders all had formal EIDM training. The three network members who consistently showed the highest degree and betweeness centrality scores all had formal EIDM training, and two out of three participated in NCCMT workshops. Therefore it does not appear that there were influential network members for EIDM who have not had formal training, however because of the low participation in the study the story of those who chose not to participate in not known. Overall, the knowledge translation literature highlights the importance of training in EIDM, and the need for training in EIDM in order to overcome barriers to effective knowledge use (Brownson et al., 2014; Dobbins, Hanna, et al., 2009a; Dodson et al., 2010; Peirson, Ciliska, Dobbins, & Mowat, 2012b; Yost et al., 2014).

7. Did factors related to the organizational structure contribute to the diffusion of EIDM?

The findings of the survey suggest that 50% of the survey participations reported having moved divisions since 2010, and 13% reported moving more than once. Based on the results that

two of the three influential network members appear to have moved to multiple divisions and report ties within the divisions they previously worked in, this suggests that moving divisions may be a factor that results in the formation of some EIDM related ties. However, overall the results suggest that discussion of EIDM is more likely to occur between employees of the same division. Shifts in organizational priorities and re-structuring are realities faced in health care practice, and the literature suggests that changes to the practice environment can have an impact on effective implementation of EIDM (Bowen et al., 2009; Traynor, Dobbins, & DeKorby, 2014). Furthermore the network literature suggests that the network structure will change as a result of increased diversity and variety in network ties (B. H. Erickson, 1997).

In summary, even with limited data it appears that EIDM has spread through the organization well beyond the division of Public Health and Primary Health Care that originally participated in NCCMT led workshops in 2010. Factors that influenced the spread of EIDM include interpersonal influence and encouragement, primarily through colleagues and supervisors. Furthermore it appears discussion ties occur primarily within organizational divisions, where encouragement for EIDM appears to occur within and outside of employees' organizational division. It also appears that training from NCCMT and other training within and outside of Manitoba Health, Healthy Living and Seniors may have contributed to the diffusion process. This study identified three individuals from EMT who consistently acted as opinion leaders who were influential in the diffusion and adoption of EIDM in this organization.

Limitations and Challenges

There are many limitations to the findings of this research. Because of the low participation rate in this study, it is difficult for any strong claims to be made regarding this information portraying the whole network of Manitoba Health, Healthy Living and Seniors. For

this reason a descriptive ego-network analysis was also conducted. The limitations of the conclusions that can be made based on the data were considered during the discussion of each research question. Therefore this discussion of the limitations and challenges will first discuss the challenges inherent to utilizing a network approach, followed by a reflection and analysis of methods used in this study, and a discussion of the specific limitations within the context of this study.

Challenges to social network analysis research. There is increasing interest in utilizing a social network approach to research in the field of nursing and knowledge translation. The nursing literature describes a social network perspective as relevant to the core nursing values of understanding whole person, family centered care and the influence of social and physical environment, such as in school health promotion (Pow, Gayen, Elliott, & Raeside, 2012). Pow and colleagues (2012) assert that social network analysis is an "important addition to the tool kit for researchers in nursing" (p. 2777). In knowledge translation research there is an interest in the use of opinion leaders to support behaviour change, which has lead to a growing interest in social network analysis methods for identifying opinion leaders (Chambers et al., 2012; Farley, Hanbury, & Thompson, 2014). Therefore it is highly important to understand the challenges and limitations of conducting social network research.

As an approach to research, social network analysis has a number of limitations. First, social networks by their nature do not remain stagnant, rather they will continually remain in flux as new connections are added, and existing ties change as a result of evolving relationships, changing contexts and personal mobility. Therefore, even when a network is studied at one point in time, the accuracy of the network is limited to that particular point in time. This is a reason longitudinal network studies are needed, as cross-sectional methods without a comparator are not

able to show the effect of social network analysis over time (Chambers et al., 2012). Another limitation of social network analysis relates to the limited generalizability of findings. As a network study focuses on the relational ties on a specific setting or context this limits the transferability of the findings beyond the context of the study (Chambers et al., 2012).

Diversity and variety within the field of social network research. A challenging aspect of social network analysis research is the diversity of methods and approaches that are used, such as the variety of theories that guide the network research ranging from diffusion of innovations theory (Coleman et al., 1966; Rogers, 2003), to social capital (Burt, 1997; Lin & Erickson, 2008), and the various network perspectives that can be explored from whole sociocentric networks, to egocentric networks (Marsden, 1987; Valente, 2010). Furthermore various methods are employed within social network analysis research. These include methods of name generator questions which tend to focus on strong tie relations and core networks (Marsden, 1990), position generator techniques which examine weak ties and tie diversity (B. H. Erickson, 1996; Lin & Dumin, 1986; Lin & Erickson, 2008) and resource generator instruments which examine diversity of resources available through network connections (Van der Gaag, Snijders, Tom AB, & Flap, 2008). In network research there is diversity in the types of relationships that can be explored, such as close ties of friends and colleagues (Coleman et al., 1957; 1966), and discussion about "important matters" (Burt, 1984, p. 331; Marsden, 1987 p. 123), work relationships and communication (Creswick, Westbrook, & Braithwaite, 2009; Lewis, Baeza, & Alexander, 2008; Patterson et al., 2013), and information seeking ties (Yousefi-Nooraie et al., 2012; 2014). Also the methods of measuring ties can vary, from dyadic, binary, directional, or weighed ties (Hannerman & Riddle, 2005; Valente, 2010). Furthermore, utilizing a network perspective can involve a variety of study designs such as quantitative surveys delivered by pen

and paper, electronically or by interview (Coleman et al., 1966; Lewis et al., 2008; Marsden, 1987; Yousefi-Nooraie et al., 2012), and qualitative research such as case studies and ethnographies (Ormrod, Ferlie, Warren, & Norton, 2007).

In addition, in the network research literature there is tremendous diversity in the settings in which social network research is applied. The settings in which the role of networks have been studied range from general social surveys and/or census surveys (Burt, 1984; B. H. Erickson, 2004; Marsden, 1987), to specific physical communities and a variety of social settings (Childress & Friedkin, 2012; B. H. Erickson & Nosanchuk, 1984; Wellman, 1979), to workplaces and companies (B. H. Erickson, 1996) and specific health care settings and contexts (Becker, 1970; Chambers et al., 2012; Coleman et al., 1957; Creswick et al., 2009; Cunningham et al., 2012; Mascia & Cicchetti, 2011; Yousefi-Nooraie et al., 2012). This diversity and variety within the field of research adds additional challenges for new researchers interested in exploring social network analysis as an innovative strategy to utilize in their research.

Although social network research has been conducted since the 1950's (Valente, 2010), the types of questions that can be asked and the general approach used in network research and is still new to many potential participants. Furthermore the literature suggests the sensitive nature of the questions about personal interactions may result in participants who are concerned about the risk their responses may be disclosed (De Lange et al., 2004). Social network questions pose the additional challenge of being time consuming and challenging to complete as participants are required to think of their interactions, provide names of contacts, and their characteristics (De Lange et al., 2004; Marsden, 2005). According to De Lange and colleagues (2004), low responses to social network questions is more common due to the sensitive nature and relatively high burden that answering them requires.

Challenges to methods used in this study. In the current study some of the methods used pose additional challenges and may have contributed to the limited response rate.

