**AN ASSESSMENT
OF THE STATE OF KNOWLEDGE TRANSFER
IN HEALTH SERVICES:
A FRAMEWORK AND A HEALTH SERVICES CASE STUDY**

**A Dissertation By
Douglas A. Orendorff**

**Submitted to the Faculty of the
Sprott School of Business
Carleton University
In Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy**

September, 2006

© Copyright by Douglas A. Orendorff, 2006

UMI Number: NR23299

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI[®]

UMI Microform NR23299

Copyright 2007 by ProQuest Information and Learning Company.

All rights reserved. This microform edition is protected against unauthorized copying under Title 17, United States Code.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

ABSTRACT

This research develops and partially substantiates a framework for horizontal knowledge transfer in health services through a case study of the transfer of clinical practice guidelines for the treatment of Acute Myocardial Infarction from Canada's University of Ottawa Heart Institute to fourteen Champlain District hospitals via a clinical pathway package. This Knowledge Transfer Framework consolidates the findings of previous studies from both health services and business knowledge transfer theory and research.

The research found support for the existence of seven of these ten determinants of successful knowledge transfer (Knowledge Codifiability, Prior Related Knowledge, Positive Receiver Motivation, Perceived Credibility of Source, Relationship Quality, Richness of Transmission Channels, and Supportive Organizational Context). The research also found indications of separate but related transfers of tacit and explicit knowledge, where the transfer of tacit knowledge was both horizontal and vertical.

This research advances the theory and research of knowledge transfer by: 1) mapping and synthesizing the determinants for successful KT from the health services and business environments into a single comprehensive Knowledge Transfer Framework underpinned with a solid theoretical basis and vocabulary that is applicable to the business and health services environments; 2) demonstrating a health services/business-based KT Framework in health services including support for related explicit-tacit knowledge flows; 3) describing broadly the transfer of tacit knowledge for the initial internalization of the knowledge and in detail for the use of this knowledge; and 4) demonstrating the

complexity of the knowledge transfer phenomenon by addressing it separately in its various partitions, such as horizontal or vertical and knowledge internalization or knowledge use. This research also identifies a potential bi-product of this guideline transfer via clinical pathways in terms of increased physician guideline compliance, and suggests ways for health services managers to assess the initial organizational capability for successful knowledge transfer and identify areas for action to increase the likelihood of KT success.

TABLE OF CONTENTS

ABSTRACT	ii
LIST OF TABLES.....	vii
LIST OF FIGURES	ix
LIST OF APPENDICES.....	x
1. INTRODUCTION.....	1
2. LITERATURE REVIEW.....	9
2.1. The Knowledge Concept	9
2.2. The Knowledge Management Concept.....	15
2.3. Knowledge Transfer Theory and Research	25
2.3.1. The Knowledge Transfer Concept	25
2.3.2. Foundational KT Theory and Research.....	34
2.3.2.1. Communications Theory Approach and the Definition of KT.....	38
2.3.2.2. Diffusion of Innovations Theory Relationship to KT Theory.....	42
2.3.3. Knowledge Transfer Theory and Research	49
2.3.3.1. KT Frameworks.....	51
2.3.3.2. Transfer of Tacit Knowledge	55
2.3.3.3. Empirical Studies.....	58
2.3.4. Knowledge Transfer Research Directions	60
2.4. Summary of Literature Review	64
3. RESEARCH QUESTION AND RESEARCH MODEL.....	66
3.1. Literature Gaps and Resulting Research Question	66
3.1.1. Determinants For Successful KT	67
3.1.2. Transfer of Tacit Knowledge	68
3.1.3. Investigating Increasing Receiver Compliance with Clinical Practice Guidelines Through KT	69
3.1.4. Research Question.....	70
3.2. Research Model.....	71
3.2.1. Dependent Variable – Knowledge Transfer Success	72
3.2.2. Knowledge Transfer Determinant Categories.....	73
3.2.3. Knowledge Transfer Determinants	76
3.2.3.1. Research Propositions.....	77
3.2.4. Integrating the Existing KT Frameworks – A Validation	79
3.2.5. KT Framework.....	83
3.2.5.1. Tacit Aspects of the KT Framework.....	84
3.3. Summary	86
4. RESEARCH METHODOLOGY AND DESIGN	87
4.1. Qualitative Research	87

4.1.1.	The Qualitative Aspect of This Research	88
4.2.	Case Study Methodology.....	90
4.2.1.	Case Studies in Health Services and Knowledge Transfer Research.....	93
4.2.2.	The Case Study Approach In This Research	95
4.3.	Research Population and Unit of Analysis	97
4.3.1.	Researcher Perspective	98
4.4.	Research Design	99
4.4.1.	Data Collection.....	100
4.4.1.1.	Data Collection Instrument	100
4.4.1.2.	Key Informants.....	102
4.4.1.3.	Data Collection Schedule.....	104
4.4.1.4.	Data Collection Procedures.....	105
4.4.2.	Researcher As An Active Participant	107
4.5.	Research Context, Motivations and Processes	108
4.5.1.	Champlain District Health Council Response	111
4.5.2.	EFFECT Study	113
4.5.3.	Clinical Practice Guidelines.....	114
4.5.3.1.	Knowledge To Be Transferred	116
4.5.3.2.	Patient Specific Aspect of Clinical Guidelines	117
4.5.4.	Knowledge Sender - Heart Institute	117
4.5.5.	Knowledge Transfer Timing	119
5.	<i>DATA ANALYSES AND FINDINGS.....</i>	<i>120</i>
5.1.	Data Analyses	120
5.2.	Knowledge Shared	122
5.2.1.	Explicit Knowledge	123
5.2.2.	Tacit Knowledge	126
5.3.	Knowledge Transfer Outcome.....	129
5.4.	Findings	132
5.4.1.	KT Framework Determinants Of Successful Transfers	134
5.4.2.	KT Framework Determinants Of Partial And Unsuccessful Transfers...	137
5.4.3.	Perceived Necessity of Each KT Framework Determinant	140
5.4.3.1.	Impact of Interviewee Profession.....	145
5.4.4.	Knowledge Internalization and Knowledge Use Differences.....	149
5.4.5.	The Transfer Of Tacit Knowledge	151
5.4.5.1.	Micro Knowledge Transfer – Heart Institute to Receiving Hospitals ..	153
5.4.5.1.1.	Role of KT Framework in Transfer of Tacit Knowledge	157
5.4.5.2.	Macro Knowledge Transfer – AMI Guidelines to Receiving Hospitals	163
5.4.5.3.	Horizontal and Vertical KT	166
5.4.6.	KT Framework Evaluation	168
5.5.	Discussion	170

5.5.1.	KT Framework Fit.....	171
5.5.1.1.	Weakness of External Motivators.....	174
5.5.1.2.	Key Role of Internal Motivation	176
5.5.2.	Knowledge Transformation - Pathways as a Vehicle For Increasing Physician Compliance.....	179
5.5.3.	Pathway, Protocol or Orders.....	180
5.5.4.	Reliability and Validity.....	182
5.5.5.	Generalization of the Findings.....	187
6.	CONCLUSION	191
6.1.	Research Significance.....	201
6.2.	Value of KT Framework to Managers	203
6.3.	Research Limitations	204
6.3.1.	Instrumentation Accuracy.....	206
6.3.2.	Researcher As Communications Conduit.....	207
6.4.	Future Research	208
	REFERENCES	210

LIST OF TABLES

<i>Table 2.2-1: Definitions of Knowledge Management.....</i>	<i>15</i>
<i>Table 2.2-2: Knowledge Management Processes</i>	<i>18</i>
<i>Table 2.3.1-1: Definitions of Knowledge Transfer.....</i>	<i>27</i>
<i>Table 2.3.2-1: The Contribution of Reference Disciplines to the Study of Knowledge Transfer (Based on Green & Johnson, 1996).....</i>	<i>35</i>
<i>Table 2.3.2.2-1: Comparison of Innovation Diffusion and KT Characteristics</i>	<i>43</i>
<i>Table 2.3.3.3-1: KT Determinant Vocabulary Cross-Reference.....</i>	<i>59</i>
<i>Table 3.2.2-1: KT Framework Potential Determinant Categories</i>	<i>74</i>
<i>Table 3.2.4-1: Comparison of KT Framework With Five Comprehensive KT Studies....</i>	<i>80</i>
<i>Table 4.4.1.1-1: Cross Reference of Research Question and Data Collection Questions</i>	<i>102</i>
<i>Table 4.4.1.2-1: Key Informants Interviewed</i>	<i>103</i>
<i>Table 5.2.1-1: Explicit Knowledge Shared By Heart Institute</i>	<i>124</i>
<i>Table 5.3-1: Knowledge Transfer Outcome.....</i>	<i>131</i>
<i>Table 5.4.1-1: Successful Transfer Determinants</i>	<i>134</i>
<i>Table 5.4.2-1: Non-Successful Transfer Determinants</i>	<i>137</i>
<i>Table 5.4.2-2: Transfer Determinants – Comparison of Support.....</i>	<i>139</i>
<i>Table 5.4.3-1: Transfer Determinants Perceptions.....</i>	<i>142</i>
<i>Table 5.4.3-2: Determination of Significant Determinants</i>	<i>143</i>
<i>Table 5.4.3.1-1: Determination of Significant Determinants - Physicians</i>	<i>146</i>
<i>Table 5.4.3.1-2: Determination of Significant Determinants - Directors</i>	<i>147</i>
<i>Table 5.4.5.1.1-1: Perceived Relevance of KT Framework Determinants To The Transfer of Tacit Knowledge.....</i>	<i>159</i>
<i>Table 5.4.5.2-1: Tacit Knowledge Sources</i>	<i>165</i>
<i>Table 5.5.1-1: Fit of Findings With KT Framework Determinant Ratings</i>	<i>171</i>
<i>Table 6-1: KT Framework Determinants</i>	<i>192</i>
<i>Table 6-2: Determination of Significant Determinants</i>	<i>195</i>
<i>Table A-1: Summary of Knowledge Transfer Empirical Research.....</i>	<i>230</i>
<i>Table B-1: Basis for Knowledge Transfer Framework Determinants – Knowledge Category.....</i>	<i>239</i>
<i>Table B-2: Basis for Knowledge Transfer Framework Determinants – Sender Category</i>	<i>242</i>
<i>Table B-3: Basis for Knowledge Transfer Framework Determinants – Receiver Category</i>	<i>243</i>
<i>Table B-4: Basis for Knowledge Transfer Framework Determinants – Sender-Receiver Relationship Category</i>	<i>247</i>
<i>Table B-5: Basis for Knowledge Transfer Framework Determinants – Transmission Category.....</i>	<i>250</i>
<i>Table B-6: Basis for Knowledge Transfer Framework Determinants – Context Category</i>	<i>251</i>
<i>Table E-1: Practice Guideline Standards – Explicit and Tacit Knowledge</i>	<i>266</i>
<i>Table G-1: Rating Table.....</i>	<i>276</i>
<i>Table G-2: Perceived Credibility of Source - Successful Transfers.....</i>	<i>279</i>
<i>Table G-3: Perceived Credibility of Source Impact - Successful Transfers.....</i>	<i>282</i>

<i>Table H-1: Receiving Hospital Use of Explicit Knowledge – Part 1</i>	284
<i>Table H-1: Receiving Hospital Use of Explicit Knowledge – Part 2</i>	287

LIST OF FIGURES

<i>Figure 1-1: Knowledge Transfer Framework.....</i>	<i>7</i>
<i>Figure 2.2-1: Knowledge Management Process Model.....</i>	<i>22</i>
<i>Figure 2.3.1-1: Definition of Knowledge Presented in Terms of Knowledge Transfer ...</i>	<i>26</i>
<i>Figure 2.3.2.1-1: Communication Theory (Krone, Jablin & Putnam, 1987).....</i>	<i>39</i>
<i>Figure 2.3.2.1-2: A Cognitive-Affective Model of Organizational Communication (Te'eni, 2001).....</i>	<i>41</i>
<i>Figure 2.3.3-1: Theoretical Framework for Organizing Research on Organizational Learning and Knowledge Management (Argote, McEvily & Reagans, 2003)</i>	<i>50</i>
<i>Figure 2.3.4.2-1: The Ottawa Model of Research Use (Logan & Graham, 1998).....</i>	<i>62</i>
<i>Figure 3.2.3.1-1: Knowledge Transfer Framework Variables</i>	<i>79</i>
<i>Figure 3.2.5-1: Knowledge Transfer Framework.....</i>	<i>83</i>
<i>Figure 4.5-1: Research Context</i>	<i>109</i>
<i>Figure 5.4.5-1: AMI Guideline Knowledge Transfer</i>	<i>152</i>
<i>Figure 6-1: AMI Guideline Knowledge Transfer.....</i>	<i>194</i>
<i>Figure F-1: ACS Clinical Pathway</i>	<i>271</i>
<i>Figure F-2: Physician Orders – ACS/STEMI Clinical Pathway Admission Orders</i>	<i>273</i>
<i>Figure F-3: ACS Discharge Tool.....</i>	<i>274</i>

LIST OF APPENDICES

<i>APPENDIX A – KNOWLEDGE TRANSFER EMPIRICAL STUDIES.....</i>	<i>229</i>
<i>APPENDIX B – KT DETERMINANT DEFINITION AND BASIS OF SELECTION</i>	<i>238</i>
<i>APPENDIX C – DATA COLLECTION INSTRUMENT.....</i>	<i>252</i>
<i>APPENDIX D –INFORMED CONSENT.....</i>	<i>265</i>
<i>APPENDIX E – KNOWLEDGE TRANSFERRED.....</i>	<i>266</i>
<i>APPENDIX F – ACS PATHWAY PACKAGE</i>	<i>271</i>
<i>APPENDIX G – DETAILED KNOWLEDGE TRANSFER FINDINGS</i>	<i>276</i>
<i>APPENDIX H – EXPLICIT KNOWLEDGE TRANSFER</i>	<i>283</i>

1. INTRODUCTION

Health services is a very knowledge intensive environment populated by health professionals who have responsibilities for keeping current with their continually evolving knowledge base. A central challenge in health services, termed Knowledge Translation, is “the iterative, timely and effective process of integrating best evidence into the routine practices of patients, practitioners, health care teams and systems, in order to effect optimal health care outcomes and to maximize the potential of the health care system” (11th Cambridge Conference, 2003). One avenue to address improved Knowledge Translation is through a better understanding of the determinants of knowledge transfer success in health services.

Business oriented knowledge use derives from a similar context. Organizational knowledge is seen as “the most strategically important of the firm’s resources” (Grant, 1996, 110); a principal source of sustainable competitive advantage (Nonaka 1991, Spender and Grant 1996, Argote and Ingram 2000) and much of an organization’s value derives from knowledge, regardless of whether these organizations are in the public or private sectors (Neilson, 2002). This competitive advantage can be sustained by reinvesting in these competencies through knowledge creation and knowledge transfer activities (Reed and DeFillippi, 1990). Organizations have improved their innovative capacity by leveraging the skills of others through the transfer of knowledge (Pennings & Harianto, 1992) both within and across organizations (Garud & Nayyar 1994; Gilbert & Cordey-Hayes 1996; Szulanski 1996a).

This transfer of knowledge has been more difficult than expected both in business (Gupta & Govindarajan, 1991) and in health services (Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002). A central problem in the design and implementation of health services is how to transfer relevant information and knowledge to active practitioners (Sullivan & Rapp, 1991, 327) since dissemination via publication in professional journals and other passive methods “rarely lead to changes in professional behaviour” (Feder, Eccles, Grol, Griffiths & Grimshaw, 1999, 728). For example Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002, 720) found a clinical practice guideline compliance rate change from 58% to 61% after active attempts to change physicians’ behaviour. The main message here is that while “dissemination and implementation of guidelines can promote compliance with recommended practices” (Grimshaw, Thomas, MacLennan, et al. 2004, 61), the compliance rate is lower and slower than considered appropriate. Thus, at a very macro level there is an opportunity for knowledge transfer theory and research to provide a vehicle to help raise this compliance level.

Since approximately 45% of innovations come from external sources (Foos, Schum & Rothenberg, 2006, 6) requiring borrowing rather than invention, then the transfer of the requisite knowledge to recreate that innovation is a major part of business activity. Thus, at the macro level there is an opportunity for knowledge transfer theory and research to improve innovation.

But knowledge transfer theory and research has not yet achieved this potential (Argote, McEvily & Reagans 2003, 572; Gupta & Govindarajan 2000, 491; Lahti & Beyerlein 2000, 68). For example, the study of knowledge transfer has occurred in silos thereby not

leveraging findings in other areas. There are the related studies, not termed knowledge transfer, in the areas of Diffusion of Innovations, Technology Transfer and Organizational Learning, as well as separate knowledge transfer studies in the environments of health services and business. This separation of the health services environment and the business environment; each with their own vocabulary, motivations and theory and research; does not need to continue. Thus, even though the contexts and focal points of the health services and business environments may be quite different, both have expressed a need for knowledge transfer theory and research. Perhaps bringing together the strengths of these two communities will result in synergies to move the KT field forward for the benefit of all.

The study of knowledge transfer over the past twelve years encompasses over 20 empirical business studies and at least four empirical health services studies which together have identified over 22 unique determinants of knowledge transfer success presented as approximately 50 logically overlapping determinants. This diversity and redundancy suggests that the field of KT is very complex and it may benefit from partitioning the KT construct into smaller, more manageable sub-components so that the number of determinants of KT success becomes more manageable.

This research addresses each of these opportunities. It uses a taxonomic approach, appropriate for an emerging but still fragmented field (Cooper 1988), developing a vocabulary about knowledge, knowledge management (KM) and knowledge transfer to underlie this research. It critically reviews not only KT theory, but also the influential theories of Technology Transfer, Organizational Learning and Diffusion of Innovations

and those of health services as they relate to KT. The health services and business communities' KT empirical research is then mapped and synthesized into a single vocabulary of KT determinants for health services and business, a contribution of this research. This synthesis of vocabulary and determinants forms the basis for the development of a KT Framework, a research model for KT success. In addition, this research takes each of its steps in a well-documented way so others can use this material as a toolkit for further development of the KT field of study.

The Knowledge Concept Section (2.1) reviews how the term knowledge has been defined, how these definitions interrelate, and develops a new working definition of knowledge to provide a better understanding of the concepts of knowledge management and knowledge transfer; another contribution of this research. This working definition of knowledge is derived from the apparently conflicting cognitive and constructionist views and the seminal work of Polanyi (1966). The Knowledge Management Concept Section (2.2) defines the term knowledge management and then proposes a model for the knowledge management lifecycle based on this knowledge definition using the processes of create, transform, hold, share, internalize, and use knowledge. This six-part process segmentation enables the definition of knowledge transfer (Section 2.3.1). The theory and research of KT is presented using the building blocks of Communications theory (Krone, Jablin & Putnam 1987; and Te'eni 2001); Diffusion of Innovations theory (Rogers 1995, xvi); Organizational Learning theory (March & Simon, 1958) and Technology Transfer theory (Brooks, 1964) (Section 2.3.2). The emphasis on these foundational theories may be considered a divergence with the formal KT literature, but is considered necessary to provide a firm foundation on which to construct this study's research model, the KT

Framework. The Knowledge Transfer theory and empirical research reviewed (Section 2.3.3) includes the knowledge management framework of Argote, McEvily & Reagans (2003) as well as authors contributing to the development of a knowledge transfer framework including Szulanski (1996a); Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998); Ko, Kirsch & King (2005); Shearer (2002); and Cummings & Teng (2003). This literature review concludes with a summary of the ongoing health services research directions (Section 2.3.4).

This literature review identifies the gaps of: wide variation in determinants and frameworks of determinants for KT success (Section 3.1.1); the important consideration of the role of tacit knowledge in transfer success (Section 3.1.2); and the opportunity for KT to assist in increasing receiver compliance with clinical practice guidelines thus integrating business KT theory and research with health services KT theory and research (Section 3.1.3). These three gaps drive the guiding question (Section 3.1.4).

Q1: What are the determinants of horizontal knowledge transfer success in health services?

Q1.1: How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge?

Q1.2: How do these determinants of horizontal knowledge transfer success differ between cases of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed?

To answer this research question a research model was developed (Section 3.2) by first identifying determinants of transfer success that have been found to be significant in the health services and business empirical knowledge transfer studies and then by investigating each of these determinants and their underpinning theories according to a set of inclusion criteria. The result is a KT Framework of the determinants of knowledge transfer success that integrates the previous health services and business versions into one parsimonious, representative and grounded model. This Framework is presented in Figure 1-1 and defined in terms of:

- Receiver Knowledge Transfer outcomes depicted as Equivalent Applied Knowledge by the knowledge sender and knowledge receiver (Receiver rectangle in bottom-right of the Figure being functionally equivalent to the Sender rectangle in the upper-left);
- Determinant categories of Knowledge, Receiver, Sender-Receiver Relationship, Transmission, and Context (*italicized within oval*);
- Determinants within those categories of knowledge (Knowledge Codifiability, Knowledge Complexity), receiver (Prior Related Knowledge, Unlearning Capacity, Positive Receiver Motivation, and Perceived Credibility of Source), sender-receiver relationship (Sender-Receiver Distance, Relationship Quality), transmission (Richness of Transmission Channels) and context (Supportive Organizational Context) (*within rectangles within oval*);
- The unidirectional explicit knowledge flow from Sender to Receiver and the bidirectional tacit knowledge flow are also considered as separate but related flows in the KT Framework (the two arrows); and

- These determinants and flows function within the scope of the transfer process denoted by the elliptical boundary.

These elements are all depicted in the figure below. They are explained in detail in Section 3.2 Research Model.

Figure 1-1: Knowledge Transfer Framework

The research methodology is a qualitative case study, selected because of its ability to fully address the research question (Sections 4.1 and 4.2). This is followed by introducing the research population of Canadian Champlain District hospitals treating adult Acute Myocardial Infarction; the unit of analysis of the transfer of AMI clinical practice guidelines via a clinical pathway; and the researcher perspective, a key aspect of the qualitative approach (Section 4.3). The research design (Section 4.4) describes the elements required to perform an effective case study and applies the case study steps proposed by Yin (2003, 21) to this research. This design includes a combination of interviews with the knowledge senders and receivers according to a data collection tool

developed from the KT literature and an artefact analysis of the documented knowledge in place at the receiver hospitals. The research context presented in terms of the expected organizational motivators for transferring this knowledge and the transfer initiation activities of the Knowledge Sender, the Heart Institute (Section 4.5), a very accessible and representative tertiary knowledge source. The timing of the research is for Knowledge Sharing from March 2004 to November 2005.

The data analysis and findings begin with descriptions of the data analysis process (Section 5.1) and the knowledge shared, both explicit and tacit (Section 5.2). It continues with the definition of the KT outcome from the analysis of the implemented ACS Pathway artefact at each hospital (Section 5.3) identifying the cases of Successful Transfer, Unsuccessful Transfer and in between these two, the majority of cases, termed Partial Transfer. The findings are then presented and the KT Framework evaluated for its effectiveness in representing this Heart Institute knowledge transfer (Section 5.4). Discussion follows including the reliability, validity and generalizability of the research results (Section 5.5). Finally, the research conclusions are presented (Section 6) including the significance of these findings, the value of this research to administrative and clinical managers, along with the research limitations and the proposed path of future related research.

2. LITERATURE REVIEW

To understand the concept of knowledge transfer, it is crucial to first have a clear understanding of the concept of knowledge (Cohen, 1998, 24). It is also useful to have a process framework within which to position knowledge transfer (Argote, McEvily & Reagans, 2003) and define knowledge transfer outcomes. Therefore, the first two subsections of this literature review address the knowledge concept and the knowledge management concept. This foundational terminology enables a structured review of the Knowledge Transfer theory and research including knowledge transfer terminology (Section 2.3.1). But knowledge transfer is a concept with a parentage so this review also investigates the founding literatures and identifies their impact on, and need for, knowledge transfer (Section 2.3.2). From this, KT theory and research is presented (Section 2.3.3) along with some future KT research directions (Section 2.3.4). A summary section pulls the key threads of this literature review together, developing the platform on which to position the research question, research model, research methodology and research findings.

2.1. The Knowledge Concept

The cognitive view of knowledge as an object that can be coded and stored outside of an individual (Grover & Davenport, 2001, 11), following the rationalist philosophy of absolute truth deduced by rational reasoning (Nonaka & Takeuchi, 1995), often implicit in the use of the term explicit knowledge (Polanyi, 1966, 7), does not reflect the individual nature of knowledge (Gardner, 1985, 44).

Rather, a constructionist view (Lambert, 1995, 1) considers knowledge to be situation and people dependent (Suchman, 1987, 179), a “mapping of experienced reality by some observer” (Holzner & Marx, 1979, 93), and tied to each individual’s own reality (von Glaserfeld, 1995, 1). The term tacit knowledge adds to this constructionist individuality the concept of some portion of all knowledge being embedded in a human brain (Polanyi, 1967, 6).

While many authors reference the importance of this tacitness in a definition of knowledge (Berman, Down & Hill, 2002, 13; Von Krogh, Ichijo & Nonaka, 2000, 6) such a comprehensive definition of knowledge that explains the relative roles of tacit and explicit knowledge is still outstanding. This is particularly true in health services where tacitness has not been considered. For example, a clinical guideline to provide long-term Beta-Adrenoceptor Blocker therapy to survivors of Acute Myocardial Infarction who are low-risk and without a clear contraindication to this therapy (Ryan, Antman, Brooks et al., 1999, 1029) identifies the explicit knowledge or information in this guideline statement that is expected to be fully replicated or adhered to. However, this guideline entails the context of being able to identify low risk patients, to be aware of the potential contraindications as well as the various potential impacts and complications (e.g., moderate or severe left ventricular failure (Ryan, Antman, Brooks et al., 1999, 1029)) and patient specific elements (Heart Institute Cardiologist). The tacit elements of this explicit knowledge therefore include, but are not limited to, the understanding of the concepts of low risk, contraindications and patient specific needs.

To develop such a working definition of knowledge it is useful to start with Davenport & Prusak's (1998, 5) commonly quoted definition of knowledge (Bouthillier & Shearer 2002, Tsoukas & Vladimirou 2001):

“Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information that results in action. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms”.

This definition captures much of the knowledge discussion. It is constructionist since experience and values tend to be individually perceived and defined. It has social or organizational elements. It is tacit due to its origination and application in the minds of knowers. It also has an explicit component when embedded in documents, routines and norms. However, this definition has been criticized for being unclear and incomplete (Tsoukas & Vladimirou, 2001, 974). It is unclear about the relationships of ‘values’, ‘experiences’ and ‘contexts’ and how individuals draw upon it; and incomplete in not addressing: 1) tacit/explicit integration; 2) knowledge as information; and 3) knowledge context. Thus, the working definition of knowledge becomes:

“Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework (3) for evaluating and incorporating new experiences and information that results in action. It originates and is applied in the minds of knowers (1), (2)”.

Where 1): Expresses the portion that can be transferred to others, using the terminology of tacit and explicit; 2) Expresses one person's knowledge is another person's information; and 3) Adds that knowledge has context and is applicable within a certain domain; resulting in:

Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework within a specific domain for evaluating and incorporating new experiences and information that results in action. It originates and is applied tacitly in knowers. Knowledge can be expressed without its context or mental model as documents or repositories. This explicit expression when coupled with its tacit aspect, from the sender's perspective, can be termed explicit knowledge. When seen without its tacit component from a receiver perspective this explicit knowledge can be termed information. When a receiver internalizes this information, defining the receiver's tacit understanding, it becomes the receiver's knowledge.

This working definition of knowledge is the basis of this study of knowledge transfer.

Health services clinical knowledge, involving the observation and direct treatment of patients (Benner, 1984), has both academic knowledge (e.g., knowledge of diagnosing symptoms and distributing medications, knowledge of equipment and its uses, and knowledge of how to teach patients about their illnesses) and practical knowledge (e.g., determining when to teach a patient about an illness given the patient's responsiveness, clinician time available, and how the family wants to handle the situation) (Berry & Irvine, 1986) each with a set of abilities associated with a different knowledge base (Fox, 1997).

Academic or explicit knowledge exists in many forms including clinical practice guidelines (Davies, 2002) that are "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" (Field & Lohr, 1990, 2). They are usually constructed by an expert panel and incorporate the results of relevant systematic reviews, other research, consensus views of expert clinician and researcher panel members (Davies, 2002) with the goal to "improve the quality of care for patients" (Feder, Eccles, Grol, Griffiths & Grimshaw,

1999, 728). The underlying assumption is that “synthesizing and conveying the available scientific knowledge as a message to physicians through a credible source and in an easily understandable form can improve providers’ performance by itself” (Grilli & Lomas, 1994, 203). These explicit knowledge forms have become increasingly popular since the mid 1980s (Grilli & Lomas, 1994), for example, Grimshaw, Shirran, Thomas, Mowatt, Fraser & Bero (2001) located 41 systematic reviews on the effectiveness of interventions to prompt physicians to apply research findings into their practice, while Thomas, McColl, Cullum, Rousseau & Soutter (1999) published a nursing systematic review of clinical practice guidelines from 18 studies.

This practical clinical knowledge is termed tacit (Fox, 1997) or implicit (Reber, 1967). Tacit knowledge is the practical know-how that is usually neither openly expressed nor taught and is often acquired through implicit and informal learning (Wagner, 1991). Implicit learning “takes place in a rich stimulus environment, and people are capable of using these implicitly learned rules to guide their behaviour in other similar situations. This process occurs even in the absence of awareness of the rules” (Fox, 1997, 460). It is learned through experience on-the-job or through the observation of experts (Benner, 1984). The acquisition and use of tacit knowledge has been considered the most important aspect of success at work and the most important aspect of practical intelligence (Sternberg & Wagner, 1989). Nurses depend on tacit knowledge for effective clinical practice (Carper 1978; Benner 1984).

One example of this practical or tacit knowledge in daily operation is the key organizational knowledge repository of the patient chart or health record, a composite of

information about each patient seen by the organization or jurisdiction. The interplay of explicit and tacit knowledge in this patient health record described by Heath & Luff (1996, 356-358) portrays the applicability of the working definition of knowledge to health services:

“[Physicians] are sensitive to the inferences that can be drawn from particular items. They can rely upon those inferences not only to include information which might otherwise seem relatively trivial, but to exclude particular items (or even categories of objects) knowing that any competent reader would be able to make sense of the entry and retrieve the relevant information...[Entries are] not so much a précis of what happened in the consultation, but rather a brief sketch which provides a certain sense of the event...The very brevity of the entry, the omission of certain categories of item, coupled with the presence of some mentioned treatment, serve as an embedded instruction to the reader to turn to previous entries in order to retrieve the relevant information. The practices that doctors use to assemble the records are the selfsame practices on which they rely in reading the records”.

The “official nature of the guidelines, their objective of synthesizing evidence to reflect the best quality of care” (Grilli & Lomas, 1994, 208) and the use of the terminology of ‘compliance’ all suggest a cognitive view of knowledge where there is one best way to perform a procedure, etc. However, when best practices are viewed as average results (Tetroe, 2005) that use tacit knowledge on a patient-by-patient basis (Heart Institute Cardiologist), this indicates that in fact health services does not necessarily follow a cognitive approach, but is in fact quite constructionist or patient specific. Therefore, this research’s definition of knowledge may be considered appropriate to health services. It also indicates that clinical practice guidelines are a health services container or explicit expression of knowledge.

The working definition of knowledge is a necessary step in developing a definition and an understanding of knowledge transfer. The next step towards developing this understanding and being able to assess KT in health services is to define KT's overarching construct, knowledge management, from which knowledge transfer can then be derived. The knowledge management construct will also provide necessary context within which knowledge transfer outcomes can be defined.

2.2. The Knowledge Management Concept

Interest in organizational knowledge has led to the activity of managing this knowledge for the organization's benefit (Neilson 2002) but the meaning of knowledge management, like knowledge itself, is difficult to define (Earl, 2001). To better understand what exactly is meant by the concept of knowledge management, a number of proposed recent definitions of the term are listed chronologically in the table below.

Table 2.2-1: Definitions of Knowledge Management

Perspective	Themes	Author(s)
"A systemic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge of employees so that other employees may make more use of it to be more effective and productive in their work".	Process, Outcome	Alavi & Leidner (1997)
"The processes for creating, sustaining, applying, sharing and renewing knowledge to enhance organizational performance and create value".	Process, Outcome	Allee (1997)
"A conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance".	Strategy, Process, Outcome	O'Dell, Grayson & Essaides (1998)

Perspective	Themes	Author(s)
"The formal management of knowledge for facilitating creation, access, and reuse of knowledge".	Process	O'Leary (1998, 34)
"The formalization of and access to experience, knowledge, and expertise that create new capabilities, enable superior performance, encourage innovation, and enhance customer value".	Characteristics Outcome	Beckman (1999, 1-6)
"The systematic and explicit management of knowledge-related activities, practices, programs, and policies within the enterprise".	Management	Wiig (1999, 3-3)
"The process of identifying existing knowledge, providing opportunities to create new knowledge, and effectively applying what the organization knows".	Process, Outcome	Howarth, Choo & Wallace (2001, 13)
"A dynamic management of the process of creating knowledge out of knowledge" (not the static management of information).	Process	Nonaka, Konno & Toyama (2001)
"Knowledge management is then primarily the dynamic process of turning an unreflective practice into a reflexive one by elucidating the rules guiding the activities of the practice, by helping give a particular shape to collective understandings, and by facilitating the emergence of heuristic knowledge".	Process	Tsoukas & Vladimirou (2001, 990)
"An audit of 'intellectual assets' that highlights unique sources, critical functions and potential bottlenecks which hinder knowledge flows to the point of use".	Operational Process	Grey (2002)
"The explicit and systematic management of vital knowledge and its associated processes in pursuit of organizational objectives".	Process, Outcome	Skyrme (2002, 4)
"The individual and organizational activities by which organizations develop or leverage their knowledge base".	Process	Kalling (2003, 116)
"A method to simplify and improve the process of creating, sharing, distributing, capturing, and understanding knowledge in a company".	Process	Karlsen & Gottschalk (2004)
"Any process or practice of creating, acquiring, capturing, sharing and using knowledge, wherever it resides, to enhance learning and performance in organizations".	Process	Coakes & Bradburn (2005, 64)

Perspective	Themes	Author(s)
“KM is the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization’s effectiveness” “A KM system as that system created to facilitate the capture, storage, retrieval, and reuse of knowledge”	Process, Outcome	Jennex (2005, i)

The common theme in these diverse definitions, presented in the Themes column, is that knowledge management is a set of related processes and that applying these processes will improve organizational outcomes. The process perspective enables one to further define the concept of knowledge management through the description of these processes, as shown in Table 2.2-2. This second table partitions the major actions or functions in each authors’ knowledge management process description. This partitioning occurred using grounded theory (Glaser & Straus, 1967), where an initial attempt was made to develop these process categories then these categories were saturated with appropriate cases from the literature resulting in a more general model. Each of the authors listed in Table 2.2-1 with a process orientation has been included in this second table along with other authors describing a process view. In aggregate, this list of knowledge management process perspectives can be consolidated into a knowledge management model, presented in the last row of this table. A similar review of KM definitions from authors in the KM community by Jennex (2005, i) presents this KM process model or management of knowledge processes often within the context of management decision-making to improve organizational effectiveness, a view consistent with the KM definitions presented in Table 2.2-1.

Table 2.2-2: Knowledge Management Processes

Author(s)	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6
Holzner & Marx (1979)	Produce, Create, Discover		Organize, Package, Store	Disseminate, Distribute, Retrieve	Absorb into routines	Use
Nonaka (1991, 1994)	Externalize		Combine	Socialize	Internalize	
Davenport & Beers (1995, 73)	Identify			Collect, Distribute	Analyze	Use
Davenport, Jarvenpaa & Beers (1996, 57)	Create, Find		Assemble, Package	Acquire		Apply, Reuse
Marquardt (1996)	Create		Store	Acquire, Transfer		Use
Allee (1997)	Create, Renew		Sustain	Share		Apply
Ruggles (1997, 1998, 81)	Generate, Represent	Synthesize, Fuse, Adapt	Code,	Transfer, Access	Absorb, Embed	Use, Measure Impact
O'Dell, Grayson & Essaides (1998)	Create, Identify		Organize	Collect, Share	Adapt	Use
O'Leary (1998, 32)	Create			Access		Reuse
Baskerville & Pries-Heje (1999, 36)	Acquire, Search		Own, Memory, Store	Disseminate		Problem solve
Beckman (1999, I-6)	Create, Formalize			Access		

Author(s)	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6
Coleman (1999, 12)	Create	Valuate	Map, Index, Store	Transport, Distribute, Share		
Despres & Chauvel (1999)	Create		Map, Bundle, Store	Share, Transfer		Reuse, Evolve
Holsapple & Joshi (1999, 7-6)		Filter	Organize (Distil, Refine, Assemble, Transform, Orient, Package)	Acquire, Select, Transfer, Send	Internalize, Interpret	Use
Wiig (1999, 3-3)	Create	Compile, Verify, Validate	Organize	Distribute	Transform	Apply
Choo (2000, 5)	Identify, Write-up	Refine, Edit	Organize, Index, Package	Extract, Acquire, Publish, Disseminate		
Gupta & Govindarajan (2000b, 73)	Create		Retain	Acquire, Identify, Outflow	Inflow willingness	
Alavi & Leidner (2001)	Create, Construct		Store	Transfer, Retrieve		Apply
Bhatt (2001, 70-72)	Create	Validate		Present, Distribute		Apply

Author(s)	Process 1	Process 2	Process 3	Process 4	Process 5	Process 6
Earl (2001, 215, 217)	Create		Codify, Protect	Collaborate, Provide, Share		Use
Grover & Davenport (2001, 7-8)	Generate, Develop	Convert, Make Applicable	Codify, Make Accessible	Acquire, Transfer	Personalize	Realize, Use
Howarth, Choo & Wallace (2001, 13)	Identify, Create					Apply
Markus (2001, 60-61)	Generate, Mine, Search, Document	Cull, Clean, Filter, Polish	Package, Structure, Format, Index, Codify	Capture, Distribute, Publish, Recall, Recognize		Reuse, Apply
Nissen & Oxendine (2002)	Create		Organize, Formalize	Distribute		Apply, Evolve
Schultze & Leidner (2002)	Generate, Represent		Store, Protect	Transfer	Embed, Transform	Apply,
Lehaney, Jack, Clarke & Coakes (2003)	Create, Acquire		Retain, Identify	Share		Utilize, Measure
Coakes, Bradburn & Sugden (2004, 119)	Surface, Capture		Codify, Store	Distribute	Leverage	Measure
Karlsen & Gottschalk (2004, 4)	Create, Capture			Share, Distribute	Understand	
Coakes & Bradburn (2005, 64)	Create, Capture Acquire			Share		Use
Synthesis	Create	Transform	Hold	Share	Internalize	Use

Overall these authors' views have a high degree of consistency in that they are able to be grouped into six processes. There is some deviation in terms of "the numbering and labelling of processes" (Alavi & Leidner, 2001, 114), for example, Markus focused on explicit knowledge reuse and the importance of an explicit store or holding. Choo, Davenport & Beers, and Holsapple & Joshi have an explicit knowledge sharing focus with the steps identify, collect, classify, organize/store, share/disseminate, access, use/exploit. Bhatt, Nissen & Oxendine, Nonaka & Takeuchi, O'Dell & Grayson, and Ruggles take a combined explicit and tacit knowledge view, usually involving the transformation of tacit knowledge to explicit knowledge in the Knowledge Creation process and the transformation of explicit knowledge to tacit knowledge in the knowledge internalization process. Holzner & Marx (1979) considered knowledge systems to consist of four sets of social processes: creation, storage/retrieval, transfer, and application (Alavi & Leidner 2001, 115); deriving this view from the work on the concept of the sociology of knowledge (Berger & Luckmann 1967, Gurvitch 1971, Holzner & Marx 1979); and the perspective of organizations as 'knowledge systems'.

Taken together these views can be synthesized into a six-process model for knowledge management. The six processes, shown in the last row of Table 2.2-2, are Knowledge Creation, Knowledge Transformation, Knowledge Holdings Management, Knowledge Sharing, Knowledge Internalization and Knowledge Use. The main deviation individual authors have from this synthesized view is that some authors did not include distinct processes for Knowledge Transformation and Knowledge Internalization. These authors

In the **Knowledge Creation** step a medical professional has noted a medical problem, for example, elderly individuals falling:

Of the more than one-third of adults aged 65 years and older that fall each year (Hornbrook, Stevens, Wingfield, Hollis, Greenlick & Ory, 1994), 20% to 30% suffer moderate to severe injuries such as hip fractures or head traumas reducing mobility and independence, and increasing the risk of premature death (Sterling, O'Connor & Bonadies, 2001).

The medical professionals attempt to address this condition by identifying preventative activities that could reduce the likelihood of falls in the elderly. A professional, Tinetti for example, performs a clinical trial which shows that Tai Chi training three times a week improves balance in a group of seniors and significantly reduces their likelihood of falling and associated hip fractures. The carrying out of this trial represents a creation of new knowledge.

The next step, **Knowledge Transformation**, may involve Tinetti and other authors attempting to replicate this result and to produce a meta-analysis of similar studies or having a group develop an associated set of clinical practice guidelines from this and the related falls in the elderly clinical trials. This knowledge transformation adds credibility and validity for this new knowledge. From both the Knowledge Creation and the Knowledge Transformation step there has been an action to have this result placed into **Knowledge Holdings Management** and made accessible to other health professionals. Holdings could be peer reviewed journal articles, organizational policies and procedures or a credible repository such as the Cochrane Collection, a leading health services best practice guideline repository organization.

The **Knowledge Sharing** step is both a push approach where the research findings are published (e.g., Tinetti & Speechley, New England Journal of Medicine 1989) and a pull approach where various professionals either receive the NEJM articles or search for them in various archives, collections or search engines. Other push activities include: the study authors presenting at conferences and other events to answer questions and further share both their explicit and tacit knowledge; or a more automated push strategy of a medical inference engine such as Weed's Knowledge Coupler (1997), where new medical knowledge is integrated into this medical hypothesis generating General Practitioner support tool. This sharing can be either vertical (knowledge put to use for the first time) or horizontal (knowledge already in use) from another organization or group (Szulanski 1996b).

The next step, **Knowledge Internalization**, is up to the individual members of the medical community and health organizations such as Health Maintenance Organizations and hospital medical staffs to understand this falls-in-the-elderly prevention knowledge. Tacit elements of this part of the knowledge transfer include patient specifics or domain specifics where this preventative action was appropriate and some of the other variables that limit or enable the sharing of this best practice to other patient groups.

The final step in the KM Process Model is medical practitioners with potential patients deciding to and then applying this research with their patient population (**Knowledge Use**), for example, by implementing a similar Tai Chi balance training regimen with a population of frail elderly. This KM Process Model in a health services environment

often includes an evaluation of outcome improvement due to the knowledge transferred followed by any required knowledge use refinements.

2.3. Knowledge Transfer Theory and Research

This section describes the knowledge transfer concept, developing a working definition and then presenting its theoretical and empirical basis. This KT view is an integration of health services and business theory and research, but heavily weighted by the preponderance of KT literature in the business field.

2.3.1. The Knowledge Transfer Concept

Health services terminology relating to knowledge transfer includes the terms: applied health research; capacity building; co-optation - cooperation – competing; diffusion; dissemination; getting knowledge into practice; impact; implementation; knowledge communication; knowledge cycle; knowledge exchange; knowledge management; knowledge translation; knowledge mobilization; knowledge transfer; linkage and exchange; popularization of research; research into practice; research mediation; research transfer; research translation; science communication; teaching; ‘third mission’; translational research; transmission; and utilization. The most common terms being diffusion; dissemination; and implementation (Graham, Grimshaw, Eccles et al., 2005, 18). This diversity of KT concepts in health services emphasizes the need for a common definition of KT.

The basis for a working definition of knowledge transfer is the definition of knowledge from Section 2.1 and the concept of the transfer of explicit knowledge as information along with some tacit knowledge which is received and integrated into a receiver's tacit knowledge. Extending this definition of knowledge to the process of knowledge transfer, the working definition indicates that the transfer of knowledge to another person cannot happen directly (Papert, 1993). It occurs indirectly by the sending individual expressing a portion of their tacit understanding explicitly, then having that information received and integrated into the receiver's tacit understanding or knowledge. This knowledge transfer view is depicted in the following figure.

Figure 2.3.1-1: Definition of Knowledge Presented in Terms of Knowledge Transfer

The transfer of knowledge therefore involves moving elements and networks formed between and among elements in which the knowledge is located (Argote and Ingram, 2000). Thus, knowledge transfer includes the transfer of meaning and value (Kostova, 1999) or collective meaning structures (Dixon, 2000).

A working definition of KT needs to consider at least three other dimensions: which of the six Knowledge Management processes to include; whether the knowledge is already

in use; and whether the definition will be applied at the individual, group or organizational level. A number of KT authors have proposed definitions of KT which can be differentiated along these three dimensions as shown chronologically in Table 2.3.1-1. Each of these dimensions is discussed below to arrive at a definition of KT. Note that the Vertical/Horizontal rating is derived in part from Table A-1 – Summary of Knowledge Transfer Empirical Research (Appendix A). This table begins in 1995 with the first KT studies as prior related studies were from the related areas of international technology transfer (Mansfield, Romeo & Wagner 1979 and Vernon & Davidson 1979) and other international studies (Teece 1977 and Mansfield & Romeo 1984).

Table 2.3.1-1: Definitions of Knowledge Transfer

KT Definition	KM Processes	Vertical / Horizontal	Aggregation Level	Author(s)
“Transferred knowledge can reside in design, production, installation, sales and distribution, operation and maintenance, or management”.	Sharing, Internal-ization and Use	Horizontal	Group	Zander & Kogut (1995, 77)
<p>“Transfers of best practice are thus seen as dyadic exchanges of organizational knowledge between a source and a recipient unit in which the identify of the recipient matters.</p> <p>The exchange of organizational knowledge consists of an exact or partial replication of a web of coordinating relationships connecting specific resources so that a different but similar set of resources is coordinated by a very similar web or relationships”.</p> <p>“The movement of knowledge is a distinct experience, not a gradual process of dissemination”.</p>	Sharing and Internal-ization	Horizontal	Group	Szulanski (1996b, 28)

KT Definition	KM Processes	Vertical/Horizontal	Aggregation Level	Author(s)
“Transfer = Transmission + Absorption (and Use)”.	Sharing, Internalization and Use			Davenport & Prusak (1998, 101)
“Successful knowledge transfer...means that transfer results in the receiving unit accumulating or assimilating new knowledge”.	Sharing and Internalization	Both	Group	Bresman, Birkinshaw & Nobel (1999, 444)
“Knowledge transfer in organizations is the process through which one unit (e.g., group, department, or division) is affected by the experience of another”.	Sharing and some Internalization	Horizontal	Group, Organization	Argote & Ingram (2000, 151)
“Transfer has occurred when a contributor shares knowledge that is used by an adopter... Knowledge transfer is conceived as an event through which one organization learns from the experience of another...Transfer has occurred when a contributor shares knowledge that is used by an adopter”.	Sharing, Internalization and Use	Horizontal	Group, Organization	Darr & Kurtzberg (2000, 29)
Knowledge transfer is the incorporation of the business and technical knowledge into the business application where clients are able to reconstruct the underlying rationale of such knowledge, and under different circumstances.	Sharing and Internalization	Both	All	Wheatley (2000)
“To transfer source knowledge successfully to a recipient.” “The degree to which a recipient obtains ownership of, commitment to, and satisfaction with the transferred knowledge”.	Sharing and Internalization	Vertical	All	Cummings & Teng (2003, 41, 42)

KT Definition	KM Processes	Vertical / Horizontal	Aggregation Level	Author(s)
"The processes by which members within an organization learn from each other, without interacting with the environment".	Sharing and Internalization	Horizontal	Individual	Kalling (2003, 116)
"Knowledge transfer is the communication of knowledge from a source so that it is learned and applied by a recipient".	Sharing, Internalization and Use	Both		Ko, Kirsch & King (2005, 62)

This table demonstrates the two schools of thought about which of the six Knowledge Management processes to include in the KT definition. One view is that knowledge transfer is the concatenation of the Knowledge Sharing and Knowledge Internalization processes (Argote & Ingram, 2000; Cummings & Teng, 2003; Kalling, 2003; and Szulanski, 1996a). It is the extent to which a recipient receives or acquires the knowledge, understands its intricacies and implications, and then is able to apply it (Darr & Kurtzberg, 2000). Thus, knowledge transfer results in a change in knowledge in the recipient (Bresman, Birkinshaw & Nobel, 1999, 444). KT is the degree to which a recipient takes ownership of, becomes committed to, and is satisfied with the transferred knowledge (Cummings & Teng, 2003, 42). The theoretical basis for this perspective is Communications theory and Institutional theory (Meyer & Rowan, 1977), where successful completion of the communication is an understood message, not the use of this message in some subsequent action. This view occurs in roughly half of the literature, consistently over time, as shown in Table 2.3.1-1.

The alternate view is more action oriented and considers knowledge transfer to be made up of the Knowledge Sharing, Knowledge Internalization and Knowledge Use processes

(Darr & Kurtzberg, 2000, 29; Davidson & McFetridge, 1985; Davenport & Prusak, 1998; Ko, Kirsch & King, 2005; Kogut & Zander, 1993; Subramaniam & Venkatraman, 2001). This performance-oriented view (Argote & Ingram, 2000) is proposed in part as a way to overcome the measurement problem of how one can quantitatively determine if a knowledge transfer has occurred without seeing evidence through the application of that knowledge (Darr & Kurtzberg, 2000, 29). This view derives from the definition of knowledge that connects knowledge to action (Davenport & Prusak 1998, Leonard & Sensiper 1998, Suchman 1987) found in Technology Transfer and Diffusion of Innovation literature (Cummings & Teng, 2003). However, it is not clear how and when knowledge is connected to action (Tsoukas & Vladimirou, 2001, 974). As Cummings & Teng (2003, 42) argued:

“The problem with this replication approach is that knowledge can be embedded in many different structural elements of an organization, such as in the people and their skills, the technical tools, and the routines and systems used by the organization, as well as in the networks formed between and among these elements. Since it is often difficult to know which elements (e.g., people, tools and routines) comprise a source’s knowledge package, assessing replication is difficult”.

The definition of knowledge transfer that includes Knowledge Use is in this sense a much more complex construct involving all the barriers to Knowledge Use such as the organizational elements of incentives; the psychology of behaviour and intent; etc., essentially the adoption portion of the Diffusion of Innovations theory (Rogers, 1983), along with all the potential means that connects action to Knowledge Internalization (Kelloway & Barling, 2000, 289).

In health services, knowledge recipients are continually being bombarded with potential new knowledge via distribution of materials, educational meetings, local consensus processes, educational outreach visits and academic detailing, local opinion leaders, audit and feedback, (computer generated) reminders, and marketing activities to addressing barriers (Grimshaw, McAuley, Bero et al., 2003, 299), where the emphasis is on putting that new knowledge to use. Thus, health services adopts the operational view of knowledge transfer as putting the new knowledge to use and changing practice patterns to reflect that new knowledge (Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002).

A second dimension of the definition of knowledge transfer is whether the transfer involves knowledge already in use (horizontal knowledge transfer), or knowledge put to use for the first time (vertical knowledge transfer) (Brooks 1964; Szulanski 1996a, 437); whether the sender and receiver are at the same level of the value chain (horizontal) or at a different level (vertical) (George, Zahra, Wheatley & Khan, 2001). Vertical knowledge transfer is typically between dissimilar units, such as between a Research and Development group and the factory floor (George, Zahra, Wheatley & Khan, 2001, 207) or researcher and practitioner. With horizontal knowledge transfer there are barriers to successful KT from characteristics of the source, recipient, and the context in which the transfer occurs (Szulanski, 1996b). This multifaceted situation makes horizontal transfer “a more balanced empirical setting to study the components of stickiness” (Szulanski, 1996a, 437) or barriers to KT. Examples of the value of horizontal knowledge transfer is the study of rates of improvement in Minimally Invasive Cardiac Surgery (Edmondson, Winslow, Bohmer & Pisano, 2003) or the 1990-91 transfer of coronary-artery bypass

surgery skills from surgical teams at five northern New England medical centers—via observing each other’s work, feedback on outcomes and training in improvement techniques—resulting in a 24% reduction in patient mortality (Davenport & Prusak, 1998, 97-98). Therefore this research will focus on horizontal knowledge transfer.

A third dimension of a definition of knowledge transfer relates to the level of aggregation of the transfer and what differences in definition are required for KT between individuals, between groups and between organizations. Knowledge transfer between individuals has been defined as “how knowledge acquired in one situation applies (or fails) in another” (Singley & Anderson, 1989, 1). Knowledge transfer has also been studied within small groups (Paulus & Yang, 2000), between units or departments (Adler, 1990), and across organizations (Darr, Argote & Epple, 1995). While some sources argue that knowledge can only reside at the individual level because only individuals have cognition which cannot be extracted from its context (Huber, 1991), the organizational learning view is that the agglomeration and institutionalization of individuals’ knowledge gives rise to organizational routines that can exist independently of the individual within the organization (Cyert & March 1963; Nelson & Winter 1982; Senge 1990). Thus, individual and collective knowledge relate to one another like the “parts of individual performers to a complete musical score, the lines of each actor to a movie script, or the roles of team members to the overall performance of a team and a game” (Brown & Duguid, 1998, 96).

This organizational-level view of knowledge and KT is consistent with other management literature, for example, research on cognitive strategic groups (Peteraf &

Shanley, 1997) or organizational memories (Hedberg, 1981). Individual-collective interaction very much describes the health services environment which is dominated by members of professional disciplines who work as individuals and groups, often within organizations in the multiple systems of health services. Knowledge is social in that much knowledge belongs to social groups (Nonaka, 1994), for example, when one learns a discipline such as nursing one learns more than facts, ideas, and techniques; one enters a domain already occupied by others and learns by participating with them in the language of that discipline and seeing the world through its distinctions (McDermott, 1999, 108).

There are a number of other potential dimensions along which to define knowledge transfer, for example:

- The task is content or goal oriented versus process oriented (i.e., strategic what versus operational how) (Becerra-Fernandez & Sabherwal, 2001);
- The knowledge is codified versus personalized (a form of explicit versus tacit) (Grover & Davenport 2001; Hansen, Nohria & Tierney 2001);
- Observable versus not observable, complex versus simple, or part of a system versus independent (Kogut & Zander, 1992); and
- Serial, near, far, strategic and expert (Dixon, 2000).

Each of these categorizations implicitly or explicitly was developed to explain differences in knowledge transfer effectiveness in relation to the circumstances or characteristics under which knowledge is transferred or what type of knowledge is being transferred (Inkpen & Dinur, 1998). Thus, they are not really aspects relating to a

definition of knowledge transfer but more appropriately should be considered as part of the discussion on the determinants of successful knowledge transfer, so they will be addressed in Section 3.2 Research Model.

Therefore, *horizontal knowledge transfer can be defined as a process where knowledge already in use is shared, internalized and used by an individual, group or organization.*

This working definition of KT will be used to review the KT theory and research. Other element required to interpret KT theory and research from the business community and health services community are the foundational theories underpinning KT theory and research: Communications theory and Diffusion of Innovations theory; as well as two other theoretical areas integrated with KT, organizational learning and technology transfer.

2.3.2. Foundational KT Theory and Research

KT theory seems to be predominantly progressing with “a limited appreciation of the links across disciplinary perspectives”, thereby “rediscover(ing) what is known already” (Argote, McEvily & Reagans, 2003, 572). But KT theory grew out of the theory of other disciplines and is strongly rooted in the work of these other disciplines such as the social and psychological sciences which have developed a significant amount of related theory and research in the past few decades (Gardner, 1985) in the areas of psychology, sociology, organizational behaviour, philosophy, economics and education (Green & Johnson, 1996). KT has been considered as closely related to the concepts of organizational learning, organizational memory, information sharing, and collaborative

work (Schultze & Leidner, 2002). At a macro level Table 2.3.2-1, derived from the work of Green & Johnson (1996), presents a view of which theory and research of other disciplines may be applied to knowledge transfer. Some of the areas of strongest relationship are Technology Transfer (Kogut & Zander 1993), Communications, Organizational Learning (Mody, 1989) and Diffusion of Innovations (Rogers, 1995). These four areas have been highlighted in the middle column of Table 2.3.2-1 and are described in detail in the section below.

Table 2.3.2-1: The Contribution of Reference Disciplines to the Study of Knowledge Transfer (Based on Green & Johnson, 1996)

Discipline	Central Focus as It Applies to Knowledge Transfer	Examples of Questions Pursued
Anthropology	The study of how cultures have evolved and have influenced each other, including how knowledge and technologies have been transferred within and across cultures.	How does culture influence KT processes? What are the agents and objects of change and their spin-off effects (Zhao & Reisman, 1992, 17)?
Business	The study of the organizational characteristics that enhance the 'innovativeness' of organizations. Diffusion of Innovations theory	What organizational factors lead to information processing breakdowns in organizations?
Communications	The study of various communications processes. Communications theory	What are the aspects of the various system levels, learning modes, learning types and learning phases that can inform KT processes?
Economics	The study of market forces that influence innovation.	How do profitability, firm size, and concentration ratios influence KT processes?

Discipline	Central Focus as It Applies to Knowledge Transfer	Examples of Questions Pursued
Education	The study of how knowledge can be shared so that it is understood, used, and valued.	What educational factors influence the process of knowledge transfer?
Library Science	The study of how information and knowledge can be stored and catalogued so it can be easily accessed.	Which structures and approaches of library science can be leveraged to knowledge holdings management and the resultant KT processes?
Linguistics	The study of speech acts and conversation.	What characteristics and components of speech act theory and the broader conversation theory are transferable to KT?
Organizational Behaviour	<p>Organizational Learning - The study of the behaviour of organizations as learning entities.</p> <p>Technology Transfer - The study of how technology is transferred to other users.</p>	<p>What creates a culture of learning so that one can integrate individual learning into a learning organization?</p> <p>What barriers impede technology transfer?</p>
Philosophy	The study of the nature of knowledge and how knowledge is used in practice (epistemology).	Is know-how knowledge (procedural) different from know-what knowledge (descriptive, explanatory) and how can that characteristic be applied to KT?
Psychology	The study of human behaviour and the factors that influence individuals to act, particularly cognitive and emotional states.	Are individuals able to transfer knowledge from one situation to another (Singley & Anderson 1989, Thompson 1998)?

Discipline	Central Focus as It Applies to Knowledge Transfer	Examples of Questions Pursued
Sociology	The study of interpersonal and inter-group behaviours, including the influence of social structures and norms on behaviours and practices.	How do social structures and social arrangements influence KT processes?

Accounting, entrepreneurship, organizational behaviour, marketing and strategy have also been added to this list (Teece, 1998, 289) as have interdisciplinary items like marketing (economics and psychology), development studies (anthropology, sociology etc.), and health promotion (social psychology, epidemiology and marketing), as well as clinical epidemiology (Greenhalgh, Robert, MacFarlane, Bate & Kyriakidou, 2004, 6). In the same vein technology transfer has been considered to span disciplines, specifically economics, sociology, anthropology, and management (Zhao & Reisman, 1992, 13-14). Here the management focus is sustaining a firm's competitive advantage (Zhao & Reisman, 1992) where the transfer involves patented or unpatented know-how (Baranson, 1976).

Given that this related literature in other disciplines exists and assuming that "There is a real danger that knowledge management will become discredited if it proceeds in ignorance of the extant literatures" (Teece, 1998, 289) then how can KT learn from and leverage the experience of these other disciplines and how can KT help solve some of the problems related to knowledge transfer being encountered in these other disciplines? The strongest two of these precursors to KT are presented below, showing how they inform

KT theory. Two additional precursors to KT are organizational learning and technology transfer.

A learning organization is one result of knowledge transfer (Bender & Fish, 2000) and knowledge transfer is one means by which an organization learns, so these two concepts are tightly coupled. Organizational learning informs KT through the concept of a learning barrier such as an individual 'learning horizon' (Senge, 1990) or other "problems that impede learning (e.g., memory turnover, conflicts, competency traps, tacitness, superstitious learning, fragmented learning, and learning from small samples)" (Simonin, 1997, 1155).

Technology transfer is the "process by which science and technology are diffused throughout human activity" (Brooks, 1966). KT theory has adopted some of the thinking of Technology Transfer theory, e.g., the work of Tatikonda & Stock (2002) and their areas of technology uncertainty and inter-organizational interaction. Further, it is quite possible that knowledge transfer could be further informed from the technology transfer concepts of: nature of information exchanges (aspects of codification and degree of tacitness); formality of transfer process; knowledge novelty; and certain effectiveness evaluation measures.

2.3.2.1. Communications Theory Approach and the Definition of KT

Leading knowledge transfer researchers have proposed explaining knowledge transfer using Communications theory (Szulanski 1996b). Communications theory is derived

from, 1) Shannon & Weaver's (1949) mathematical theory of communication, which specified the basic elements of a transfer as source, channel, message, recipient, and context, and 2) the communications-based logic of Arrow (1971). Shannon & Weaver's work was extended by identifying the key elements of any two-person communication as: a message; a sender; a coding scheme; a channel; a decoding scheme; a receiver; and the actions of transmission through the channel and assignment of meaning to the decoded message (Krone, Jablin & Putnam, 1987, cited in Gupta & Govindarajan, 2000, 475). This model is shown in the figure below.

Figure 2.3.2.1-1: Communication Theory (Krone, Jablin & Putnam, 1987)

Using this model, knowledge transfer is described as analogous to communicating information through a message where a sender sends a message and a receiver receives the message and that communication only occurs once the sender and receiver have the same understanding of this message (Krone, Jablin & Putnam, 1987). This model is consistent with the working definition of knowledge in that the sender message and the receiver understood message are considered to be the sender and receiver tacit knowledge, while communication involves the sender explicit knowledge or coded

message and the decoded transfer of the information which together make up the explicit knowledge. With this Krone, Jablin & Putnam model, however, it is not clear which of these receiver activities constitutes an understood message.

Communications theory is applicable to knowledge transfer since a primary aim of communication is to affect the receiver's behaviour by the sender's intent being understood and accepted once the message has been received (Te'eni, 2001, 258). That is, the decoded message is absorbed or understood by the receiver resulting in an understood message that is again significantly tacit knowledge. It is the movement of knowledge from its point of creation, transformation or holding to its point of use (Grover & Davenport, 2001, 8). The use of this knowledge is not part of this communications theory perspective of knowledge transfer (Jensen & Meckling, 1996), however, the recipient of the message is assumed to understand the message well enough to act on it (Darr & Kurtzberg, 2000).

Te'eni (2001, 255) extended this communications model of KT via the Cognitive-Affective Model of Organizational Communication. The Te'eni model is shown in the figure below.

Figure 2.3.2.1-2: A Cognitive-Affective Model of Organizational Communication (Te'eni, 2001)

In this model the Communication Inputs are the items that affect the communication process including attributes of the task, the sender and receiver characteristics, and their respective values and norms. Communication Process includes the communication strategies for a given communication goal, the physical medium on which the message is transmitted, and the form in which the information is packed into a message. Communication Impact was defined as mutual understanding and a trust relationship of the sender and receiver, while Communication Complexity refers to the use of limited resources to ensure effective communication in an uncertain and dynamic environment. For example, in the communication of clinical practice guidelines: the Communication Inputs could be the medical specialty and medical diagnosis of the guidelines, the researcher expertise, reputation and relationships; Communication Process could be distribution of materials, educational meeting, local opinion leader actions, etc.; Communication Complexity could be various competing organizational or professional

priorities; and the expected Communication Impact is increased compliance with the practice guidelines.

Even though Communications theory does not consider Knowledge Use as a transfer outcome, it does propose a structure in which to study KT. That is, KT success is impacted by attributes of the task, the sender and receiver characteristics, and their respective values and norms, as well as the level of mutual understanding and trust relationship between the sender and receiver, and the process environment.

2.3.2.2. Diffusion of Innovations Theory Relationship to KT Theory

Another precursor to Knowledge Transfer theory is Diffusion of Innovations theory. It is a precursor not only because it comes before KT theory chronologically, but also because KT theory addresses weaknesses or areas of inadequacy in the Diffusion of Innovations theory.

Two key concepts in the Diffusion of Innovations theory are diffusion and adoption. Diffusion is the human interaction process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 1995, 10, 13). Adoption is a decision-making process where an individual or group passes from first hearing about an innovation to final adoption (Rogers, 1962, 15) based on stages in the adoption process and on the categorization of the adopters (Rogers, 1983). In KT theory, using the KM Process Model presented in Section 2.2, diffusion is termed

Knowledge Sharing and adoption is termed Knowledge Internalization plus Knowledge Use.

The shared understanding between Diffusion of Innovations theory and Knowledge Transfer theory begins with their common base in Communication theory. Diffusion of Innovations theory is “based on a linear model of communication, the process by which messages are transferred from a source to a receiver” (Rogers, 1995, xvi). It continues with the five general innovation characteristics, as perceived by target adopters (Rogers, 1962, 124). The general characteristics of relative advantage, compatibility, complexity, observability and communicability were derived from 39 terms used by diffusion researchers (Rogers, 1962, 134). Thus, like knowledge transfer an initial plethora of research proven determinants were streamlined into a parsimonious framework. The similarity of these Diffusion of Innovations characteristics and similar items in KT is shown in Table 2.3.2.2-1. The similar KT Characteristics are discussed in Section 3.

Table 2.3.2.2-1: Comparison of Innovation Diffusion and KT Characteristics

Innovation and Diffusion Characteristics	Characteristic Description	Theoretical Basis	Similar KT Characteristic
Relative Advantage	The degree to which an innovation is perceived as better than the idea it supersedes (Rogers, 1995, 15).	Various examples of agricultural and economic crisis (e.g., Wilkening, 1953, 13) or social promotional efforts (Ross, 1952, 36).	Perceived Knowledge Value where the greater the value of the knowledge the greater the attractiveness of the transfer (Gupta & Govindarajan, 2000, 475).

Innovation and Diffusion Characteristics	Characteristic Description	Theoretical Basis	Similar KT Characteristic
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters (Rogers, 1995, 15).	Numerous examples included television adoption rates by social class (Graham, 1956) and Catholicism by Rio Grande Indians (Hawley, 1946).	Sender-Receiver Distance, the degree of similarity in values, norms, philosophy and social identities (Nelson & Coopridier 1996; Child & Rodrigues 1996), and compatibility with clinicians current norms and values in practice (Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002, 720).
Complexity	The degree to which an innovation is perceived as difficult to understand and use (Rogers, 1995, 16), requiring the adopter to develop new skills and understandings.	Examples included farm innovations (Kivlin, 1960) and canasta versus television (Graham, 1956).	Knowledge Complexity, the extent to which the knowledge is an element of a set of interdependent components (Winter 1987), dependent on the number of individuals, interdependent technologies, organizational routines and organizational resources (Simonin, 1999, 622).
Trialability or Divisibility	The degree to which an innovation may be experimented with (tried and used) on a limited basis (Rogers, 1995, 16).	A farming example for seed corn (Ryan & Gross, 1943).	Trialability copies this Rogers construct, while Richness of Transmission Channels is similar, since the farmers were 'trialing' the innovation to test whether it was worthwhile to be adopted.

Innovation and Diffusion Characteristics	Characteristic Description	Theoretical Basis	Similar KT Characteristic
Communicability / Observability	The degree to which the results of an innovation are visible to others (Rogers, 1995, 16).	Examples included farming (Hruschka, 1961) and preliterate society innovations (Erasmus, 1961, 23).	Observability copies this construct (Kogut & Zander, 1995), while Richness of Transmission Channels is again indirectly similar, since communication is a way of making the knowledge visible.

Other similarities between Diffusion of Innovations theory and KT theory include the following.

- Re-invention: The degree to which an innovation is changed by the user in the process of adoption (Rogers, 1995, 17), part of Knowledge Internalization and Knowledge Use processes.
- Communication channels: processes for creating and sharing information with one another to reach a mutual understanding (Rogers, 1995, 17), or knowledge transmission channel activities that have the intention of enabling the receiver to have the same view of the knowledge as the sender.
- Homophily and heterophily: while two individuals may be homophilious on items like education and social status they must be heterophilious about the innovation or no diffusion can occur (Rogers, 1995, 19). The same Sender-Receiver Distance applies to knowledge transfer. If the sender and receiver have each internalized the same knowledge there is nothing to transfer.

- Historical basis: diffusion research occurred in anthropology, sociology, education communication, marketing, public health, geography, economics and in other disciplines (Rogers, 1995, 42-43). This is a very similar list to that of Green & Johnson (1996) at the start of this section (Table 2.3.2-1).
- Communications model basis: most diffusion research is “based on a linear model of communication, the process by which messages are transferred from a source to a receiver” (Rogers, 1995, xvi).

While these five innovation and diffusion characteristics plus these theoretical parallels of internalization, transfer channels and homophily and heterophily are similar aspects of these two theories, there are some significant differences that are crucial to understand. The most important of these is Rogers’ choice half a century ago that the diffusion process includes innovation adoption; a choice facing KT today.

“There is some disagreement among diffusion researchers as to whether the diffusion process ends when the individuals in a social system (1) are aware of, or (2) have adopted the new idea. The author prefers the latter viewpoint, and it is most prevalent among diffusion writers. This view of the diffusion process implies that it includes the adoption processes for individuals in the social system” (Rogers, 1962, 18).

The equivalent knowledge transfer choice would be to define knowledge transfer as Knowledge Sharing plus Knowledge Internalization plus Knowledge Use because Rogers considers adoption to mean “the full use of the innovation” (Rogers, 1962, 86). This choice is essential to understand because the health services community has adopted this Diffusion of Innovations theory perspective on knowledge transfer.

A second difference is that the Diffusion of Innovations theory finds it difficult “to distinguish between the source of a message and the channel that carries the message” (Rogers, 1995, 194). Channels here include mass media (for changes in weakly held attitudes) and interpersonal channels (to form or change strongly held attitudes). Knowledge transfer requires a sender to communicate the tacit portion of the knowledge and the channel is considered a separate determinant for successful KT (Gupta & Govindarajan, 2000).

A third difference is the inability of the classical Diffusion of Innovations model to accommodate complex innovations and complex technology (Attewell, 1992, 4). Questions have been raised whether inter- and intra-organizational diffusion of innovations behaved in a similar fashion (Cool, Dierickx & Szulanski, 1997a, 543). This seems due in part to the inability of a single individual to understand and therefore disseminate or adopt the complex technology (Eveland & Tornatzky, 1990, 123) and the need for secondary decisions (Leonard-Barton, 1986, 2). However, while KT theory considers the negative impacts on successful transfer of more complex knowledge (Kogut & Zander 1993, Simonin 1999, Hansen 1999), KT theory has not addressed the question of what is required to achieve successful knowledge transfer of complex knowledge. A related deficiency found with Diffusion of Innovations is when the adoption process is gradual and critical mass cannot be defined as yes or no (Cool, Dierickx & Szulanski, 1997, 556-557).

A fourth and crucial difference is that Diffusion of Innovations theory does not see an innovation from the perspective of the respondent or receiver, prohibiting an understanding of why an innovation is adopted or rejected.

“If diffusion scholars could more adequately see an innovation through the eyes of their respondents, including a better understanding of *why* (italics by author) the innovation was adopted or rejected, diffusion research would be in a better position” (Rogers, 1995, 111).

In KT however, transfer is used rather than diffusion to emphasize the distinct experience rather than a gradual process (Szulanski, 2000b, 17) that depends on the characteristics of everyone involved (Szulanski, 1996b, 28). More strongly, one could argue that the perspective of the knowledge receiver is the dominant perspective of KT (See Section 2.3).

More basically, Rogers’ definition of an innovation as “a design for instrumental action that reduces uncertainty in the cause-effect relationships involved in achieving a desired outcome” (Rogers, 1995, 12) connotes that a solution is derived before the individual problem is known. Even stronger, “it is argued that an individual becomes aware of an innovation by accident, since the individual cannot actively seek an innovation until he/she knows that it exists” (Rogers, 1995, 162). This situation and this perspective can only occur logically if one has a cognitive/objective view of the world. Knowledge Transfer theory, in this researcher’s view, is constructionist considering knowledge to have a tacit element with which to address Aristotle’s conundrum of knowing the solution to the problem before knowing the problem. In Knowledge Transfer theory the willingness to adopt the new knowledge has been made prior to the transfer, rather than

after the transfer (meaning sharing) as Diffusion of Innovations proposes. No change of behaviour is needed to achieve the knowledge transfer decision, although a change of behaviour may definitely be needed to use the knowledge.

Diffusion of Innovations theory, over three decades older than KT theory, symbiotically informs KT theory by further defining at least three of the key determinants of KT success (Sender-Receiver Distance, Knowledge Complexity, Richness of Transmission Channels and possibly Perceived Knowledge Value) and by strongly suggesting the need for Knowledge Use to be part of the KT definition.

2.3.3. Knowledge Transfer Theory and Research

Knowledge Transfer theory and research has developed from these precursor theories, providing a wide latitude and range of elements. To organize this literature Argote, McEvily & Reagans (2003, 573) proposed an “integrative framework” which is shown in Figure 2.3.3-1. It presents a two dimensional view with Knowledge Management Outcomes on the vertical axis and Knowledge Management Context on the horizontal axis. As this is a high-level framework the nine Framework integration points in the central portion of the diagram have been purposefully left blank.

Figure 2.3.3-1: Theoretical Framework for Organizing Research on Organizational Learning and Knowledge Management (Argote, McEvily & Reagans, 2003)

The three Knowledge Management Outcomes of Creation, Retention and Transfer are consistent with this studies' KM Process Model elements of Knowledge Creation, Knowledge Holdings Management, and Knowledge Transfer (Knowledge Sharing, Knowledge Internalization, and Knowledge Use). Similarly the Knowledge Management Context categories of Properties of Units, Properties of Relationships Between Units and Properties of Knowledge match closely with the Communications theory structure of Sender/Receiver, Message (Figure 2.3.2.1-1) and Communication Inputs/Communication Impact (Figure 2.3.2.1-2). That is, the unit is the individual, group or organization which is sending or receiving the knowledge, and some properties of these units such as their status may be a determinant of successful transfer. Similarly, Relationship Between Units such as mutual understanding or shared values and norms may be determinants of successful transfer. Further, properties of knowledge that indicate some medium, messages or form more appropriate than another, may lead to successful knowledge transfer.

The essence of knowledge transfer theory and research are aimed at making this black box in Figure 2.3.2.1-2 of Communication Inputs, Communication Processes, and Communication Complexity resulting in Communication Impact (Te'eni, 2001) understood and controllable. KT theory has approached this problem predominantly from the perspective of the barriers to successful transfer (Allen 1977; Ounjian & Carne 1987 and Szulanski 1996a). Identified barriers have included: loss of productivity in the transfer of complex manufacturing technology (Galbraith, 1990); cost of transferring technical information due to the attributes of the knowledge (von Hippel, 1994) and those transferring the knowledge (e.g., problem solvers must have the knowledge and skills to use new knowledge (von Hippel, 1994)); differing “group contexts (Singley & Anderson, 1989); and limited problem-solving, inability to innovate with new tools and methods, limited experimentation, and screening out external knowledge (Leonard-Barton, 1998). Szulanski (1996b) termed these barriers stickiness.

2.3.3.1. KT Frameworks

Following this KT barriers line of thinking, Szulanski (1996b, 30) developed a knowledge transfer model by integrating four sets of factors to be used together in “an eclectic model that allows their relative influence to be measured”. These were knowledge characteristics (causal ambiguity and unprovenness), source characteristics (lack of motivation and not seen as reliable), characteristics of the knowledge recipient (lack of motivation, lack of absorptive capacity, and lack of retentive capacity), and characteristics of the context (barren organizational context and arduous relationship). The Szulanski (1996a, 1996b, 2000) research defined the concept of horizontal KT and

was the first to consider a model with barriers to KT from multiple dimensions: knowledge; sender; receiver; sender-receiver; and context. It considered the transfer of “organizational knowledge between a source and a recipient unit in which the identity of the recipient matters” (Szulanski, 1996b, 28). The knowledge transferred was considered to be at the group or organizational level consisting of a “web of coordinating relationships connecting specific resources” (Szulanski, 1996b, 28).

Similarly, Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) used 16 characteristics in the transfer of clinical practice guidelines according to a dissemination approach. These 16 determinants can be mapped to the business KT terminology (see Table 2.3.3.3-1: KT Determinant Vocabulary Cross Reference).

The case study by Shearer (2002) used three cases of successful transfer and three cases of unsuccessful transfer between the software engineering stages of design and testing of new software to identify KT success differences. This very informal and exploratory case study identified areas where successful cases differed from unsuccessful cases and other areas all cases seemed to address.

The Cummings & Teng (2003) research looked at the transfer of new product development in terms of the categories of knowledge, recipient, sender-receiver relationship, transfer process, and context. Determinants in these categories were defined from both theoretical and empirical sources making it one of the most comprehensive and grounded KT studies. This research also was unique in its attempt to differentiate

between basic and advanced transfer activities, and explicit and tacit knowledge respectively, on transfer success.