Data collection. An electronic survey was selected for data collection in this study and self-administered surveys have been successfully used in similar research studies (Yousefi-Nooraie et al., 2012; 2014). With the goal of collecting whole network data on a large organization, a self-administered electronic survey seemed to be an appropriate and feasible strategy for data collection. As previously mentioned, name generator questions are challenging for participants to answer, and use of a roster may have improved participant recall (Marsden, 2005). Other options that have been proposed and/or successfully used in the literature include pen and paper surveys with health care employees directly at their workplace (Patterson et al., 2013; Sales, Estabrooks, & Valente, 2010). It is possible these in-person methods for data collection may have improved awareness of the study and possibly improved response, but it is not known to what extent, given that participation in the study was voluntary. Using survey instruments to guide interviews is another data collection strategy that has been used in network research literature (Burt, 1984; Coleman et al., 1957; Marsden, 1987; 2005). Although this approach to data collection is time consuming, this strategy may have supported more participation from a targeted group of potential participants. An added advantage to this approach is participants would have been able to discuss potential questions or concerns with the researcher. Marsden (2005) suggests that name generator questions are more complicated than conventional survey questions, and use of an interviewer can be advantageous if participants require assistance to complete them. However, the literature asserts that self-administered surveys are practical from the perspective of time and resources required to conduct data collection and are widely used in research (Kho, Rawski, Makarski, & Brouwers, 2010). Kho

and colleagues (2010) describe, self-administered surveys as an essential tool for knowledge translation and health service research. However because surveys can be plagued with low response rates, Kho and colleagues concluded that even when evidence-based methods are used to recruit for self-administered mail surveys, that recruitment should involve up to five times the required sample in order to obtain necessary response rates.

Although there is mounting interest in use of social network techniques, there is evidence from recent studies that use of sociometric methods can result in very limited data for use in research or the development of behaviour change interventions. In a recent study to assess methods for identifying opinion leaders, two questionnaires were evaluated, a sociometric questionnaire with name interpreter questions including, job roles, the direction of contact, frequency and mode of communication, and a brief nomination tool with fewer additional questions. The full sociometric tool and a brief nomination tool were trialed in a randomized controlled trial and both had very low response rates of 13-15% (Farley et al., 2014). Based on the results of this trial, Farley and colleagues (2014) concluded that utilization of social network techniques required high levels of engagement from researchers and respondents and recommended further investigation of non-questionnaire based methods for identifying opinion leaders. The results of the current study which used similar methods to the ones evaluated by Farley and colleagues showed a similar low response rates at less than 10% of potential participants who completed the survey. Despite this limitation, Marsden (2005) asserts that surveys are extensively used in network research and requires modest demands of participants and researchers compared to alternative data collection options such as diaries and observation, which also create additional challenges. Therefore, in future network studies careful consideration of the method of collecting network data should be made.

There are network studies that have demonstrated more successful participation than was observed in the current study. A recent network study by Gainforth and colleagues (2014) had a response rate of 72% (N=56/78) among employees of a community based organization. In this study the sample was well defined, and a roster approach was used which are strategies that may have facilitated participation. However it is interesting to note that volunteers at the organization were invited to participate in the study, but with a low response rate of 9%, they were excluded from analysis. Based on the information in the literature suggesting that participation may be low in network studies, in future studies extra effort and planning to promote participation should be incorporated into the negotiations with organizations during the initial planning phases of the study.

Survey development. Another important factor that may have contributed to the challenges experienced with response rates is the complexity of the survey. In this study the final administered survey was complex in nature and asked many questions associated with both network ties and the use and spread of EIDM. The literature suggests questions that are burdensome to complete are more likely to be skipped by participants (De Lange et al., 2004; Tourangeau & Smith, 1996). In the current study, all survey questions related to important research questions, however future social network studies should consider ways to reduce the respondent burden as much as possible.

In this study to ensure the survey questions were relevant to Manitoba Health, Healthy Living and Seniors employees, input and feedback was sought from one member of the organization. However some preliminary field work and additional effort to build a relationship with the organization and may have lead to slightly different survey questions and implementation strategies that could possibly have been more effective at soliciting a higher

response rate. In social network research in the traditional sociology domain, it is common for preliminary fieldwork to be conducted. For example, when exploring the sensitive ideas of esteem and disesteem within a bounded network, Erickson and Nosanchuck (1984) conducted extensive field work prior to developing the questionnaire, to study network relationships associated with performance, prestige, deviance and disapproval. In this extreme example the fieldwork included ten years as a participant observer (B. H. Erickson & Nosanchuk, 1984). Although intense amounts of fieldwork are not possible or practical in most research projects, effort to build effective relationships and learn about the community under investigation is a strategy that may result in social network questionnaires that are more effectively tailored to the group under investigation, and increased engagement and participation in the research.

Furthermore, due to the low participation in the survey that was observed, in hindsight use of an egocentric approach may have provided more options for analysis. If the goal at the outset was to conduct an egocentric social network analysis, the survey questions could have been designed slightly differently. The survey questions could have focused on who the participants are friends with within the organization, whom they most often worked with, who their supervisors and superiors were, and then ask if they ever discussed EIDM or were encouraged to use EIDM resources by any of their contacts. This approach would have resulted in answering slightly different research questions on the effect of social influence on adoption of EIDM, rather than understanding the diffusion of EIDM through the organization as a whole.

Sampling. When designing this study, various methods of sampling were considered. Early in the conception and design of this study understanding the role employees who attended the first NCCMT workshops played in the diffusion process was of interest. Initial ideas of how to study this organization included directly contacting employees in the 2010 NCCMT workshop

group to inquire about whom they have discussed EIDM with, and whom they may have encouraged to use EIDM, and use of snowball sampling to contact the people they named. However, as more was learned about utilizing a sociocentric social network approach, it became apparent that by starting with employees that we suspect to be influential, the results would likely be biased by supporting this hypothesis, and the network measures of centrality would not be very accurate. Therefore it was hoped that by contacting all relevant employees that there would be adequate representation by employees from these workshops, and if they were indeed identified as influential then their central position would have been determined in an unbiased way. The decision was made to define explicit inclusion and exclusion criteria to target the survey to the most relevant employees in order to generate whole network data. However, in hindsight given the very low participation rate it is possible that beginning with groups of employees with a previous connection to NCCMT may have resulted in better participation rates. This approach may have been most effective if the focus was solely on the ego network reported by employees who attended the 2010 NCCMT workshops.

Ethical challenges. Social network analysis research presents many unique ethical challenges. Because of the nature of the phenomenon of network connections and relationships within a bounded community such as an organization, anonymity is not possible during data collection (Borgatti & Molina, 2003). In addition, in network research nonparticipation does not necessarily mean a respondent is not included in the study. To ensure participants are well informed of the risks and benefits of participating in this research, extra care was taken to ensure transparency of methods was communicated to potential participants in the letter of information. However it is possible these ethical issues may cause confusion with potential participants that may result in less response. Furthermore, the idea of social network analysis may be relatively

new to potential participants, and for the organization to truly understand both the benefits and risks of participating interactive communication and education strategies such as an in-person presentation or information session may have benefited the potential participant's understanding of the research. In the current study ethical issues arose including concerns that this information may be used to evaluate participants' job performance. Based on recommendations for addressing ethical issues in network research with organizations by Borgatti (2003; 2005), in the current study, complete transparency on how the data will be used, stored and reported was clearly outlined in the study information and consent forms. In future studies providing in-person information sessions about the study, the approach of social network analysis, and a discussion of the specific methods that will be utilized in the research is an approach that may be useful to improve collaboration and transparency with the organization and address concerns from potential participants.

Challenges to the research context. In the specific context in which this study took place there are unique challenges that may have contributed to the outcomes of the research.

Relationship and partnership with the organization. In this study a relationship was developed between the student researcher and a project liaison with Manitoba Health, Healthy Living and Seniors. At the outset of the project the organization was thrilled to be involved in a student research project investigating their success. The organization already had an established relationship with NCCMT. Connections between the student researcher and project liaison were made through regular email communication and three telephone conferences. The physical distance between the researchers and Manitoba Health, Healthy Living and Seniors made it difficult to connect in person, but a working relationship was established. However, the

importance of building relationships, collaboration and partnerships in research should not be underestimated and may require greater emphasis in the research process.

The literature identifies partnership between research and decision makers as important to promote effective knowledge translation and exchange (Mitchell, Pirkis, Hall, & Haas, 2009). Ross and colleagues (2003) conducted research on the experience of partnership with decision-makers in the research. They identified three levels of decision maker involvement that ranged from the least involved in partnership at the level of "formal support" of the research, to active involvement at the level of "responsive audience", to the level of "integral partner" which is characterized by engagement in the research process (p. 29). This highlights the spectrum of involvement that may be seen in research when working with an external organization fostering a partnership. In the current study, the organization was not a formal partner investigator, as they still remained in the role of the subject of the research. In order to design and implement a study that investigates the diffusion phenomenon within a health care organization, it has been essential to build and maintain a working relationship with Manitoba Health, Healthy Living and Seniors. However, in future social network studies it may be beneficial to utilize more formal strategies for collaboration and partnership with the organization being studied. It may be helpful to clearly outline the partnership and commitment that is expected from the organization, and to consider a written agreement that outlines what is expected on the part of both the researchers and the organization. This idea of a formalized agreement is in line with Borgatti's (2005) recommendations for the ethical application of social network research with an organization. A formal agreement and partnership that is clearly stipulated may be beneficial in supporting the research process, and by being transparent to potential participants about the role of the

organization and how exactly the social network information will be used is a strategy that should be considered in future studies.

Challenges to the specific context. There were a number of challenges encountered during the research process that may have contributed to some of the difficulties experienced in this research. The first being the significant time lag that was experienced between agreement to participate and data collection due to delays during the research ethics approval process. The time required to implement research projects, and changes or shifts in priorities in the practice setting have been identified as challenges in partnership research (Traynor et al., 2014). Although there may never be an ideal time for research to be conducted, as there are always barriers and challenges, the aim for data collection to begin in November 2013 and be completed before the end of the year was a priority for Manitoba Health, Healthy Living and Seniors. The reason being, this was considered to be the preferred time by the organization as it was a time period with fewer competing priorities. At that time the project had recently been shared at an EMT meeting by the project liaison, and it seemed that there was support for data collection to move forward as soon as ethics approval was received. The delay in ethics approval led to deferring data collection into early 2014. At that time the organization was focusing on their planning and alignment priorities. Moreover, in mid-January 2014 the re-structuring of the organization resulted in the amalgamation of two government departments, which created a new division of Healthy Living and Seniors, and a change in the Assistant Deputy Minister's office. Although there is never an ideal time for research, this organization experienced a shift in structure and priorities immediately before the survey implementation took place with the planning and alignment focus and the re-opening of the provincial legislature in early March 2014. In the literature Traynor and colleagues (2014) describe how changes to the administration

within the organization such as re-structuring or changes to the strategic plan, or more broad changes to the political landscape can lead to a change in priorities and needs which can effect the research partnership. Although efforts were made in the current study to build a relationship with the organization, there are inherent challenges with not fully understanding the realities faced within an organization as an outside member. In this study it was necessary to rely on the project liaison with Manitoba Health, Healthy Living and Seniors to facilitate the research process moving forward on the side of the organization.

Recommendations for future studies.

Based on the experiences and lessons learned during this study the following recommendations can be made to researchers interested in conducting sociometric network research. First, the importance of building a relationship and fostering partnership with the organization should be prioritized. In future research with organizations the possibility of connecting in person should be explored in order to discuss the research goals, the benefits to the organization, the steps in the research process and the activities required on the part of the organization to promote a successful outcome of the research. In a context such as this with Manitoba Health, Healthy Living and Seniors that had an existing relationship with an organization such as NCCMT, it may have been helpful to connect the study to other education activities, such as future NCCMT workshops. This may have connected the ideas of the research to education on EIDM and possibly provide a venue for interaction between the researcher and the organization in order for the researcher to better understand the organization and for questions and clarification about the study and the approach used in social network analysis to occur. This type of in-person interaction is not always possible in the context of graduate student research with groups a significant physical distance away. However for larger scale social

network studies of knowledge translation in public health, this may need to be a higher priority. Based on the experience of low participation in this study, future whole network studies should seriously consider strategies such as in-person education sessions as a way to ensure commitment from the leadership of the organization to the research, raise awareness of the study with the intended sample, provide information to potential participants about a social network approach, the time involved in participating, the benefits to the organization and research community that may result from the study and provide confirmation and assurance of how the information will be used and the strict confidentiality procedures that will be followed.

Another recommendation would be to create a written agreement during the research planning stage. This may include clarifying what is required from the organization in order to conduct the research, such as information on number of employees to calculate accurate response rates, and an agreed upon process for inviting eligible employees, and a shared strategy to support response rates. Engaging in a written agreement has the additional advantage of promoting transparency to participants. Borgatti (2005) suggests using a written agreement or "management disclosure contract" (p. 111), as a strategy to be transparent about exactly what data the management will see and clarity about the types of decisions that will or will not be made based on the data. This strategy would be of particular benefit for organizations that wish to use the aggregated findings to support or manage planned change or to increased communications and more effectively share information, to bridges identified gaps in the network, or use the network data to support a knowledge translation intervention. With commitment and partnership with health care organizations, in-person education with the intended sample, and written agreements between researchers and organizations and it is hoped that future social network studies may overcome some of the challenges faced in this research.

Conclusion

This study provided insight into the social network structure and the diffusion of EIDM through the healthcare organization of Manitoba Health, Healthy Living and Seniors. However, due to the limitation of a small sample size and low participation rates, the findings of the analysis are not an accurate representation of the whole network. Based on the reported high rate of behaviours indicative of EIDM among the group of participants, it appears the study participants may represent a group of employees with an interest in using EIDM in their work that is greater than the organization as a whole.

This study has demonstrated that the use of a social network approach in research has some significant challenges. In this study in became apparent that social network analysis is time and resource intensive on the part of the researcher and participants, that there are some ethical challenges in social network research, and that the types of questions asked in social network research can be sensitive in nature. In addition, the accuracy of the findings in sociocentric social network analysis is limited by the participation rate, which has contributed to the limited conclusions in this study. Furthermore, although a social network approach allows researchers to gain insight into the relational variables within an organization that may be influencing the diffusion of ideas, the findings are not generalizable beyond the specific context. Therefore, a whole network approach should be limited to use in research where there is a significant commitment from the organization to the research and commitment to protecting the confidentiality of participants. This study adds to the knowledge translation and social network literature by demonstrating the experiences and challenges in conducting a social network approach with a large health care organization.