The Ko, Kirsch & King (2005) research of the transfer of Enterprise Resource Planning implementation knowledge from consultants to another organization is structurally built on the investigations and informal KT model of Argote (1999, 167) who proposed the characteristics of relationship among organizations (embedded relationships, geographical proximity, degree of similarity of group contexts, relationship quality), organizations involved in the transfer (organization size, leading organization imitateness, receiver absorptive capacity and motivation), features of the knowledge being transferred (codifiability, causal ambiguity, complexity, observability), and dimensions of the transfer process (timing of transfer, richness of transmission channels). Ko, Kirsch & King used a subset of the characteristics of relationship among organizations (degree of similarity of group contexts, relationship quality), organizations involved in the transfer (receiver absorptive capacity and motivation), features of the knowledge being transferred (causal ambiguity, observability), and dimensions of the transfer process (richness of transmission channels), and added perceived credibility of source; choosing not to include Argote's embedded (or context) relationships, geographical proximity, organization size, leading organization imitateness, codifiability, complexity, or timing of transfer.

The literature basis to defining a knowledge transfer framework is varied. Szulanski (1996b, 30) briefly cited a single source or two to back-up each characteristic while Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998, 859) used an undocumented and

undefined “non-systematic study of scientific articles and documents” from multiple countries on clinical guideline development. Simonin (1999) substantively underpinned each of the seven KT characteristics, while Argote (1999) took a mixed approach. At a macro level Argote derived the KT informal model through her own quantitative research on organizational learning curves, resulting in the four KT characteristic categories. At a micro level each of the characteristics proposed was based on a support continuum ranging from strong, significant industry experience on one end, to briefly identified concepts with a single reference point at the other end. The interaction between these four authors’ models consists of Argote & Simonin referencing Szulanski, but no other author referenced or explicitly built on the work of any other.

Other authors followed this KT conceptual period of the late 1990s with refinements to this KT success factors approach and structure, furthering certain lines of research:

- The formal use of the communications model to explain KT (Gupta & Govindarajan, 2000);
- Simonin (1999) use of seven antecedents to knowledge ambiguity; and
- Further empirical testing of the Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) characteristics, both pre- and post-clinical practice intervention (Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002).

Section 3 of this research consolidates these frameworks by further considering these categories and the various proposed KT success characteristics to propose a KT Framework to address the gaps stemming from these initiatives. Another step in this

direction is to review the empirical studies and determine their level of support and determine which KT success determinants should be part of a KT Framework (Section 2.3.3.3 Empirical Studies); then the concept of tacit knowledge transfer is reviewed to determine how it has been understood.

2.3.3.2. Transfer of Tacit Knowledge

Knowledge transfer is sometimes simply presented as a knowledge-based process where the knowledge of a new process or product is made explicit and fully documented. Then this comprehensive documentation is shipped to a receiver site where the documentation is read and fully understood, whereby a replica knowledge-based process or product is produced exactly as specified (Von Krogh, Ichijo & Nonaka, 2000). What happens in practice is somewhat different from this overemphasis on codification (Stenmark, 2000, 10), since some of the knowledge is “still tacit, no matter how thorough experts believe their documentation is” and the knowledge received will be refined and changed (Von Krogh, Ichijo & Nonaka, 2000, 211-212). It has been argued that “even modern science and technology typically cannot be transferred by documents alone” (Gorman, 2002, 219) an argument supported by the examples of English steel-making; English textile expertise; laser technology; the Space Shuttle O-ring problem; and the nuclear bomb. Even rule-based expert systems only capture part of what experts do (Gorman, 2002).

Methods to transfer tacit knowledge, or in psychological terms implicit knowledge (Reber, 1967), include:

- Transfer of mental models, for example from ‘old-timers’ to ‘newcomers’ (Levine and Moreland, 1999);
- Incorporate tacit knowledge into worker routines and tacit actions (Grant & Gregory, 1997); and
- Share a technological frame (Bijker, 1995) where representations of that technological frame are shared by groups or constituencies, where a health care constituency could be a professional discipline such as cardiologists or cardiac nurses. For example, the Sears case of introducing a mass merchandising system into Mexico and Peru (Gorman, 2002).

If one starts from the definition that tacit knowledge: is personal in nature (Polanyi, 1964); is learned through practices or routines that are assimilated informally and unconsciously (Boiral, 2002); is difficult to codify since it is manifest in people knowing more than they can tell (Polanyi, 1964); and is oriented to accomplishing specific tasks (Boiral, 2002), then how exactly is this tacit knowledge being transferred? Beyond Gorman’s (2002) examples listed above, which mostly involved transferring a knowledgeable person, the main approaches found in the literature are codification (Nonaka, 1994) and application, for example, recommender systems (pointing to relevant Web documents rather than creating lists of keywords for searching) (Stenmark, 2000), and making employees responsible for environmental improvements (Boiral, 2002). The broader terms assigned to this ‘application’ approach are innovation and organizational learning (Johannessen, Olaisen & Olsen, 2001).

But defining in detail exactly what tacit elements are being transferred is not clear from the literature. To some it is measures of transfer barriers like codifiability, complexity and observability (Cavusgil, Colantone & Zhao, 2003) while to others it is various measures of learning by doing (Howells, 1996). Everyone is saying the words, but there are few fully discrete examples, perhaps by definition.

A subtle element of the application approach is that its transfer can at times be analogous to the transfer of a skill where a skill cannot be acquired merely by learning to perform its fragments, but the knack of coordinating its fragments must be discovered (Polanyi, 1964), for example via learning by doing (Howells, 1996). This recreating the coordination of the knowledge fragments is very much in line with the working definition of knowledge used in this research where the knowledge is recreated by the receiver.

These descriptions of the transfer of tacit knowledge exist substantively in the business literature with only limited consideration in the health services KT literature. For example, the Minimally Invasive Cardiac Surgery learning curve study concluded that, “Accustomed to relying on weak ties (journal articles, opinion leader endorsements) to transfer codified medical knowledge, the surgeons studied were not sensitive to the importance of collective tacit knowledge for performance improvement with the new technology” (Edmondson, Winslow, Bohmer & Pisano, 2003, 216). The collective tacit knowledge was not transferred.

2.3.3.3. Empirical Studies

This section reviews the empirical knowledge transfer literature. The process begins a review of the empirical studies of knowledge transfer presented in Table A-1 in Appendix A. This cross-reference matrix of studies and concepts as proposed by Webster & Watson (2002, xvii) is presented in chronological order to show how they build on one another. The initial studies, although initially considered technology transfer studies, deal with concepts that will later be considered knowledge transfer, so these studies head this list. Most of these empirical studies addressed the questions of what is required for knowledge transfer success often through a description and testing of various determinants of knowledge transfer.

All of the quantitative studies used a model of dependent and independent variables to test some aspect of knowledge transfer success where the independent variables are a set of KT success determinants. Almost every author used a different measure of knowledge transferred, different dependent variables, and different vocabulary to define their independent variables. There were a mix of transfer types: horizontal, vertical and a mix of horizontal and vertical; sender focused (sharing) and receiver focused (access, search, receive); and inter- and intra-organizational. There was also the expected equal split in the definition of the dependent variables in terms of Knowledge Internalization or Knowledge Use.

The linkage of health services research to business knowledge transfer research occurs with the Grilli & Lomas (1994) assessment of the association between characteristics of

these clinical practice guidelines and their rate of adoption. They found compliance higher for guidelines displaying trialability and lower for complex guidelines, while observability had no impact. This is a very similar result to Kogut & Zander (1993) where both studies used Rogers (1962) Diffusion of Innovations characteristics as the starting point (See Section 2.3.2.2 (Diffusion of Innovations Theory Relationship to KT Theory)). Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) took a similar approach and identified 16 characteristics of the guidelines, finding ‘not precisely described’, ‘not based upon sound evidence’, ‘not compatible with clinicians’ current norms and values in practice’ and ‘required changes to fixed routines or habits to be significant characteristics or determinants. The intention of this approach was to investigate the interaction of the practice guideline with the physician behaviour intervention to determine how better to apply the interventions and thereby increase physician compliance with the practice guidelines (Grimshaw, Shirran, Thomas, Mowatt, Fraser & Bero (2001).

Interestingly, despite totally independent sources the health services KT determinants and business environment KT determinants seem to almost exactly match. The 16 health services determinants specified by Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) can be mapped to the business environment determinants as shown in the table below.

Table 2.3.3.3-1: KT Determinant Vocabulary Cross-Reference

Health Services KT Determinant Name	Corresponding Business KT Determinant Name
-------------------------------------	--

Health Services KT Determinant Name	Corresponding Business KT Determinant Name
Addresses Common Issue; Addresses a Patient Care Issue; Key Feature; Has A High Profile	Perceived Knowledge Value ==> Positive Receiver Motivation
Precisely Described; Core Guideline Element	Knowledge Codifiability
Compatible	Sender-Receiver Distance
Based Upon Sound Evidence; Based on Clinical Skills and Experience	Perceived Credibility of Source
Fits Patient Expectations	Positive Receiver Motivation
Observable	Observability ==> Knowledge Codifiability
Requires Organizational Change	Supportive Organizational Context
Requires Changed Routines	Unlearning Capacity
Is Complex	Knowledge Complexity
Triable	Triability
Requires New Knowledge or Skills	Prior Related Knowledge
	Relationship Quality
	Richness of Transmission Channels

2.3.4. Knowledge Transfer Research Directions

The main research directions are, 1) to continue identifying the barriers to successful KT by identifying the determinants of successful KT, and 2) to influencing receiver behaviour change by sender actions, essentially a Diffusion of Innovations approach.

The extensive research on barriers to successful knowledge transfer beginning in the late 1990s continuing with the broad framework of Cummings & Teng (2003) and the very complex health services research on the impact of the KT determinants on increases in physician use of clinical practice guidelines (Foy, MacLennan, Grimshaw, Penney,

Campbell & Grol, 2002). In health services Grimshaw, Thomas, MacLennan, et al (2004, 66) highlighted that “despite 30 years of research in this area, we still lack a robust, generalisable evidence base to inform decisions about strategies to promote the introduction of guidelines or other evidence-based messages into practice” indicating the broad research direction. They suggested that an initial step in the development of the theoretical basis of professional and organizational behaviour could involve testing the applicability of such theories in healthcare settings (Grimshaw, Thomas, MacLennan, et al, 2004).

Approaches to changing clinical practice have been categorized into the theoretical groupings of educational approaches (i.e., stimulating individual motivation), epidemiological approaches (i.e., rational arguments such as practice guidelines), marketing approaches (i.e., developing an attractive message or product), behavioural approaches (i.e., performance review and other feedback), social interaction approaches (e.g., opinion leaders, outreach, peer review), organizational approaches (i.e., health care system perspective of organizational performance), and coercive approaches (e.g., laws, regulations, accreditation and utilization review) (Grol, 1997, 419). Four examples of theoretical models or frameworks to try to move forward this line of work addressing the problem of implementation of Health Services ‘best practices’ are list below.

1) The Ottawa Model for Research Use (Logan & Graham, 1998), shown in Figure 2.3.4.2-1, provides a framework specifying the practice setting elements known to influence the decision to adopt and use research results. Structural factors include decision-making; regulations and policies; physical structure; workload; resources and

supplies; system incentives; and medical-legal risks. Social factors include politics; local champions; and culture and beliefs, while patient factors include problems; beliefs; influence; and willingness.

Figure 2.3.4.2-1: The Ottawa Model of Research Use (Logan & Graham, 1998)

2) The model for implementation of evidence-based practice by Kitsom, Harvey & McCormack (1998) proposed that successful utilization is a result of the relationship of the evidence for the proposed change, context of the proposed change, and the mechanisms through which the change will be facilitated, where each of these three dimensions is considered simultaneously. Thus, a context with unclear roles and poor leadership that is task driven and has few performance monitoring systems would be less likely to be successfully implemented. Similarly, in a study of the transfer of nursing knowledge to address gaps between nursing theory and practice, Tsai & Tsai (2004)

found support for the determinants of motivation (willingness to learn), linking theory to practice, and sufficient nursing skills (prior related knowledge).

3) The knowledge, attitudes and behaviour framework of action for guidelines identified barriers in these three areas (Woolf 1993; Cabana, Rand, Powe, et al. 1999): a) knowledge barrier of familiarity and lack of awareness; b) attitude barrier of lack of agreement with guidelines (specifically and in general), lack of outcome expectancy, lack of self-efficacy, and lack of motivation; and c) external barriers of patient factors, guideline factors and environmental factors. The outcome measures were defined as adoption (decision to change practice), diffusion (distribution of guidelines and unaided adoption), dissemination (active diffusion), and implementation (active dissemination involving strategies to overcome barriers). The proposed approach was to consider multiple barriers simultaneously, unlike the 58% of the studies reviewed by these authors which each considered a single barrier. In addition there was recognition that the implementation of most clinical guidelines requires system change and hence organizational change as well as individual change (Grimshaw, Thomas, MacLennan et al., 2004). The suggested approach was to influence knowledge and attitudes rather than behaviour directly since this indirect influence was considered more sustainable (Cabana, Rand, Powe, et al. 1999). A clinical pathway could be considered a multiple threaded approach entailing a rational argument using social processes within an organizational process (Grol, 1997, 419).

4) The Conceptual Model for Considering the Determinants of Diffusion, Dissemination, and Implementation of Innovations in Health Service Delivery and Organization

(Greenhalgh, Robert, MacFarlane, Bate & Kyriakidou, 2004) encompasses aspects of the innovation; communication and influence; system antecedents for innovation; system readiness; model components linkages, outer context, and outcome (adoption, implementation and routinization, and consequences). The purpose of this model was to provide a memory aid for considering different aspects of this complex phenomenon and to identify associated gaps in the research.

Each of these four directions is similar in terms of consideration of barriers to outcome success grouped in terms of context, relationship, and change evidence and then addressing these barriers simultaneously through a process framework. This addressing of barriers is exactly the path being followed by the business knowledge transfer literature.

2.4. Summary of Literature Review

This key points from this literature review are:

- KT is an important area of study with the potential to increase competitive advantage, organizational innovativeness, and organizational learning, and to improve productivity and effectiveness through increased use of leading practices;
- There is a long history of KT-related theory and research; about 20 years of KT and over 40 years of the founding literatures;
- KT applies Communications theory with a receiver focused extending the research of Diffusion of Innovations, Organizational Learning and Technology Transfer;

- KT does not use a common terminology to represent similar elements (i.e., dependent and independent variables including knowledge transferred; health services and business); and treats different transfer elements the same: outcomes of Knowledge Internalization or Knowledge Use; varied transfer types (horizontal/vertical, inter-/intra-organizational, tacit/explicit, simple/complex); in varied contexts;
- The main research focuses on identifying the characteristics that differentiate successful KT from unsuccessful KT;
- Health services and business determinants of successful KT are almost completely overlapping, despite following totally independent research streams;
- Recent research has entailed developing frameworks or families of KT determinants.
- KT theory has been rather light in support of the 20 plus empirical studies;
- There has been a general awareness by some authors of the tacitness of knowledge, usually studied in terms of complexity or absorptive capacity; and
- A major direction of KT research in health services is identifying enablers for and barriers to knowledge translation success, considering multiple barriers simultaneously, and focusing on receiver behaviour change via sender actions, a Diffusion of Innovations orientation.

The next section builds on this literature review, developing the resultant research question and a model to test this question.

3. RESEARCH QUESTION AND RESEARCH MODEL

This section begins with a review of the gaps in the knowledge transfer literature that require further study and presents the research question that logically arises from the literature review. It describes in detail the development of a research model, the Knowledge Transfer Framework which will be used to answer the research question through its testing. Section 4: Research Methodology and Design depicts how this KT Framework was tested.

3.1. Literature Gaps and Resulting Research Question

KT theory has evolved from the simple linear models of Diffusion of Innovations and Technology Transfer (TT) to more complex and integrated models considering senders, receivers, S-R interaction and various environmental aspects, coming to agreement on these determinant categories but with still a lot of play in the determinant specifics. The theory and research has occurred independently but in parallel in the business and health services environments, where the health services focus has been to use KT to further the investigation into increased physician adoption of clinical practice guidelines. The literature review indicates three broad avenues for future research, KT determinant research to develop a consolidated and parsimonious framework for successful knowledge transfer; investigating the role and capacity of tacit knowledge as a specific element in these transfers; and helping address the key health services challenge of increasing receiver compliance with clinical practice guidelines. In addition a number of implicit assumptions appear to underpin this literature including: all knowledge is the

same; all contexts are equivalent; and a transfer is a defined event. These assumptions need to be tested.

3.1.1. Determinants For Successful KT

Knowledge Transfer theory and Diffusion of Innovations theory (Rogers, 1983) are based on Communications theory that considers transfer in terms of a source, communication channel, message, recipient and context. A version of this Communications model has been used in most KT empirical studies reviewed in Section 2.3.3.3. Almost all of these studies used a model of dependent and independent variables to test some aspect of knowledge transfer success; and all but one of these studies tested as independent variables a set of KT success determinants.

Almost all of these KT empirical studies with dependent and independent variables used different knowledge artefacts to be transferred, a different dependent variable, a different study population, and often referenced different elements of the KT theoretical basis (Table A-1, Appendix A). Further, these studies tested on average five determinants (i.e., 126/25) and found on average three determinants (i.e., 73/25) to be significant (Table A-1, Appendix A). The many different determinants being tested and being found significant by these empirical studies indicates either a wealth of KT research opportunities or the lack of a robust theoretical basis for knowledge transfer, or both. The concepts are many, their variations extensive and their measurement diverse. There is a need to formalize and structure these potential determinants and identify which are the determinants of KT success.

Five of these empirical KT studies have investigated a comprehensive set of KT determinants or KT Frameworks: Szulanski (1996b); Grol, Dalhuijsen Thomas, Veld, Rutten & Mokkink (1998); Ko, Kirsch & King (2005); and Cummings & Teng (2003). Each of these studies has a different area of emphasis and significance and there is an opportunity to integrate these views into a single composite KT Framework. Further, existing KT theory and research does not at this time fully describe the mechanics of knowledge transfer enabling management of KT. The successful horizontal transfer of knowledge and meaning (Kostova, 1999) involving receiver ownership of, commitment to, and satisfaction with the transferred knowledge (Cummings & Teng, 2003) is a complex social activity that is difficult to describe.

3.1.2. Transfer of Tacit Knowledge

The working definition of knowledge indicates the key role of tacit knowledge in KT but the theory and research to date, while acknowledging the existence and even the importance of tacit knowledge in these transfers, has not studied this phenomenon directly nor been able to describe qualitatively its role in these transfers. Mooradian (2005) for example has used Polanyi's (1966) concepts of 'local' or explicit knowledge and 'subsidiary' or tacit knowledge, where this explicit knowledge "through repetition, experience, and integration with memory, they are transformed into their subsidiary role" (Polanyi 1969), to present tacit knowledge as a potential to address a logical gap. Thus, Mooradian (2005, 110) argues that "explicit knowledge cannot be transferred unless its underlying tacit knowledge is transferred, exists or is recreated". This view represents a change in KT thinking from one of making tacit knowledge explicit to one of linking tacit

knowledge to various explicit knowledge elements where the relationship between this tacit and explicit knowledge need to be understood to enable its transfer, no qualitative or other case study-type description has yet been provided for an example of this tacit knowledge transfer.

3.1.3. Investigating Increasing Receiver Compliance with Clinical Practice Guidelines Through KT

The results of the practice guideline compliance studies indicated to the authors that the relatively poor definition of the KT determinants (Grilli & Lomas, 1994) shows the need for further empirical research, and that further work along this path may have better outcomes if the types of determinants were expanded to include:

- The target group, the setting, and the obstacles to change encountered (Grol, 1997, 420); and
- Environment or culture, since the research found half of variance just considering knowledge elements. “Both the diffusion of innovations literature and the growing physician behaviour change literature support the idea that setting and the audience are likely to be quite influential on compliance rates” (Grilli & Lomas, 1994, 210).

Unfortunately the negative results of Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) have resulted in an apparent dead end for health services research on knowledge transfer frameworks (personal communication of Grimshaw, 2005), so this ten-year old view still represents the current status.

3.1.4. Research Question

This research investigates knowledge transfer in health services that contributes to improving patient outcomes and system performance. This research is built on the existing KT empirical research which looks at the determinants of KT success and leverages these strengths and addresses weaknesses. From the discussion in Section 3.1.1 (Determinants For Successful KT) the research question is:

Q1: What are the determinants of horizontal knowledge transfer success in health services?

A related requirement described in Section 3.1.2 (Transfer of Tacit Knowledge) is to describe the transfer mechanism, including any distinction between the transfer of more tacit knowledge elements from the transfer of more explicit knowledge elements. Thus, the subordinate research question:

Q1.1: How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge?

The split in the KT literature about whether knowledge transfer should include Knowledge Use or just Knowledge Sharing and Knowledge Internalization, exacerbated by the support for the Knowledge Use perspective by the health services literature, the Diffusion of Innovations literature and the Organizational Learning literature, indicates these differences require scrutiny via KT research. None of the 24 empirical studies

reviewed have addressed this need so it is a significant research gap. Thus, the second subordinate research question:

Q1.2: How do these determinants of horizontal knowledge transfer success differ between cases of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed?

Another gap in the literature is a detailed understanding of the process of KT. Thus, the research question will be addressed from the perspective of acquiring a better understanding of the KT phenomenon in action.

The KT empirical studies have used a composite of generally defined measures of knowledge, KT, and transfer type and often have not identified the transfer mechanism, so a related research requirement is to use an objective and measurable definition of knowledge and an equally measurable definition of KT success.

3.2. Research Model

The first step in addressing the research question ‘What are the determinants of horizontal knowledge transfer success in health services?’ is to propose a model of determinants that can be tested. This model in this research is called the Knowledge Transfer Framework. The development of the KT Framework begins with the identification of the dependent variable, the definition of knowledge transfer success. The independent variables are then developed, the identification of the determinants of KT

success. These dependent and independent variables together result in a model that can be tested to address the primary part of the research question. However, to test the supporting research question elements this model is elaborated into the KT Framework by introducing separate flows for explicit and tacit knowledge.

3.2.1. Dependent Variable – Knowledge Transfer Success

There are three main ways to evaluate knowledge transfer, 1) assess changes to the knowledge base of the recipient (Knowledge Sharing plus Knowledge Internalization), 2) assess changes in the recipient's actions and performance attributed to the transferred knowledge (Knowledge Sharing plus Knowledge Internalization plus Knowledge Use); 3) assess performance change (outcome of Knowledge Use) (Argote & Ingram, 2000). The first two of these will be evaluated for this research. The third means of assessing KT success has been used in both the business and health services literature (Blancett & Flarey, 1998) in terms of outcome or end-result, e.g., performance (Kalling, 2003, Argote & Ingram, 2000), productivity (Darr, Argote & Epple, 1995), survival (Baum & Ingram, 1998), and improved medical outcome such as reduced in-hospital mortality (Canadian Cardiovascular Outcomes Research Team, 2004, 1). However, these outcomes are costly and difficult to gather, e.g., via a chart audit, and secondly, there may be a multiplicity of factors impacting on these outcomes, e.g., on inpatient mortality; of which this transfer of knowledge is likely only a minor aspect, hence this outcome measure of KT success is considered out of scope for this research.

The definition of Knowledge Use is quite straightforward. For horizontal KT it involves determining if the knowledge in use by the recipient after the transfer is sufficiently similar to that in use by the sender. Therefore Knowledge Use will be one dependent variable.

The definition of Knowledge Sharing plus Knowledge Internalization is much more difficult to measure. Previous studies have proposed:

- Changes in knowledge (Argote & Ingram, 2000, 151);
- Knowledge re-created in recipient (Cummings & Teng, 2003, 42) or internalized (from Institution theory of Meyer & Rowan, 1977) ;
- Preparation of an associated training document (Ko, 2002, 18); and
- Shared understanding of the knowledge by the sender and receiver (Polanyi 1967, 29; Habermas 1984, 1987).

To the degree possible this dependent variable will be measured for the research population by assessing the level of understanding of the knowledge by the receiver.

3.2.2. Knowledge Transfer Determinant Categories

The trend in KT studies has been to study multiple categories of KT determinants (Szulanski 1996b; Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink 1998; Simonin 1999). The proposed general determinant categories identified by communication theory (Te'eni, 2001), the Argote, McEvily & Reagans (2003) Theoretical Framework for

Organizing Research on Organizational Learning and Knowledge Management, and other authors who have grouped these determinants into categories are shown in the table below.

Table 3.2.2-1: KT Framework Potential Determinant Categories

Potential Determinant Categories	Author(s)
Relationship dimensions (intensity, social similarity and communication frequency); contextual mechanisms (ability and motivation); and emergent themes (social relations, fit, experience and environmental factors)	Argote, McEvily & Reagans (2003, 573)
Knowledge context (articulability, embeddedness); relational context (organizational distance, physical distance, knowledge distance, norm distance); activity context (transfer activities); and recipient (learning culture, priority)	Cummings & Teng (2003, 40)
Scientific validity; relevance; formulation and style (the recommendation is a central element of the guideline); compatibility; complexity; consequences; and dissemination process	Grol, Dalhuijsen, Thomas, Veld, Rutten & Mekkink (1998, 859)
Characteristics of sender (source credibility, communication encoding competence); characteristics of receiver (communication decoding competence, intrinsic motivation, absorptive capacity); characteristics of the relationship among individuals (shared understanding, relationship quality); and characteristics of the knowledge transferred (knowledge observability)	Ko (2002, 21)
Characteristics of the knowledge transferred (causal ambiguity, unprovenness); characteristics of the source (motivation, reliability); characteristics of the recipient (motivation, absorptive capacity, retentive capacity); and characteristics of the context in which the transfer takes place (supportive organizational context, sender-receiver relationship)	Szulanski (1996b, 30)
Communication inputs (attributes of task, sender and receiver characteristics); communication process (communication strategies, communication form); communication impact (sender-receiver mutual understanding and trust); and communication complexity (available resources)	Te'eni (2001, 255)

The integration of these perspectives indicates six KT determinant categories.

1. Knowledge determinants: termed knowledge context (Cummings & Teng, 2003); characteristics of knowledge (Ko, Kirsch & King 2005; Szulanski 1996b; Argote 1999); and communication inputs-attributes of task (Te'eni, 2001).
2. Sender determinants: contextual mechanisms (Argote, McEvily & Reagans, 2003); characteristics of sender (Ko, Kirsch & King 2005; Szulanski 1996b); communication inputs-sender inputs (Te'eni, 2001); and organizations involved in the transfer (Argote, 1999).
3. Receiver determinants: contextual mechanisms (Argote, McEvily & Reagans, 2003); recipient (Cummings & Teng, 2003); characteristics of receiver (Ko, Kirsch & King 2005; Szulanski 1996b); communication inputs-receiver inputs (Te'eni, 2001); and organizations involved in the transfer (Argote, 1999).
4. Sender-receiver relationship determinants: relationship dimensions and emergent themes (Argote, McEvily & Reagans, 2003); relational context (Cummings & Teng, 2003); characteristics of the relationship (Ko, Kirsch & King 2005; Argote 1999); and communication impact (Te'eni, 2001).
5. Transmission determinants: activity context (Cummings & Teng, 2003); communication process (Te'eni, 2001); and dimensions of the transfer process (Argote, 1999).
6. Context determinants: environmental factors (Argote, McEvily & Reagans, 2003); context (Szulanski 1996b); and communication complexity (Te'eni, 2001).

The empirical results discussed in Section 2.3.3.3 are quite clear and consistent in supporting these six KT determinant categories. Further, the literature of the related

disciplines is also supportive. Diffusion of Innovations theory (Rogers, 1995) identified categories of message, source, receiver and communication channel, not including transfer context or sender-receiver relationship, and effectively ignoring the receiver by the approach of not seeing the innovation from the receiver perspective (Rogers, 1995, 111). The marketing literature (Winkler, Lohr & Brook, 1985) identified categories of message, source, audience, channel and setting, not including sender-receiver relationship. The aggregate view from 13 research traditions (Greenhalgh, Robert, MacFarlane, Bate & Kyriakidou, 2004) can be represented as using these same six categories. Thus, a six category KT Framework is strongly indicated by the literature and supported by Diffusion of Innovations and Marketing literature in terms of not proposing any additional categories.

3.2.3. Knowledge Transfer Determinants

Potential knowledge transfer determinants within these six knowledge transfer determinant categories are presented in Table B-1 in Appendix B with its definition, aliases, empirical and theoretical bases, and a recommendation for inclusion into the KT Framework. The alias column highlights the use of different terminology to measure similar constructs, where the selected terms “capture similar attributes of the same construct” (Zahra & George, 2002, 187). The identification of which determinants to include in the Framework is driven by the criteria:

- The determinant must fit within one of the six determinant categories. It must be within the scope of the KT Framework;

- The determinant must have been found to be significant by at least two empirical KT studies (Greenhalgh, Robert, MacFarlane, Bate & Kyriakidou, 2004);
- There must be a documented theoretical basis for the determinant, preferably depicting a universal construct applicable to the business and health services environments; and
- The determinant must represent a unique and non-overlapping KT Framework element.

Table B-1 records the selected determinants as Yes in the Recommended for Knowledge Transfer Framework column. Thus, the ten determinants included in the Knowledge Transfer Framework should include: Knowledge Codifiability; Knowledge Complexity; Prior Related Knowledge; Unlearning Capacity; Positive Receiver Motivation; Perceived Credibility of Source; Sender-Receiver Distance; Relationship Quality; Richness of Transmission Channels; and Supportive Organizational Context.

3.2.3.1. Research Propositions

The research propositions that derive from this KT Framework are listed below. Each proposition is composed of two parts: part a – successful Knowledge Internalization; and part b – successful Knowledge Use. To reduce redundancy each proposition is worded in terms of successful knowledge transfer, referring implicitly to parts a and b. The research propositions are also coded, where KN refers to knowledge, RE to receiver. SR to sender-receiver relationship, TR to transmission and EN to environment.

Propositions relative to knowledge determinants are:

- KN1: High Knowledge Codifiability will be positively related to KT success; and
- KN2: High Knowledge Complexity will be negatively related to KT success.

Propositions relative to receiver determinants are:

- RE1: High Prior Related Knowledge will be positively related to KT success;
- RE2: High Unlearning Capacity will be positively related to KT success;
- RE3: High Positive Receiver Motivation will be positively related to KT success;
and
- RE4: High Perceived Credibility of Source will be positively related to KT success.

Propositions relative to sender-receiver relationship determinants are:

- SR1: High Sender-Receiver Distance will be negatively related to KT success; and
- SR2: High Relationship Quality will be positively related to KT success.

Proposition relative to transmission determinant is:

- TR1: High Richness of Transmission Channels will be positively related to KT success.

Proposition relative to context determinant is:

- EN1: High Supportive Organizational Context will be positively related to KT success.

These propositions are shown in the figure below.

Figure 3.2.3.1-1: Knowledge Transfer Framework Variables

3.2.4. Integrating the Existing KT Frameworks – A Validation

A review of the five comprehensive KT studies in relation to the KT Framework provides a measure of fit between each of these broad frameworks and the proposed KT Framework. This validation is summarized in Table 3.2.4-1.

Individually, each of the five comprehensive studies can be represented in the KT Framework, that is, all of the significant determinants and many of the non-significant

determinants exist in the KT Framework. In addition, the KT Framework creates synergy across these five studies.

Table 3.2.4-1: Comparison of KT Framework With Five Comprehensive KT Studies

KT Framework Determinants	Szulanski (1996b)	Grol et al. (1998)	Shearer (2002)	Cummings & Teng (2003)	Ko et al. (2005)
Knowledge Codifiability (KN1)		Significant		Significant	
Knowledge Complexity (KN2)	Significant	Determinant	Identified	Significant	Significant
Prior Related Knowledge (RE1)	Significant	Determinant	Discussed	Significant	Determinant
Unlearning Capacity (RE2)	Significant	Significant	Difference		
Positive Receiver Motivation (RE3)	Partly Significant	Determinant	Difference		Partly Significant
Perceived Credibility of Source (RE4)	Determinant	Significant	Difference		Significant
Sender-Receiver Distance (SR1)		Significant	Identified		Determinant
Relationship Quality (SR2)	Significant		Difference	Significant	Significant
Richness of Transmission Channels (TR1)			Difference	Significant	Partly Significant

KT Framework Determinants	Szulanski (1996b)	Grol et al. (1998)	Shearer (2002)	Cummings & Teng (2003)	Ko et al. (2005)
Supportive Organizational Context (EN1)	Determinant	Determinant	Difference	Determinant	

Individually, each of the five seminal studies addresses as significant or different 4 to 6 of the KT Framework determinants. When taken together, 10 of the 10 KT Framework determinants are addressed by significant or different determinants in one or more of these five studies. This very high degree of congruence between these five seminal studies and the Knowledge Transfer Framework indicates strong validity for this KT Framework.

The comparison with the Greenhalgh, Robert, MacFarlane, Bate & Kyriakidou (2004). research shows:

- Support for 8 of the 10 determinants of the KT Framework;
- Support for no other determinants than cannot be subsumed into the KT Framework;
- Support for two determinants (Outer Context and Implementation and Assimilation) outside the scope of the KT Framework. Outer Context is beyond the hospital-to-hospital focus of this research and Implementation and Assimilation is considered an outcome rather than a determinant in this research; and
- No support for determinants not incorporated into the KT Framework (Teachability, Causal Ambiguity, Specificity, Positive Sender Motivation, Retentive Capacity, Group Stability, Link Duration, Physical Distance, and Communication Competence).

This comparison provides further support for the KT Framework determinants. It shows the high degree of consistency between the modern Diffusion of Innovations perspective and the KT perspective, moving from a Roger's perspective of support for just four of the KT Framework determinants (Section 2.3.2.2) to support of up to eight determinants. This comparison suggests an integration of these literatures is occurring.

A similar comparison with two more recent but not empirically tested framework shows a similar level of overlap, but difference.

- Joshi & Sarker (2003) proposed an 16 element framework including the seven KT Framework elements of Knowledge Codifiability; Knowledge Complexity; Prior-Related Knowledge; Positive Receiver Motivation; Perceived Credibility of Source; Relationship Quality; and Richness of Transmission Channels plus the nine non-KT Framework elements of Causal Ambiguity; Knowledge Specificity; Source Experience; Source Motivation; Recipient Absorptive Capacity; Receiver Retentive Capacity; Communication Frequency; Communication Encoding Competence; and Communication Decoding Competence. All nine of these additional elements were considered in the development of the KT Framework to some degree, although Source Experience could be defined separately from Perceived Credibility of Source, in which case it would be a new element to be considered. The authors tested the source characteristics of this Framework (see Appendix A) and found support for 3 of 4 of these elements (Sarker, Sarker, Nicholson & Joshi, 2005).
- Kwan & Cheung (2006) extended the work of Szulanski (1996b) proposing a nine element framework including the seven KT Framework elements of Knowledge

Complexity; Prior-Related Knowledge; Perceived Credibility of Source; Sender-Receiver Distance; Relationship Quality; Richness of Transmission Channels; and Organizational Context plus the non-KT Framework elements of Sender Intrinsic and Extrinsic Motivation. This approach is quite similar to that of Ko, Kirsch & King (2005).

3.2.5. KT Framework

The Knowledge Transfer Framework is a vehicle to enable successful knowledge transfer in health services. There are two dimensions to the KT Framework: 1) the ten KT determinants or independent variables and the two outcome or dependent variables; and 2) the separate tacit and explicit transfer flows. This KT Framework is shown in the figure below.

Figure 3.2.5-1: Knowledge Transfer Framework

The explicit knowledge flow is unidirectional from Sender to Receiver and the tacit knowledge flow is bidirectional due to the expected enabling communication between Sender and Receiver. The tacit aspect of the KT Framework is described below.

3.2.5.1. Tacit Aspects of the KT Framework

The transfer of tacit knowledge, integral in this research's definition of knowledge where knowledge is considered to always have a tacit element, entails the recreation by a receiver of the sender knowledge. That is, for equivalent knowledge to exist with a receiver as exists with a sender, where this parity did not previously exist, the transfer of the knowledge must include some tacit elements which are 'recreated' by the receiver.

The role of tacit knowledge in this transfer is shown in Figure 3.2.5-1. Here the solid arrow (Explicit KT) represents the initial sending of explicit knowledge while the dashed two-ended arrow (Tacit KT) represents the two-way interaction of the sender and receiver via some channel to complete the transfer of tacit knowledge, per the view that "the exchange of tacit knowledge must rely on extended social contact" (Baughn, Denekamp, Stevens & Osborn, 1997, 107). This two-way interaction could occur at the same time as the explicit transfer, or it could occur subsequently or even in advance. This timing does not mean that tacit knowledge is sent from sender to receiver like explicit knowledge, but that sufficient interaction between sender and receiver occurs for the receiver to recreate an equivalent version of the sender's knowledge. It is even conceivable that the receiver implementation process, where there is a high degree of prior related knowledge and a very low sender-receiver distance, could produce equivalent knowledge at the receiver

site without and interaction between send and receiver (e.g., manufacturing firms ability to emulate highly tacit competitor knowledge with relative ease, Hakanson & Nobel, 1998).

The explicit knowledge transfer is considered to be a single discrete activity, such as transmitting a clinical pathway via email to a receiver. The tacit knowledge or broader implementation process is considered to be a 'long transaction'. For example, 2.9 years elapsed on average from release of a guideline to the time at which compliance was addressed (Grilli & Lomas, 1994, 206). During that time, as barriers are identified, the receiver may interact with the source for advice if similar barriers have been met and overcome.

The KT Framework can be initiated by either the sender or the receiver. This view is based on the Knowledge Management model Knowledge Sharing process (see Table 2.2-2 Knowledge Management Processes, Section 2.2) where Sharing encompasses both the push or sender initiation perspective (e.g., verbs distribute, publish, share, provide and present) and the pull or receiver initiation perspective (e.g., verbs access, extract, acquire, collect, retrieve and capture). A pull perspective suggests a higher receiver motivation than a push perspective, but the impact on the other KT Framework determinants is at this point undefined. Thus, it is not considered important to the KT Framework whether the sender or receiver initiates the transfer, except to recognize this likely differential in Positive Receiver Motivation.

3.3. Summary

Section 3 identified three gaps in the knowledge transfer literature, where the first two—the identification of the determinants of successful knowledge transfer and the role of tacit knowledge in this transfer—are addressed through the research question. A research model was formulated to address this research question, identifying the dependent variables for KT success, the determinant categories and the KT success determinants according to the defined determinant selection criteria. This part of the research model was validated against the five seminal KT framework studies, showing that the proposed KT Framework encompasses all the proposed and significant determinants from each of these leading studies. This consolidation of previous research was then extended by introducing tacit and explicit knowledge flows, together forming the research model.

4. RESEARCH METHODOLOGY AND DESIGN

This section identifies the methodology used to test the research model presented in Section 3.2. It describes how the research model was tested and the research question answered. Research specifics are presented including the research population, research context and research design.