Nonetheless, this study has identified some important factors about the social network ties that have supported EIDM in this organization. This study found that EIDM discussion occurred most often within the organizational divisions, however influence or encouragement to use EIDM often occurred through ties between different divisions as well as within divisions. Those in leadership positions within the organization were shown to have played an important role in the diffusion of EIDM. The type of relationships that appeared most important in discussion of EIDM included colleague relationships. Whereas supervisor relationships played a more important role in encouraging use of EIDM than they did in discussion of EIDM. For those network members identified as opinion leaders for EIDM, common factors include being in a leadership position, and having formal training in EIDM from NCCMT or other EIDM training within and outside of Manitoba Health, Healthy Living and Seniors. When looking for champions to support EIDM, organizations may want to look for members of the organization who have contacts within their own division, but also outside their direct area of work, and who have training in EIDM. In organizations trying to support the diffusion of EIDM, the findings of this study suggest it is important to ensure support and encouragement for EIDM comes from those in leadership positions.

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Appendix A: Consent and Survey

Understanding the Spread of Evidence-Informed Decision Making

This survey was developed by Stephanie Workentine, Graduate Student with McMaster University, School of Nursing; Supervisor Dr. Maureen Dobbins, McMaster University, School of Nursing, and is conducted in collaboration with the National Collaborating Centre for Methods and Tools. The information gathered using this survey will be written up as a master's thesis. The general findings of the analysis will be shared with Manitoba Health, Healthy Living and Seniors prior to publication, but your individual results will not be shared. Results from this survey will help us understand how interpersonal interactions influence the spread of ideas through organizations.

The purpose of this study is to explore how the ideas of evidence-informed decision making (EIDM) spread throughout Manitoba Health, Healthy Living and Seniors. For this study, a social network analysis will be conducted using the survey results to explore interpersonal connections and relationships. You will be asked to provide **your name** and the **names of other Manitoba Health, Healthy Living and Seniors employees with whom you have discussed EIDM**. The names you provide will be used to create graphs that map the spread of EIDM. Only Stephanie Workentine will see your individual responses and your responses will be kept confidential. Any identifying information will not be shared or reported back to the organization.

To learn more about the survey and the researcher's study, particularly any risks or harms associated with the survey, how confidentiality will be handled, withdrawal procedures, and how to obtain information about the survey's results, please read the accompanying letter of information attached to the email inviting you to participate.

This survey should take approximately 20-25 minutes to complete

Participation in this survey is completely voluntary. The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair; HIREB at 905.521.2100 x 42013.The HIREB protocol number associated with this survey is 13-725-S.

If you would like to withdraw from the study completely, please select "No, I do not agree to participate". You will be asked to provide your name to ensure you will be removed from all analyses, even if other employees name you as a person with whom they have discussed EIDM. Information about your choice to participate will not be shared with Manitoba Health, Healthy Living and Seniors.

Consent to Participate Statement:

Having read the above, I understand that by clicking the "Yes" button below, I agree to take part in this study under the terms and conditions outlined in the accompanied letter of information.

Yes "I agree to participate."

No "I do not agree to participate."

Do Not Agree to Participate Statement:

Thank you. You have decided not to participate in this survey. To ensure you are removed from all analyses, please provide your first and last name: _____

Please answer the following 6 questions to provide information about yourself and your role in Manitoba Health, Healthy Living and Seniors:

Please provide your first and last name:

First Name: _____ **Last Name:** _____

How many years have you worked in the Manitoba Government Departments of Health or Healthy Living and Seniors? _____ *Years*

What is your highest degree earned? ☐Diploma ☐Baccalaureate ☐Masters ☐Doctorate

In which division and branch do you work within Manitoba Health, Healthy Living and Seniors?

Division	**Branch:**	
☐Administration and Finance	☐ Regional Finance & Capital Finance ☐ Comptrollership	☐ Health Information Management ☐ Management Services
☐ Health Workforce Secretariat	☐ Health Human Resource Planning ☐ Contracts & Negotiations ☐ Fee for Service/Insured Benefits	☐ Medical Staff Recruitment & Administration ☐ Medical Consulting Group
☐ Regional Policy & Programs	☐ Acute, Tertiary and Specialty Care ☐ Cancer & Diagnostic Services ☐ Continuing Care	☐ Health Emergency Mgmt ☐ Chief Provincial Psychiatrist ☐ Mental Health & Spiritual Health Care
☐ Public Health and Primary Health Care	☐ Office of the Chief Provincial Public Health Officer ☐ Public Health ☐ Federal/Provincial Policy Support	☐ Primary Health Care ☐Aboriginal & Northern Health Office
☐ Provincial Policy & Programs	☐ Corporate Services ☐ Provincial Drug Programs ☐ Capital Planning ☐ Provincial Blood Programs ☐ Coordinating Office	☐ Information Systems ☐ Selkirk Mental Health Centre ☐ Cadham Provincial Laboratory
☐ Healthy Living & Seniors	☐Healthy Living & Populations ☐ Mental Health & Spiritual Health Care ☐ Tobacco Control & Cessation	☐ Addictions Policy & Support ☐ Seniors & Healthy Aging Secretariat ☐ Cross-Department Coordination Initiatives

What best describes your role?

☐Assistant Deputy Minister
☐Director
☐Epidemiologist/Scientist
☐Executive director
☐Manager
☐Medical Officer of Health
☐Policy Analyst/Consultant
☐Public Health Inspector
☐Statistical Analyst
☐Other _____

At which location do you work?

☐ 300 Carlton Street
☐ Legislative Building
☐ Emergency Medical Services Building
☐ Selkirk Mental Health Centre
☐ Cadham Lab
☐ Other

Please answer the following 10 questions that ask about who you interact with within Manitoba Health, Healthy Living and Seniors and how you use EIDM.

Definition of Evidence-informed decision making (EIDM): For the purpose of this study, EIDM will be defined as the use of current best evidence to inform decisions related to policies, programs or practice. Some examples of evidence include primary studies such as randomized controlled trials and cohort studies, qualitative studies, systematic reviews, meta-analyses, summaries, synopses, Manitoba Centre for Health Policy reports and CADTH products.

1) Who within Manitoba Health, Healthy Living and Seniors have you discussed EIDM with?
Please list up to 5 names of individuals you have directly discussed EIDM with

☐ **No one**

Please list first name: _____

And last name: _____

Division:
☐Administration and Finance
☐Health Workforce Secretariat
☐Regional Policy & Programs
☐Public Health and Primary Health Care
☐Provincial Policy & Programs
☐Healthy Living & Seniors

Role:
☐Assistant Deputy Minister
☐Director
☐Epidemiologist/Scientist
☐Executive director
☐Manager
☐Medical Officer of Health
☐Policy Analyst/Consultant
☐Public Health Inspector
☐Statistical Analyst
☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
☐A supervisor
☐An employee you supervise
☐A colleague
☐A friend
☐Other (please describe)
_____

Please list first name: _____

And last name: _____

Division:
☐Administration and Finance
☐Health Workforce Secretariat
☐Regional Policy & Programs
☐Public Health and Primary Health Care
☐Provincial Policy & Programs
☐Healthy Living & Seniors

Role:
☐Assistant Deputy Minister
☐Director
☐Epidemiologist/Scientist
☐Executive director
☐Manager
☐Medical Officer of Health
☐Policy Analyst/Consultant
☐Public Health Inspector
☐Statistical Analyst
☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
☐A supervisor
☐An employee you supervise
☐A colleague
☐A friend
☐Other (please describe)
_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