4.1. Qualitative Research

The research question entails the need for a detailed understanding of the process of KT, to get at the “real and stimulating meaning” (Trumbell, 2000, 79) of what is required for KT success. A qualitative research approach can provide such an in-depth and interpreted understanding (Snape & Spencer, 2003, 22). Qualitative research is an interpretive approach (McMillan, 1996, cited in Trumbell, 2000, 90; Snape & Spencer, 2003, 3-5)..where:

- Research is conducted in a natural environment with no controls of conditions or behaviours;
- The researcher is an active participant interacting directly with the research participants;
- Descriptions are expressed in rich or detailed narratives;
- The researcher is looking for the process by which the behaviour occurred;

- At times, data is collected or synthesized inductively to formulate theory and hypotheses; and
- Researchers attempt to communicate the reality as stated by the participants, depending entirely on information provided by the participants.

Researchers using the qualitative method attempt to make sense of a phenomena in terms of meanings attributed by the individuals involved (Hunter, 2000)., where the researcher is involved in the process (Gilqun, 1922, cited by Trumbell, 2000), or more strongly plays a central role in the construction of knowledge (Finlay, 2006a, 6). This researcher subjectivity—called bias in quantitative research—is viewed as an opportunity in qualitative research (Finlay, 2006a).

4.1.1. The Qualitative Aspect of This Research

This research adopted each of the methodological aspects of qualitative research as expressed by Snape & Spencer (2003):

- The perspective of the researcher and the topic under research was to take the perspective of the people being studied including maintaining ‘empathetic neutrality’ by using the researcher’s personal insight with a non-judgemental viewpoint;
- The nature of the research design was a naturalistic inquiry where the data generation was sensitive to the social context of the data and involved close contact between the researcher and the research participants;

- The nature of the research methods used were qualitative methods of in-depth interviews and the analysis of documents;
- The nature of the analysis and interpretation reflect the complexity, detail and context of the data; respecting the uniqueness of each hospital and health profession as well as conducting cross-hospital analyses; and developing explanations at the level of meaning of the data; and
- The nature of the outputs were ‘rounded understandings’ based on the perspectives of the participants; answering ‘how’ and ‘why’ questions; and considering the influence of the researcher’s perspectives.

In addition, each of McMillan’s six conditions are met by this research. The research was conducted in the natural environment of the Champlain Local Health Integrated Network (LHIN) hospitals (Section 4.3: Research Population and Unit of Analysis); where the researcher was an active participant in the data gathering and analysis (Section 4.4.3: Researcher As An Active Participant); and the questionnaire responses are expressed in rich and detailed narratives which communicate the reality as stated by the participants (Section 5.4: Findings). The research question entails looking for the process by which KT occurred and while the KT Framework imposed an a priori structure on the data the research included formulating theory in the area of the transfer of tacit knowledge (Section 5.4.5: The Transfer of Tacit Knowledge).

4.2. Case Study Methodology

A taxonomy of qualitative methods by Trumbell (2000) includes five qualitative methods.

- Phenomenology describes human events and behaviours by investigating feelings, thoughts and awareness. It requires a clean slate, no preconceived notions or framework to guide the researcher (O'Mary 1983 cited in Trumbell, 2000, 80). This approach starts with a research question which is followed by a literature review (Trumbell, 2000, 82). Phenomenology is not applicable to this research since the literature review, research question and KT Framework already exist and would guide the research.
- Ethnography is a description and interpretation of a cultural or social group or system (Harris, 1968 cited in Trumbell, 2000, 86). It involves a researcher examining the group's observable and learned patterns of behaviour, customs, and ways of life (Trumbell, 2000, 86). Ethnography is not applicable to this research since this level of social group interaction is not required to answer the research question.
- Grounded theory (Glaser and Straus 1967, Yin 1981, Eisenhardt 1989, Lee 1989) involves constructing theory related to the phenomenon under study (Leach, 2000). When using this approach a grounded theoretical position can be taken where no prior theory is available (Eisenhardt, 1989). This approach is not used for this research since the KT Framework has already been developed using the existing KT theory and the intent of this research is not to generate a replacement theory.

- Case studies have been described as explorations of a bounded system to investigate societal problems in their natural settings (Merriam, 1988) Here the researcher can “converse with participants and interview them in depth to gain insight into certain phenomenon” (Trumbell, 2000, 88).
- Biographical studies depict the life experiences of an individual (Trumbell, 2000, 86). This research is much broader than a single individual and this approach would not answer the research question.

Hunter (2004) in a similar taxonomy adds Action research, while Finlay (2006b) adds others, each including case study as one of these methodologies:

- Action research is a form of research leading to social action through a set of planning, action and evaluation steps. This methodology involves an interactive facilitation role by the researcher which was not formally undertaken in this research (Hunter 2004).

Of these six potential qualitative methodologies only case studies support both a prior selected theory (i.e., the KT Framework) and a relatively passive researcher role with respect to the research participants, a passive role being dictated by restrictions in researcher time availability (see Section 4.3.1: Researcher Perspective. Therefore, the selected research method is a qualitative case study empirical inquiry to understand these dynamics within the health services setting of what is actually occurring in a knowledge transfer situation (Bromley, 1986); enabling both a holistic understanding (Dayasindhu,

2002) and an in depth exploration via detailed interviews with participants (Taylor, 2000).

Case studies can be used to test existing theory or explain that theory termed a natural science model (Sypher, 1997, 2). This research seeks to confirm existing theory (Markus, 1989) through the KT Framework. Formally, this research meets all four of Yin's criteria for using the case study method.

1. There is a need to understand a complex social phenomenon (Yin, 2003, 13). The complexity of knowledge transfer is portrayed by the multiplicity of determinants, theories and populations used in the over 20 empirical studies and by their different inter- and intra-organizational environments. This complexity-capturing capability of the case study enables seeking patterns of interrelationships between many categories, and in answering questions where the answer is not straightforward. (McCracken, 1988, 16).
2. The boundaries between phenomenon and context are not clearly evident (Yin, 2003, 13). KT has been defined at the individual, group and organizational levels in terms of varied aspects of the knowledge, sender, receiver, sender-receiver relationship, transfer medium and organizational context. The KT contextual and enabling elements, including their various interactions, are not yet well understood.
3. There are more variables of interest than data points (Yin, 2003, 13). The proposed KT framework has ten independent variables and two dependent variables while the research population has a maximum of 14 data points (see Section 4.3).

4. The research question deals with operational links that need to be traced over time, rather than counting frequencies or incidence (Yin, 2003, 6). It takes time to internalize and use the transferred knowledge, although retrospective studies can provide a reasonable picture of knowledge transfer at various points in time.

The proposed case study is also exploratory in terms of developing meaning from this case data and developing a deeper understanding of what is actually occurring (Gable, 1994, 112). For example, the research question does not yet enable a respondent to answer “readily and unambiguously” (McCracken, 1988, 16) since the terminology is still too varied and the meanings ambiguous. Grilli & Lomas (1994) is but one example of a potential more complete definition of terms, specifically defining the various physician outcomes in terms of physician daily practice. In this research the cardiovascular disease in-hospital process of care best practice knowledge is well-defined by the Acute Myocardial Infarction clinical practice guidelines (Ryan, Anderson, Antman et al. 1996; Ryan, Antman, Brooks et al. 1999; Smith, Blair, Bonow et al., 2001; Antman, Beasley, Califf et al. 2002; Antman, Anbe, Armstrong et al., 2004).

4.2.1. Case Studies in Health Services and Knowledge Transfer Research

Case study research has been used extensively in the social sciences (e.g., anthropology, economics, history, political science, psychology, sociology) and practice-oriented fields (e.g., education, health services, management science, public administration, social work, urban planning) including in theses and dissertation research (Yin, 2003). Jenkins (1985) lists case study as one of 13 research methodologies that have been applied in

Management Information System research. Representative examples in Health Services and Knowledge Transfer are listed below. Each is focused on a discrete population and involves a qualitative case study involving one or more cases.

- A set of nine case studies of the NHS policy making interface between research and the commissioning process studied (Harries, Elliott & Higgins, 1999).
- Global competitiveness of Indian software industry via a single case study of four organizations to test a dynamic theoretical framework for global competitiveness (Dayasindhu, 2002).
- A single case study of more effective knowledge transfer of requirements definition by a submarine manufacturer (Fernandes & Raja, 2002).
- The importance of motivation in knowledge transfer in a manufacturing multinational corporation studied via a single case involving 36 interviews across six plants (Kalling, 2003).
- Knowledge transfer in new product development investigated via six cases (Shearer, 2002).
- A single case of consultant knowledge transfer via one hour, structured interviews of six consultants (Lahti & Beyerlein 2000).
- Impact of changing ownership on knowledge transfer studied via a single case (Hasegawa, 2000).
- Eight cases involving the transfer of tacit knowledge in environmental management (Boiral, 2002).

4.2.2. The Case Study Approach In This Research

For this research a single case study was used involving multiple embedded units (Yin, 2003, 43). The single case is the transfer of Acute Myocardial Infarction (AMI) clinical practice guidelines from the University of Ottawa Heart Institute to fourteen Ontario Champlain district hospitals (the embedded units) via a clinical pathway package. This single case design was chosen since this research satisfies a number of the rationale proposed for a single case design (Yin, 2003, 40-42).

- The single case represents the critical case in testing a well-formulated theory. In this situation the transfer of AMI guideline knowledge will be used to test the KT Framework.
- The single case is a representative or typical case. The sender, receiver and transfer aspects of this case are considered to be typical. That is, the Heart Institute is representative of tertiary-level teaching hospitals who have a mandate to share their best practice knowledge with local hospital programs, in this situation cardiac programs. The fourteen Champlain District hospitals are representative of Champlain District, Ontario and Canadian hospitals with secondary-level cardiac programs; while the transfer of AMI practice guidelines via a clinical pathway is representative of clinical guideline transfer via clinical pathways.
- The single case is revelatory. No known previous KT research has qualitatively investigated knowledge transfer in health services at the level proposed by the KT Framework, i.e., considering these ten determinants of KT success and tacit knowledge.

- The single case is longitudinal. The knowledge transfer timeline is March 2004 to November 2005.

While multiple cases might have enabled a more comprehensive view of the KT phenomenon a single case was considered appropriate because: a) this single case was able to satisfy Yin's four criteria, and b) the fourteen embedded units enable the comparative capability to measure multiple occurrences of the outcomes and multiple views of the KT Framework determinants and hospital KT processes. This single instrumental case study (Stake, 1994) with its attendant level of access provides detailed insight into the KT Framework theoretical model. A second case with presumed lesser access would not necessarily provide more detailed insight.

This research aims to understand the relationship between the determinants of the KT Framework and the Knowledge Internalization and Knowledge Use dependent variables. It is both exploratory and descriptive. This KT Framework is applied in health services where the various causes and effects and influencers are unclear (Yin 2003). It involves data collection by archives, interviews, observations, and questionnaires (Eisenhardt, 1989). This research involves the prior development of theoretical propositions (the KT Framework) to guide data collection and data analysis and to enable generalization of its results (Yin, 2003). This research's approach enables the researcher to have ongoing interactions with the participants, as opposed to the one-shot indirect nature of surveys (Cheng & Daniels, 2003), which is important in the multidimensional KT social environment. The goal is to make sense of the various KT determinants and their relationships in the KT process for both explicit and tacit knowledge.

The researcher role in the case study is one of a witness “who faithfully records what the participant is saying and what is going on” (Finlay, 2006b, 21) with the aim of neutrally representing the participants’ world and perspective and not introducing assumptions or biases into the analysis (Finlay, 2006b, 21).

4.3. Research Population and Unit of Analysis

The research population is Ontario Champlain District hospitals treating adult cardiovascular disease, specifically Acute Myocardial Infarction. This research population exemplifies the extensive research tradition of health services through the crucial role of new knowledge in the care of patients and the primary role of the teaching hospital unit as the knowledge sender.

The access point for this research, within the Cardiac Performance Project of the Champlain District Health Council and under the umbrella of the Heart Institute led STEMI (ST segment Elevated Myocardial Infraction) Care Improvement Project, is the evaluation of the Acute Coronary Syndrome (ACS) clinical pathway knowledge transfer activities.

The unit of analysis is the transfer of AMI clinical practice guidelines via the cardiovascular disease in-hospital process of care best practice: the ACS Clinical Pathway; related physician orders; nursing protocols; ACS Discharge Tool (also known as the ACS Pathway Package); and related implementation process knowledge to another hospital. Since these processes of care are interrelated (e.g., part of a single clinical

pathway or a single patient discharge tool), a unit is defined to be at the hospital-to-hospital transfer level rather than at the process of care best practice level (e.g., ACE inhibitor or Statin prescription on discharge). Therefore, this research has a maximum of 14 units of analysis, the number of relevant Champlain District hospitals able to receive this knowledge from the University of Ottawa Heart Institute. For confidentiality purposes these 14 hospitals are identified as Hospital A to Hospital N.

4.3.1. Researcher Perspective

In qualitative research the research findings are “value-mediated” (Snape & Spencer, 2003, 13) by the researcher, hence it is important to understand this filter, the researcher perspective.

This researcher experience is that of a health services consultant with approximately ten years of consulting experience with this study population as a health information system implementation project manager, hospital internal consultant, and regional health services restructuring project manager. In the last ten years the researcher’s consulting role has broadened into provincial health services and other non health services consulting, including five years as a Community Health Center board member. This initial and ongoing involvement with the health services sector has created credibility and access to the Champlain region hospitals and in particular to the University of Ottawa Heart Institute. The ongoing full-time consulting role occurring in parallel with this research also created limitations in on-site time to interview and potentially observe the key informants.

The researcher overarching goal is to help this community better respond to the constant and growing cost, quality and change pressures. The researcher value-mediation is that of a non-health professional, having been trained in administration with Masters degrees in Business Administration and Health Administration. It is also that of an urban teaching hospital, having never worked in a community hospital.

The researcher perspective, therefore, is that of one: familiar with the hospital vocabulary; with CEO-level access to all of the hospitals in the Champlain LHIN; with a consultant's eye for improving hospital and regional health services processes; but with an external view of the individual hospital activities, perhaps enabling recognition of patterns not evident to practicing health professionals. In methodological terms the researcher perspective is constructivist-interpretive (Finlay, 2006b), as demonstrated by the working definition of knowledge.

4.4. Research Design

This section presents the logic that links the research question to the data to be collected and eventually to the conclusions to be drawn (Yin, 2003). The five components of a research design proposed by Yin (2003, 21) are: a research's question (Section 3.1: Literature Gaps and Resulting Research Question); propositions (Section 3.2.3.1: Research Propositions); unit of analysis (Section 4.3: Research Population and Unit of Analysis); the logic linking data to propositions (Section 4.4.1: Data Collection; and Appendix C: Data Collection Instrument); and criteria for interpreting the findings (Section 5.1 Data Analysis). Section 5.5.2 (Reliability and Validity) addresses design

quality in terms of construct validity, internal validity, external validity and reliability (Yin, 2003).

4.4.1. Data Collection

The data collection protocol is made up of the Data Collection Instrument and the data collection procedures to be followed in using the Data Collection Instrument. Its purpose is to guide the gathering of data in a consistent fashion, forming a standardized agenda for the investigation line of inquiry (Yin, 2003). These sections are presented below along with a description of the key informants and the mechanism for evaluating the success of the knowledge transfer. Ethics approvals for the Data Collection Instrument and procedure are presented in Appendix D.

4.4.1.1. Data Collection Instrument

Semi-structured interviews form the basis of this research. This approach was chosen both because they are more efficient and less obtrusive than the unstructured ethnographic interviews (McCracken, 1988) and to address the two research needs: the research question defined need of testing the KT Framework; and the need of understanding the mechanisms of KT, the exploratory nature of this research. The structured aspect applies to both data collection method and Data Collection Instrument. The unstructured aspect relates to additional controlled data collection as an extension of the Data Collection Instrument.

The Data Collection Instrument was developed from previous KT research quantitative instruments. The rationale for choosing the approach of using prior instrumentation was primarily that the KT Framework determinants were already well defined and using prior instrumentation reduced the potential of bias from selective data gathering. Using prior instrumentation also ensures the efficiency of data collection; and enables comparability of results (Miles & Huberman, 1984, 42-43). Relevant questions were derived from the instruments of Szulanski (1996b, 41), Subramaniam & Venkatraman (2001, 377), Lyles & Salk (1996, 900), Zander & Kogut (1995, 88), Simonin (1999, 621), Hansen (2002, 246), Cummings & Teng (2003, 61), Takeishi (2001, 427), and Gupta & Govindarajan (2000, 495). The questions in the Data Collection Instrument reference the relevant knowledge transfer studies (see Appendix C: Data Collection Instrument).

The linkage between this research's propositions and the Data Collection Instrument is presented via the bold letters prefacing each question in Appendix C (Data Collection Instrument). This code cross-references the research proposition and the question number. For example, RE4-2: "How has the existence of pre-existing tools and processes enabled change in these tools and processes?" refers to Receiver Determinant #4 – Unlearning Capacity, question #2 (see Unlearning Capacity section in Appendix B). Note that questions for physicians are coded with the suffix <P> in Appendix C (Data Collection Instrument). This physician coding was performed in awareness of the reduced availability of physicians for these interviews.

The linkage between the research question and the Data Collection Instrument questions is shown in the table below.

Table 4.4.1.1-1: Cross Reference of Research Question and Data Collection Questions

Research Question	Data Collection Questions	Comment
What are the determinants of horizontal knowledge transfer success in health services?	Sections 3-12	
How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge?	O1-3, SR1-4; RE1-5, SR2-5, RE2-4, RE3-7; RE4-5, EN1-6, KN2-5)	Specific questions to differentiate between the explicit guideline knowledge and the tacit guideline knowledge as depicted in Table E-1 of Appendix E.
How do these determinants of horizontal knowledge transfer success differ between cases of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed?	O1, O2 especially question O2-1	The measure of Knowledge Internalization was internally developed for this research from the realization that the clinical guidelines contain many items not in the clinical pathway.

4.4.1.2. Key Informants

Hospital representatives for the Cardiac Performance Project of the Champlain District Health Council with responsibility for cardiovascular disease in-hospital process of care best practice improvements were the key informants for this research. These representatives included patient care managers, leads and educators and those responsible for developing the ACS tools in the Champlain District hospitals, including physicians participating in the program. Identification of these individuals was initiated with the

invitee list for the March 4, 2004 STEMI symposium augmented as required with Heart Institute staff direction.

For the initiating organization, the University of Ottawa Heart Institute, the key informant was the Heart Institute Manager with additional input from a Cardiologist. These individuals were selected via the Administrative Vice-President. In addition, separate Heart Institute staff, including the Administrative Vice-President, assisted with validating the Data Collection Instrument, evaluating the receiving hospital tools and processes and providing research oversight. The list of key informants is presented in the table below.

Table 4.4.1.2-1: Key Informants Interviewed

Hospital	Key Informants (Frequency in Parentheses)	Interview Method
A	Lead (1)	Phone
B	Physician (1)	Face-to-face
C	Lead (1)	Phone
D	Director (1)	Face-to-face
E	Two Managers (1) together	Face-to-face
F	Two Managers (1) together	Face-to-face
G	Manager (1); Cardiologist (1)	Face-to-face; Manager via phone
H	Lead (1), Educator (1); Physician (1)	Phone
I	Director and Lead (1) together	Face-to-face
J	Director (1); Physician (1)	Phone
K	Director (1); Manager (3) with Educator (2) and Lead (1); Coordinator (1); Cardiologist (1)	Face-to-face
L	Director and Lead (1) together; Educator (1)	Face-to-face
M	Lead (1)	Face-to-face
N	Manager (1)	Face-to-face

Hospital	Key Informants (Frequency in Parentheses)	Interview Method
Heart Institute	Vice President Administration; (1); Educator (3 with Manager); Coordinator (1); Manager (9); Cardiologist (1)	Face-to-face

Key informants from all 14 hospitals plus the Heart Institute were interviewed. The individual(s) selected at each site were either those designated by the Heart Institute or by the hospital CEO, depending on whether the Heart Institute or the researcher was the first effective first point of contact. The designated individuals were all responsible for cardiovascular disease in-hospital process of care, either nursing or physician, and were available to be interviewed. This census of sites and sample of responsible individuals is considered sufficient since at least one responsible individual at each site was interviewed and a multiplicity of medical backgrounds were involved. In all there were:

- 37 interviews including 13 with Heart Institute; and
- 33 interviewees: 6 Physicians; 8 Managers; 7 Leads; 4 Educators; 5 Directors; 2 Coordinators; 1 Vice-President.

4.4.1.3. Data Collection Schedule

Data collection occurred in two phases: 1) pilot testing of the Data Collection Instrument with hospitals D, F, and K from February to July, 2005; and 2) collecting data from the remaining hospitals from September to November 2005. This two-phased data gathering enabled refinements of the instrument and the development of familiarity with the analysis tools and mechanisms. To support and guide this process interviews were held with Heart Institute staff. The primary contact was the Heart Institute Manager (9

interviews), while other Heart Institute staff were interviewed for focused inputs: Cardiologist for medical context; Educator to review Data Collection Instrument and proposed measure of tacit knowledge; and Coordinator about the level and scope of regional communications.

At least one interview of 60 to 120 minutes occurred with at least one key informants of each receiving hospital team. All physician interviews were approximately 60 minutes and most non-physician receiver hospital interviews were about 120 minutes. The duration of the Heart Institute interviews varied from 60 minutes to just over 120 minutes.

4.4.1.4. Data Collection Procedures

All knowledge receiver interviews used the Data Collection Instrument (Appendix C). This ensured that each KT receiver interview followed the same data-gathering template, asking the same questions in the same order. It was unstructured in that a number of questions were open ended enabling elaboration. It was also unstructured in the sense that the researcher had the option to ask follow-up clarifying questions, where these follow-ups were predominantly ‘why’-type questions in order to minimize related interviewer bias.

Data was also be captured for control variables including 1) hospital size, in terms of number of Cardiologists or other physicians and number of AMI cases per year, because larger centers and larger cardiac teams tend to have more resources for the best practice

to draw upon; 2) urban/town/rural client focus, and 3) clinical pathway experience, to determine if lack of such experience was a confounding variable.

Pilot testing of the instrument was performed with Heart Institute staff to test the face validity of the interview instrument and to test the naturalness of the flow, order of questions, respondents overall interest and attention and question clarity (Converse & Presser, 1986). Subsequent adjustments were made to the wording and flow. One enhancement was to extend question O2-1 to refer to each of the AMI Guidelines listed in Table E-1 (Practice Guideline Standards – Explicit and Tacit Knowledge, Appendix E), essentially developing a Knowledge Internalization or the transfer of tacit knowledge instrument (see Section 4.5.3.1 Knowledge To Be Transferred). This instrument was developed according to the structure of the ACC/AHA AMI guidelines and reviewed and approved by Heart Institute staff.

To ensure that a minimum of ‘active listening’ or other obtrusive interviewer behaviour occurred in these interviews (McCracken, 1988) a research assistant took notes, completed the interview summary sheet and compared results with the researcher to ensure consistency of data gathering. This included all of the Phase 1 interviews and many of the early Phase 2 interviews after which the interview pattern was well established.

The interviews, as recommended by McCracken (1988), were taped via dictaphone and transcribed by the researcher using a voice editor. All interview transcripts were

standardized as directed by Weller & Romney (1988, 15) using correct grammar and making each statement autonomous and clear

4.4.2. Researcher As An Active Participant

The researcher participation occurred in a planned but restricted fashion in:

- Tailoring the data gathering instrument for the study population including developing questions to assess changes in tacit knowledge levels and interviewee perception of the importance of each of the KT Framework determinants;
- Asking clarifying follow-up questions using the developed health services vocabulary and environment understanding described in Section 4.3.1: Researcher Perspective;
- Extending the coding scheme beyond the outcome and KT Framework determinants and related data gathering instrument questions, especially the second and third passes to capture additional interview input and meaning;
- Selecting examples of rich descriptions to describe levels of support or non-support for the KT Framework determinants and KT process; and
- Developing analytical interpretations from the coded data, e.g., the example of tacit knowledge transfer including the interview triggers for this interpretation.

Restrictions on the researcher participation to try to maintain the natural environment and the descriptions of the participant reality, as opposed to a researcher reality included:

- Rigorously following the data gathering instrument to ask the interview questions and restricting related follow-up questions to clarifying questions including using the research assistant as a control on this compliance; and
- Rating the interview answers using three raters prior to determining the hospital outcome level.

These restrictions were seen as necessary to ensure comparability of hospital results. No such restrictions existed in the exploratory aspects of this research such as the investigation of the transfer of tacit knowledge.

4.5. Research Context, Motivations and Processes

The context for the research is presented in three streams as shown in Figure 4.5-1: 1) the Macleans feedback and resultant Champlain District hospital actions (Champlain Mortality Results); 2) the EFFECT study and related actions (EFFECT Study); 3) the AMI clinical practice guideline development and dissemination (AMI Practice Guidelines); and 4) the knowledge creation activity of the clinical trials. The first two streams provide much of the potential external motivation for this knowledge transfer (dashed arrows in Figure); the AMI practice guideline stream provides much of the capability to respond to these potential external motivators (dotted arrows). The large solid arrow depicts the expected knowledge transfer. Clinical trials are included in this context since they drive the Practice Guidelines and this specific STEMI Symposium, and may directly influence receiving hospitals in advance of the summarizing AMI Practice Guidelines (solid unlabelled arrows). Thus, the clinical trials provided the basis

for the Heart Institute ACS Clinical Pathway; the EFFECT Study best practices, plus potentially independently influenced the various hospital ACS Package developments.

Figure 4.5-1: Research Context

The initial steps in the transfer of the AMI guidelines to the receiving hospitals via the ACS pathway according to this research context are list below.

1. Clinical trials performed (for example, 1398 references were cited by Antman, Anbe, Armstrong, et al., 2004, many of these clinical trials).
2. Clinical practice guidelines developed via consensus process. Versions and refinements of guidelines developed over time (Ryan, Anderson, Antman et al. 1996; Ryan, Antman, Brooks et al. 1999; Smith, Blair, Bonow et al., 2001; Antman, Beasley, Califf et al. 2002; Antman, Anbe, Armstrong et al., 2004).

3. Guidelines promulgated by various means to practitioners: in detailed form; summary form; and other peer reviewed journal article, conferences, etc.
4. Portions of guidelines implemented at the Champlain Local Health Integrated Network hospitals but with varied compliance and resultant mortality; partial Knowledge Internalization and Knowledge Use.
5. Macleans article (July 2003) – Heart Institute verification of Macleans data with CIHI and Statistics Canada (Fall 2003).
6. EFFECT study (December 2003) – impacted hospitals D, F, G, H and J some of whom changed their physician orders; partial Knowledge Internalization and Knowledge Use.
7. Champlain District Health Council response to Macleans feedback (January – March 2004), Champlain District CEO meeting (Fall, 2003).
8. HI implementation and refinement of ACS Pathway (March 2004 – November 2004), codifying Heart Institute leading practice that is easily able to be replicated.
9. HI sharing of ACS Pathway with selected Champlain hospitals (September 2004 – October 2005).

Initial Heart Institute evaluation of ACS Pathway implementation (Dec. 2004 period, occurring Aug. 2005).

4.5.1. Champlain District Health Council Response

The identification of substantial variation in the in-hospital mortality of patients with Acute Myocardial Infarction (AMI) (Macleans Magazine, June 16, 2003), as substantiated by a follow-up Heart Institute study with Statistics Canada and the Canadian Institute for Health Information (Heart Institute Vice-President Administration), initiated the Cardiac Performance Project of the Champlain District Health Council (DHC). The Champlain District Health Council Response (per item #7 in Section 4.5 list) was broadly defined by the stated goals to (Champlain District Health Council, 2003, 1):

- “Develop strategies to reduce AMI mortality in the region including the identification of the target population, rapid access to the Heart Institute and the development of regional follow-up care; and
- Increase the effectiveness of communication and triage systems in Ottawa and the Champlain DHC for AMI patients.”

This change process began with a meeting of the Champlain region CEOs in the fall of 2003 where all supported these Project goals; and continued with the March 4, 2004 Heart Institute facilitated ST segment Elevated Myocardial Infarction (STEMI) Care Improvement Project symposium. At this symposium the Heart Institute staff presented:

1) the research behind the proposed change in regional practice was presented (reperfusion strategies for STEMI); 2) recommendations including those of the Heart Institute Cardiologist: the “development of post-Percutaneous Coronary Intervention (PCI) clinical pathways for repatriation, acute- and recovery-care management, early discharge and rehabilitation” (Labinaz, 2004, 9); and 3) Heart Institute example “tools for post AMI Care”.

The Heart Institute then used the feedback from the STEMI Symposium and completed the development of the ACS Pathway Package along with the associated staff and patient education material. This package was reviewed with all the Heart Institute physicians, implemented and evaluated. Then “once we were happy how it was working here then we said it is time to distribute it” (Heart Institute Cardiologist). The initial distribution occurred between September 2004 and November 2004 with support and subsequent distribution as necessary thereafter, all via email and phone. The Heart Institute ACS Pathway Package was evaluated for internal compliance by the Heart Institute Manager via a chart audit in December, 2004 and quarterly thereafter (Heart Institute Manager).

Twelve Champlain regional hospitals participated in the Champlain DHC project. They ranged in size from small community sites (3), town hospitals (6), and urban hospitals (3). Members of all 12 of these sites were invited to the March 4, 2004 STEMI Symposium in Ottawa. Two additional town hospitals not part of this Champlain DHC were added to this region as a result of the creation of an expanded regional structure, the Champlain Local Health Integrated Network. The urban hospitals are located in Ottawa with the University of Ottawa Heart Institute, the tertiary-quaternary cardiac care site for

the region. All of these Champlain Local Health Integrated Network hospitals refer their patients to the Heart Institute and most have worked with the Heart Institute on a previous telehealth project.

4.5.2. EFFECT Study

In parallel with the Champlain District Health Council activities, an independent study by the Ontario Institute for Clinical Evaluative Studies (ICES) Canadian Cardiovascular Outcomes Research Team (2004) of the Quality of Cardiac Care in Ontario, the EFFECT study of AMI Process of Care Quality Indicators, identified AMI process variations for Hospitals D, F, G, H, and J. This independent public study prompted the hospitals surveyed to review their physician orders and related processes and make adjustments. The Phase 1 EFFECT study actual Champlain District results are shown below with target and actual ratings indicating the size of the gap between best practice and actual practice:

- ASA within six hours of hospital admission target of > 90% for ideal patients (actual Ontario 76%, Champlain 77%);
- Beta-blocker within 12 hours of admission > 85% (Ontario 30%, Champlain 21%)
- Lipid sample obtained within 24 hours of admission >85% (Ontario 36%, Champlain 34%);
- Left ventricular evaluation before or during admission >75% (Ontario 48%, Champlain 43%);

- ASA prescribed at hospital discharge > 90% (Ontario 85%, Champlain 80%);
- Beta-blocker prescribed at discharge > 85% (Ontario 78%, Champlain 73%);
- ACE inhibitors prescribed at discharge > 85% (Ontario 72%, Champlain 70%); and
- Statin prescribed at discharge >70% (Ontario 61%, Champlain 60%).

The results identified by Macleans (June 2003), the Cardiac Performance Project (Champlain District Health Council, 2003), and by the Canadian Cardiovascular Outcomes Research Team (2004) all indicate by the wide variation amongst hospitals that these AMI clinical practice guidelines are not fully in use. This transfer of the ACS Pathway Package was intended to help improve these EFFECT Study results listed above.

In summary, the motivations for change were, 1) Senior Management response to Macleans' initiated feedback on varied AMI practice and mortality results; and 2) physician response to EFFECT study feedback at the five Phase 1 hospitals.

4.5.3. Clinical Practice Guidelines

A key aspect of the research context is the substantial geographic variation that exists in the treatment of patients with acute myocardial infarction. "Therapies with proven benefit for AMI (Acute Myocardial Infarction) are underutilized despite strong evidence that their use will result in better patient outcomes" (O'Connor, Quinton, Traven, et al. 1999, 627). The Journal of the American Medical Association has documented this situation

(O'Connor, Quinton, Traven, et al., 1999). It has also been argued this geographic variation is also the case in Canada (Macleans July 2003, Canadian Cardiovascular Outcomes Research Team 2004).

A common approach to address this geographic variation is the development of clinical practice guidelines. The American College of Cardiology / American Heart Association practice guidelines for the management of patients with acute myocardial infarction (Ryan, Antman, Brooks et al. 1996; Ryan, Antman, Brooks et al., 1999; Smith, Blair, Bonow 2001; Antman, Beasley, Califf et al. 2002; Antman, Anbe, Armstrong et al., 2004) provides the detailed knowledge to be transferred. They are described in Section 4.5.3 and presented in more detail in Appendix E. These AMI practice guidelines apply to Acute Coronary Syndrome patients—unstable angina, non ST segment elevation MI and ST segment elevation MI (ACS Pathway Information Sheet, 2004)—for care after the intervention. “Down the road the treatment is the same. Whether you are an unstable angina, a non ST Elevation MI, or an STEMI, those are the three classes of ACS. The only difference is in the upfront treatment, in emergency room right away. For STEMI you must open that artery immediately, ideally within 90 minutes. That is the only difference” (Heart Institute Cardiologist). This Cardiologist clarification means that either AMI or STEMI clinical guidelines can be used to represent all post intervention AMI/ACS care.

4.5.3.1. Knowledge To Be Transferred

Clinical pathways such as the ACS Pathway are considered a standard vehicle for applying established clinical practice guidelines into local protocols and pathways and their subsequent implementation into clinical practice.

In this research the ACS Pathway Package is proposed as a means of applying the AMI guidelines. This relationship is shown in part by Table E-1 (Appendix E), specified by the column 'Knowledge To Be Transferred – Explicit Heart Institute Application'. It is a mapping between guideline elements and ACS Pathway Package elements. The guideline elements were identified by a sequential reading of the five cited AMI guideline sources and validated in a line-by-line review with a Heart Institute Educator. The specific views about the ACS Pathway Package being representative of the AMI guidelines expressed in this research include:

- “I think it is a fair representation of the guidelines and that it is a workable representation of the guidelines” (Hospital G Cardiologist); and
- “What we are doing is taking elements from the guidelines, ones that we think are the most important, and ones we think are the easiest to transfer to the majority of patients... that is the whole reason they (the ACS Pathway Package elements) were designed specifically for these ACC/AHA guidelines to try to match them as best possible.” (Heart Institute Cardiologist).

Therefore the AMI clinical guidelines of the ACC/AHA represent the gold standard for care to ACS patients and are fairly represented by the ACS Pathway Package.

4.5.3.2. Patient Specific Aspect of Clinical Guidelines

The patient specific nature of these guidelines is captured by two of the physician interviews:

“I try to get the 90% of the care. You can’t treat a patient like every other patient. Each patient is different. For instance, I don’t mind looking at a cookbook that tells me I should give beta blockers, and then I look at the patient and if they have an allergy to beta blockers or aspirin I won’t give them that. You have to use a little judgement and common sense” (Hospital B Physician).

This patient specific view both supports the working definition of knowledge as constructionist and argues against the negative connotation of clinical practice guidelines as being a ‘cookbook’ approach to patient care, a potential barrier to successful KT.

4.5.4. Knowledge Sender - Heart Institute

The University of Ottawa Heart Institute is a tertiary-quaternary urban center providing cardiac services to the Champlain region. The Heart Institute has a role as a referral center for the Champlain District hospitals for the diagnosis and Percutaneous Transluminal Interventions (PCI) for acute AMI patients:

“This was how we did it in the city. The outlying hospitals dealt with the MIs and then the MI patients would go over (to the HI) for angiography and possible stenting only if they were symptomatic or they had a big

infarct and had some co-morbidities like failure or unstable angina, hypotension or arrhythmia” (Hospital L Lead).

The Heart Institute Triage Coordinators interact with staff at each hospital to prioritize and transfer these patients to, and sometimes from, the HI. The 26 Cardiologists on staff see approximately 3,000 ACS patients a year. The site has seven clinical pathways in operation (ACS, Congestive Heart Failure, Cardiac Surgery, Cardiac Surgery Step Down, Chest Pain Evaluation, Minimally Invasive CABG, Percutaneous Coronary Intervention) out of a possible nine. Exception charting on this pathway is a recent innovation and is being used with the Heart Failure and ACS Pathways (Heart Institute Manager). Developing the ACS Pathway Package was the top organizational priority in 2004, in terms of activities fully within the Heart Institute control (Heart Institute Manager).

The Heart Institute took about six months to design, print and implement the ACS Pathway (March to October 2004), building on about two years of planning and consideration of how to extend the MI Pathway (for STEMI) to cover unstable angina, chest pain, STEMI and non-STEMI (Heart Institute Manager) since every one of these patients should be getting same treatment. Interviews with Heart Institute staff took place throughout the process. Sharing of the draft ACS Pathway Package elements began in March 2004 with the ACS Pathway Package being released between September and November 2004 to those organizations that expressed an interest at the March 4, 2004 symposium (Heart Institute Manager).

4.5.5. Knowledge Transfer Timing

This research began with the STEMI Care Improvement Project symposium on March 4, 2004, continued with the Heart Institute development and sharing of the implemented ACS Pathway Package between September 2004 and November 2004, and then with the receipt of this knowledge by the Champlain District Hospitals from March 2004 to November 2005 and their subsequent use by January 2006. The November 2005 end date represents the final aspects of the transfer activities to the two ‘directly’ successful transfer hospitals, so that complete data sets could be analyzed.

5. DATA ANALYSES AND FINDINGS

The data analyses and findings presented in this section begin with an overview of the data analysis approach (Section 5.1); the knowledge shared (Section 5.2); along with the resultant transfer outcomes (Section 5.3). The interview findings are summarized using Next Step Summarizing Tables (Miles & Huberman, 1984) which depict the findings for each outcome and determinant answering the research question (Section 5.4); and then there is a discussion of these results (Section 5.5).

5.1. Data Analyses

This section describes the process of coding and analyzing the interview data. This analysis process began with the coding of the data by the researcher using NVIVO (Gahan & Hannibal, 1998), a computer-assisted qualitative research tool. A cut-and-paste coding approach was used (Dolan & Ayland, 2001) as supported by the tool. The coding of the Data Collection Instrument responses followed the structure of the KT Framework determinants, and the research question. The coding involved three iterations to address further details as the data was reviewed (Miles & Huberman, 1984).

The first iteration created the determinant outcome structure by coding the interviews for the ten determinants and the two outcomes from the section of the Data Collection Instrument where these questions were asked. For example, KN1 Knowledge Codifiability was initially structured into six codes: Support/Not Support; Pro Transfer/Con Transfer; and Pro Outcome/Con Outcome, then codes were added for %

Explicit; Explicit Elements; and Tacit Elements. The second iteration involved a review of each interview transcript from front to back, coding each uncoded relevant unit into the coding structure plus the addition of new codes to further investigate the phenomenon, for example, Source of Tacit Knowledge was added to KN1 Knowledge Codifiability. The third iteration involved searches and cross-referencing to investigate particular issues or potential findings and generally thinking about the data, for example adding Vertical Transfer of tacit knowledge. This coding enabled thinking creatively about the data and asking the data questions to generate interpretations (Coffey & Atkinson, 1996). In all approximately 650 units were coded, many overlapping, using the about 170 codes.