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- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
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- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
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- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
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- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

If you have discussed EIDM with an entire branch or team, please select the group below: *For example, discussing EIDM at a branch or team meeting*

Administration and Finance
- ☐ Regional Finance & Capital Finance
- ☐Comptrollership
- ☐ Health Information Management
- ☐ Management Services

Health Workforce Secretariat
- ☐ Health Human Resource Planning,
- ☐ Contracts & Negotiations
- ☐ Fee for Service/Insured Benefits
- ☐ Medical Staff Recruitment & Administration
- ☐ Medical Consulting Group

Regional Policy & Programs
- ☐ Acute, Tertiary and Specialty Care
- ☐ Cancer & Diagnostic Services
- ☐ Continuing Care
- ☐ Health Emergency Mgmt
- ☐ Chief Provincial Psychiatrist
- ☐ Mental Health & Spiritual Health Care

Public Health and Primary Health Care
- ☐ Office of the Chief Provincial Public Health Officer
- ☐ Public Health
- ☐ Federal/Provincial Policy Support
- ☐ Primary Health Care
- ☐Aboriginal & Northern Health Office

Provincial Policy & Programs
- ☐ Corporate Services
- ☐ Provincial Drug Programs
- ☐ Provincial Blood Programs
- ☐ Coordinating Office
- ☐ Capital Planning
- ☐ Information Systems
- ☐ Selkirk Mental Health Centre
- ☐ Cadham Provincial Laboratory

Healthy Living & Seniors
- ☐Healthy Living & Populations
- ☐ Mental Health & Spiritual Health Care
- ☐ Tobacco Control & Cessation
- ☐ Addictions Policy & Support
- ☐ Seniors & Healthy Aging Secretariat
- ☐ Cross-Department Coordination Initiatives

☐Prefer not to answer

2) Who within Manitoba Health, Healthy Living and Seniors encouraged, influenced or supported you to use EIDM resources in your work?

For example, completing the online EIDM module by NCCMT, using the NCCMT Wheel of Evidence Informed Public Health, using library services, CADTH, CIHI, Manitoba Centre for Health Policy and various evidence portals such as healthevidence.org

☐**No one**

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

Role:
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- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
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- ☐Manager
- ☐Medical Officer of Health
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- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

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- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

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- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

☐Prefer not to answer

3) A) Have you used any resources to support EIDM in your work?
For example, completing the online EIDM module by NCCMT, using the NCCMT Wheel of Evidence Informed Public Health, using library services, CADTH, CIHI, Manitoba Centre for Health Policy and various evidence portals such as healthevidence.org

- ☐Yes
- ☐No

☐Prefer not to answer

B) If so, what resources have you used? (Select all that apply)

- ☐NCCMT resources, e.g. EIDM module, Wheel of Evidence Informed Public Health
- ☐Library services
- ☐CADTH
- ☐CIHI
- ☐Manitoba Centre for Health Policy
- ☐Evidence portals
- ☐Other, please list _____

☐Prefer not to answer

4) How have you used EIDM resources in your work? (Select all that apply)

☐for policy, programs or standards development
☐defining a problem
☐developing and analyzing options
☐to identify needs, gaps or issues
☐to identify outcomes or indicators for monitoring and evaluation
☐other, please list _____

☐Prefer not to answer

5) Who within Manitoba Health, Healthy Living and Seniors have <u>you</u> encouraged, supported or influenced to use EIDM resources?
Please list up to 5 names of individuals you have directly encouraged to use EIDM resources
☐**No one**

Please list first name:
_____

And last name:
_____

Division:
☐Administration and Finance
☐Health Workforce Secretariat
☐Regional Policy & Programs
☐Public Health and Primary Health Care
☐Provincial Policy & Programs
☐Healthy Living & Seniors

Role:
☐Assistant Deputy Minister
☐Director
☐Epidemiologist/Scientist
☐Executive director
☐Manager
☐Medical Officer of Health
☐Policy Analyst/Consultant
☐Public Health Inspector
☐Statistical Analyst
☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
☐A supervisor
☐An employee you supervise
☐A colleague
☐A friend
☐Other (please describe)
_____

Please list first name:
_____

And last name:
_____

Division:
☐Administration and Finance
☐Health Workforce Secretariat
☐Regional Policy & Programs
☐Public Health and Primary Health Care
☐Provincial Policy & Programs
☐Healthy Living & Seniors

Role:
☐Assistant Deputy Minister
☐Director
☐Epidemiologist/Scientist
☐Executive director
☐Manager
☐Medical Officer of Health
☐Policy Analyst/Consultant
☐Public Health Inspector
☐Statistical Analyst
☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
☐A supervisor
☐An employee you supervise
☐A colleague
☐A friend
☐Other (please describe)
_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
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Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
- ☐Healthy Living & Seniors

Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

Please list first name:

_____

And last name:

_____

Division:
- ☐Administration and Finance
- ☐Health Workforce Secretariat
- ☐Regional Policy & Programs
- ☐Public Health and Primary Health Care
- ☐Provincial Policy & Programs
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Role:
- ☐Assistant Deputy Minister
- ☐Director
- ☐Epidemiologist/Scientist
- ☐Executive director
- ☐Manager
- ☐Medical Officer of Health
- ☐Policy Analyst/Consultant
- ☐Public Health Inspector
- ☐Statistical Analyst
- ☐Other _____

How would you characterize your relationship with this person? (Select all that apply)
- ☐A supervisor
- ☐An employee you supervise
- ☐A colleague
- ☐A friend
- ☐Other (please describe)

_____

If you have encouraged, supported or influenced an entire branch or team to use EIDM resources, please select the group below:
For example, if you recommended an entire branch or team to complete an EIDM module.

Administration and Finance
- ☐ Regional Finance & Capital Finance
- ☐Comptrollership
- ☐ Health Information Management
- ☐ Management Services

Health Workforce Secretariat
- ☐ Health Human Resource Planning
- ☐ Contracts & Negotiations
- ☐ Fee for Service/Insured Benefits
- ☐ Medical Staff Recruitment & Administration
- ☐ Medical Consulting Group

Regional Policy & Programs
- ☐ Acute, Tertiary and Specialty Care
- ☐ Cancer & Diagnostic Services
- ☐ Continuing Care
- ☐ Health Emergency Mgmt
- ☐ Chief Provincial Psychiatrist
- ☐ Mental Health & Spiritual Health Care

Public Health and Primary Health Care
- ☐ Office of the Chief Provincial Public Health Officer
- ☐ Public Health
- ☐ Federal/Provincial Policy Support
- ☐ Primary Health Care
- ☐Aboriginal & Northern Health Office

Provincial Policy & Programs
- ☐ Corporate Services
- ☐ Provincial Drug Programs
- ☐ Provincial Blood Programs
- ☐ Coordinating Office
- ☐ Capital Planning
- ☐ Information Systems
- ☐ Selkirk Mental Health Centre
- ☐ Cadham Provincial Laboratory

Healthy Living & Seniors
- ☐Healthy Living & Populations
- ☐ Mental Health & Spiritual Health Care
- ☐ Tobacco Control & Cessation
- ☐ Addictions Policy & Support
- ☐ Seniors & Healthy Aging Secretariat
- ☐ Cross-Department Coordination Initiatives

☐Prefer not to answer

6) In the past 6 months, have you conducted a search to find research evidence, (or have you had someone conduct a search on your behalf, or assisted someone in searching the literature?)