Data display occurred via Site Ordered Descriptive Data (Miles & Huberman, 1984, 162). Selected coded elements were presented in the structure of transfer outcome, by determinants, and by determinant measure (for example, determinant measures Motivation Description, Champion and Motivation Impact for the determinant Positive Receiver Motivation) according to the structure of the Data Collection Instrument and coding scheme. A sample of this Site Ordered Descriptive Data is presented in Appendix G.

The Next Step Summarizing Tables (Miles & Huberman, 1984, 163-164) rolled up this Site Ordered Descriptive Data by determinant, according to various views of transfer outcome (Successful Direct, Successful Indirect, Successful, Partial, Unsuccessful and Non-Successful, per Section 5.3). These tables enabled analysis, interpretation and the drawing of conclusions (Miles & Huberman, 1984) which are presented in Sections 5.4,

5.5 and 6 respectively. The Next Step Summarizing Tables provided data reduction and classification to give meaning to the data (Coffey & Atkinson, 1996). These tables also enabled the identification of key factors and key relationships and presenting and organizing the data to make inferences (Miles & Huberman, 1984) to enable answering the first part of the research question, the identification of the determinants of successful knowledge transfer.

An interim analysis was performed after the first three interviews, as suggested by Miles & Huberman (1984), as part of a cyclical and reflexive activity (Coffey & Atkinson, 1996). This analysis reoriented previous views of the types of transfers possible and their associated sense making, specifically, the Data Collection Instrument and coding structure was refined. Together the interim and main analyses involved the use of the whole of the Site Ordered Data, while subsequent analyses looked at this data by health profession.

5.2. Knowledge Shared

The transfer of knowledge began with the explicit knowledge shared directly by the Heart Institute, the ACS Pathway Package. This transfer also involved the sharing of tacit knowledge, which was expected to be the AMI clinical guidelines and the how-to aspect of the ACS Pathway Package.

5.2.1. Explicit Knowledge

The Heart Institute Manager performed a lead role in communicating with the participating Champlain hospital staff, communicating explicit knowledge and providing support for the overall knowledge transfer. Based on the participation and interest generated by the March 4, 2004 STEMI Symposium, the Heart Institute formally shared the explicit knowledge of their operational ACS Pathway Package in draft form at the STEMI Symposium and the final, evaluated version via email. This package entailed:

- Acute Coronary Syndrome Clinical Pathway (completed 2004 07) (see Figure F-1, Appendix F);
- O2 protocol (2004 04) and Oxygen Therapy Delivery Devices Nursing Policy and Procedure Manual Guidelines;
- Chest Pain protocol (2004 03) and Chest Pain Plan of Care;
- Physician Orders (2004 10) – Admission to Heart Institute, Cardiology Transfer, ACS/STEMI Clinical Pathway Admission Orders, ACS/STEMI Clinical Pathway Transfer Orders (see Figure F-2, Appendix F);
- Patient Discharge Information – Acute Coronary Syndrome (2004 04) (see Figure F-3, Appendix F);
- PowerPoint education slides from a nurse educator perspective; and
- Cardiology Discharge Booklet, ACS Patient/Family Information (English and French), Instructions for use of ACS Clinical Pathway, ACS Pathway Information Sheet (not referenced since not directly relevant to transfer of AMI clinical guidelines).

In aggregate the explicit knowledge in these documents refers to agreed upon aspects of AMI care. “We have some hard numbers on things like cholesterol and on what types of medications and even for the most part on dosages for the medications. Those are hard points” (Heart Institute Cardiologist).

The summary of the knowledge shared is presented by hospital in Table 5.2.1-1. The primary means of this sharing was the STEMI Symposium (Column 2) and the Heart Institute Manager email (Column 3: Primary Communications). In addition there was informal sharing via the Heart Institute Triage Co-ordinators and other Heart Institute staff. Given these multiple possible formal and informal paths the Heart Institute Manager was not able to definitively indicate which hospitals received the ACS Pathway Package. Therefore, Column 4 presents the receiving hospital staff view about their receipt of this Package. Column 5 is a synthesis of these various views indicating whether the receiving hospital is known to have received the Package.

Table 5.2.1-1: Explicit Knowledge Shared By Heart Institute

Hospital	March 4, 2004 STEMI Symposium Participant	Primary Communications	Awareness of Heart Institute ACS Pathway Package	Formal Sharing of ACS Pathway Package
A	Yes	Package received March 4, 2004	“Yes” (Received copy March 4)	Yes
B	Yes	Not shared electronically	“No” (Apparently the physician who attended the Symposium, did not pass on package to subsequent physician)	Yes

Hospital	March 4, 2004 STEMI Symposium Participant	Primary Communications	Awareness of Heart Institute ACS Pathway Package	Formal Sharing of ACS Pathway Package
C	Yes	Not shared electronically	"Not to my knowledge". (Other Hospital C staff attended the Symposium but did not pass any package on to this interviewee)	Yes
D	Yes	Nov. 2004, emailed full package	"March got stuff immediately from (Heart Institute Manager) including oxygen titration"	Yes
E	Yes	Nov. 2004	"Then we thought why reinvent the wheel we will just call the Heart Institute and see what they are using."	Yes
F	Yes	Dec 2004, emailed package, not received by managers responsible	"The doctors were looking at the Heart Institute package and looking at what would apply here".	Yes
G	No	Not shared electronically	"Not at all (Lead)". "Yes" (Viewed by Cardiologist while working at HI)	Yes
H	Yes	Nov. 2004, emailed full package, person replaced. Sept 2005, emailed full package, following request	"I have them, they are what (Triage Co-ordinator) sent me, maybe two weeks ago" (Lead) "They gave us a copy of all of the information." (Educator)	Yes
I	Yes	Package received March 4, 2004	"They handed us a package"	Yes
J	Yes	June 2004 emailed full package	"No" (Director) "No" (Physician)	Yes
K	Yes	Oct. 2004, handed hard copy of documents	"Planning to adopt all of the package including the Gap tool" (Manager)	Yes

Hospital	March 4, 2004 STEMI Symposium Participant	Primary Communications	Awareness of Heart Institute ACS Pathway Package	Formal Sharing of ACS Pathway Package
L	Yes	Not shared electronically	<p>"I don't even know if we know that it exists" (Hospital L Educator).</p> <p>Vice President Nursing indicated Heart Institute package was not relevant to Hospital L (Background interview)</p>	No
M	No	Not shared electronically	"I don't have one... We do access their material" (This quotation referred to an old version prior to March 2004)	No
N	No	Not shared electronically	"I have seen their clinical orders. I asked for a copy to develop mine, in March 2005" (Hospital N Manager).	No

This table indicates that hospitals L, M and N did not receive the ACS Pathway Package. It was not shared, so this knowledge could not be transferred from the Heart Institute to these three hospitals. For the other 11 hospitals knowledge transfer is possible.

5.2.2. Tacit Knowledge

A portion of the tacit knowledge considered necessary to make effective use of this explicit ACS Pathway knowledge is identified in the middle column of Table E-1 (Practice Guideline Standards – Explicit and Tacit Knowledge, Appendix E). It is considered tacit to the ACS Pathway Package since these guideline statements are not explicitly referenced in this ACS Package, and as this knowledge is necessary for AMI care and must be tacitly known by staff providing this care, thus, if this knowledge is not

explicitly stated in the ACS package it is tacit to that package. The identification of these tacit elements was derived from the practice guidelines (Ryan, Anderson, Antman et al. 1996; Ryan, Antman, Brooks et al. 1999; Smith, Blair, Bonow et al., 2001; Antman, Beasley, Califf et al. 2002; Antman, Anbe, Armstrong et al., 2004) verified with Heart Institute staff (February, 2005), and then necessary subsets of these tacit items were identified by Heart Institute staff along with questions to ascertain the receiving hospital understanding of this tacit knowledge. For example, Beta Blockers, “Patients with moderate LV failure or other relative contraindications to Beta-Adrenoceptor blocker therapy provided patients can be monitored closely” (Ryan, Antman, Brooks et al., 1999, 1026). An example of this tacit knowledge is “If heart rate below 50 not give beta blocker, the subtlety is with low heart rate could give with reduced dose. Possibly use if heart rate can get above 50” (Heart Institute Educator).

This practice guideline tacit knowledge was neither formally identified by the Heart Institute staff, “There are medications: we are fairly explicit in the groups of medications, beta blockers and ACE inhibitors, but we are not very specific in the particular type or the dosage for the most part, with the exception of aspirin and plavix” (Heart Institute Cardiologist) nor formally transferred. It is implicit in the ACS Pathway Package. The research expectation for the major transfer of tacit knowledge was that “Once (Hospital K team) has map (clinical pathway) in their hands and using teaching tools, subtleties will be unearthed. (We) expect lots of interaction” (Heart Institute Manager), since the transfer of more tacit knowledge requires higher levels of collaboration, resource sharing and personnel movements (Cummings, 2001, 62). The Heart Institute in their implementation of the ACS Pathway identified some of these required adjustments, “the

timing of one of the medications was changed...sometimes the nurses were not aware yet of our oxygen titration protocol” (Heart Institute Cardiologist) or problems with the coding of the order for rehabilitation (Heart Institute Vice President).

From a physician perspective, part of this practice guideline tacit knowledge is the need to enable unique physician-patient decisions.

“It is saying, may not be corrected with supplemental oxygen. It is saying consider it, perhaps, or might be useful for some people. It's hard for me to give a standing order with ‘perhaps’ and ‘consider this’. That's where we need the individual physician to say in this case yes and in this case no. Because there are too many potential choices either way... So there are some patients when they come with ACS that should have a treadmill or an angiogram. Where an individual physician in discussion with a patient will go is still open. And we don't have to set that in advance. Some might go more conservative and do a treadmill other might say go straight to an angiogram. Peripheral hospitals tend to be more conservative and here more aggressive. The guidelines don't say everyone needs to do this. We don't have the data to back that up.” (Heart Institute Cardiologist).

Another area of tacitness is that the guidelines represent areas of broad agreement and there are other areas where agreement has not yet been reached. “There are a lot of areas where there are still discrepancies, even in the guidelines, because the guidelines are still trying to be fairly general to encompass everyone” (Heart Institute Cardiologist). The main areas of tacit knowledge were seen as “what tests to order, these tend to be a little softer...How you focus on smoking is a grey zone. Same with diet and exercise. Exactly how you do that is a grey zone” (Heart Institute Cardiologist).

Thus the expected transfer of tacit knowledge involved clinical guideline knowledge not explicitly stated in the ACS Pathway but necessary for their effective use, knowledge that is often patient specific.

5.3. Knowledge Transfer Outcome

The transfer outcomes as defined by the KT Framework are Knowledge Internalization and Knowledge Use. This section describes how each outcome was determined from the research data.

The Knowledge Internalization outcome was identified from the receiving hospital answers to the Data Collection Instrument questions labelled as O1 (Outcome 1: Internalization). The essence of responses to these questions are recorded in Appendix H (Tables H-1 and H-2: Receiving Hospital Use of Explicit Knowledge, in the second last row of each table). This result is summarized in the Knowledge Internalization – Self-Assessment column of Table 5.3-1 (Knowledge Internalization - Self-Assessment). These ratings were derived using Table G-1, Appendix G. It indicates that 12 of 14 hospitals thought they had internalized this knowledge, per their ratings of Medium or higher.

The Knowledge Use outcome was determined through a review of each hospital's documentation supporting AMI/ACS cardiac care, specifically the ACS Pathway Package. This documentation for each of the 14 hospitals was compared with the Heart Institute ACS Pathway Package according to the related 29 clinical practice guidelines evident in the Heart Institute documentation. This is presented in detail in Appendix H.

The results of this comparison are summarized in Table 5.3-1 (Knowledge Use – Artefact Analysis). This comparison was validated first with each receiving hospital to make sure all the documentation has been received and correctly interpreted, and then with Heart Institute staff to ensure the evaluation accuracy. Each hospital's use of this knowledge is defined as High, Medium, or Low according to the definitions of:

- High denotes more than 2/3 of the practice guidelines implemented, that is, formal hospital documentation in use representing more than 2/3 of these 29 identified practice guidelines;
- Medium denotes 1/3 to 2/3 usage; and
- Low denotes less than 1/3 usage.

Each hospital's self-assessment of their level of knowledge use is also presented from their answers to the Data Collection Instrument questions labelled O2 (Appendix H, Tables H-1 and H-2 Receiving Hospital Use of Explicit Knowledge, in the last row). This result is summarized in the Knowledge Use – Self-Assessment column of Table 5.3-1. This self assessment was higher than the artefact evaluation for all but Hospital K, suggesting a level of bias with these self-assessments.

The Heart Institute level of formal sharing of the ACS Pathway Package from column 5 of Table 5.2.1-1 (Explicit Knowledge Shared By Heart Institute, Section 5.2), denoted as Yes or No, is shown in Table 5.3-1 (Explicit Knowledge Shared.

The final column of Table 5.3-1 portrays the level of Knowledge Transfer defined as follows:

- Successful Knowledge Transfer (Direct) – High Knowledge Use – Artefact Analysis with Explicit Knowledge Sharing equal Yes;
- Successful Knowledge Transfer (Indirect) - High Knowledge Use – Artefact Analysis with Explicit Knowledge Sharing equal No;
- Partial Knowledge Transfer - Medium Knowledge Use – Artefact Analysis with Explicit Knowledge Sharing equal Yes or No; and
- Unsuccessful Knowledge Transfer – Low Knowledge Use – Artefact Analysis with Explicit Knowledge Sharing equal Yes or No.

Table 5.3-1: Knowledge Transfer Outcome

Hospital	Knowledge Internalization - Self-Assessment	Knowledge Use - Self-Assessment	Knowledge Use – Artefact Analysis	Explicit Knowledge Shared	Knowledge Transfer
A	Low	Low	Low	Yes	Unsuccessful
B	Medium-High	High	Medium	Yes	Partial
C	Medium-High	High	Medium	Yes	Partial
D	Medium	Medium	Medium	Yes	Partial
E	Low-Medium	Medium	Medium	Yes	Partial
F	Medium-High		Medium	Yes	Partial
G	High	Medium-High	Medium	Yes	Partial
H	High	High	High	Yes	Successful - Direct
I	High	Medium-High	Low	Yes	Unsuccessful
J	Medium	Medium-High	Medium	Yes	Partial

Hospital	Knowledge Internalization - Self-Assessment	Knowledge Use - Self-Assessment	Knowledge Use – Artefact Analysis	Explicit Knowledge Shared	Knowledge Transfer
K	Medium-High	Medium-High	High	Yes	Successful - Direct
L	Medium-High	Medium-High	High	No	Successful - Indirect
M	High	High	Medium	No	Partial
N	Medium-High	High	High	No	Successful - Indirect

Thus, the knowledge transfer outcomes are: two Unsuccessful; eight Partial; and four Successful. Two of the Successful involved sharing of the ACS Pathway Package from the Heart Institute and so are denoted as Successful-Direct transfers (i.e., directly from the Heart Institute); while the other two transfers not involving the Heart Institute are denoted as Successful-Indirect (i.e., indirectly from other than the Heart Institute). The decision to partition the outcomes into three groupings reflects the results shown in Appendix H where the ratings were: 4-8; 13-18; and 22-28, out of 29. Note that both Hospital H and K were rated as Partial transfers prior to their uptake of the Heart Institute package.

5.4. Findings

These findings are structured to answer the research question, starting with the primary element, then the two secondary elements, culminating with an evaluation of the KT Framework.

The primary research question element is, What are the determinants of horizontal knowledge transfer success in health services? This portion of the research question is addressed in two parts: a) which determinants are present for successful transfers; and b) which determinants are differentiated between examples of KT success and KT non-success. Sections 5.4.1 and 5.4.2 address these two aspects of the research question. To take into consideration strongly supported determinants that are present for both successful and non-successful transfers the determinant differentiation view is augmented with the interviewee perspective on which determinants are important for KT success, presented in Section 5.4.3.

The subordinate research question, How do these determinants of horizontal knowledge transfer success differ between hospitals of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed? is addressed in Section 5.4.4. The other subordinate research question, How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge? is answered by the Knowledge Transfer Framework itself, presented in Section 5.4.5.

The KT Framework is then evaluated in Section 5.4.6 according to these KT Framework elements: KT determinants; Knowledge Internalization and Use outcomes; and tacit-explicit transfer of the KT Framework..

5.4.1. KT Framework Determinants Of Successful Transfers

The method used to identify the determinants of successful KT is a rating of the interviewee responses to the Data Collection Instrument determinant questions. The rating process involved three independent raters evaluating each Data Collection Instrument response according to the instructions listed in Appendix, essentially rating each response as High, Medium or Low levels of support for the existence of the determinant.

The presentation of the ratings for the Successful-Direct and Successful-Indirect Transfers are shown in Table 5.4.1-1. These ratings are derived from Table G-1 (Appendix G). The definition of Support for a determinant is a rating of Medium-High or the top quarter of the rating scale (or Low-Medium for inverse determinant relationships). Strong Support is given for High ratings, the apex of the rating scale. Three sets of ratings are presented: Successful Direct; Successful Indirect; and the combined Successful outcomes. For each cell the ratings and results (bolded, in parentheses) are shown. An example of the Data Collection Instrument responses and their rating is shown in the Site Ordered Descriptive Data of Table G-2, Appendix G.

Table 5.4.1-1: Successful Transfer Determinants

	Successful Transfer Determinant Rating	Successful Direct Transfer Determinant Rating	Successful Indirect Transfer Determinant Rating
Knowledge Codifiability (KN1)	Medium-High+ (Support)	High (Strong Support)	Medium-High (Support)

	Successful Transfer Determinant Rating	Successful Direct Transfer Determinant Rating	Successful Indirect Transfer Determinant Rating
Knowledge Complexity (KN2) (Inverse Relationship)	<u>Medium</u>	<u>Medium-High</u>	<u>Low-Medium</u>
Prior Related Knowledge (RE1)	Medium-High (Support)	Medium-High+ (Support)	Medium-High (Support)
Unlearning Capacity (RE2)	Medium-High (Support)	Medium+	Medium-High+ (Support)
Positive Receiver Motivation (RE3)	Medium-High (Support)	Medium-High+ (Support)	Medium-High (Support)
Perceived Credibility of Source (RE4)	Medium-High+ (Support)	Medium-High+ (Support)	High (Strong Support)
Sender-Receiver Distance (SR1) (Inverse Relationship)	<u>Low+</u> (Support)	<u>Low-Medium</u>	<u>Low</u> (Strong Support)
Relationship Quality (SR2)	Medium-High (Support)	Medium-High (Support)	Medium-High (Support)
Richness of Transmission Channels (TR1)	Medium+	Medium-High (Support)	Medium+
Supportive Organizational Context (EN1)	Medium-High (Support)	Medium-High (Support)	Medium+

Table 5.4.1-1 indicates that for Successful Transfers (Column 2) eight of ten determinants have Support (excluding Knowledge Complexity (KN2) and just excluding Richness of Transmission Channels (TR1)). If one considers only the Direct Transfers (Column 3), seven of the ten determinants appear to have Support (now excluding Knowledge Complexity (KN2) and just excluding Unlearning Capacity (RE2) and Sender-Receiver

Distance (SR1)). The third view is Successful Indirect Transfers (Column 4) showing support for seven of ten determinants, just including Unlearning Capacity (RE2) and just excluding Knowledge Complexity (KN2). In aggregate at least one of these views shows support for nine of ten determinants, just excluding Knowledge Complexity (KN2), indicating a moderate or greater level of support for the overall KT Framework set of ten determinants.

The most appropriate of these three views is the Successful Direct Transfer view, given that this transfer involved sharing from the Heart Institute and the following comparison or Successful Direct and Successful Indirect Transfer determinant results:

- Knowledge Codifiability – the codifiability was rated as High by the Direct Transfer hospitals and Medium-High by the Indirect Transfer hospitals, a measurable difference;
- Knowledge Complexity – the knowledge was seen as of Medium-High+ complexity for the Direct Transfer hospitals and as Low-Medium+ by the Indirect Transfer hospitals, a major difference;
- Sender-Receiver Distance – this gap was seen as Low by the Indirect Transfer hospitals (highly supportive) and a Low-Medium (not supportive) by the Direct Transfer hospitals, a measurable difference; and
- Prior Related Knowledge, Positive Receiver Motivation, Richness of Transmission Channels, and Supportive Organizational Context – all were rated as slightly higher by the Direct Transfer hospitals.

These variances indicate that the Indirect Transfers behave somewhat differently from the Direct Transfers. Therefore, since the majority of KT literature is focused on Direct Transfers, that is, transfers occurring as a result of knowledge being made available by a sender, this research will focus on Direct Transfers as the measure of Successful Transfer. However, comparative analysis with Non-Successful Transfers was performed for both Direct and Indirect Transfers to identify any other variances.

5.4.2. KT Framework Determinants Of Partial And Unsuccessful Transfers

A similar tabulation of Support and Strong Support for Partial and Unsuccessful Transfers is presented below. The combination of Partial and Unsuccessful has been named Non-Successful, the antithesis of Successful.

Table 5.4.2-1: Non-Successful Transfer Determinants

	Non-Successful Transfer Determinant Rating	Partial Transfer Determinant Rating	Unsuccessful Transfer Determinant Rating
Knowledge Codifiability (KN1)	Medium-High+ (Support)	High (Strong Support)	Medium
Knowledge Complexity (KN2) (Inverse Relationship)	<u>Medium+</u>	<u>Medium+</u>	<u>Medium</u>
Prior Related Knowledge (RE1)	Medium+	Medium+	High (Strong Support)
Unlearning Capacity (RE2)	Medium	Medium+	Low-Medium
Positive Receiver Motivation (RE3)	Medium	Medium	Low-Medium+

	Non-Successful Transfer Determinant Rating	Partial Transfer Determinant Rating	Unsuccessful Transfer Determinant Rating
Perceived Credibility of Source (RE4)	Medium-High+ (Support)	Medium-High+ (Support)	Medium-High (Support)
Sender-Receiver Distance (SR1) (Inverse Relationship)	<u>Low-Medium</u>	<u>Low-Medium</u>	<u>Low</u> (Strong Support)
Relationship Quality (SR2)	Medium	Medium	Low-Medium+
Richness of Transmission Channels (TR1)	Low-Medium+	Low-Medium+	Medium
Supportive Organizational Context (EN1)	Medium+	Medium+	Medium

The results for the Non-Successful Transfers (Column 2) show support for Knowledge Codifiability (KN1) and Perceived Credibility of Source (RE4). Determinants at the edge of this Support range (i.e., Medium+) include Prior Related Knowledge (RE1), Sender-Receiver Distance (SR1) and Supportive Organizational Context (EN1). Thus, about half of the determinants show some level of support by the Non-Successful Transfer hospitals. Since the results for Partial Transfer are almost identical to the results for the Non-Successful Transfers, due in part to the small Unsuccessful Transfer sample size, the Non-Successful Transfer category will be used in further comparisons and analysis, rather than the Partial or Unsuccessful categories.

The next step with this rating structure is to compare these two sets of results. Table 5.4.2-2 shows the relative differences between the Successful Direct Transfer and the

Non-Successful Transfer determinants. Other comparisons involving Successful, Successful-Indirect, Partial and Unsuccessful transfers do not substantially alter these results.

Table 5.4.2-2: Transfer Determinants – Comparison of Support

	Successful Direct Transfer Determinant Rating	Non-Successful Transfer Determinant Rating	Comparison Result
Knowledge Codifiability (KN1)	High (Strong Support)	Medium-High+ (Support)	
Knowledge Complexity (KN2)	<u>Medium-High</u>	<u>Medium+</u>	
Prior Related Knowledge (RE1)	Medium-High+ (Support)	Medium+	Slightly Stronger Support - Partial
Unlearning Capacity (RE2)	Medium+	Medium	
Positive Receiver Motivation (RE3)	Medium-High+ (Support)	Medium	Much Stronger Support - Yes
Perceived Credibility of Source (RE4)	Medium-High+ (Support)	Medium-High+ (Support)	
Sender-Receiver Distance (SR1)	<u>Low-Medium</u>	<u>Low-Medium</u>	
Relationship Quality (SR2)	Medium-High (Support)	Medium	Stronger Support - Yes
Richness of Transmission Channels (TR1)	Medium-High (Support)	Low-Medium+	Much Stronger Support - Yes
Supportive Organizational Context (EN1)	Medium-High (Support)	Medium+	Slightly Stronger Support - Partial

Table 5.4.2-2 shows Successful Transfer hospitals have: 1) much stronger support for Positive Receiver Motivation (RE3) and Richness of Transmission Channels (TR1); 2) stronger support for Relationship Quality (SR2); and 3) slightly stronger support for Prior Related Knowledge (RE1) and Supportive Organizational Context (EN1) (between 1 and 1.5 points on the rating scale, Table G-1). This much stronger support for Positive Receiver Motivation (RE3) was corroborated by the interview responses, “Motivation comes first. Then we beg for the resources” (Hospital I, Director); or “It is interesting that we have two groups who want to do this and we are meeting these barriers. Imagine if we didn’t want to do this” (Heart Institute Manager). Thus, Relationship Quality (SR2), Positive Receiver Motivation (RE3), Richness of Transmission Channels (TR1), Prior Related Knowledge (RE1) and Supportive Organizational Context (EN1) are seen to differentiate Successful Transfers from Non-Successful Transfers.

5.4.3. Perceived Necessity of Each KT Framework Determinant

An additional means of answering the first part of the research question is to know whether each KT Framework determinant is perceived to be necessary for transfer success. This approach was developed to address the concern that there may be determinants of successful transfer that are found in both the Successful Transfer hospitals and the Non-Successful Transfer hospitals, and a method that only looks at determinant differences would consider this determinant as not required for successful transfer. One example is Perceived Credibility of Source (RE4) which has a Medium-High+ rating in both Table 5.4.1-1 (Successful Transfer Determinants) and Table 5.4.2-1

(Non-Successful Transfer Determinants). This determinant was strongly indicated in the interviews to be a requirement for successful KT:

“If the guidelines did not come from a credible institution and if the institution had not derived the guidelines from a credible organization then we would be stupid to use these guidelines. They have to have that value” (Hospital K Cardiologist).

Yet the comparison shown in Table 5.4.2-2 (Transfer Determinants – Comparison of Support) would exclude this determinant from consideration of KT success. The exclusion of such a strongly supported determinant is clearly an illogical result.

Thus, an additional means of identifying determinants necessary for KT success is proposed based on the perceptions of the interviewees about the impacts of changes in each determinant to KT success. These are summarized in Table 5.4.3-1. This second means of deducing the determinants of KT success involves cross-referencing the interviewees perspective with their other Data Collection Instrument answers. Two questions for each determinant were asked about the impact if the determinant was observed by a lesser amount. For example, RE4-4: If there were more of a credibility gap would the communications with the Heart Institute have been different? RE4-5: What impact did any of these differences have on your understanding of the Heart Institute ACS documentation?

This alternative view is an exploration by this research. It is not grounded in previous KT studies and no data collection instrument have been previously developed. Thus, while some positive response bias is expected in acquiring these interviewee perceptions, the

fact that almost half the responses in Table 5.4.3-1 are rated as Medium or less suggests this bias is not too severe. An example of the Data Collection Instrument responses is shown in the Site Ordered Descriptive Data of Table G-3, Appendix G.

Table 5.4.3-1: Transfer Determinants Perceptions

	Successful Direct Transfer Perceived Impact Rating	Non-Successful Transfer Perceived Impact Rating	Result
Knowledge Codifiability (KN1)	Medium+	Low-Medium+	Partial support
Knowledge Complexity (KN2) (<u>Inverse Relationship</u>)	Low-Medium+	Low	
Prior Related Knowledge (RE1)	Medium-High+ (Support)	Medium+	Support by Successful Transfers
Unlearning Capacity (RE2)	Medium	Low-Medium+	
Positive Receiver Motivation (RE3)	Medium-High (Support)	Medium-High (Support)	Support by both
Perceived Credibility of Source (RE4)	Medium-High+ (Support)	Medium-High (Support)	Support by both
Sender-Receiver Distance (SR1) (<u>Inverse Relationship</u>)	Low-Medium	Low-Medium+	
Relationship Quality (SR2)	Medium	Low-Medium	
Richness of Transmission Channels (TR1)	Medium	Low-Medium	
Supportive Organizational Context (EN1)	Medium+	Medium	Partial support

Table 5.4.3-1 indicates that the three determinants receiving the most Support for KT success are Prior Related Knowledge (RE1), Positive Receiver Motivation (RE3) and Perceived Credibility of Source (RE4). These are followed by Knowledge Codifiability (KN1) and Supportive Organizational Context (EN1) with a Medium+ rating.

These results together answer the first element of the research question, What are the determinants of horizontal knowledge transfer success in health services? This is shown in Table 5.4.3-2. The Determinant Support in Successful Direct Transfers from Table 5.4.1-1 depicts the support for seven of ten determinants by the Successful Direct Transfer hospitals. The Comparative Determinant Differences from Table 5.4.2-2 (Comparison Result) presents determinants with a higher rating for the Successful than the Non-Successful hospitals. The Determinants With A High Perceived Impact on KT Success show the five differentiated determinants from Table 5.4.3-1 (Result column) which were considered to be necessary for KT success. The final column in Table 5.4.3-2 combines the Comparative Determinants with the Perceived Impact Determinants (columns 3 and 4).

Table 5.4.3-2: Determination of Significant Determinants

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Knowledge Codifiability (KN1)	Strong Support		Partial	Partial
Knowledge Complexity (KN2)				

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Prior Related Knowledge (RE1)	Support	Partial	Yes	Yes
Unlearning Capacity (RE2)				
Positive Receiver Motivation (RE3)	Support	Yes	Yes	Yes
Perceived Credibility of Source (RE4)	Support		Yes	Yes
Sender-Receiver Distance (SR1)				
Relationship Quality (SR2)	Support	Yes		Yes
Richness of Transmission Channels (TR1)	Support	Yes		Yes
Supportive Organizational Context (EN1)	Support	Partial	Partial	Yes

This combination of the Comparative Determinant Differences result with the Determinants With A High Perceived Impact on KT Success provides a more comprehensive depiction of determinant support for KT success than Comparative Determinant Differences alone. This combination (column 5) indicates a lack of support for the Sender-Receiver Distance (SR2), Knowledge Complexity (KN2), and Unlearning Capacity (RE2) determinants, the same three determinants not supported by the

Successful Direct Transfer hospitals (column 2), thus collaborating the Successful Direct Transfer hospital result.

5.4.3.1. Impact of Interviewee Profession

The results presented in Table 5.4.3-2 reflect the combined views of all the key informants, but these results do not indicate to what degree they may represent the views of one health services profession versus another. Receiving hospital interviews were held with 28 key informants: 5 physicians (including Cardiologists); 5 directors; and 18 nursing unit staff (managers, leads, and educators). Each of these groups has a somewhat different health services focus hence each group may have responded in a systematically different way to the Data Collection Instrument (Appendix C): physicians from a holistic patient care perspective; directors from a hospital administration perspective; and nursing unit staff from a day-to-day operational perspective.

An analysis of the Data Collection Instrument responses indicates that in aggregate the three groups responded very similarly to the determinant existence questions (with the nursing unit staff answers being slightly less positive), but the physicians and directors responded much more positively to the determinant impact questions per Table 5.4.3-1 (Transfer Determinant Perceptions), about 20% more positively. The impact of these different perspectives is depicted in the two copies of Table 5.4.3-2 (Determination of Significant Determinants) shown below, one for the physician perspective and one for the director perspective.

An important caveat on these new tables is they reflect a much smaller sample of Data Collection Instrument responses, both due to the smaller number of key informants involved and because the directors and physicians tended to answer fewer Data Collection Instrument questions. That is, the directors provided about 16% of the number of answers of the unit nursing staff while the physicians provided about 30%. Secondly, the impact of removing these director and physician answers from the complete set of responses had minimal impact on the results shown in Table 5.4.3-2. Thus, Table 5.4.3-2 reflects the nursing unit staff responses with minor non-significant changes to the data from Table 5.4.2-1 (Non-Successful Transfer Determinants) and Table 5.4.3-1 (Transfer Determinant Perceptions).

Table 5.4.3.1-1: Determination of Significant Determinants - Physicians

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Knowledge Codifiability (KN1)	Strong Support		Yes	Yes
Knowledge Complexity (KN2)				
Prior Related Knowledge (RE1)	Support		Yes	Yes
Unlearning Capacity (RE2)	NA			
Positive Receiver Motivation (RE3)	Support	Yes	Yes	Yes
Perceived Credibility of Source (RE4)	Support		Yes	Yes

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Sender-Receiver Distance (SR1)				
Relationship Quality (SR2)	Strong Support	Yes		Yes
Richness of Transmission Channels (TR1)	Strong Support	Yes		Yes
Supportive Organizational Context (EN1)	Partial		Partial	Partial

Table 5.4.3.1-2: Determination of Significant Determinants - Directors

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Knowledge Codifiability (KN1)	Strong Support			
Knowledge Complexity (KN2)	NA			
Prior Related Knowledge (RE1)	Support			
Unlearning Capacity (RE2)	NA		Yes	Yes
Positive Receiver Motivation (RE3)	Support	Yes	Yes	Yes
Perceived Credibility of Source (RE4)	Strong Support		Yes	Yes

Determinant	Determinant Support in Successful Direct Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Sender-Receiver Distance (SR1)	Strong Support			
Relationship Quality (SR2)	NA		Yes	Yes
Richness of Transmission Channels (TR1)	NA			
Supportive Organizational Context (EN1)			Partial	Partial

Note: NA refers to no responses for these questions.

The physician view presented in Table 5.4.3.1-1 is very similar to the composite view presented in Table 5.4.3-2; the difference being a stronger physician view on Knowledge Codifiability (KN1), and the Richness of Transmission Channels (TR1) which comes from physician perception rather than the determinant difference. The director view presented in Table 5.4.3.1-2 has quite a number of differences.

- Determinant Support for Successful Direct Transfers – support for Sender-Receiver Distance (SR1) and lack of support for Relationship Quality (SR2), Richness of Transmission Channels (TR1), and Supportive Organizational Context (EN1).
- Differentiators and High Impact Determinants - no support for Knowledge Codifiability (KN1), Prior Related Knowledge (RE1) or Richness of Transmission Channels (TR1); with support for Unlearning Capacity (RE2).

This divergence in director results may be related to the much smaller set of director responses, or an actual important difference in perspective.

Thus, the composite support for seven of the ten KT Framework determinants is consistent with the results from the nursing unit staff and the physicians, but it may diverge for the directors, although with the small number of responses the director differences are tentative.

5.4.4. Knowledge Internalization and Knowledge Use Differences

The research context diagram (Figure 4.5-1 Research Context, Section 4.5) depicts the known knowledge and motivation sources relevant to this research: AMI Clinical Trials; AMI Practice Guidelines; EFFECT Study; and the Macleans popularization of the CIHI AMI 30-day in-hospital mortality results. These sources are associated with multiple mechanisms by which AMI Clinical Trials and AMI Practice Guidelines can be transferred to a Receiving Hospital including direct transfer vehicles such as magazines, the publication of the EFFECT Study and its distribution to participating hospitals, feedback to participants in Clinical Trials, conferences and journals disseminating the latest updates to the AMI Practice Guidelines and the Heart Institute STEMI Symposium and follow-up emails with the ACS Pathway Package. In addition there are numerous formal and informal networking relationships by which this information and knowledge is either sent from a source or searched for and found by a receiver: individuals participating at multiple sites; friends; acquaintances; and references to published sources. Taken together this indicates a very complex network of potential knowledge

transfer mechanisms at work in relation to just this research and the AMI Practice Guidelines.

A major impact of this complex network combined with the high level of health services professional motivation to remain current with new health services knowledge is that for this research the AMI Practice Guideline knowledge had been Internalized prior to the Heart Institute initiated transfer of the ACS Pathway as shown in Table 5.3-1 (Knowledge Transfer Outcome: Knowledge Internalization - Self-Assessment, Section 5.3). All but two of the hospitals considered that they had internalized the AMI Guidelines and implemented the knowledge and all but one indicated they were using this knowledge, even though only four of the 14 hospitals have demonstrated this knowledge use. Further, the transfer of the AMI Guideline knowledge did not originate with the Heart Institute but from various other sources referenced above and described in Figure 4.5-1 Research Context. Therefore, since almost all hospitals considered that they had already internalized this knowledge including all three who did not receive the ACS Pathway package from the Heart Institute, and since there are a multitude of mechanisms and motivations to independently acquire this knowledge, the second research sub-question is outside the scope of this research since the transfer was considered to have already occurred by a non-Heart Institute path, an area this research was not considering.

“There is a certain degree of background knowledge that has been known for years. Most of these things that are in our new ACS Pathway and that, nothing is really new. Everyone knows that cholesterol is important and all these medications we use are important” (Heart Institute Cardiologist).

In fact, the only aspect of the AMI Guidelines not fully Internalized in addition to the discharge-related guidelines captured in the ACS Discharge Tool was the Heart Institute ACS Pathway differences from each Receiving Hospital's existing practices, e.g., diet, coordinators, which were typically 'transferred' through an initial review of the ACS Pathway Package by the Receiving Hospital team. The prevalence and ready availability of this AMI knowledge is summarized by the Hospital H Lead:

"I was looking through the Safer Healthcare Now program www.saferhealthcarenow.ca. It is trying to standardize care for AMI and most of those things we are already doing; in fact all of them. We've got the Enoxaparin, ACE, statin, plavix, and beta blocker so pretty much we are following what the standards are recommending. I just got this package for acute MI the other day. It is a whole binder. And there were different topics as well. It is part of a program we were looking at. They definitely have an MI package they were recommending".

5.4.5. The Transfer Of Tacit Knowledge

To understand the transfer of tacit knowledge it is useful to refer again to the Communications Model of Figure 2.3.2.1-1 (Communications Theory, Section 2) and represent each component in this Model with actual elements from this research.

Figure 5.4.5-1: AMI Guideline Knowledge Transfer

- The Message is the AMI Guidelines.
- The Coding Scheme is the development of the Heart Institute ACS Pathway. “So how can we help them follow the guidelines? Going and telling them about the guidelines again wouldn't be sufficient. So we thought maybe we can help them out with prompts to the guidelines, which is essentially what the ACS protocol is. It is just a prompt to the guidelines” (Heart Institute Cardiologist). Thus, the ACS Pathway Package is a demonstration of the implementation of the AMI Guidelines that can be transferred to others. This Coding Scheme is the Heart Institute demonstration that they have Internalized these guidelines.
- The Coded Message is the Implemented Heart Institute ACS Pathway successfully representing the implementation of the AMI Guidelines. In the Heart Institute this implementation is demonstrated by the successful evaluation of the ACS Pathway.