☐Yes
☐No
☐Prefer not to answer

7) Have you participated in workshops with NCCMT? If so, when?

☐Have not attended a workshop ☐March 2010 ☐November 2011 ☐May/June 2012 ☐October 2013

☐Prefer not to answer

8) Have you participated in other education or training on EIDM?

Within Manitoba Health, Healthy Living and Seniors ☐Yes ☐No

Outside of Manitoba Health, Healthy Living and Seniors ☐Yes ☐No

☐Prefer not to answer

9) In which division did you work in April 2010?

☐Administration and Finance
☐ Health Workforce Secretariat
☐ Regional Policy & Programs
☐ Public Health and Primary Health Care
☐ Office of the Chief Provincial Public Health Officer
☐Provincial Policy & Programs
☐ I worked in the department Healthy Living, Youth and Seniors
☐Not applicable, I did not work at Manitoba Health in 2010

☐Prefer not to answer

10) A) In which divisions have you worked in since 2010?

☐I work in the same division as in 2010

☐Administration and Finance
☐Health Workforce Secretariat
☐ Regional Policy & Programs
☐ Public Health and Primary Health Care
☐Provincial Policy & Programs
☐Healthy Living & Seniors

B) When did you move to this division?

☐2010
☐2011
☐2012
☐2013
☐2014

+ Have you worked in any other divisions since 2010? Yes/No

☐Prefer not to answer

☐ **Save Survey:** Thank you for taking this survey. Your answers have been saved. You may return and complete the survey until March 5, 2014

☐ **Complete and Save Survey:** Thank you for taking this survey. Your answers are a valuable part of this research.

☐ **Quit Survey:** Thank you. You have decided to quit this survey and withdraw from the study. None of your responses will be used in the analysis

Appendix B: Email Scripts

Email Recruitment Script: Survey Invitation
Sent on Behalf of the Researcher by the Holder of the Participants' Contact Information

Further to discussion and approval at Admin Group June 19, 2013, Manitoba Health, Healthy Living and Seniors is involved in a research project with McMaster University. Please complete this survey, and send the invitation (email below and attached document) to staff within your area who use evidence in their work including consultants/policy analysts, statistical analysts, epidemiologists/scientists, and public health inspectors.

I encourage you and your staff to participate, as the results of this project will be beneficial in further developing our EIDM capacity within the department.

Thank you.

Name
A/ADM, Public Health and Primary Health Care Division

Dear Employees,
Stephanie Workentine is a graduate student in the School of Nursing at McMaster University who is working with the National Collaborating Centre for Methods and Tools. She has invited Manitoba Health, Healthy Living and Seniors to participate in a knowledge translation research project that will explore how the ideas of evidence-informed decision making (EIDM) have spread throughout Manitoba Health, Healthy Living and Seniors. As an employee who may use research evidence in your work, you are invited to complete **a 10 question electronic survey** that will take **about 20-25 minutes to complete**. This survey has been developed in collaboration with Manitoba Health, Healthy Living and Seniors, and the Executive Management Committee has approved your participation. The following is a brief description of the study. Attached to this email is a letter of information that gives you full details about the study, including the risk of participating.

In this study a social network analysis will be conducted, which explores interpersonal connections and relationships. You will be asked to identify **your name** and the **names of other Manitoba Health, Healthy Living and Seniors employees** with whom you have discussed EIDM. The names you provide will be used to create graphs that map the spread of EIDM. These graphs and the study findings will be shared with Manitoba Health, Healthy Living and Seniors upon completion of the study, however no names will be included on the graphs, and your individual responses will not be shared with Manitoba Health, Healthy Living and Seniors.

Participation in this study is voluntary. **Your responses will be kept confidential**. No research is risk free, but by keeping responses confidential, the risks of participating are minimal. The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HIREB at 905.521.2100 x 42013. If you have questions or need more information about the study itself, please contact Stephanie Workentine at sworken@mcmaster.ca.

In **one week** you will receive an email to remind you of the deadline to complete the survey, which

is **March 5, 2013**. Thank you for your time and consideration.

Sincerely,

Name
A/ADM, Public Health and Primary Health Care Division
Manitoba Health, Healthy Living and Seniors

The following link will lead you to the online survey:
http://fhswedge.csu.mcmaster.ca/nursingresearch/index.php?sid=42715&lang=en

Email Script: Follow-up
Sent on Behalf of the Researcher by the Holder of the Participants' Contact Information

Please send the email reminder for the McMaster research study (email below and attached document) to staff within your area who use evidence in their work (e.g. consultants/policy analysts, statistical analysts, epidemiologists/scientists, and public health inspectors).

If you have not yet completed the survey, I encourage you and your staff to participate as the results of this project will be beneficial in further developing our EIDM capacity within the department.

Thank you.
Name
A/ADM, Public Health and Primary Health Care Division

Dear Employees,

This is a follow-up email reminding you of the invitation to participate in the study exploring how the ideas of evidence-informed decision making have spread throughout Manitoba Health, Healthy Living and Seniors.

I am sending this email to you on behalf of Stephanie Workentine, a graduate student in the School of Nursing at McMaster University. You are invited to complete a **10 question electronic survey** that will take **about 20-25 minutes to complete**.

Participation in this study is voluntary. The risks of participating are minimal, as your responses will be kept confidential. Attached to this email is a letter of information that gives you full details about the study, including the risk of participating

The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HIREB at 905.521.2100 x 42013. If you have questions or need more information about the study itself, please contact Stephanie Workentine at sworken@mcmaster.ca.

The deadline to complete the survey is **March 5, 2013**. Thank you for your time and consideration.

Sincerely,
Name
A/ADM, Public Health and Primary Health Care Division
Manitoba Health, Healthy Living and Seniors

The following link will lead you to the online survey:
http://fhswedge.csu.mcmaster.ca/nursingresearch/index.php?sid=42715&lang=en

Email Script: Follow-up email #2
Sent on Behalf of the Researcher by the Holder of the Participants' Contact Information

The deadline to complete the survey for the McMaster research project has been extended by one week to allow for more participation. If you have not yet completed the survey I encourage you and your staff to participate as the results of this project will be beneficial in further developing our evidence-informed decision making (EIDM) capacity within the department.

Please send the email reminder for the McMaster research study (email below and attached document) to staff within your area who use evidence in their work (e.g. consultants/policy analysts, statistical analysts, epidemiologists/scientists, and public health inspectors).

Thank you.

Name
A/ADM, Public Health and Primary Health Care Division

Dear Employees,

This is a second follow-up email reminding you of the invitation to participate in the study exploring how the ideas of evidence-informed decision making (EIDM) have spread throughout Manitoba Health, Healthy Living and Seniors.

I am sending this email to you on behalf of Stephanie Workentine, a graduate student in the School of Nursing at McMaster University. You are invited to complete a **10 question electronic survey** that will take **about 20-25 minutes to complete**.

Participation in this study is voluntary. The risks of participating are minimal, as your responses will be kept confidential. Attached to this email is a letter of information that gives you full details about the study, including the risk of participating
The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HIREB at 905.521.2100 x 42013. If you have questions or need more information about the study itself, please contact Stephanie Workentine at sworken@mcmaster.ca.

The deadline to complete the survey has been extended to **March 13, 2014**. Thank you for your time and consideration.