- The Communication Channel is the vehicle to send the explicit knowledge and possibly uniquely related tacit knowledge not known or able to be reconstructed by the potential receiver. These can be generically termed transmission channels.
- The Decoded Message is the receiver understanding of the Heart Institute ACS Pathway, the perception and interpretation of the tacit knowledge (Garavelli, Gorgoglione & Scozzi, 2002, 272)
- Assign Meaning represents the receiver development of their version of the ACS Pathway, including making the necessary changes to the Heart Institute Pathway to address differences in receiving hospital resources and processes, such as nursing coordinators and Rehabilitation programs. This Assign Meaning may be part of an iterative process along with decoding the message.
- The Understood Message is the receiving hospital use of the AMI Guidelines through the effective implementation of the receiver ACS Pathway.

Within this AMI Guidelines knowledge transfer there is a macro and a micro knowledge transfer occurring. These are each presented in the following sub sections.

5.4.5.1. Micro Knowledge Transfer – Heart Institute to Receiving Hospitals

The transfer of the explicit knowledge—the ACS Pathway Package—occurs via the Transmission Channels, the STEMI Symposium and email of Table 5.2.1 (Explicit Knowledge Shared By Heart Institute). It is less clear where and how the tacit knowledge

is being transferred, or even more basically, What is this knowledge that is “embedded in a human brain and not easily expressed” (Polanyi, 1967, 6)? The answer lies in the transfer process itself as described by Hospitals H and K. In the words of the Hospital K Manager:

“We took this (the ACS Pathway Package) back to the Cardiac Care Committee made up of two cardiologists, the Manager, Educator, an intensive care area nurse, the area pharmacist and a dietician and social worker. This (the ACS Pathway Package) was put on the table...We had discussions around certain points. There was nothing that were show stoppers. It was little things, when an echogram is really ordered, that kind of instruction. When do we really do this? We don't order this anymore. It was that kind of instruction. And we came out of that meeting with everybody happy with this (revised) Pathway. We all had our say. We went through it line by line and made notes on it and talked about it. We knew there were minor things that we needed to fix”.

The result for Hospital H was:

The changes to the ACS Discharge Tool included: “no carbon copy, removed rehabilitation referral” (Educator); replaced Quit Smoking phone number, replaced Diet Handout name; and adjusted Exercise Regularly wording.. The changes to the ACS Pathway included: removed Chest Pain Protocol (not approved yet); replaced Heart Institute Diet with Cardiac Diet; took out consultation to rehabilitation; deleted education courses (“we had no backup”); “took out the ‘Anti Xa Assay’ (Day 1 tests) since we don’t have that here...24 call in is all gone... the Intervention day is gone because we don’t do that here... outcomes that don’t (apply) were taken out” (Hospital H Educator).

Thus, Hospital H and K created new instances of the ACS Pathway with their receiving hospital organizational processes and resource profiles:

- Hospital H – no rehabilitation referral, Chest Pain Protocol, Anti Xa Assay’ Day 1 test, 24-hour on call service, or education courses; different Quit Smoking phone number, Diet name, and Exercise Regularly wording; and

- Hospital K - no Nursing Coordinator consult, Discharge class, Nitroglycerin/ Betablocker/ ACE inhibitor quantity, diabetic IV insulin, or 24 hour call service; change in Diet name, kept existing O2 protocol approach, and add 'notify MD' to Chest Pain protocol since floors not able to read ECGs.

So the transfer of this resource and process tacit knowledge involved the explicit knowledge, the ACS Pathway Package, as a trigger to the receiving hospital skills and know-how in a specific context (Lahti & Beyerlein, 2000, 66) and “mental model, paradigms, schemata and beliefs that assist people in understanding their environments” (Johnson-Laird, 1983). The transfer of tacit knowledge was not something the Heart Institute sent; it was built in by the Heart Institute in their development of the ACS Pathway and then uncoupled by the receiving hospitals using their mental models and know-how.

Sometimes it was incompletely uncoupled. For example, Hospital D tried to adopt the Heart Institute Oxygen protocol from the ACS Pathway Package but failed to do so when the Heart Institute was unable to explain why it was appropriate for ICU and what would have to change to make it appropriate for the whole hospital (Hospital D Director). The Heart Institute was no longer aware of this differentiation, it was tacit knowledge that this Oxygen Protocol was designed for critical care nurses. The Heart Institute staff did not include any written or oral instructions with the Pathway saying these assumptions need to be tested in the receiving hospital. Another example is the Stress ECG in the list of AMI Guidelines embedded in the ACS Pathway. When looked at closely this guideline standard is not in the Heart Institute ACS Pathway since the Heart Institute performs the

cardiac intervention (see Appendix H – ECG-Stress), but it should be added to the Pathway for receiver hospitals that do not perform this intervention, like Hospitals H and K. Neither Hospital H nor K added this guideline standard for their patients not being transferred to the Heart Institute for an intervention. Thus, this knowledge was not communicated to these hospitals by the Heart Institute.

The Heart Institute supported the tacit and explicit KT to Hospital K by providing rationale for various pathway decisions, “(Heart Institute) Vice President Administration left us an initial set of ideas; but when we got down to the nitty gritty we had to take some things out (of the pathway) things we didn’t have...They invited us to a meeting, shared how they educated their nurses, they offered support” (Hospital K Manager). However, this support was incomplete as made evident by the Hospital K lack of awareness of the need to integrate the in-hospital ACS Pathway with the Emergency Department processes being followed, causing a further implementation delay from September to December 2005. This barrier was overcome by the Heart Institute explaining to Hospital K that the Heart Institute had a second version of the ACS Physician Orders that enabled this integration with Emergency, essentially a microcosm of this overall explicit and the transfer of tacit knowledge.

In conclusion, the tacit knowledge that was transferred was this integration of the Heart Institute resource profile and organizational processes with the AMI Guidelines. This process and resource profile or how-to knowledge is the micro knowledge transfer. This transfer occurred exactly as this research’s working definition of knowledge predicted:

- The AMI Guideline knowledge was expressed without its mental model as the ACS Pathway Package;
- The Heart Institute had the associated tacit knowledge of the integration of the Heart Institute resource profile and organizational processes with the ACS Pathway when it developed their Pathway Package;
- The receiver hospital without this tacit knowledge received the ACS Pathway Package information; and
- When Hospitals H and K understood and internalized this explicit knowledge they created their own integration of their resource profiles and organizational processes with the AMI Guidelines and its tacit understanding so that the implemented ACS Pathway Package became the receiving hospital's knowledge. In the case of Hospital K this understanding was facilitated by face-to-face contact with the HI, sometimes considered a prerequisite for some transfer of tacit knowledge (Roberts, 2000). Hospital H did not have or require this face-to-face interaction.

5.4.5.1.1. Role of KT Framework in Transfer of Tacit Knowledge

The role of the KT determinants in this transfer of tacit knowledge was extracted through a systematic analysis of the interview responses. The columns of Table 5.4.5.1.1-1 address the interviewee indication of relevance of the determinants to the transfer of tacit knowledge; the perceived impact of this determinant on the successful transfer of tacit knowledge; and then the derived relative importance of the impact of this determinant on the successful transfer of tacit knowledge.

This input suggests the KT Framework has a role in the transfer of tacit knowledge and its emphasis may be on a subset of the determinants found important in Table 5.4.3-2 Determination of Significant Determinants. Specifically, the transfer of tacit knowledge does not seem to require Knowledge Codifiability (KN1), Richness of Transmission Channels (TR1) or Supportive Organizational Context (EN1), but involves the other four determinants: Prior Related Knowledge (RE1); Positive Receiver Motivation (RE3); Perceived Credibility of Source (RE4); and Relationship Quality, all with High ratings.

Table 5.4.5.1.1-1: Perceived Relevance of KT Framework Determinants To The Transfer of Tacit Knowledge

Determinant	Perceived Relevance of Tacitness for Determinant	Perceived Impact of Tacitness on KT	Relative Importance of Determinant on Tacit KT Success
Knowledge Codifiability (KN1)	“It has to be about what is written. You can try to get into each other's heads is helpful to a certain point, but you can't draw upon that experience because it is not your own. It is some one else's experience” (Hospital A Lead).	“It would matter if the gap occurred in the hard and fast guidelines rather than the nuances” (Hospital K Cardiologist).	By definition, the more codified the knowledge the less the transfer of tacit knowledge and the less impact of the tacit knowledge on transfer success. The perceived level of non-codified knowledge is around 25%, thus the associated Pathway tacit knowledge impact is expected to be even smaller. Rating Low.
Knowledge Complexity (KN2)	“The complexity is with the patient differences and not the protocols or explicit data” (Hospital H Educator). “It is usually the tacit that is more complex” (Hospital K Cardiologist).	“You know how I said I didn't go back to reevaluate or share or have that discussion. I think I would with the more complex” (Hospital N Manager).	Thus, tacit knowledge is considered to be more complex than the explicit knowledge, which is consistent with the perception that AMI knowledge is complex and can be more effectively applied by experienced nurses. The implication is that the more complex the knowledge the more interaction points, hence the more tacit knowledge interaction is required for transfer success. However, since the knowledge is predominantly explicit, this interaction is still perceived to be moderate. Rating Medium.

Determinant	Perceived Relevance of Tacitness for Determinant	Perceived Impact of Tacitness on KT	Relative Importance of Determinant on Tacit KT Success
Prior Related Knowledge (RE1)	"I think it is an accumulation of knowledge over a time frame with a frequency of exposure to it" (Hospital N Manager).		The more AMI care tacit Prior Related Knowledge the better the patient outcome, per the experienced nurse discussion. Thus, the more ACS Pathway Package Prior Related Knowledge the better the understanding of the needed resource and approach adjustments and the better knowledge transfer success. Thus, more Prior Related Knowledge enables tacit KT, much like the explicit KT. Rating High.
Unlearning Capacity (RE2)			To move from a Physician Orders approach to an ACS Pathway approach, can involve very little unlearning if the organization is familiar and comfortable with the pathway approach (Hospital E Managers). For organizations without pathways and concerned about cookbook medicine a much greater amount of unlearning is required (Hospital F Managers). In tacit knowledge terms a comfort with pathways is predominantly a tacit activity, hence Unlearning could be greatly facilitated with the appropriate transfer of tacit knowledge. However, unlearning of ingrained habits can be considered more difficult than unlearning the use of specific explicit pathways. Rating Medium.

Determinant	Perceived Relevance of Tacitness for Determinant	Perceived Impact of Tacitness on KT	Relative Importance of Determinant on Tacit KT Success
Positive Receiver Motivation (RE3)			Motivation for the overall knowledge transfer was found to be supported by the Direct Transfer Hospitals and not supported by the Non-Successful Transfer Hospitals. Specifically, Hospitals H and K were able to assemble the teams to successfully decode the Heart Institute resource profile and process framework from the AMI Guidelines and then using these same teams, apply their own resource profile and process framework, thus, successfully transferring this tacit knowledge at the individual, group and organizational levels. Both Hospital's H and K were therefore positively motivated to make this change. Where necessary this motivation resulted in interaction with the Heart Institute, especially for Hospital K. Rating High.
Perceived Credibility of Source (RE4)	"Tacit stuff, the stuff that is not written down, the credibility does not really influence that part of it. It is something that is individual specific, in some ways institution specific and patient specific" (Hospital K Cardiologist).		The Cardiologist's view is this determinant is not relevant to tacit knowledge. However, the interview responses about the Heart Institute influence in making changes and perceived change if lower credibility do not distinguish between explicit and tacit knowledge, but clearly relate to both. Rating High.
Sender-Receiver Distance (SR1)		"It is more the 10-15% ," (Hospital K Physician).	While the quote indicates that tacit knowledge would be 'more' influenced by this determinant, the interview responses suggest 'more' of 'not much' influence is a small amount. Rating Low.

Determinant	Perceived Relevance of Tacitness for Determinant	Perceived Impact of Tacitness on KT	Relative Importance of Determinant on Tacit KT Success
Relationship Quality (SR2)			“Relationships are all about people, tacit knowledge not explicit” (Hospital K Director). Therefore, if the transfer of tacit knowledge involves the interaction between senders and receivers then the quality of these relationships are crucial to this transfer of tacit knowledge. Rating High.
Richness of Transmission Channels (TR1)	“The cardiologist is getting it face-to-face, the pharmacist is getting it on a piece of paper. That knowledge transfer is made, then it has to be disseminated to make a difference to the organization” (Hospital L Educator).		Using the same logic as Relationship Quality (SR2), the higher the richness the more oral transfer. This logic is supported by the experience of Hospital K where the rich transmission via the Cardiologist’s decision meeting was important for this transfer to occur. But, while the interview responses indicates higher richness is preferred, it also indicates the impact of this increased richness is minor in terms of KT success. Taken together this reasoning indicates: Rating Medium.
Supportive Organizational Context (EN1)			Much like Receiver Motivation the organizational impact on tacit KT is not different from overall KT success. Rating Medium.

5.4.5.2. Macro Knowledge Transfer – AMI Guidelines to Receiving Hospitals

This micro knowledge transfer applies to Hospitals H and K and potentially to all the other hospitals except Hospital L and Hospital N which had already transferred this knowledge. In the case of Hospitals L and N the preexistence of the internalization of the AMI knowledge enabled these hospitals to independently develop a similar implementation instrument to the ACS Pathway Package from the AMI Guidelines at a similar time as the Heart Institute was developing its first version of the ACS Pathway.

Their knowledge did not originate at the Heart Institute:

“We got some information through the Emergency and the ICU docs. Talked with the Emergency docs. We got some best practice guidelines, they weren't called that then, some benchmarks information. We called several of the trauma hospitals. We got some ideas of what they were using for their thrombolytic protocols and how they were dealing with things... We had reams and reams of information from all over... We were involved with the Fast Track study and a lot of things we did came from that study. It was through Toronto and it was a registry... It was bits and pieces. Some of the docs might have read a study or whatever. It was really by the seat of our pants” (Hospital L Lead).

And their process was different than that of a receiving hospital deciphering the tacit knowledge in the ACS Pathway. This process was more creative in nature:

“It was bumpy at the start, we just weren't sure how to connect all the diagnosis... The initial one certainly wasn't what we ended up with. What we started with we revised, as we went through... When (the) educator came to the hospital and got involved with the project. She had previous involvement with respiratory. She had certainly worked with care maps. She could see that a care map would work. Then once we all met as a team and started to break it down we said hey, maybe it can work.” (Hospital L Lead).

And it was a long term process rather than a one or two meeting decoding exercise:

“It was a really big team when we started out. There were probably a dozen people on it. We met monthly at the beginning, and then as we got things rolling we met twice a month... (Duration was) probably 6 months to 8 months once we decided to make it a care map. Before that we didn’t really have a huge direction. We were trying, we were stumbling. New benchmarks were out there. How to get to them took us a while. It went fairly quickly once we got going” (Hospital L Lead).

These quotations indicate the Hospital L process was parallel to that of the HI. The AMI Guideline transfer, using the structure of Figure 5.4.5-1 (AMI Guideline Knowledge Transfer), entailed:

- The Message is the same AMI Guidelines;
- The Coding Scheme is the development of the Hospital L ACS Pathway. Thus, the Hospital L ACS Pathway Package is also a demonstration of the implementation of the AMI Guidelines that could be transferred to others; and
- The Coded Message is the Implemented Hospital L ACS Pathway successfully representing the implementation of the AMI Guidelines. Hospital L demonstrated this by their medical records audits and tracking.

Thus, when the Heart Institute initiated their ACS Pathway transfer in March 2004 Hospital L had already internalized the AMI Guideline knowledge with their own ACS Pathway Package and did not require a tacit or explicit KT from the Heart Institute as they had developed their own integration of Hospital L processes and resource profile with these guidelines. Therefore, the working assumption for knowledge transfer that the receiver internalizes the AMI Guideline knowledge as a result of the transfer and then

uses the knowledge, needs to be broadened to encompass this transfer of AMI knowledge that did not come from the Heart Institute. This broader and more general transfer of knowledge, depicted in part in Figure 4.5-1 (Research Context), can be termed macro knowledge transfer.

To understand if this implementation of the AMI Guidelines at the Heart Institute and at Hospital L involved a transfer of tacit knowledge it is first necessary to track this AMI tacit knowledge and identify where it comes from. The following feedback was provided in the interviews about the source of this implicit or tacit knowledge.

Table 5.4.5.2-1: Tacit Knowledge Sources

Perspective	Tacit Knowledge Source Description
Source of tacit knowledge in reference material and experience	“They'll have their basic knowledge from their training in medical school. But things will change over time. Where are they going to get that information and which way will I lean. They get it from reading journals and articles. That is where there are some discrepancies. Some studies say more conservative is better than more aggressive, some the reverse, more predominant. So they can learn from that perspective. They can get it from an individual experience and I have a patient and this is what happened, and also experience in relationship to us. Oh they only did a test, or we did an angiogram, so we are somewhat of an influence on the community” (Heart Institute Cardiologist)
Explicit knowledge becomes tacit knowledge over time	“The idea of beta blockers being good for the heart is a general concept or idea out there now, as opposed to some study saying this dose for a certain beta blocker should be given at this point in time. That is where it comes from. You get research that says this type of beta blocker. Another study could look to a different brand of beta blocker. Slowly over the years people forget the names of all the research and studies and this knowledge becomes general, that specific knowledge becomes tacit. Aspirin is like that” (Hospital B Physician).

From this description of tacit knowledge sources one can estimate that between 20 to 30% of AMI patient care's tacit knowledge has arrived at each of the Champlain District hospital staff members through a unique combination of education, training, and experience. The 'how was transferred' here is as important as the 'what was transferred'. Much of the learning, especially the experiential learning occurred through face-to-face contact in the classroom and emergency room. This evidence of experiential learning supports the contention by Roberts (2000, 433) that certain elements of tacit knowledge can only be transferred through such a process of demonstration and facilitated face-to-face contact between the sender and receiver, a mixture of explicit and tacit knowledge transfer. These descriptions of micro and macro knowledge transfer lead to the next section.

5.4.5.3. Horizontal and Vertical KT

Micro knowledge transfer in this research is horizontal KT while macro KT is vertical knowledge transfer. Vertical KT puts knowledge to use for the first time transferring the knowledge from different levels on the value chain between dissimilar units such as between a Research and Development group and the factory floor (George, Zahra, Wheatley & Khan, 2001). In the case of AMI knowledge this vertical transfer is from both the guideline originating source plus the various educational sources. Horizontal knowledge transfer takes knowledge in use and transfers it to a similar group on the same level of the value chain (Brooks 1966; Szulanski 1996a).

For the AMI practice guidelines the Heart Institute and Hospital L each performed a vertical transfer from the various sources in existence at that

time implementing their distinct versions of the ACS Pathway. In 2004 the Heart Institute offered to share their ACS Pathway Package with other Champlain District hospitals initiating horizontal knowledge transfers. These receiving hospitals, once they became aware of this transfer opportunity could in theory have made the transfer from either the Heart Institute or Hospital L.

KT in this research was much greater than the horizontal KT if the horizontal is measured by the Hospital K and H changes to the ACS Pathway Package and the vertical is measured as the remainder of the necessary knowledge required to care for AMI patients. Even if the vertical is measured by the other elements of the AMI guidelines not explicitly stated in the Pathway Package (the tacit elements per Appendix E, Table E-1: Tacit Elements column) the vertical tacit elements still significantly outnumber the horizontal tacit elements or process and resource profile integration points.

This research attempted to measure the vertical tacit KT. The Tacit Elements column was used in the Data Collection with Hospital K where interviews pre- and post-implementation were intended to determine if any guideline-specific tacit knowledge was transferred in this timeframe (see question O2-1 of the Data Collection Instrument, Appendix C). The expectation was that the process of implementation would unearth a set of minor problems or barriers that would be evidence of tacit knowledge that was required, and the resolution of these problems or issues would depict elements of this transfer of tacit knowledge. However, the pre- and post-implementation results were rated the same for 21 of 28 guidelines, higher for four and lower for 3 guidelines. Essentially the two results were equivalent. Thus, at Hospital K the vertical transfer of tacit knowledge was earlier in this process and this rudimentary instrument did not pick up any changes in the level of guideline tacit knowledge.

The key message here is that the AMI patient care tacit knowledge is only partially being transferred from the Heart Institute to the receiving hospitals, but it is predominantly being transferred from the various primary knowledge sources, predominantly through direct patient care experience. Only the very specific portion of this overall tacit knowledge that relates to the ACS Pathway Package in terms of implementation experience and implications of resource and process differences between the Heart Institute and receiving hospital was horizontally transferred.

5.4.6. KT Framework Evaluation

In this section an evaluation of the KT Framework summarizes the results of Sections 5.4.1 to 5.4.5 and then reviews the ability of the KT Framework to explain the KT phenomenon depicted in the 14 hospitals.

A Medium-High to High level of support was found in the Successful Direct Transfer hospitals for seven of the ten KT Framework determinants, where support was not found for Knowledge Complexity (KN2) while Unlearning Capacity (RE2) and Sender-Receiver Distance (SR1) had a border-line level of support. This support for seven of the determinants shows these seven determinants are relevant in this health services knowledge transfer situation.

A second approach to determining the level of determinant support for KT success was to combine the findings of differentiated support for five of the determinants in the Successful versus Non-Successful transfer hospitals with the receiver perception of

support for five determinants as impacting KT success, resulting in the same list of seven supported determinants of KT success. Both of these results extend the work of previous health services KT research, specifically Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998), in terms of finding support for Positive Receiver Motivation (RE3), and to a lesser degree Prior Related Knowledge (RE1).

The role of explicit and tacit knowledge in the transfer was intertwined. The hypothesis that explicit knowledge would be transferred first followed by a tacit interaction was to some extent observed, but the interaction occurred at the start of the transfer process rather than at its end. Further the STEMI Symposium involved the transfer of both explicit and tacit knowledge while Hospital K required a second transfer of explicit and tacit knowledge during the latter part of the transfer process. Feedback from Hospital N also suggests that additional transfer of tacit knowledge can occur in the post transfer stage if major barriers are encountered. Similar tacit KT determinant support was found for four of the seven supported determinants, excluding Knowledge Codifiability (KN1), Richness of Transmission Channels (TR1) and Supportive Organizational Context (EN1); although there was only limited use and response to questions about the role and importance of these determinants for tacit KT, indicating this identification of support for four determinants is a preliminary finding.

One unexpected aspect of this transfer of tacit knowledge was that it does not need to flow from the horizontal source to the recipient, but could flow from vertical sources and be reintegrated by the recipient. This vertical flow was seen in terms of the AMI clinical guideline Knowledge Internalization outcome being perceived as achieved prior to the

start of this ACS Pathway transfer from the HI. The subtlety here is that there are two knowledge transfer streams occurring and potentially being internalized. The macro flow is the AMI clinical practice guidelines, related trials and resulting consensus packages. It is this macro knowledge that was considered to be already internalized at the time of this research. The micro flow relates to the specific aspects of the ACS Pathway Package that need to be changed to fit into the receiving hospital set of processes and resources. In this research 29 of these guideline standards were found to be embedded in the ACS Pathway Package and the micro flow involved their communication to the receiving hospitals. The Internalization of this micro data occurs when the receiving hospital working group or equivalent reviews the sender Pathway Package from their receiving hospital perspective and suggests changes to make it fit in their resource and process reality. This micro internalization was not captured with the Data Collection Instrument.

5.5. Discussion

These findings presented so far answer the research question in terms of the proposed Knowledge Transfer Framework. These finding, however, provide further answers. Two such discussions are presented in this section: KT Framework fit; and the study motivation of the applicability of the ACS Pathway Package as a mechanism to increase physician compliance with the AMI guidelines. This section also discusses the reliability and validity of the findings and their subsequent generalizability.

5.5.1. KT Framework Fit

Another way to evaluate the success of the KT Framework is to determine if the hospital level of Framework support matches its level of transfer success. To do this, the determinant ratings from the interview responses for each hospital were totalled. These hospital summations are labelled as High, Medium-High, Medium, Low-Medium, and Low and the results are as follows:

Table 5.5.1-1: Fit of Findings With KT Framework Determinant Ratings

Hospital	High	Medium-High	Medium	Low-Medium	Low
Successful					
H		X			
K		X			
L		X			
N			X		
Partial					
B		X			
C			X		
D			X		
E			X		
F					X
G	X				
J					X
M					X
Unsuccessful					
A		X			
I				X	

Table 5.5.1-1 indicates that Hospital G with a rating of High is the most transfer ready of any hospital in the Champlain Local Health Integrated Network; that hospitals A and B along with H, K, and L all with Medium-High ratings are likely also ready; and hospitals C, D, and E along with Hospital N all with Medium ratings may also be ready. The remaining four hospitals seem a long way from being ready to transfer this knowledge. This result occurs whether all ten determinants are used or only the eight non-knowledge Determinants (removing Knowledge Codifiability (KN1) and Knowledge Complexity (KN2)). Thus, while the KT Framework accurately indicated Hospitals H, K and L should be Successful Transfer hospitals it did not indicate why hospitals G, A and B are Partial Transfers or why Hospital A was an Unsuccessful Transfer.

Another observation is why ten of the Champlain Local Health Integrated Network hospitals did not make use of the ACS Pathway Package. For example, the context for this research included two purportedly strong external motivators, an apparent strong sender motivation and supportive set of ongoing actions by the Heart Institute, plus an apparent wide receiver hospital interest, given the number of attendees to the STEMI Symposium. Yet in the following 18 months from March 2004 only two out of 14 Champlain Local Health Integrated Network hospitals have taken any steps to adopt a version of the ACS Pathway Package.

The first reason for this apparent lack of fit of the KT Framework is that the external motivators were not as strong to insiders as they appeared to outsiders (see Section 5.5.1.1), thus fewer hospitals saw the need to change than expected. A second reason relates to the key role of Positive Receiver Motivation by a local champion (see Section

5.5.1.2), without whom organizational transfer success is apparently much more difficult. Part of the answer is also the time it takes for an organization to decide to move forward on a new initiative like adopting a pathway. For example, the two Direct Successful Transfer hospitals that did move forward didn't decide to do so until November 2004 and August 2005. This delayed start suggests that others of the remaining ten hospitals may move forward with an ACS Pathway in 2006. Part of this delay is due to the overriding importance of key hospital initiatives, most notably major construction projects such as a new Emergency Area or critical care wing; hospital accreditation; and hospital mergers.

“I think they are just too busy. Too many competing priorities. One way of looking at it is, maybe they are not convinced that a pathway is going to make a big difference. But somehow we are convinced. It has only been in recent years that the literature (less than 5 years) has provided us with the evidence that such simple methods as a pathway can make a big difference. But it may not have percolated down to the non cardiology hospitals” (Hospital K Cardiologist).

Examples of such delays were observed at hospitals D, E, F, G, H, K, L, and M. Turnover of key staff can also result in major delays (e.g., hospitals B and L). The other part may be timing; that “nidus for motivation and change” (Hospital H Physician) or confluence of resources and interest which is required to bring about an organizational change.

A main reason for not transferring the ACS Pathway Package can be that there was no perceived need to change. Prior to the completion of the transfer at Hospitals H and K, 12 of 14 hospitals considered they had internalized and implemented these AMI clinical guidelines to a sufficient extent (Table 5.3-1 – Knowledge Transfer Outcome).

5.5.1.1. Weakness of External Motivators

It was expected that the two external motivators to this research, the Macleans cross-Canada comparison (Sections 4.5.1 – Champlain District Health Council Response) and the Ontario EFFECT study (Section 4.5.2 – EFFECT Study), would result in additional transfers of the AMI Pathway through the ACS Pathway Package. However, none of the four Successful Transfers appear to have been influenced by these potential motivators and none of the five EFFECT Study sites seem to have been significantly influenced by this study. Successful Transfer Hospitals L and N implemented these changes prior to March 2004 and prior to these external motivators; Hospital K was being motivated by separate internal forces combined with internal processes already underway, and Hospital H—the only one of these 4 to have been an EFFECT Study site—considered the ACS Pathway Package one further refinement in a long change process.

The EFFECT Study appears to have had no impact on Hospitals F and J since no changes were indicated in the last two years; while minor adjustments to physician orders were identified at Hospitals D, G and H which may have had some relation to the EFFECT Study but were not measured as significant changes by this research. Further, the three physicians interviewed from the EFFECT Study sites identified possible EFFECT Study data collection problems in relation to their facility and through various means minimized its impact on their facility. The Cardiologist also identifies potentially related weaknesses in the Macleans report:

“Our worst result was related to a Medical Records coding problem that we have since had corrected” (Hospital F physician; author’s informal notes from STEMI Symposium, 2004).

“The Macleans study also has its limitations, in terms of it is not clear how and why all the data was gathered. If we are making the assumption that the Macleans data is accurate and the EFFECT study clearly shows Hospital G is a laggard with respect to implementation I don’t have a good answer for you, but I would be suspect the information from the EFFECT study because it seems contradictory that you can be leaders in some categories and laggards in others, when you are talking about the same problem. It doesn’t make sense. I don’t buy it” (Hospital G Cardiologist).

“There are a lot of problems with these types of studies. 1) That study was done in a timeframe and then compared to guidelines several years later. Added to that, evidence has changed dramatically over a relatively short time. For most organizations it takes time to develop these changes so that is one problem. The other problem is the data can always be suspect. I suspect a lot of the data was not that well collected, particularly from our organization. When I look at some of the comparative analysis it just didn’t make sense, not even that it was not quite right. Ours didn’t fit at all. Mortality rates were off the map. I don’t know how they could have got the numbers. We just couldn’t make sense” (Hospital H Physician).

The previously mentioned concerns about the veracity of these findings is crucial in light of how health professionals process these inputs in considering making changes to their behaviour:

“I can take a piece of paper that is given to me with this direct knowledge and not knowing anything about it and say fine Ok I’ll do that, whatever you say. I don’t think people in this profession at this level of this education and intelligence and practice, practice like that. It is the inquisitive mind. You get to this level and you want the evidence for and the evidence against and you want to be able to make up your own mind. You want to discuss it backwards and forwards because that way you are getting better communication and knowledge transfer” (Hospital L Educator).

So the potential external motivators didn’t motivate. When the evidence for change was thoroughly examined there was enough perceived methodological weakness in each study

(Macleans had old data not necessarily reflective of current practice and a questionable inpatient mortality measure; EFFECT has an apparent weak methodology and inconsistent results) that they resulted in minimal impact.

5.5.1.2. Key Role of Internal Motivation

The need for motivation is well expressed by the Hospital H Physician:

“I think the biggest change to change human behaviour is to incorporate it into your organization, how to integrate that knowledge so you actually change care...What you need is to be able to work them (Guidelines) in your organization so they actually work for you, and actually improve efficiencies in care, and don't overly (impact) the investigator or overly create complexity of care or unleash responsibilities to people who shouldn't have them”

So it was no surprise that Positive Receiver Motivation was the number one differentiator between Successful Transfer and Non-Successful transfer hospitals. This rating result was corroborated by those who indicated motivation was the leading reason for transfer success:

- “I think if the motivation was there then the resources would be there” (Hospital A Lead);
- “Motivation has to be the main reason things happen” (Hospital H Physician);
- “You have to have a driver...As soon as you have a champion who is going to take it, it is going to go” and the succinct “Motivation comes first. Then we beg for the resources” (Hospital I Director); and
- “Motivation is huge...that is the big one” (Hospital K Manager).

Motivation was best operationalized in the form of a champion such as the renal transplantation champion where the loss of such a champion was seen as having a Medium-High impact on transfer success.

“This is a huge pathway that starts at pre-admit goes to the floor to the Operating Room to Preadmission Ambulatory Care Unit and back to the floor. That individual walked the pathway from campus to campus from individual to individual getting signatures and changes. She would call and pester people for meetings, you are going to be there, the meeting is going ahead. She did that for my working committee here and for the working committee out of the clinics. She drove us all. She took every piece back to the physicians who had to sign off on it, and to the pharmacists. She made sure that steering committee meetings happened that oversaw this and that we were all there at the table. Then when we had no educator, no money, she came and taught it herself. She brought money too for lunches. Motivation is huge” (Hospital K Manager).

There is however a possible refinement on the importance of motivation in the form of this champion. The identified champion at the Successful Transfer hospitals was either the Manager; the Educator; or at one site it was considered to be equally the Educator and the Physician. At the Heart Institute it was considered to be equally the Vice President Administration and the HI Manager. In no case was it a physician without extensive organizational support. In contrast, the identified champion at the Non-Successful Transfer hospitals was either a physician (hospitals B, D, F, G), Director (Hospital C) clinical lead (hospitals A, M), or considered to be a group of individuals (hospitals E, I, J).

However, this non-physician champion requires the support of a physician sponsor, “If you don’t have a physician who is in a power-making position to buy into it, you are in

trouble” (Hospital G Cardiologist). This sponsor role is significantly one of influencing the physicians but also can be an overall leadership role:

“I think the cardiologist, his role is up front in terms of being a champion of this is where we should be going...The ball carrying in terms of actual implementation is at the level of nursing and allied health professionals. They are getting paid a salary and sit down and mould the guidelines or the new information to the context they are in. The cardiologist or whatever has to be the front person to say we have to do this. They are not the detail person” (Hospital G Cardiologist).

“I was hopeless unless I had people to do the groundwork. There is a lots of paperwork and protocols that have to be worked and reworked, and discussion with different groups.” (Hospital H Physician).

“I would probably say 80-20 nursing to physician. It was more the nursing who actually helped design it...Because if you leave it to physicians I don't have time for this. Whereas if you can get someone who can get a scaffold and all we have to do is say yes to this and no to that and reword this, physicians are going to be much more available to do that” (Heart Institute Cardiologist).

This champion motivation may also entail an organizational support aspect in part in terms of a long-term ongoing change capacity:

“You have to help people through it, show how their organizations can bring it in play, to interpret these and then use them. That evolves over a much longer period of time and requires a more hands-on guidance and a big part of it is structure in the organization, i.e., you can't just bring in 3 or 4 doctors who do most of the MI management and say, here are the latest studies and here are our protocols and good luck. It took us for instance, hundreds of hours of work, from multiple individuals” (Hospital H Physician).

5.5.2. Knowledge Transformation - Pathways as a Vehicle For Increasing Physician Compliance

Two recent studies of the impact of a clinical pathway on the care of AMI patients have found improved physician compliance with the clinical guidelines (Wolff, Taylor & McCabe, 2004; Bestul, McCollum, Stringer & Burchenal, 2004). The findings of this research also suggest that the implementation and use of the ACS Pathway Package can increase physician compliance with the AMI guidelines:

“(To what degree would a pathway be a formal reminder to increase guideline compliance?) Quite a bit. Our old statistics for ASA, beta blockers and things like that, were down about 30 % whereas we are up to 80 % now. If you took away contraindications we were getting close to 100%” (Hospital B physician).

“I would expect to see a large compliance shift based on these guidelines.... I think the uptake on the internists standpoint was obviously much better after those guidelines” (Hospital G Cardiologist).

“I think physician compliance would increase big time. (How much?) 20-30 percent.” (Hospital J Physician).

The role of the ACS Pathway in increasing AMI Guideline use compliance is as a reminder to physicians:

“It is really as a reminder. That is what we learned. When we just keep educating them over and over again. They've heard it a 100 times....What is required is a system process that somehow takes some of it out of the hands of the physician or at least prompts a physician a little bit more. That is really all this protocol does....So how can we help them follow the guidelines? Going and telling them about the guidelines again wouldn't be sufficient. So we thought maybe we can help them out with prompts to the guidelines, which is essentially what the ACS protocol is. It is just a prompt to the guidelines” (Heart Institute Cardiologist).

Sometimes just being a reminder is not sufficient, there also needs to be organizational supports to make sure the reminding occurs:

“We have seen a decrease in the number of care maps that are used in the medical side and we are not sure why. It is in the last eight months. We are wondering if it is because we have moved to this new area. We don’t have an overload area any more. The team leader in overload area was very good in getting the patient on the care maps” (Hospital L Educator).

5.5.3. Pathway, Protocol or Orders

The Champlain District hospitals implementation of the ACS Pathway Package occurs in a number of different artefact structures. The Heart Institute used a separate ACS Pathway and physician orders and a number of hospitals have adopted this same artefact organization (hospitals B, C, E, J, K, M, N), while other hospitals used physician orders alone (hospital D, F), protocols alone (hospital A, I), or an integrated pathway (hospital G, H, and L) where the integrated pathway referenced the orders and the discharge elements. The choice involves to what degree are the physician orders integrated with or separated from the ACS Pathway. When the orders are split from the pathway then the process for completing the knowledge transfer can also be separated, where the process to implement the orders tends to involve only the approval of the medical staff. Alternately, the process to implement the pathway involves the approval of the medical staff and the associated hospital multidisciplinary teams, a much more involved and complex change process; “I think they are easier to get through when you separate them” (Hospital I Director). That is, it is much easier for a hospital to implement physician orders (or physician orders and ACS Discharge Tool) than the combined orders and pathway:

“Physicians are experts in the treatment requirements, dieticians are experts in the nutritional needs, physiotherapy are experts in mobility, and nursing are experts in the education component. I think the reason it takes so long to get through with the multidisciplinary teams is we all have our piece. The docs are just bang, one piece one group. Neat and tidy and its done, because it applies to all of them and it actually decreases their workload” (Hospital N Manager).

The importance of the choice of artefact structure on this research is twofold. First the Knowledge Transfer outcome measurement presented in Section 5.3 is based on a pathway, orders and the discharge tool transfer. Implementing only the orders will usually result in a Partial Transfer status, whereas implementing the orders and all of the pathway or the orders and the ACS Discharge Tool would result in Successful Transfer ratings. Secondly, what is the added value of the ACS Pathway to the patient care outcome because one must assume it is substantial or the significant level of effort involved would not be borne by an organization. A review of the feedback from the Champlain hospitals indicates there are clear advantages of the ACS Pathway beyond the value of the physician orders. For example,

“There are lots of ways of trying to implement a new practice guideline. One is to sit around have discussions until everyone gets on board and does it. Sometimes you use preprinted orders. Sometimes you change policies and procedures and implement it through some practical tool. And pathways are one of those practical tools. They focus not only on the implementation of evidence into practice, but they also focus on the coordination aspect of care systems and processes. So the implementation of evidence in guidelines into practice is one part of what you are trying to accomplish with a pathway” (Hospital K Coordinator).

For this research the transfer outcomes have been measured according to compliance with the Heart Institute ACS Pathway Package embedded clinical practice guidelines, somewhat sidestepping this concern.