Sincerely,

Name
A/ADM, Public Health and Primary Health Care Division
Manitoba Health, Healthy Living and Seniors

The following link will lead you to the online survey:
http://fhswedge.csu.mcmaster.ca/nursingresearch/index.php?sid=42715&lang=en

Email Script: Follow-up email #3
Sent on Behalf of the Researcher by the Holder of the Participants' Contact Information

E-mail Subject line: Reminder: McMaster Study – Understanding the spread of EIDM using social network analysis

Please send the email reminder for the McMaster research study (email below and attached document) to staff within your area who use evidence in their work including employees in the roles of Consultants/Policy Analysts, Statistical Analysts, Epidemiologists/Scientists, and Public Health Inspectors who are in management roles, and the EMT [Deputy Minister, Assistant Deputy Ministers, Executive Directors, Directors, Medical Officer's of Health, and Managers].

The deadline to complete the survey for the McMaster research project has been further extended to allow for more participation. If you have not yet completed the survey I encourage you and your staff to participate as the results of this project will be beneficial in further developing our evidence-informed decision making (EIDM) capacity within the department.

Thank you.
Name
A/ADM, Public Health and Primary Health Care Division

Dear Employees,

This is a second follow-up email reminding you of the invitation to participate in the study exploring how the ideas of evidence-informed decision making have spread throughout Manitoba Health, Healthy Living and Seniors.

I am sending this email to you on behalf of Stephanie Workentine, a graduate student in the School of Nursing at McMaster University. You are invited to complete a **10 question electronic survey** that will take **about 20-25 minutes to complete**.

Update: Employees who complete the electronic survey will be entered in a draw for one of four $25 gift certificates to Indigo/Chapters. Winners of the draw will be randomly selected.

Participation in this study is voluntary. The risks of participating are minimal, as your responses will be kept confidential. Attached to this email is a letter of information that gives you full details about the study, including the risk of participating

The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HIREB at 905.521.2100 x 42013. The deadline to complete the survey has been extended to **March 20, 2014**. Thank you for your time and consideration.

Sincerely,
Name
A/ADM, Public Health and Primary Health Care Division
Manitoba Health, Healthy Living and Seniors

The following link will lead you to the online survey:
http://fhswedge.csu.mcmaster.ca/nursingresearch/index.php?sid=42715&lang=en

Appendix C: Letter of Information

Understanding the spread of EIDM through social network analysis

Student Investigator:
Stephanie Workentine RN, BN
Faculty of Health Science
McMaster University
Hamilton, Ontario, Canada
(905) 525-9140
E-mail: sworken@mcmaster.ca

Faculty Supervisor:
Dr. Maureen Dobbins RN, PhD
Faculty of Health Science
McMaster University
Hamilton, Ontario, Canada
(905) 525-9140 ext. 20455
E-mail: dobbinsm@mcmaster.ca

Research Sponsor: National Collaborating Centre for Methods and Tools

My name is Stephanie Workentine and I am a graduate student with McMaster University, School of Nursing. I am doing this research as a part of my master's thesis. The National Collaborating Centre for Methods and Tools and Manitoba Health, Healthy Living and Seniors support this study.

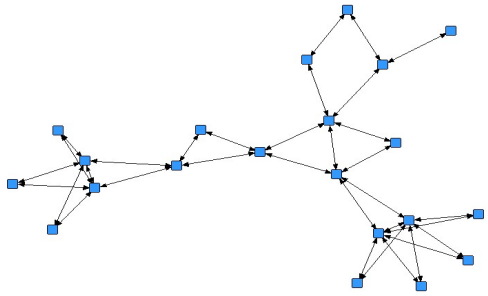
Study Purpose
You are invited to take part in this study to explore how the ideas of evidence-informed decision making spread throughout Manitoba Health, Healthy Living and Seniors. The overall goal of this research is to gain a better understanding of how interpersonal interaction and communication help to spread ideas through organizations. Understanding how information flows through an organization may assist in identifying other organizations that would benefit from knowledge translation interventions.

Evidence-informed decision making (EIDM)
For the purpose of this study, evidence-informed decision making or EIDM, is defined as the use of the current best evidence to inform decisions related to policies, programs or practice. It is recognized that not all Manitoba Health, Healthy Living and Seniors employees may be involved in the formal decision making process for policies and programs, but evidence may be used to define a problem, inform activities, develop options and recommendations. For the current study, all of this will be considered EIDM.

For this study, research evidence will be defined as primary studies, systematic reviews, and other high-level syntheses based on research evidence, as well as relevant grey literature such as reports, and unpublished information such as surveillance data. For this study evidence will **not** include assessment or evaluation data on a target group or related to the topic under investigation. Although this is an important aspect of making evidence informed decisions, the purpose of the study relates to understanding how organizations are using the best available research evidence in the EIDM process.

What is involved and what are the risks?
In this study, a social network analysis will be conducted which explores interpersonal connections and relationships. You will complete an online survey that should take approximately 20-25 minutes. During the survey you will be asked to provide information about

yourself including your name and your role in the health department. You will also be asked to identify the names of other Manitoba Health, Healthy Living and Seniors employees with whom you have discussed EIDM. Furthermore, you will be asked about any EIDM training you have completed, and any EIDM resources you have used. The names you provide will be used to create graphs that map the spread of EIDM such as in the example provided below. As in the example below, no names will be included on the graphs.



Participation in this study is voluntary. By participating you will be contributing to the map that will help create a picture of the adoption of EIDM throughout Manitoba Health, Healthy Living and Seniors. No research is risk free, but the risk of participating in this study is relatively low. Because you need to provide your name, your responses will not be anonymous. I will analyze your responses, **but your responses will be kept confidential**. Your name and the names you provide will be transformed into ID numbers that will be used in the analysis. Your individual results will not be shared or reported back to the organization in a way that identifies you or your responses, and your responses will not be used in any way to evaluate your job performance. Given that all identifying information will be removed, you will not be clearly identifiable on the maps However, a risk of participating in this type of study within an organization where people know each other is that even when all identifying information is removed, sometimes people can guess the identity of certain positions in the network.

You may choose not to answer any or all of the survey questions. If you select that you would prefer not to answer one of the network questions, you will be excluded from the maps, even if other people name you in their responses. You may withdraw from the study at any time by selecting to quit the survey, or emailing me directly at any time after the survey is completed. If you decide to withdraw from the study your responses will not be used, and there will no consequences to you, and you will not be included on any of the network maps or analyses.

In this study, it is possible a colleague at Manitoba Health, Healthy Living and Seniors may name you as someone who has been supportive or influential in encouraging him or her to use EIDM. In this situation you would appear as a node on the map even if you do not participate in the survey. However, you can choose to withdraw from the study completely, by following the survey link, and selecting that you do not want to participate in the study. At this time you will be asked to provide your name to ensure you are excluded from all analysis. Information about your choice to participate in the study will not be shared with Manitoba Health, Healthy Living and Seniors. Only Stephanie Workentine will know if you decide to withdraw from the study.

I expect to have the study completed by July 2014 at which time the findings will be shared with Manitoba Health, Healthy Living and Seniors. If you have questions or need more information about the study itself, please contact me at sworken@mcmaster.ca

The Hamilton Integrated Research Ethics Board (HIREB) has reviewed this study. The HIREB is responsible for ensuring that participants are informed of the risks associated with the research, and that participants are free to decide if participation is right for them. If you have any questions about your rights as a research participant, please call the Office of the Chair, HIREB at 905.521.2100 x 42013.