5.5.4. Reliability and Validity

Reliability and validity are important issues in a research study because they support the objectivity of the research (Kirk & Miller, 1986). Reliability, “the degree to which the finding is independent of accidental circumstances of the research” (Kirk & Miller, 1986, 20) refers to the consistency of measurement and the degree to which another researcher would derive the same results with the same instruments (Fraenkel & Wallen, 2003). or would expect to obtain these same findings if the research were repeated (Perakyla, 1997). Here reliability is closely related to assuring the quality of the field notes and providing public access to the process of their production (Silverman, 1993), in this case the accuracy and completeness of the interview transcripts and the level of bias introduced by the researcher asking the questions of the data-gathering instrument, particularly the unscripted follow-up elucidating questions. The objectivity of the interview tapes and transcripts involves efforts to assure the accuracy and inclusiveness of recordings as well as efforts to test the truthfulness about the analytic claims that are made in the recordings specifically the technical quality of the recordings and the adequacy of the transcripts (Perakyla, 1997).

This research addresses the potential of the tapes missing a comment (e.g., due to a noise in the room) or technical malfunction of a tape (e.g., running out of time or battery) by the interviewer minuting the substance of each conversation as they occurred and the research assistant recording in short form the key points for each answer on draft minutes that were then compared with the completed minutes after each face-to-face interview.

The concern about study bias due to the investigator serving as an instrument in the collection and analysis of the data (Schwartz & Schwartz, 1955, 343) was mitigated in the case of this research due to the close adherence to the Data Collection Instrument developed from previous KT study instruments, and providing sufficient structure and time constraints to at least limit this bias. Further, the use of ad hoc open-ended questions to gather additional context and explanation for the interviewee responses occurred predominantly using generic terms (e.g., why, how, could you explain that further) so the key informant would not be biased in answering the questions.

This concept of reliability goes further. To quote and then paraphrase Feldman (1995, 2), “By the time you have completed fieldwork, you have so much data that, if you were looking to support a particular theory, you probably could....The goal...(is to interpret how the parts) fit together, or relate to one another, that is intrinsic to the setting one has studied and, at the same time, sheds light on how similar processes may be occurring in other settings”. Reliability strongly relates to the coding structure used to tease out this interpretation which is therefore iterative. Additionally, these interviews were supplemented with comparative analysis of the explicit knowledge to determine the outcomes for each hospital transfer (see Section 5.3: Knowledge Transfer Outcome). These multiple data collection techniques (interviews and comparative analysis), termed triangulation (Miles & Huberman, 1984) were used to improve the data validity (Hamel, Dufour & Fortin, 1993).

The next stage of reliability is the rating of the coded interview data as one approach to determining the level of support for each of the KT determinants. The rating reliability

occurred in two ways. First, the researcher used a number of techniques to minimize rater bias, specifically: coding the text once (with the minor exception of revisions due to the final Hospital K Manager interview and the corrections required by the interviewee approval feedback); determining the rating scale prior to the initiation of the rating process (Table G-1, Appendix G); and enabling subsequent reviewers to replicate the rating process, presented via highlighted interview text. The second form of rating reliability was to have a second team of two raters independently use the rating scale and rate the interview data and then review their rating differences and agree on a set of common ratings for each hospital question. This two-rater view provided a more reasonable rating than two individual ratings since each rater made some rating errors in terms of either misreading the question or missing the concept of an inverse relationship for Knowledge Complexity (KN2) and Sender-Receiver Distance (SR1). However, to ensure transparency all five ratings are shown in the examples in Appendix G, the three individual ratings, the paired rating and a three-way agreed rating. The inter-rater reliability between the paired rating and the researcher rating was 74% while the reliability between the paired rating and the three-way rating was 95% (See Appendix G for further description of this rating process and these results).

Validity refers to the appropriateness, meaningfulness, and usefulness of the inferences the researcher makes based on the data collected (Fraenkel & Wallen, 2003), that is, the “degree to which the finding is interpreted in a correct way” (Kirk & Miller, 1986, 20). It comes in three forms: construct; internal; and external validity. Construct validity is “establishing correct operational measures for the concepts being studied” (Yin, 2003, 34). This research derives its construct validity through the use of operational measures /

instrument questions from previous KT studies as referenced in Appendix C. Thus, these questions are considered appropriate since they are based on similar questions from KT empirical studies; they are considered comprehensive since they span the whole KT Framework and the various perspectives of each determinant; and they are considered to logically represent each variable or determinant due to the pre-test of this instrument with Heart Institute staff and the three Phase 1 hospitals (Fraenkel & Wallen, 2003).

External validity is the ability to demonstrate generalizability of the research findings, that is, the research can be repeated with the same results. The research findings are expected to be somewhat generalizable through the KT framework and its grounding in previous KT theory and research, that is, through analytical generalization (Yin, 2003). The 'representativeness' of the three outcome categories also provides a basis for this external validity (Yin, 2003). The detailed description of the generalizability of these findings to health services is presented in Section 5.5.3: Generalization of the Findings.

Internal validity refers to the research conclusions and the degree to which they can be demonstrated by the research (Cooper & Emory, 1995), or more generally, that observed differences on the dependent variable are due to the independent variables and not something else (Fraenkel & Wallen, 2003). Possible internal validity concerns with this research approach are selection bias, instrumentation bias and maturation bias.

- Selection bias, for example in the identification of the sender and receiver organizations, does not exist since there is only a single sender and they are representative of health services knowledge sending organizations (i.e., tertiary

teaching hospital units) (Yin, 2003). There was a possible self-selection bias in the receiver hospitals to be included in the research, but this potential bias was eliminated when all 14 Champlain District hospitals were interviewed and most had the same opportunity including attendance at the March 2004 STEMI symposium and many had similar resources and similar conflicting priorities.

- Instrumentation bias, from results changing between observations in measuring instrument or observer, is limited by using the same Data Collection Instrument and the same interviewers. There is possible instrument bias in that the first three hospital interviews (Hospitals K, F and D) used a longer and less precise Data Collection Instrument than the subsequent key informants, but the grouping of these into the Successful and Partial KT outcome categories muted any such bias due to their inclusion with other hospital transfers. Similarly, in certain interviews the respondent was less focused and answers may have been less clear, and again the aggregation of interviews into these categories has mitigated this bias. The third area of such potential bias is the separation of the Hospital K Manager/Educator interview into two parts. This separation occurred due to the delay in the implementation of the ACS Pathway so instead of the interview occurring on subsequent days as occurred for Hospital H the separation was 10 months. This potential bias was offset by overlapping a significant number of questions on the second part of the interview with those of the first part and finding a minimum level of variance in these repeated answers. Overall this bias was minimized by the same Data Collection Instrument being used with the same questions being asked in the same order, and the same research assistant being used throughout. The potential bias of the research assistant

available for seven of 14 hospitals was mitigated by these seven being more at the start of the interview cycle when the interview pattern is being set.

- Maturation is where changes occur over time in the research population. Maturation is possible in this research in terms of the data collection occurring over a 21-month period (March 2004 to December 2005) where a system shock could impact part of the research population. While the printing delays and organizational restructuring were minor system shocks that extended the transfer duration to November 2004 and December 2005 for the sender and Hospital K respectively, the research interviews were able to be completed in a similar sender and receiver hospital environment to when they were initiated.

5.5.5. Generalization of the Findings

Empirical generalization relates to the applicability of the findings and conclusions of a qualitative study beyond the particular study (Lewis & Ritchie, 2003, 264). That is, to what degree are KT receivers in similar situations to the one encountered in this research? This generalization has two elements, representational generalization and inferential generalization (Lewis & Ritchie, 2003, 264).

Representational generalization addresses the question of whether the research sample can be generalized to its parent population. If one thinks of the parent population as the Champlain LHIN then since all the hospitals were included in this case it is by definition represented. Alternately, if one thinks of the parent population as North American

hospital networks with a tertiary cardiac program this is a broader discussion starting with a review of the case studied. It involved:

- A single source, the Heart Institute, a high volumes cardiac tertiary center and area cardiac research leader;
- 14 hospitals who refer their AMI patients to the Heart Institute;
- AMI practice guidelines which are well defined, substantively codified, and strongly supported by clinical trials;
- The explicit knowledge of the ACS Pathway Package;
- The horizontal transfer of tacit knowledge of the integration of local resource profile and processes with the AMI guideline knowledge; and
- The vertical tacit knowledge of AMI care and teaching experience.

There are many North American and European networks of referring hospitals with a teaching tertiary lead site who share best practice knowledge; and there are likely a number which share aspects of these same AMI guidelines, since these AMI guidelines are considered to be standard for North America. The studies by Wolff, Taylor & McCabe (2004) and Bestul, McCollum, Stringer & Burchenal (2004) indicate that it is not unique in AMI care to use a clinical pathway as a vehicle to transfer clinical guidelines, hence that aspect may also be generalizable. Further it is logical to assume that the identified elements of horizontal and vertical transfer of tacit knowledge are also common in these hospitals. This logic suggests that at a macro level the research findings may be generalizable to other cardiac hospital networks promulgating AMI guidelines via

clinical pathways in North America and Europe, or at least Canada and Europe given the potentially differentiating for-profit nature of U.S. health care.

At a more granular level in terms of the degree to which the specific dynamics of the KT Framework between the Heart Institute and these Champlain District hospitals is generalizable to other cardiac health networks is a more difficult area to make such generalization. Given the particular personalities involved, their history and the associated organizational histories, the different organizational priorities, etc. it is unlikely that any other Canadian situation will exactly mirror the Heart Institute to specific Champlain hospital situation. Thus, it is expected that different transfer situations will result in different elements of the KT Framework being strongly, moderately or weakly enabling. What is expected to be generalizable to the other cardiac networks is the KT Framework system; that some configuration of these ten determinants and tacit and explicit flows will be representative of Canadian hospital to hospital transfers of clinical practice guidelines via pathways.

Inferential generalization considers whether the findings can be inferred to other settings or contexts beyond the research sample. If the parent population is considered to be the Champlain LHIN hospitals then by the above discussion the findings are inferentially generalizable to North American tertiary hospital networks with cardiac programs. To generalize beyond cardiac programs to all medical programs with a core Centre of Excellence may also be logical given some variation in the level of codifiability, credibility and complexity of the clinical practice guidelines. However, generalizability to health services situations not involving guidelines or further to non-health services

situations involving a transfer between members of a regulated profession, is more of a stretch.

A third aspect of generalization is theoretical generalization. This is theory-building, the generation of new theoretical concepts which may have broad application (Lewis & Ritchie, 2003, 264). In a sense this study is based on an aspect of theoretical generalization where the business KT literature has been generalized to the health services community. The bridge from the large amount of KT research in the business sector to only four health services quantitative studies is, the comparable vocabulary, comparable theory and comparable research which indicate the KT in general and the KT Framework in particular is applicable in the business and health services environments. Thus, since this study is based on the comparable KT theory and research in the business and health services environments, the KT Framework is therefore similarly generalizable from the health services case to the business environment. This study is also generalizable on the basis of the KT Framework and underpinning theory (Maxwell, 2005) which was derived in parallel from both the business and health services environments to propose a set of universal determinants (see Appendix B). The similarity of constraints and dynamics to other situations and the universality of the KT phenomenon provide credibility of this generalizability from this qualitative study.

6. CONCLUSION

Knowledge transfer is a complex phenomenon and this complexity is reflected in the multiplicity of perspectives of the definition of KT:

- As Knowledge Sharing plus Knowledge Internalization or Knowledge Sharing plus Knowledge Internalization plus Knowledge Use where the Knowledge Use view encompasses the adoption portion of Diffusion of Innovations theory and its attendant complexities;
- Involving knowledge being put to use for the first time (vertical knowledge transfer) or knowledge already in use (horizontal knowledge transfer); and
- As a transfer between individuals, groups or organizations and for organizations inter-organizationally or intra-organizationally.

This complexity is also reflected in the varied nature of:

- Underlying theories informing KT (Communications, Diffusion of Innovations, Organizational Learning, and Technology Transfer);
- The different constructs embedded within the concept of KT (explicit knowledge, tacit knowledge); and
- Its broad empirical history with its various
 - Dependent variables or outcomes (productivity improvements, satisfaction, defined goals, knowledge levels, performance levels and transfer times);

- Potential success determinants or independent variables (over 50 logically overlapping determinants, on average five unique determinants per study);
- Subjects (manufacturing products, technology innovations, practice guidelines, administrative practices, technical information, and process know-how); and
- Finding a subset of these determinants significant in that study setting (25 empirical knowledge transfer studies identified 22 unique determinants).

Complexity has been addressed in knowledge transfer theory and research by studying the determinants of KT success in groupings or frameworks, most thoroughly by Szulanski (1996b), Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998), Ko, Kirsch & King (2005), Shearer (2002) and Cummings & Teng (2003). This research took a similar approach by investigating the research question, What are the determinants of horizontal knowledge transfer success in health services? How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge? and How do these determinants of horizontal knowledge transfer success differ between cases of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed? The approach was to synthesize these and other KT research and develop a ten determinant KT Framework composed of:

Table 6-1: KT Framework Determinants

Determinant Category	Determinants
Knowledge	Knowledge Codifiability (KN1), Knowledge Complexity (KN2)
Receiver	Prior Related Knowledge (RE1), Unlearning Capacity (RE2), Positive Receiver Motivation (RE3), and Perceived Source Credibility (RE4)

Determinant Category	Determinants
Sender-Receiver Relationship	Sender-Receiver Distance (SR1), Relationship Quality (SR2)
Transmission	Richness of Transmission Channels (TR1)
Context	Supportive Organizational Context (EN1)

but also incorporating into the Framework separate explicit and tacit knowledge flows.

This research focused on a small portion of this diverse KT domain applying a Knowledge Use and horizontal transfer definition, using the very tightly defined knowledge element of Acute Myocardial Infarction clinical practice guidelines as formulated in an ACS Pathway Package and transferred from the Ottawa Heart Institute (Heart Institute) to 14 Champlain District hospitals between March 2004 and November 2005.

An analysis of receiving hospital ACS Pathway documentation, in place as of December 2005, according to what percentage of the potential 29 AMI guideline standards were incorporated into that documentation, resulted in four hospitals being identified as Successful Transfers, two as Unsuccessful Transfers and eight as Partial Transfers.

The case study research methodology used an interview survey research design involving 33 key informants from the 14 hospitals and the Heart Institute, where the hospitals are anonymously referenced as Hospitals A to Hospital N. Thus, this studies' focus within the overall KT domain is shown in the Communications theory-based figure below.

Figure 6-1: AMI Guideline Knowledge Transfer

In answer to the research question, What are the determinants of horizontal knowledge transfer success in health services? the determinants substantially present in the Successful Transfer hospitals were identified and then contrasted with the determinants substantially present in the Non-Successful Transfer hospitals. This contrasted result was then integrated with the interviewee perspective on the impact of each determinants on KT success because the Comparative Determinant Differences on their own do not sufficiently define transfer success since they ignore strong determinants found in both the Successful and the Non-Successful Transfers, such as Perceived Credibility of Source. Each of these approaches indicated that 7 of 10 determinants appear to have support (excluding Knowledge Complexity and just excluding Unlearning Capacity and Sender-Receiver Distance). These findings are shown in the table below from left to right, where the Determinant Support in Successful Transfers shows the level of Successful Transfer hospital support and the Differentiators and High Impact Determinants show the combined comparative and perceived impact results.

Table 6-2: Determination of Significant Determinants

Determinant	Determinant Support in Successful Transfers	Comparative Determinant Differences	Determinants With A High Perceived Impact on KT Success	Differentiators and High Impact Determinants
Knowledge Codifiability (KN1)	Strong Support		Partial	Partial
Knowledge Complexity (KN2)				
Prior Related Knowledge (RE1)	Support	Partial	Yes	Yes
Unlearning Capacity (RE2)				
Positive Receiver Motivation (RE3)	Support	Yes	Yes	Yes
Perceived Credibility of Source (RE4)	Support		Yes	Yes
Sender-Receiver Distance (SR1)				
Relationship Quality (SR2)	Support	Yes		Yes
Richness of Transmission Channels (TR1)	Support	Yes		Yes
Supportive Organizational Context (EN1)	Support	Partial	Partial	Yes

The potential determinants Knowledge Complexity (KN2), Unlearning Capacity (RE2), and Sender-Receiver Distance (SR1) were found not to be supported.

The effect of job roles on this result was negligible. Physicians and nursing unit staff results were almost identical. Administrative Directors' results in aggregate were quite similar, however, the determinants specific results were quite different, with different determinants being supported. But the Administrative Director number of Data Collection Instrument responses was quite limited so it is unclear whether this difference was due to actual job role variances or sample size biases.

The effect of organizational differences such as politics, language and culture was not expressly studied in this research, but to the degree it was captured through the Supportive Organizational Context determinant there was a measurable but not significant difference. Successful Transfer hospitals had more organizational support and fewer organizational barriers, assigned a higher priority to this change, and were more innovative. These organizational differences do not seem to be a function of organizational size as the top four hospital ratings went to mid-sized town hospitals, only one of whom was a Successful Transfer hospital. The detailed interviews with Hospital K shed some light on this result, as extensive formal and informal organizational 'knowledge transfer' acceptance processes had to be negotiated to implement the ACS Pathway Package; steps that were much less onerous in the smaller sites.

To answer the subordinate research question, How do these determinants of horizontal knowledge transfer success differ between explicit knowledge and tacit knowledge? this transfer was first described in detail. Transfer of tacit knowledge from the Heart Institute to the receiving hospitals was depicted in terms of:

- Sender perspective: The integration points of the Heart Institute resource profile and organizational processes with the AMI Guidelines expressed within the ACS Pathway are not clearly understood. The integration points are examples of tacit knowledge.
- Receiver perspective: The decoding of the ACS Pathway Package to identify which of the Heart Institute required resources and organizational processes did not apply to the receiving organization and what replacements are required as documented in the ACS Pathway steps.
- Transfer of tacit knowledge between the Heart Institute and the receiving hospital involved the Heart Institute coding of the ACS Pathway Package, subsequent transfer of the explicit Package, and then the receiving hospital decoding this Package, at times with some explanation by the Heart Institute on their rationale for certain aspects of the coded Package.

The determinants important for the transfer of tacit knowledge success are hypothesized to be a subset of those required for overall KT success, specifically: Prior Related Knowledge (RE1); Positive Receiver Motivation (RE3); Perceived Credibility of Source (RE4); and Relationship Quality (SR2). This finding, however, is preliminary due to the partial level of interview feedback in this area.

The second research question element, How do these determinants of horizontal knowledge transfer success differ between transfers of successful Knowledge Internalization and successful Knowledge Use in the health services reviewed? was not able to be evaluated since the AMI knowledge was considered by 12 of the 14 hospitals to have already been substantively Internalized and in Use. This perception of transfer

success prior to the Heart Institute knowledge transfer suggests that tacit AMI Guideline knowledge does not need to flow from the horizontal source to the recipient, it could flow from the vertical source to be reintegrated by the recipient, as has apparently occurred with these 12 hospitals. Hence, there are two knowledge transfer streams occurring and potentially being internalized. The major flow of the AMI clinical practice guidelines, related trials and resulting consensus packages involved their vertical communication from the AMI guidelines sources to the receiving hospitals resulting in this knowledge being already internalized when the Heart Institute Pathway was ready. The horizontal flow involved the specific aspects of the Heart Institute ACS Pathway Package that need to be changed to fit into the receiving hospital set of processes and resources. The Internalization of this horizontal flow occurs when the receiving hospital working group or equivalent reviews the sender Pathway Package from their receiving hospital perspective and suggests changes to make it fit into their reality.

Taken together, these answers evaluate the KT Framework indicating: support for seven of the ten determinants; and support for separate and integrated tacit-explicit knowledge flows.

The KT Framework, however, did not exactly fit with the research interview results. When the determinant ratings were summarized over the ten determinants for each hospital, the result showed that Hospital G rated High and that three of the Successful Transfer hospitals (H, K, and L) and hospitals A and B rated Medium-High. These consolidated ratings indicate that all of these hospitals should have been ready to receive and implement the Heart Institute or equivalent ACS Pathway Package. Hospitals C, D, E

and N were all rated as Medium or on the borderline in terms of this transfer readiness. Further analysis suggests the reasons for this apparent lack of fit of the KT Framework.

- There was no perceived need to change. Prior to the go-live of hospitals H and K, 12 of 14 hospitals considered they had internalized and implemented these AMI clinical guidelines to a sufficient extent. This lack of perceived need to change suggests that the Positive Receiver Motivation (RE3) or Supportive Organizational Context (EN1) determinants need to be broadened or augmented to better capture this perception.
- The external motivators were not as strong to insiders as they appeared to outsiders. The two external motivators to this research—the Macleans cross-Canada AMI inpatient mortality comparison and the Ontario EFFECT key AMI guideline use study, which indicated substantive mortality and key guideline use deficiencies respectfully for the Champlain hospitals—were criticized by the interviewed physicians for data collection, current relevancy and analysis problems. This negative physician response to these potential external motivators suggests that external motivation may have received too much support in the KT Framework Data Collection Instrument.
- A potential key aspect of Positive Receiver Motivation (RE3) was that for the Successful Transfer hospitals including the Heart Institute the local champion was a non-physician supported strongly by a physician sponsor, while in the non-Successful Transfer hospitals the local champion was either a physician (hospitals B, D, F, G), Director (Hospital C) clinical lead (hospitals A, M), or group of individuals (hospitals E, I, J). Thus, motivated non-physician leadership supported by physician

champion sponsorship may be a key to transfer success. This motivation refinement needs to be captured in the Positive Receiver Motivation determinant.

- There were delays at some hospitals possibly due to the overriding importance of key hospital initiatives such as major construction projects, hospital accreditation, and completing hospital mergers; the turnover of key staff; and the lack of the necessary confluence of resources and interest. Thus, the Supportive Organization Context (EN1) determinant needs some adjustment to capture these major intervening priorities.

Each of these four areas of lack of fit of the KT Framework are essentially measurement problems in the Positive Receiver Motivation (RE3) and Supportive Organizational Context (EN1) determinants, that is, a minor adjustment to the KT Framework.

An important motivation for this research was to investigate the potential for knowledge transfer of AMI clinical practice guidelines via the ACS Pathway to help increase physician compliance with use of these guidelines. These pathways “have been proposed as a way of encouraging the translation of national guidelines into local protocols and their subsequent application to clinical practice” (Campbell, Hotchkiss, Bradshaw & Porteous, 1998, 133). Two recent studies for AMI patients have demonstrated significant compliance increases due to the use of clinical pathways (Wolff, Taylor & McCabe, 2004; and Bestul, McCollum, Stringer & Burchenal, 2004). This compliance increase was supported by input from this study’s physician interviews. The mechanism for this increased compliance was as a physician reminder reinforced with organizational supports.

These findings are considered generalizable to the parent population of North American hospital networks with a tertiary cardiac program; inferentially to the other settings of all medical programs with a core Centre of Excellence; and theoretically to both business and health services environments.

6.1. Research Significance

This research investigates an area that has to date received only minor research attention: a qualitative study on health services horizontal knowledge transfer with special consideration of the transfer of tacit knowledge. A majority of KT research has been quantitative surveys in the business sector with four health services quantitative studies (Grilli & Lomas 1994; Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink, 1998; Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002; and Edmondson, Winslow, Bohmer & Pisano, 2003). None of these KT empirical studies reviewed fully addressed the concepts of tacit and explicit knowledge transfer and only one of these studies (Szulanski, 1996b) formally investigated horizontal KT.

This research is the first to span the health services and business sectors and the first to observe the very close proximity of the health services and business determinant definitions and parallel theoretical development. It is the first known study to reference more than one of the five empirical studies that have investigated the KT determinants in groupings or frameworks (Szulanski 1996b; Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink, 1998; Ko, Kirsch & King, 2005; Shearer, 2002; and Cummings & Teng, 2003). Previously, none of the health service KT literature referenced the business KT literature

and vice versa, and the only cross referencing of these five seminal studies was two of the business studies referencing Szulanski.

Some specific significant contributions of this research include:

- Mapping and synthesizing the determinants for successful KT from the health services and business environments into a single comprehensive Knowledge Transfer Framework underpinned with a solid theoretical basis and vocabulary that is applicable to the business and health services environments;
- Developing a new definition of knowledge to provide a better understanding of the concepts of knowledge management and knowledge transfer;
- Integrating the intellectual base of knowledge transfer through the combination of health services and business knowledge transfer literatures and re-establishing the knowledge transfer linkages to its founding theory and research of Communications, Diffusion of Innovations, Technology Transfer, and Organizational Learning; and
- Demonstrating the complexity of the knowledge transfer phenomenon and proposing addressing it separately in its various partitions, such as horizontal or vertical and knowledge internalization or knowledge use.

Some specific significant research findings of this research include:

- Demonstrating a health services/business-based KT Framework in health services related explicit-tacit knowledge flows;
- Describing of the transfer of tacit knowledge, broadly for the initial Internalization of the knowledge and in detail for the Use of this knowledge;
- Identifying as a potential key to KT success the motivated non-physician champion supported by physician sponsorship; and
- Depicting how the implementation of pathways supported with organizational informal processes can be used as organizational reminders to increase physician guideline use compliance.

6.2. Value of KT Framework to Managers

Hospital administrative managers currently face numerous resource and time pressures in their battle to continue to provide high quality patient care that the health services driving forces are expected to exacerbate. So, if managers can implement practice guidelines with less effort, in less time, and with fewer incomplete results while maintaining or improving the quality of care, it can help relieve or at least stay abreast of those pressures. The KT Framework can be conceptualized as a set of determinant levers that a manager can pull to better enable successful KT. Thus, the KT Framework could be used as a hospital readiness assessment to determine the overall level of transfer readiness. Further, at the more granular determinant-by-determinant level the Framework could be

used to identify hospital specific areas of transfer strength and weakness. This assessment is expected, however, to be a difficult and involved activity to complete effectively:

“(What do you see as the potential value of these ten determinants as levers?) It could be valuable. You would have to have a very insightful knowledge of each institution and what their resources, strengths and weaknesses are but that wouldn’t come easily. That is quite a knowledge base right there. To understand our institution for instance, the different strengths, weaknesses, structural organization, political relationship, personal relationships come in to play. A lot of things come into play and it takes time to learn in terms of implementation. It can be done but that is quite a knowledge base that would have to be developed for each institution” (Hospital H Physician).

The value to clinical managers also derives indirectly from the increased use of knowledge transfer in healthcare resulting in increased guideline use and thereby increased standardization of care and the associated expected improved patient outcomes. Similarly increased pathway use entails increased guideline compliance by physicians. There is also a value to manager’s understanding of what tacit knowledge is being transferred so they can take steps, where appropriate, to make some of this tacit knowledge more explicit, thereby potentially improving their KT success.

6.3. Research Limitations

The research limitations include:

- This knowledge transfer is for a single set of practice guidelines for a highly codified area of patient care from a single high-volume, tertiary source involving a moderate degree of organizational change. The restricting elements are the single source and its type (tertiary), the single set of guidelines and its type (highly standardized) and the

moderate degree of required organizational change. There is not the associated restriction of a single outcome since there were three outcomes with multiple hospitals providing comparable input to each outcome.

- The Data Collection Instrument developed for this research from previous quantitative KT studies could be more focused on health services in places (see Section 6.3.1). Further, a more effective mechanism is required to investigate tacit KT and all of these aspects needs to occur using a much more time-efficient instrument.
- The analysis of the interviews used the Site Ordered Descriptive Data and Next Step Summarizing Tables suggested by Miles & Huberman (1984), with its attendant rating system. A more robust and validated rating system used in concert with the related coding system to create the Site Ordered Descriptive Data would increase generalizability of these results.
- The research environment needs to be better understood and managed so all relevant communications between the source and receiver are monitored. The research design did not sufficiently take into account the possibility of the researcher acting as a communications conduit (see Section 6.3.2). In addition, the definition of the knowledge being transferred needs to be better understood from both the sender and receiver perspective, in this case, to what degree is the transfer of a pathway, protocol and/or physician orders (see Section 5.5.2).

Having a qualitative research design and analysis is not seen as a limitation for this study. On the contrary, the impact of this researcher's perspective on the research design has had a number of positive contributions: 1) providing access to all the Champlain LHIN

hospitals, a census approach; and 2) enabling extended interview sessions of up to two-hours for non-physicians and one hour for physicians; plus extended and ongoing access to key Heart Institute staff. This resulted in richer data gathering than otherwise might have been possible. The impact of this researcher perspective on the data analysis was in the extended structuring of the NVIVO coding, particularly passes two and three, and in the decision to compare hospitals using a detailed rating process and next-step tables; while the consulting experience was likely significantly responsible for noticing the cues and phenomenon of the tacit knowledge transfer. Together this resulted in the recognition and description of the in-depth process used to transfer tacit knowledge, a significant research result.

6.3.1. Instrumentation Accuracy

The Data Collection Instrument drew heavily on the quantitative business KT literature for questions to determine the existence of the various determinants. However, the answers to many of these questions were not sufficiently precise to accurately compare them with the answers of other hospitals. Examples of areas where improvement is possible includes:

- The measure of Sender-Receiver Distance (SR1), Knowledge Complexity (KN2), Unlearning Capacity (RE2), Knowledge Internalization and Knowledge Use could be better focused on the highly professional, highly innovative and tightly managed reality of the health services environment;

- The Organizational Support (EN1) determinant needs to be broadened to encompass major causes of delay such as construction, accreditation and loss of a key individual;
- The definition of the knowledge being transferred needs to be better understood from both the sender and receiver perspective. This potential confusion relates to the definition of a pathway in terms of protocols and physician orders (see Section 5.5.3); and
- Certain reinforcing questions proved very valuable is focusing the reviewer such as Heart Institute Understanding and Impact of Champion Removal on Transfer Success. If similar reinforcing aspects were added to other questions the results may improve.

6.3.2. Researcher As Communications Conduit

While the researcher intention was to act as a witness (Finlay, 2006b, 21) and minimize the impact of the research process on the participants and their evidence (Snape & Spencer, 2003), one unexpected by-product of interviewing these hospital representatives has been to act as a communications vehicle for the explicit transfer of the ACS Pathway Package. This action occurred on three occasions this researcher is aware of.

- July 5, 2004, Hospital F: The Heart Institute staff indicated the ACS Pathway Package had been sent to Hospital F but the Hospital F Managers were not aware of it. The researcher put the Heart Institute and Hospital F in contact. Known impact: The Heart Institute emailed ACS Pathway Package to Managers. No further known impact.

- Sept. 6, 2005, Hospital H: The Heart Institute staff indicated the ACS Pathway Package had been sent to Hospital H but the Educator was not aware of it. The Hospital H Lead indicated having received a similar package the week before from the Triage Co-ordinator. The researcher put the Hospital H Educator and the Heart Institute Manager in contact. Known impact, the Hospital H Educator saw ACS Discharge Tool for first time, liked it and implemented it during the following month.
- Sept. 29, 2005, Hospital G: The Heart Institute staff indicated no ACS Package was sent to Hospital G because Hospital G did not express an interest at the STEMI Symposium. The researcher put the two in contact. Known impact, none as of January 2006.

A fourth related example was alluded to by the Hospital K Manager at the December 2005 interview indicating that knowing the researcher was waiting for the pathway implementation to complete the research was an impetus to speed up this implementation date.

6.4. Future Research

The main avenues of future research derived from this case study are a mix of quantitative and qualitative applications of the KT Framework. First, testing the KT Framework with other Canadian guideline-pathway transfer studies as they become available, for example the leg ulcer horizontal transfer to other Ontario Community Care Access Centers using the Harrison/Graham outcome measures (Harrison, Graham, Lorimer, Friedberg, Pierscianowski & Brandys, 2005). This testing will include detailed

physician compliance measurement if possible and is envisaged to also include an exploratory component to both develop the necessary context-specific details for the Data Collection Instrument but to also continue to develop an increased understanding of the KT phenomenon in each context, blending together quantitative and qualitative representation of the data to improve the overall outcome (Jones & Diamadatou, 2002). This research is intended to more closely integrate with the work on knowledge transformation.

Second, applying the KT Framework in health services but outside of clinical practice guidelines, such as major changes to the Canadian accreditation standards by the Canadian Council on Health Services Accreditation.

Third, developing a parallel KT Framework for vertical KT, working in a well defined health services area such as leg ulcer care or accreditation guidelines.

REFERENCES

- Adler, P.S. 1990. Shared Learning. *Management Science*, 36, 938-957.
- Alavi, M. & Leidner, D.E. Knowledge Management Systems: Emerging Views and Practices from the Field. INSEAD Working Paper Series. (1997).
- Alavi, M. & Leidner, D.E. 2001. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly*, 25, 107-136.
- Alexander, P.A. & Murphy, P.K. 1999. Nurturing the Seeds of Transfer: A Domain-Specific Perspective. *Educational Research*, 31, 561-576.
- Allee, V. 1997. Principles of Knowledge Management. *Training & Development*, 51-71.
- Allen, T.J. (1977). *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information Within the R&D Organization*. Cambridge, MA: MIT Press.
- Anonymous. 2003. Centres of Excellence. *Macleans*.
- Antman, E.M., Anbe, D.T., Armstrong, P.W., Bates, E.R., Green, L.A., Hand, M., Hochman, J.S., Krumholz, H.M., Kushner, F.G., Lamas, G.A., Mullany, C.J., Ornato, J.P., Pearle, D.L., Sloan, M.A. & Smith, S.C. 2004. ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction: Executive Summary: A Report of the ACC/AHA Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines on the Management of Patients With Acute Myocardial Infarction). *Journal of the American College of Cardiology*, 44, 671-719.
- Antman, E.M., Anbe, D.T., Armstrong, P.W., Bates, E.R., Green, L.A., Hand, M., Hochman, J.S., Krumholz, H.M., Kushner, F.G., Lamas, G.A., Mullany, C.J., Ornato, J.P., Pearle, D.L., Sloan, M.A. & Smith, S.C. ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology / American Heart Association Task Force on Practice Guidelines (Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction) Developed in Collaboration With the Canadian Cardiovascular Society. American College of Cardiology and the American Heart Association. (2004).
- Antman, E.M., Beasley, J.W., Califf, R.M., Cheitlin, M.D., Hochman, J.S., Jones, R.D., Kereiakes, D., Kupersmith, J., Levin, T.N., Pepine, C.J., Schaefer, J.W., Smith, E.E., Steward, D.E. & Theroux, P. ACC/AHA 2002 Guideline Update for the Management of Patients with Unstable Angina and Non-ST-Segment Elevation Myocardial Infarction: A Report of the American College of Cardiology / American Heart Association Task Force on Practice Guidelines (Committee on the Management of Patients With Unstable Angina). American College of Cardiology and the American Heart Association. (2002).
- Appleyard, M.M. 1996. How Does Knowledge Flow? Interfirm Patterns in the Semiconductor Industry. *Strategic Management Journal*, 17, 137-154.
- Argote, L. (1999). *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Norwell, MA: Kluwer Academic Publishers.

- Argote, L. & Ingram, P. 2000. Knowledge Transfer: A Basis for Competitive Advantage of Firms. *Organizational Behavior and Human Decision Processes*, 82, 150-169.
- Argote, L. & Ingram, P. 2000. Knowledge Transfer in Organizations: Learning from the Experience of Others. *Organizational Behaviour and Human Decision Processes*, 82, 1-8.
- Argote, L., McEvily, B. & Reagans, R. 2003. Managing Knowledge in Organizations: An Integrative Framework and Review of Emerging Themes. *Management Science*, 49, 571-582.
- Argyris, C. & Schon, D.A. (1978). *Organizational Learning: A Theory of Action Perspective*. Reading, Mass. Addison-Wesley.
- Arrow, K. 1969. Classification Notes on the Production and Transmission of Technical Knowledge. *American Economic Review: Papers and Proceedings*, 52, 29-35.
- Arrow, K. (1971). *Classificatory Notes on the Production and Transmission of Technical Knowledge*. Amsterdam: North Holland.
- Attewell, P. 1992. Technology diffusion and Organizational Learning: The Case of Business Computing. *Organization Science*, 3, 1-19.
- Baranson, J. (1976). *International Transfer of Industrial Technology by U.S. Firms and Their Implications for the U.S. Economy*. Washington, D.C. United States Department of Labor.
- Baskerville, R. & Pries-Heje, J. 1999. Knowledge Capability and Maturity in Software Management. *Data Base*, 30, 28-43.
- Baughn, C.C., Denekamp, J.G., Stevens, J.H. & Osborn, R.N. 1997. Protecting Intellectual Capital in International Alliances. *Journal of World Business*, 32, 103-117.
- Becerra-Fernandez, I. & Sabherwal, R. 2001. Organizational Knowledge Management: A Contingency Perspective. *Journal of Management Information Systems*, 18, 23-55.
- Beckman, T.J. (1999). The Current State of Knowledge Management. In J. Liebowitz (Ed.), *Knowledge Management Handbook*. (pp. 1-1-1-22). Boca Raton: CRC Press.
- Bender, S. & Fish, A. 2000. The Transfer of Knowledge and the Retention of Expertise: The Continuing Need for Global Assignments. *Journal of Knowledge Management*, 4, 125.
- Benner, P. (1984). *From Novice to Expert: Excellence and Power in Clinical Nursing Practice*. Menlo Park, CA: Addison-Wesley.
- Berger, P. & Luckmann, T. (1967). *The Social Construction of Reality*. Garden City, NY: Doubleday.
- Berry, J.W. & Irvine, S.H. (1986). Bricolage: Savages Do It Daily. In R.J. Sternberg & R.K. Wagner (Eds.), *Practical Intelligence: Nature and Origins of Competence in the Everyday World*. (pp. 271-306). Cambridge: Cambridge University Press.
- Bestul, M.B., McCollum, M., Stringer, K.A. & Burchenal, J. 2004. Impact of a Critical Pathway on Acute Myocardial Infarction Quality Indicators. *Pharmacology*.