Appendix D: REB approval letters

Hamilton Health Sciences | McMaster University Health Sciences | St. Joseph's Healthcare Hamilton

HiREB Student Research Committee

Final Approval

Date:	23 January 2014
REB Number:	13-725-S
Title of Study:	Understanding the Spread of Evidence-Informed Decision Making in Public Health using Social Network Analysis
Student PI:	Stephanie Workentine
LPI:	Maureen Dobbins
Version date:	**Document:**
10 Oct 2013	Application
07 Jan 2014	Protocol
07 Jan 2014	Letter of Information
07 Jan 2014	Email Script
07 Jan 2014	Survey

Dear Stephanie:

We have completed our review of your study and are pleased to issue our final approval. You may now begin your study.

All recruitment and consent material must bear an REB stamp. You may pick up the stamped forms from our office.

Any changes to this study must be submitted with an Amendment Request form before they can be implemented.

This approval is effective for 12 months from the date of this letter. Upon completion of your study, please submit a **Study Completion form.**

If you require more time to complete your study, you must request an extension in writing before this approval expires. Please submit an **Annual Review form** with your request.

The Study Completion form and the Annual Review form can be found on our website: **http://fhs.mcmaster.ca/healthresearch/hireb/forms.html** and should be sent to Tina Arnosti at arnoschr@HHSC.CA.

Please cite your REB number in any correspondence.

Good luck with your research,

Kristina Trim, PhD, RSW
Chair, HiREB Student Research Committee
Health Research Services, HSC 1B7, McMaster University

Page 1 of 2

Hamilton Health Sciences | McMaster University Health Sciences | St. Joseph's Healthcare Hamilton

HiREB Student Research Committee

The HiREB SRC complies with the guidelines set by the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans and with ICH Good Clinical Practice.

Hamilton Health Sciences | McMaster University Health Sciences | St. Joseph's Healthcare Hamilton

HiREB Student Research Committee

Amendment Approval

Date:	10 February 2014
REB Number:	13-725-S
Title of Study:	Understanding the Spread of Evidence-Informed Decision Making in Public Health using Social Network Analysis
Student PI:	Stephanie Workentine
LPI:	Maureen Dobbins
Comments:	
Version date:	
06 Feb 2014	Protocol
06 Feb 2014	Letter of Information
06 Feb 2014	Email Script
06 Feb 2014	Survey

Dear Stephanie:

We have completed our review of your amendment and are pleased to issue our final approval. You may now continue your study as amended.

All recruitment and consent material must bear an REB stamp. You may pick up the stamped forms from our office. If you need to make changes to any of these documents, please submit them for review as an amendment.

Please cite the REB number in any correspondence.

Good luck with your research,

Kristina Trim, PhD, RSW
Chair, HiREB Student Research Committee
Health Research Services, HSC 1B7, McMaster University

The HiREB SRC complies with the guidelines set by the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans and with ICH Good Clinical Practice.

Hamilton Health Sciences | McMaster University Health Sciences | St. Joseph's Healthcare Hamilton

HiREB Student Research Committee

Amendment Approval

Date:	28 February 2014
REB Number:	13-725-S
Title of Study:	Understanding the Spread of Evidence-Informed Decision Making in Public Health using Social Network Analysis
Student PI:	Stephanie Workentine
LPI:	Maureen Dobbins
Comments:	
Version date:	
28 Feb 2014	Protocol
28 Feb 2014	Email Reminder

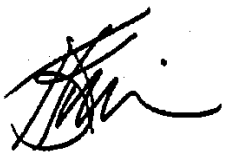
Dear Stephanie:

We have completed our review of your amendment and are pleased to issue our final approval. You may now continue your study as amended.

All recruitment and consent material must bear an REB stamp. You may pick up the stamped forms from our office. If you need to make changes to any of these documents, please submit them for review as an amendment.

Please cite the REB number in any correspondence.

Good luck with your research,



Kristina Trim, PhD, RSW
Chair, HiREB Student Research Committee
Health Research Services, HSC 1B7, McMaster University

The HiREB SRC complies with the guidelines set by the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans and with ICH Good Clinical Practice.

Hamilton Health Sciences | McMaster University Health Sciences | St. Joseph's Healthcare Hamilton

HiREB Student Research Committee

Amendment Approval

Date:	14 March 2014
REB Number:	13-725-S
Title of Study:	Understanding the Spread of Evidence-Informed Decision Making in Public Health using Social Network Analysis
Student PI:	Stephanie Workentine
LPI:	Maureen Dobbins
Comments:	
Version date:	
10 Mar 2014	Protocol
10 Mar 2014	Recruitment Material (Email)

Dear Stephanie:

We have completed our review of your amendment and are pleased to issue our final approval. You may now continue your study as amended.

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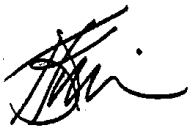

Kristina Trim, PhD, RSW
Chair, HiREB Student Research Committee
Health Research Services, HSC 3H9, McMaster University

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Appendix E: Characteristics of Participants table (all branches included)

Characteristics of Participants (all branches included)	
Years of work at Manitoba Health (n=16)	Mean 7.67 Range 0.75-27
Highest degree earned (n=16)	Number (Percent)
Diploma	2 (12.5%)
Baccalaureate	3 (18.75)
Masters	9 (56.25%)
Doctorate	2 (12.5%)
Role (n=16)	
Assistant Deputy Minister	0
Director	1 (6.25%)
Epidemiologist/Scientist	0
Executive Director	2 (12.5%)
Manager	2 (12.5%)
Medical Officer of Health	0
Policy Analyst/Consultant	9 (56.25%)
Public Health Inspector	0
Statistical Analyst	0
Other	0
Administration and Finance	5 (33.33%)
Regional Finance & Capital Finance	0
Comptrollership	0
Health Information Management	3 (20%)
Management Services	2 (13.3%)
Health Workforce Secretariat	0 (0%)
Health Human Resource Planning	0
Contracts & Negotiations	0
Fee for Service/Insured Benefits	0
Medical Staff Recruitment & Administration	0
Medical Consulting Group	0
Regional Policy & Programs	3 (20%)
Acute, Tertiary and Specialty Care	1 (6.67%)
Cancer & Diagnostic Services	
Continuing Care	1 (6.67%)
Health Emergency Mgmt	
Chief Provincial Psychiatrist	
Mental Health & Spiritual Health Care	
Public Health and Primary Health Care	3 (20%)
Office of the Chief Provincial Public Health Officer	
Public Health	

Federal/Provincial Policy Support	
Primary Health Care	3 (20%)
Aboriginal & Northern Health Office	
Provincial Policy & Programs	3(20%)
Corporate Services	
Provincial Drug Program	1 (6.67%)
Provincial Blood Program	
Coordinating Office	
Capital Planning	1(6.67%)
Information Systems	
Selkirk Mental Health Centre	1 (6.67%)
Cadham Provincial Laboratory	
Healthy Living & Seniors	1 (6.67%)
Healthy Living & Populations	1 (6.67%)
Location (n= 16)	Number (Percent)
300 Carlton Street	15 (93.75%)
Legislative Building	0
Emergency Medical Services Building	0
Selkirk Mental Health Centre	1 (6.25%)
Cadham Lab	0