- Bettenhausen, K. & Murnighan, J.K. 1995. The Emergence of Norms in Competitive Decision-Making Groups. *Administrative Sciences Quarterly*, 30, 350-372.
- Bhatt, G.D. 2001. Knowledge Management in Organizations: Examining the Interaction Between Technologies, Techniques, and People. *Journal of Knowledge Management*, 5, 68-75.
- Bijker, W.E. (1995). *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnological Change*. Cambridge, MA: MIT Press.
- Blancett, S.S. & Flarey, D.L. (1998). *Health Care Outcomes: Collaborative Path-Based Approaches*. Gaithersburg, MD: Aspen Publishers.
- Boiral, O. 2002. Tacit Knowledge and Environmental Management. *Long Range Planning*, 35, 291-317.
- Bouthillier, F. & Shearer, K. 2002. Understanding Knowledge Management and Information Management: The Need for an Empirical Perspective. *Information Research*, 8.
- Bower, G.H. & Hilgard, E.R. (1981). *Theories of Learning*. Englewood Cliffs, NJ: Prentice-Hall.
- Brandt, D. 1979. On Linking Social Performance with Social Competence: Some Relations Between Communication Style and Attributions of Interpersonal Attractiveness and Effectiveness. *Human Communication Research*, 5, 223-237.
- Bresman, H., Birkinshaw, J. & Nobel, R. 1999. Knowledge Transfer in International Acquisitions. *Journal of International Business Studies*, 30, 439-462.
- Bromley, D.B. (1986). *The Case-Study Method in Psychology and Related Disciplines*. Chichester: John Wiley & Sons.
- Brooks, H. (1964). National Science Policy and Technology Transfer. In *Proceedings of a Conference on Technology Transfer and Innovation*. Washington, D.C. National Science Foundation.
- Brown, J.S. & Duguid, P. 1998. Organizing Knowledge. *California Management Review*, 40, 90-111.
- Brown, L. (1981). *Innovation Diffusion*. London: Methuen.
- Cabana, M.D., Rand, C.S., Powe, N.R., Wu, A.W., Wilson, M.H., Abboud, P.C. & Rubin, H.R. 1999. Why Don't Physicians Follow Clinical Practice Guidelines? A Framework for Improvement. *Journal of the American Medical Association*, 282, 1458-1465.
- Campbell, H., Hotchkiss, R., Bradshaw, N. & Porteous, M. 1998. Integrated Care Pathways. *British Medical Journal*, 10, 133-137.
- Camprione, J.C., Shapiro, A.M. & Brown, A.L. (1995). Forms of Transfer in a Community of Learners: Flexible Learning and Understanding. In A. McKeough, J. Lupart & A. Marini (Eds.), *Teaching for Transfer: Fostering Generalization in Learning*. (pp. 3368 Mahwah, NJ: Lawrence Erlbaum.

Canadian Cardiovascular Outcomes Research Team & Enhanced Feedback for Effective Cardiac Treatment Team. Quality of Cardiac Care in Ontario. Institute for Clinical Evaluative Sciences. (2004). Phase 1, Report 1.

Carper, B.A. 1978. Fundamental Patterns of Knowing in Nursing. *Advances in Nursing Science*, 1, 13-23.

Carspecken, P.F. & Apple, M. (1992). Critical Qualitative Research: theory, Methodology, and Practice. In M.D. LeCompte, W.L. Millroy & J. Preissle (Eds.), *The Handbook of Qualitative Research in Education*. (pp. 507-554). San Diego: Academic Press.

Cavusgil, S.T., Calantone, R.J. & Zhao, Y. 2003. Tacit Knowledge Transfer and Firm Innovation Capacity. *Journal of Business & Industrial Marketing*, 18, 6-21.

Champlain District Health Council. Cardiac Performance Project - Preliminary Data. 2003; Champlain District Health Council.

Cheng, A.S. & Daniels, S.E. 2003. Examining the Interaction Between Geographic Scale and Ways of Knowing in Ecosystem Management: A Case Study of Pace-Based Collaborative Planning. *Forest Science*, 49, 841-854.

Child, J. & Rodrigues, S. (1996). The Role of Social Identify in the International Transfer of Knowledge Through Joint Ventures. In S. Clegg & G. Palmer (Eds.), *The Politics of Management Knowledge*. (pp. 46-68). London: Sage.

Choo, C.W. 2000. Working With Knowledge: How Information Professionals Help Organizations Manage What They Know. *Library Management*, 21.

Coakes, E. & Bradburn, A. 2005. What is the Value of Intellectual Capital? *Knowledge Management Research & Practice*, 3, 60-68.

Coakes, E., Bradburn, A. & Sugden, G. 2004. Managing and Leveraging Knowledge for Organizational Advantage. *Knowledge Management Research & Practice*, 2, 118-128.

Coffey, A. & Atkinson, P. (1996). *Making Sense of Qualitative Data*. Thousand Oaks, CA: Sage.

Cohen, D. 1998. Toward a Knowledge Context: Report on the First Annual U.C. Berkeley Forum on Knowledge and the Firm. *California Management Review*, 40, 22-39.

Cohen, W.M. & Levinthal, D.A. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35, 128-152.

Coleman, D. (1999). Groupware: Collaboration and Knowledge Sharing. In J. Liebowitz (Ed.), *Knowledge Management Handbook*. Boca Raton: CRC Press.

Converse, J. & Presser, S. (1986). *Survey Questions: Handcrafting the Standardized Questionnaire*. Thousand Oaks, CA: Sage Publications.

Cool, K.O., Dierickx, I. & Szulanski, G. 1997. Diffusion of Innovations within Organizations: Electronic Switching in the Bell system, 1971-1982. *Organization Science*, 8, 543-559.

Cooper, C.M. 1988. Organizing Knowledge Synthesis: A Taxonomy of Literature Reviews. *Knowledge in Society*, 1, 104-126.

- Cooper, D.R. & Emory, C.W. (1995). *Business Research Methods*. Chicago: Irwin.
- Crone, M. & Roper, S. 2001. Local Learning from Multinational Plants: Knowledge Transfers in the Supply Chain. *Regional Studies*, 35, 535-548.
- Cummings, J.L. (, 2001). Knowledge Transfer Across R&D Units: An Empirical Investigation of the Factors Affecting Successful Knowledge Transfer Across Intra- and Inter-Organizational Units. The George Washington University;
- Cummings, J.L. & Teng, B. 2003. Transferring R&D Knowledge: The Key Factors Affecting Knowledge Transfer Success. *Journal of Engineering and Technology Management*, 20, 39-68.
- Cyert, R.M. (1995). Management of Knowledge. *Global View; Newsletter of the Carnegie Bosch Institute for Applied Studies in Management*.
- Cyert, R.M. & March, J.G. (1963). *A Behaviour Theory of the Firm*. Englewood Cliffs, NJ: Prentice-Hall.
- Daft, R.L. & Lengel, R.H. 1986. Organizational Information Requirements, Media Richness and Structural Design. *Management Science*, 32, 554-571.
- Darr, E.D., Argote, L. & Epple, D. 1995. The Acquisition, Transfer, and Depreciation of Knowledge in Service Organizations: Productivity in Franchises. *Management Science*, 41, 1750-1762.
- Darr, E.D. & Kurtzberg, T. 2000. An Investigation of Partner Similarity Dimensions on Knowledge Transfer. *Organizational Behavior and Human Decision Processes*, 82, 28-44.
- Davenport, T.H. & Beers, M.C. 1995. Managing Information about Processes. *Journal of Management Information Systems*, 12, 57-80.
- Davenport, T.H., Jarvenpaa, S.L. & Beers, M.C. 1996. Improving Knowledge Work Processes. *Sloan Management Review*, 53-65.
- Davenport, T.H. & Prusak, L. (1998). *Working Knowledge: How Organizations Manage What They Know*. Boston, Massachusetts: Harvard Business School Press.
- Davidson, W.H. & McFetridge, D.G. 1985. Key Characteristics in the Choice of International Technology Transfer Mode. *Journal of International Business Studies*, 16, 5-21.
- Davies, B.L. 2002. Sources and Models for Moving Research Evidence Into Clinical Practice. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, 31, 558-562.
- Davies, H. 1977. Technology Transfer Through Commercial Transactions. *Journal of Industrial Economics*, 26, 161-175.
- Dayasindhu, N. 2002. Embeddedness, Knowledge Transfer, Industry Clusters and Global Competitiveness: A Case Study of the Indian Software Industry. *Technovation*, 22, 551-560.
- Despres, C. & Chauvel, D. 1999. Mastering Information Management: Part Six--Knowledge Management. *Financial Times*, 4-6.

- Dixon, N.M. (2000). *Common Knowledge - How Companies Thrive by Sharing What They Know*. Boston, Massachusetts: Harvard Business School Press.
- Dolan, A. & Ayland, C. 2001. Analysis on Trial. *International Journal of Market Research*, 43, 377-389.
- Eagley, A., Wood, W. & Chaiken, S. 1978. Causal Inferences about Communicators and Their Effect on Opinion Change. *Journal of Personality and Social Psychology*, 36, 424-443.
- Earl, M. 2001. Knowledge Management Strategies: Toward a Taxonomy. *Journal of Management Information Systems*, 18, 215-233.
- Eisenhardt, K.M. 1989. Building Theories from Case Study Research. *Academy of Management Journal*, 14, 532-550.
- Erasmus, C.J. (1961). *Man Takes Control: cultural Development and American Aid*. Minneapolis: University of Minnesota Press.
- Eveland, J.D. & Tornatzky, L. (1990). The Deployment of Technology. In L. Tornatzky & M. Feischer (Eds.), *The Processes of Technological Innovation*. Lexington, MA: Lexington Books.
- Feder, G., Eccles, M., Grol, R., Griffiths, C. & Grimshaw, J. 1999. Using Clinical Guidelines. *British Medical Journal*, 318, 728-730.
- Feldman, M.S. (1995). *Strategies for Interpreting Qualitative Data*. Thousand Oaks: Sage Publications.
- Fernandes, K.J. & Raja, V. 2002. A Practical Knowledge Transfer System: A Case Study. *Work Study*, 51, 140-148.
- Field, M.J. & Lohr, K.N. (1990). *Clinical Practice Guidelines: Directions for a New Program*. Washington, DC: National Academy Press.
- Finlay, L. (2006). Mapping Methodology. In L. Finlay & C. Ballinger (Eds.), *Qualitative Research for Allied Health Professionals: Challenging Choices*. Chichester, West Sussex, England: John Wiley & Sons, Ltd.
- Finlay, L. (2006). 'Going Exploring': The Nature of Qualitative Research. In L. Finlay & C. Ballinger (Eds.), *Qualitative Research for Allied Health Professionals: Challenging Choices*. Chichester, West Sussex, England: John Wiley & Sons, Ltd.
- Foos, T., Schum, G. & Rothenberg, S. 2006. Tacit Knowledge Transfer and the Knowledge Disconnect. *Journal of Knowledge Management*, 10, 6-18.
- Fox, C. 1997. A Confirmatory Factor Analysis of the Structure of Tacit Knowledge in Nursing. *Journal of Nursing Education*, 36, 459-466.
- Foy, R., MacLennan, G., Grimshaw, J., Penney, G., Campbell, M. & Grol, R. 2002. Attributes of Clinical Recommendations That Influence Change in Practice Following Audit and Feedback. *Journal of Clinical Epidemiology*, 55, 717-722.
- Fraenkel, J.R. & Wallen, N.E. (2003). *How to Design and Evaluate Research in Education*. New York: McGraw-Hill.

- Gable, G.G. 1994. Integrating case study and survey research methods: an example in information systems. *European Journal of Information Systems*, 3, 112-126.
- Gahan, C. & Hannibal, M. (1998). *Doing Qualitative Research Using QSR NUD*IST*. London: Sage Publications.
- Galbraith, C.S. 1990. Transferring Core Manufacturing Technologies in High-Technology Firms. *California Management Review*, 32, 56-70.
- Garavelli, A.C., Gorgoglione, M. & Scozzi, B. 2002. Managing Knowledge Transfer by Knowledge Technologies. *Technovation*, 22, 269-279.
- Gardner, H. (1985). *The Mind's New Science: A History of the Cognitive Revolution*. New York: Basic Books.
- Garud, R. & Nayyar, P. 1994. Transformative Capacity: Continual Structuring by Intertemporal Technology Transfer. *Strategic Management Journal*, 15, 365-385.
- George, G., Zahra, S.A., Wheatley, K.K. & Khan, R. 2001. The Effects of Alliance Portfolio Characteristics and Absorptive Capacity on Performance: A Study of Biotechnology Firms. *Journal of High Technology Management Research*, 12, 205-226.
- Glaser, B.G. & Strauss, A.L. (1967). *The Discovery of Grounded Theory: Strategies of Qualitative Research*. Chicago: Aldine.
- Glaser, E.M., Abelson, H.H. & Garrison, K.N. (1983). *Putting Knowledge to Use*. San Francisco: Jossey-Boss.
- Goffman, W. (1980). *Scientific Information Systems and the Principles of Selectivity*. New York: Praeger.
- Gorman, M.E. 2002. Types of Knowledge and Their Roles in Technology Transfer. *Journal of Technology Transfer*, 27, 219-231.
- Graham, I.D., Grimshaw, J., Eccles, M., Bero, L.A., Durieux, P., Oxman, A.D., Shea, B., Ward, J. & Wensing, M. (2005). An International Study of Health Research Funding Agencies' Support and Promotion of Knowledge Translation.
- Graham, S. 1956. Class and Conservatism in the Adoption of Innovations. *Human Relations*, 9, 91-100.
- Grant, E.B. & Gregory, M.J. 1997. Tacit Knowledge, the Life Cycle and International Manufacturing Transfer. *Technology Analysis & Strategic Management*, 9, 149-161.
- Grant, R.M. 1996. Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal*, 17, 109-122.
- Green, L.W. & Johnson, J.L. 1996. Dissemination and Utilization of Health Promotion and Disease Prevention Knowledge: Theory, Research and Experience. *Canadian Journal of Public Health*, 87, S11-S17.
- Greenhalgh, T., Robert, G., MacFarlane, F., Bate, P. & Kyriakidou, O. 2004. Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *The Milbank quarterly*, 82, 1-39.
- Grey, D. (2002). What is Knowledge? (un pub)

- Grilli, R. & Lomas, J. 1994. Evaluating the Message: the Relationship Between Compliance Rate and the Subject of a Practice Guideline. *Medical Care*, 32, 202-213.
- Grimshaw, J. Personal Communication. (2005).
- Grimshaw, J., McAuley, L.M., Bero, L.A., Grilli, R., Oxman, A.D., Ramsay, C., Vale, L. & Zwarenstein, M. 2003. Systematic Reviews of the Effectiveness of Quality Improvement Strategies and Programmes. *Qual Saf Health Care*, 12, 298-303.
- Grimshaw, J., Shirran, L., Thomas, R., Mowatt, G., Fraser, C. & Bero, L. 2001. Changing Provider Behavior: An Overview of Systematic Reviews of Interventions. *Medical Care*, 39, II-2-II-45.
- Grimshaw, J., Thomas, R.E., MacLennan, G., Fraser, C., Ramsay, C.R., Vale, L., Whitty, M., Eccles, M., Matowe, L., Shirran, L., Wensing, M., Dijkstra, R. & Donaldson, C. 2004. Effectiveness and Efficiency of Guideline Dissemination and Implementation Strategies. *Health Technology Assessment* 2004, 8, 1-87.
- Grol, R. 1997. Beliefs and Evidence in Changing Clinical Practice. *British Medical Journal*, 315, 418-421.
- Grol, R., Dalhuijsen, J., Thomas, S., Veld, C., Rutten, G. & Mokkink, H. 1998. Attributes of Clinical Guidelines That Influence Use of Guidelines in General Practice: Observational Study. *British Medical Journal*, 317, 858-861.
- Grover, V. & Davenport, T.H. 2001. General Perspectives on Knowledge Management: Fostering a Research Agenda. *Journal of Management Information Systems*, 18, 5-21.
- Gupta, A.K. & Govindarajan, V. 1991. Knowledge Flows and the Structure of Control Within Multinational Corporations. *Academy of Management Review*, 16, 768-792.
- Gupta, A.K. & Govindarajan, V. 2000. Knowledge Flows Within Multinational Corporations. *Strategic Management Journal*, 21, 473-496.
- Gupta, A.K. & Govindarajan, V. 2000. Knowledge Management Social Dimension: Lessons From Nucor Steel. *Sloan Management Review*, 71-80.
- Gurvitch, G. (1971). *The Social Framework of Knowledge*. Blackwell: Oxford.
- Habermas, J. (1984). *The Theory of Communicative Action: Reason and Rationalization of Society*. Boston: Beacon Press.
- Habermas, J. (1987). *The Theory of Communicative Action: Lifeworld and Social System*. Boston: Beacon Press.
- Hakanson, L. & Nobel, R. Technology Characteristics and Reverse Technology Transfer. Annual Meeting of the Academy of International Business. (1998).
- Hall, G. & Johnson, R. (1970). Transfer of United Aerospace Technology to Japan. In R. Vernon (Ed.), *The Technology Factor in International Trade*. New York: Columbia University Press.
- Hamel, J., Dufour, S. & Fortin, D. (1993). *Case Study Methods*. Newbury Park, CA: Sage.

- Hansen, M.T. 1999. The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge Across Organization Subunits. *Administrative Science Quarterly*, 44, 82-111.
- Hansen, M.T. 2002. Knowledge Networks: Explaining Effective Knowledge Sharing in Multiunit Companies. *Organization Science*, 13, 232-248.
- Hansen, M.T., Nohria, N. & Tierney, T. (2001). What's Your Strategy for Managing Knowledge. In *Harvard Business Review on Organizational Learning*. (pp. 106-116). Harvard Business School Press.
- Harries, U., Elliott, H. & Higgins, A. 1999. Evidence-Based Policy-Making in the NHS: Exploring the Interface Between Research and the Commissioning Process. *Journal of Public Health Medicine*, 21, 29-36.
- Harrison, M.B., Graham, I.D., Lorimer, K., Friedberg, E., Pierscianowski, T. & Brandys, T. 2005. A Pre-Post Implementation Evaluation of Leg Ulcer Care in the Community. *Canadian Medical Association Journal*, forthcoming.
- Hasegawa, H. 2000. Global Acquisition and Knowledge Transfer--A Case Study of Company D. *International Business Review*, 9, 587-598.
- Hawley, F. 1946. The Role of the Pueblo Social Organization in the Dissemination of Catholicism. *American Anthropologist*, 48, 407-415.
- Heath, C. & Luff, P. (1996). Documents and Professional Practice: "Bad" Organizational Reasons for "Good" Clinical Records. In *Proceedings of Computer Supported Cooperative Work*. (pp. 41-60). New York: Association for Computing Machinery.
- Hedberg, B. (1981). How Organizations Learn and Unlearn. In Nystrom & Starbuck (Eds.), *Handbook of Organizational Design*. Oxford: Oxford University Press.
- Holsapple, C.W. & Joshi, K.D. (1999). Knowledge Selection: Concepts, Issues, and Technologies. In J. Liebowitz (Ed.), *Knowledge Management Handbook*. (pp. 7-1-7-17). Boca Raton: CRC Press.
- Holsapple, C.W. & Joshi, K.D. 2002. Knowledge Manipulation Activities: Results of a Delphi Study. *Information & Management*, 39, 477-490.
- Holyoak, K.J. & Thagard, P. 1997. The Analytical Mind. *American Psychologist*, 52, 35-44.
- Holzner, B. & Marx, J.H. (1979). *Knowledge Applications: The Knowledge System in Society*. Boston: Allyn and Bacon Inc.
- Hornbrook, M.C., Stevens, V.J., Wingfield, D.J., Hollis, J.F., Greenlick, M.R. & Ory, M.G. 1994. Preventing Falls Among Community-Dwelling Older Persons: Results From A Randomized Trial. *The Gerontologist*, 34, 16-23.
- Howarth, L.C., Choo, C.W. & Wallace, D. Working with Knowledge: A Proposed Knowledge Management Strategy to Facilitate the Work of the Information and Services for Persons with Disabilities Cluster. (2001).
- Howells, J. 1996. Tacit Knowledge, Innovation, and Technology Transfer. *Technology Analysis and Strategic Management*, 8, 91-106.

- Hruschka, E. (1961). Stuttgart-Hohenheim, Germany, Institut für landwirtschaftliche Beratung an der Landwirtschaftlichen Hochschule. (un pub)
- Hu, P.J., Chau, P.Y., Liu Sheng, O.R. & Tam, K.Y. 1999. Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology. *Journal of Management Information Systems*, 16, 91-112.
- Huber, G.P. 1991. Organizational Learning: The Contributing Processes and the Literatures. *Organization Science*, 2, 88-115.
- Hunter, M.G. (2004). Qualitative Research in Information Systems: An Exploration of Methods. In M.E. Whitman & A.B. Woszczynski (Eds.), *The Handbook of Information Systems Research*. Hershey PA: Idea Group.
- Inkpen, A. & Dinur, I. 1998. Knowledge Management Processes and International Joint Ventures. *Organization Science*, 9, 454-468.
- Jenkins, M. (1985). Research Methodologies and MIS Research. In E. Mumford (Ed.), *Research Methods in Information Systems*. (pp. 103-117). Amsterdam: North-Holland: Elsevier Science Publishers.
- Jennex, M.E. 2005. What is Knowledge Management? *International Journal of Knowledge Management*, 1, i-v.
- Jensen, M.C. & Meckling, W.H. (1996). Specific and General Knowledge, and Organizational Structure. In P.S. Myers (Ed.), *Knowledge Management and Organizational Design*. (pp. 17-38). Boston: Butterworth-Heinemann.
- Johannessen, J., Olaisen, J. & Olsen, B. 2001. Mismanagement of Tacit Knowledge: The Importance of Tacit Knowledge, the Danger of Information Technology, and What to do About it. *International Journal of Information Management*, 21, 3-20.
- Jones, S. & Diamadatou, E. (2002). Developing Effective Knowledge With Both Qualitative and Quantitative Research. In R.F. Bellaver & J.M. Lusa (Eds.), *Knowledge Management Strategy and Technology*. Artech House.
- Joshi, K.D. & Sarker, S. (2003). A Framework To Study Knowledge Transfer During Information Systems Development (ISD) Process. In E. Coakes (Ed.), *Knowledge Management: Current Issues and Challenges*. Hershey, PA: IRM Press.
- Kalling, T. 2003. Organizational-internal Transfer of Knowledge and the Role of Motivation: A Qualitative Case Study. *Knowledge and Process Management*, 10, 115-126.
- Karlsen, J.T. & Gottschalk, P. 2004. Factors Affecting Knowledge Transfer in IT Projects. *Engineering Management Journal*, 16, 3-10.
- Kelloway, E.K. & Barling, J. 2000. Knowledge Work As Organizational Behaviour. *International Journal of Management Reviews*, 2, 287-304.
- Kirk, J. & Miller, M.I. (1986). *Reliability and Validity in Qualitative Research*. London: Sage.
- Kitson, A., Harvey, G. & McCormack, B. 1998. Enabling the Implementation of Evidence-Based Practice: A Conceptual Framework. *Quality in Health Care*, 7, 149-158.

- Kivlin, J.E. (, 1960). Characteristics of Farm Practices Associated with Rate of Adoption. Pennsylvania State University
- Ko, D. (, 2002). Determinants of Knowledge Transfer in Enterprise Resource Planning Implementation. University of Pittsburgh
- Ko, D., Kirsch, L.J. & King, W.R. 2005. Antecedents of Knowledge Transfer From Consultants to Clients in Enterprise System Implementations. *MIS Quarterly*, 29, 59-85.
- Kogut, B. & Zander, U. 1992. Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, 3, 383-397.
- Kogut, B. & Zander, U. 1993. Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation. *Journal of International Business Studies*, 24, 625-646.
- Kostova, T. 1999. Transnational Transfer of Strategic Organizational Practices: A Contextual Perspective. *The Academy of Management Review*, 24, 308-324.
- Kotabe, M., Martin, X. & Domoto, H. 2003. Gaining From Vertical Partnerships: Knowledge Transfer, Relationship Duration, and Supplier Performance Improvement in the U.S. and Japanese Automotive Industries. *Strategic Management Journal*, 24, 293-316.
- Krone, K.J., Jablin, F.M. & Putnam, L.L. (1987). Communication Theory and Organizational Communication. In K.J. Krone, L.L. Putnam, K.H. Roberts & L.M. Porter (Eds.), *Handbook of Organizational Communication: An Interdisciplinary Perspective*. (pp. 18-40). Newbury Park, CA: Sage.
- Kwan, M.M. & Cheung, P.-K. 2006. The Knowledge Transfer Process: From Field Studies to Technology Development. *Journal of Database Management*, 17, 16-32.
- Labinaz, M. (2004). Reperfusion Strategies for ST Segment Myocardial Infarction.
- Lahti, R.K. & Beyerlein, M.M. 2000. Knowledge Transfer and Management Consulting: A Look at "The Firm". *Business Horizons*, 43, 65-74.
- Lambert, L. (1995). Toward a Theory of Constructivist Leadership. In L. Lambert, D. Walker, D.P. Zimmerman, J.E. Cooper, M.D. Lambert, M.E. Gardner & P.J. Slack (Eds.), *The Constructivist Leader*. New York: Teachers' College Press.
- Leach, R.J. (2000). *Introduction to Software Engineering*. Boca Raton: CRC Press.
- Lee, A.S. 1989. A Scientific Methodology for MIS Case Studies. *MIS Quarterly*, 33-50.
- Lehaney, B., Jack, G., Clarke, S. & Coakes, E. (2004). *Beyond Knowledge Management*. Hershey, PA: Idea Group Publishing.
- Leonard, D. & Sensiper, S. 1998. The Role of Tacit Knowledge in Group Innovation. *California Management Review*, 40, 112-132.
- Leonard-Barton, D. The Secondary Adoption Decision: Implementing a New Technology Within an Organization. Harvard Business School. (1986). 9-787-006
- Leonard-Barton, D. & Deschamps, I. 1988. Managerial Influence in the Implementation of New Technology. *Management Science*, 34, 1252-1265.

- Levine, J.M. & Moreland, R.L. (1999). Knowledge Transmission in Work Groups: Helping Newcomers to Succeed. In L. Thompson, D.M. Messick & J.M. Levine (Eds.), *Shared Cognition in Organizations: The Management of Knowledge*. (pp. 267-296). Hillsdale, NJ: Lawrence Erlbaum.
- Lewis, J. & Ritchie, J. (2003). Generalizing from Qualitative Research. In J. Lewis & J. Ritchie (Eds.), *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London, U.K. Sage.
- Lindsay, P.H. & Norman, D.A. (1977). *Human Information Processing*. Orlando, FL: Academic Press.
- Lippman, S.A. & Rumelt, R.P. 1982. Uncertain Imitability: An Analysis of Interfirm Differences in Efficiency Under Competition. *Bell Journal of Economics*, 13, 418-438.
- Logan, J. & Graham, I.D. 1998. Toward a Comprehensive Interdisciplinary Model of Health Care Research Use. *Science Communication*, 20, 227-246.
- Lyles, M.A. & Salk, J.E. 1996. Knowledge Acquisition From Foreign Parents in International Joint Ventures: An Empirical Examination in the Hungarian Context. *Journal of International Business Studies*, 27, 877-903.
- Mansfield, E., Romeo, A. & Wagner, S. 1979. Foreign Trade and US Research and Development. *Review of Economics and Statistics*, 61, 49-57.
- Mansfield, E. & Romeo, A. 1984. "Reverse" transfers of Technology from Overseas Subsidiaries to American Firms. *IEEE Transactions on Engineering Management*, EM-31, 122-127.
- March, J.G. & Simon, H.A. (1958). *Organizations*. New York: Wiley.
- Markus, M.L. (1989). Case Selection in a Disconfirmatory Case Study. In J.I. Cash & P.R. Lawrence (Eds.), *The Information Systems Research Challenge: Qualitative Research Methods - Volume I*. (pp. 20-26). Boston, Massachusetts: Harvard Business School Press.
- Markus, M.L. 2001. Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success. *Journal of Management Information Systems*, 18, 57-93.
- Marquardt, M. (1996). *Building the Learning Organization*. McGraw Hill.
- Maxwell, J.A. (2005). *Qualitative Research Design: An Interactive Approach*. Thousand Oaks, CA: Sage.
- McCracken, G. (2004). *The Long Interview*. Newbury Park, CA: Sage Publications.
- McDermott, R. 1999. Why Information Technology Inspired Ban Cannot Deliver Knowledge Management. *California Management Review*, 41, 103-112.
- Merriam, S. (1988). *Case Study Research in Education: A Qualitative Approach*. San Francisco: Jossey-Bass.
- Meyer, A.D. & Goes, J.B. 1988. Organizational Assimilation of Innovations: A Multilevel Contextual Analysis. *Academy of Management Journal*, 31, 897-923.

- Meyer, J. & Rowan, B. 1977. Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, 83, 340-363.
- Miles, M.B. & Huberman, A.M. (1984). *Qualitative Data Analysis: A Sourcebook of New Methods*. Beverly Hills, CA: Sage Publications.
- Mody, A. 1989. Firm Strategies for Costly Engineering Learning. *Management Sciences*, 35, 496-512.
- Mooradian, N. 2005. Tacit Knowledge: Philosophic Roots and Role in KM. *Journal of Knowledge Management*, 9, 104-113.
- Moreland, R.L. (1999). Learning Who Knows What in Work Groups and Organizations. In L.L. Thompson, J.M. Levine & D.M. Messick (Eds.), *Shared Cognition in Organizations: The Management of Knowledge*. Mahwah, NJ: Erlbaum.
- Mosakowski, E. 1997. Strategy Making Under Causal Ambiguity: Conceptual Issues and Empirical Evidence. *Organization Science*, 8, 414-442.
- Mowery, D.C., Oxley, J.E. & Silverman, B.S. 1996. Strategic Alliances and Interfirm Knowledge Transfer. *Strategic Management Journal*, 17, 77-91.
- Neilson, R. (2002). Conceptual Linkages: an Analysis of the Organizational Learning, Collaborative Technology and Intellectual Capital Literature. In M. Khosrow-Pour (Ed.), *Collaborative Information Technology*. Hershey, PA: IRM Press.
- Nelson, K.M. & Coopridge, J.G. 1996. The Contribution of Shared Knowledge to IS Group Performance. *MIS Quarterly*, 409-429.
- Nelson, R. & Winter, S. (1982). *An Evolutionary Theory of Economic Change*. Cambridge: Belknap Press.
- Nissen, M.E. & Oxendine, E. (2002). Integrating Knowledge Process and System Design for Naval Battle Groups. In M. Khosrowpour (Ed.), *Advanced Topics in Information Resource Management*. Idea Group Publishing.
- Nonaka, I. 1991. The Knowledge-Creating Company--How Japanese Companies Create the Dynamics of Innovation. *Harvard Business Review*, 79, 96-104.
- Nonaka, I. 1994. A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5, 14-37.
- Nonaka, I., Konno, N. & Toyama, R. (2001). Emergence of 'Ba': A Conceptual Framework for the Continuous and Self-Transcending Process of Knowledge Creation. In I. Nonaka & T. Nishiguchi (Eds.), *Knowledge Emergence: Social, Technical, and Evolutionary Dimensions of Knowledge Creation*. (pp. 12-29). New York: Oxford University Press.
- Nonaka, I. & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.
- O'Connor, G.T., Quinton, H.B., Traven, N.D., Ramunno, L.D., Dodds, T.A., Marciniak, T.A. & Wennberg, J.E. 1999. Geographic Variation in the Treatment of Acute Myocardial Infarction: The Cooperative Cardiovascular Project. *Journal of the American Medical Association*, 281, 627-633.

- O'Dell, C., Grayson, C.J. & Essaides, N. (1998). *If Only We Knew What We Know: Identification and Transfer of Internal Best Practice*. New York: The Free Press.
- O'Leary, D.E. 1998. Using AI in Knowledge Management: Knowledge Bases and Ontologies. *IEEE Intelligent Systems*, 34-39.
- Ounjian, M.L. & Carne, E.B. 1987. A Study of the Factors Which Affect Technology Transfer in a Multilocation Multibusiness Unit Corporation. *IEEE Transactions on Engineering Management*, 34, 194-201.
- Papert, S. (1993). *The Children's Machine*. New York: Basic Books.
- Paulus, P.B. & Yang, H.-C. 2000. Idea Generation in Groups: A Basis for Creativity in Organizations. *Organizational Behavior and Human Decision Processes*, 82, 76-87.
- Pavitt, K. (1985). Technology Transfer Among the Industrially Advanced Countries: An Overview. In N. Rosenberg & C. Frischtak (Eds.), *International Technology Transfer Concepts, Measures, and Comparisons*. New York: Praeger.
- Pennings, J.H. & Harianto, F. 1992. Technology Networking and Innovation Implementation. *Organization Science*, 3, 356-382.
- Pennington, N., Nicolich, R. & Rahm, I. 1995. Transfer of Training Between Cognitive Subskills: Is Knowledge Use Specific? *Cognitive Psychology*, 28, 175-224.
- Perakyla, A. (1997). Reliability and Validity in Research Based on Tapes and Transcripts. In D. Silverman (Ed.), *Quantitative Research: Theory, Method and Practice*. (pp. 201-220). London: Sage.
- Perkins, D. (1992). *Smart Schools: Better Thinking and Learning for Every Child*. New York: The Free Press.
- Perloff, R.M. (1993). *The Dynamics of Persuasion*. Hillsdale, NJ: Erlbaum.
- Peteraf, M. & Shanley, M. 1997. Getting To Know You: A Theory of Strategic Group Identity. *Strategic Management Journal*, 18, 165-186.
- Pisano, G.P., Bohmer, R.M. & Edmondson, A.C. 2001. Organizational Differences in Rates of Learning: Evidence from the Adoption of Minimally Invasive Cardiac Surgery. *Management Science*, 47, 752-768.
- Polanyi, M. (1967). *The Tacit Dimension*. Garden City, New York: Anchor Books.
- Polanyi, M. (1964). *Personal Knowledge: Towards a Post-Critical Philosophy*. New York: Harper & Row.
- Polanyi, M. 1966. The Logic of Tacit Inference. *Philosophy*, 41, 1-18.
- Polanyi, M. (1969). M. Greene (Ed.), *Knowing and Being*. Chicago, IL: Chicago Press.
- Reber, A.S. 1967. Implicit Learning of Artificial Grammars. *Journal of Verbal Learning and Verbal Behavior*, 77, 317-327.
- Reed, R. & DeFillippi, R.J. 1990. Causal Ambiguity, Barriers to Imitation, and Sustainable Competitive Advantage. *Academy of Management Review*, 15, 88-102.

- Reisman, A. 1987. Some Thoughts for Model Insiders in the Management and Social Sciences. *Interfaces*, 17, 114-120.
- Roberts, J. 2000. From Know-how to Show-how? Questioning the Role of Information and Communication Technologies in Knowledge Transfer. *Technology Analysis & Strategic Management*, 12, 429-443.
- Rogers, E. (1983). *Diffusion of Innovations*. New York: Free Press.
- Rogers, E. (1962). *Diffusion of Innovations*. New York: The Free Press of Glencoe.
- Rogers, E. (1995). *Diffusion of Innovations*. New York: The Free Press.
- Rothwell, R. 1978. Some Problems of Technology Transfer Into Industry: Examples From the Textile Machinery Sector. *IEEE Transactions on Engineering Management*, EM-25, 15-20.
- Ruggles, R. 1998. The State of the Notion: Knowledge Management in Practice. *California Management Review*, 40, 80-89.
- Ryan, B. & Gross, N.C. 1943. The Diffusion of Hybrid Seed Corn In Two Iowa Communities. *Rural Sociology*, 8, 15-24.
- Ryan, T.J., Anderson, J.I., Antman, E.M., Braniff, B.A., Brooks, N.H., Califf, R.M., Hillis, L.D., Hiratzka, L.F., Rapaport, E., Riegel, B., Russell, R.O., Smith, E.E. & Weaver, W.D. 1996. ACC/AHA Guidelines of the Management of Patients With Acute Myocardial Infarction: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *Journal of American College of Cardiology*, 28, 1328-1428.
- Ryan, T.J., Antman, E.M., Brooks, N.H., Califf, R.M., Hills, L.D., Hiratzka, L.F., Rapaport, E., Riegel, B., Russell, R.O., Smith, E.E. & Weaver, W.D. 1999. 1999 Update: ACC/AHA Guidelines for the Management of Patients With Acute Myocardial Infarction: Executive Summary and Recommendations: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Management of Acute Myocardial Infarction). *Circulation*, 100, 1016-1029.
- Sabini, J. (1992). *Social Psychology*. New York: Norton.
- Sarker, S., Sarker, S., Nicholson, D.B. & Joshi, K.D. 2005. Knowledge Transfer in Virtual Systems Development Teams: An Exploratory Study of Four Key Enablers. *IEEE Transactions of Professional Communication*, 48, 201-218.
- Schultze, U. & Leidner, D.E. 2002. Studying Knowledge Management in Information Systems Research: Discourses and Theoretical Assumptions. *MIS Quarterly*, 26, 213-242.
- Schwartz, M.S. & Schwartz, C.G. 1955. Problems in Participant Observation. *American Journal of Sociology*, 60, 343-353.
- Senge, P.M. (1990). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Doubleday.

- Shannon, C.E. & Weaver, W. (1949). *The Mathematical Theory of Communication*. Chicago: University of Illinois Press.
- Shearer, D.F. (, 2002). The Value of Effective Knowledge Transfer and Assimilation in New Product Development Projects: An Exploratory Study. Benedictine University;
- Silverman, D. (1993). *Interpreting Qualitative Data Methods for Analyzing Talk, Text, and Interaction*. London: Sage.
- Silverman, D. (2000). *Doing Qualitative Research: A Practical Handbook*. London, U.K. Sage.
- Simon, H.A. 1962. The Architecture of Complexity. *Proceedings of the American Philosophical Society*, 106, 467-482.
- Simonin, B.L. 1999. Ambiguity and the Process of Knowledge Transfer in Strategic Alliances. *Strategic Management Journal*, 20, 595-623.
- Simonin, B.L. 1999. Transfer of Marketing Know-How in International Strategic Alliances: An Empirical Investigation of the Role and Antecedents of Knowledge Ambiguity. *Journal of International Business Studies*, 30, 463-490.
- Singley, M.K. & Anderson, J.R. (1989). *The Transfer of Cognitive Skill*. Cambridge, Massachusetts: Harvard University Press.
- Skyrme, D.J. (2002). Knowledge Management: Approaches and Policies. (un pub)
- Smith, S.C., Blair, S.N., Bonow, R.O., Brass, L.M., Cerqueira, M.D., Dracup, K., Fuster, V., Gotto, A., Grundy, S.M., Miller, N.H., Jacobs, A., Jones, D., Krauss, R.M., Mosca, L., Ockene, I., Pasternak, R.C., Pearson, T., Pfeffer, M.A., Starke, R.D. & Taubert, K.A. (2001). AHA/ACC Guidelines for Preventing Heart Attack and Death in Patients With Atherosclerotic Cardiovascular Disease: 2001 Update, A Statement for Healthcare Professionals From the American Heart Association and the American College of Cardiology. *Circulation*, 104, 1577-1579.
- Snape, D. & Spencer, L. (2003). The Foundations of Qualitative Research. In J. Ritchie & J. Lewis (Eds.), *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London, U.K. Sage.
- Sponder, J.-C. & Grant, R.M. 1996. Knowledge and the Firm: Overview. *Strategic Management Journal*, 17, 5-9.
- Stake, R.E. (1994). Case Studies. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage.
- Stenmark, D. 2000. Leveraging Tacit Organizational Knowledge. *Journal of Management Information Systems*, 17, 9-24.
- Sterling, D.A., O'Connor, J.A. & Bonadies, J. 2001. Geriatric Falls: Injury Severity Is High and Disproportionate To Mechanism. *Journal of Trauma-Injury Infection and Critical Care*, 50, 116-119.
- Sternberg, R. & Wagner, R. (1989). Individual Differences in Practical Knowledge and its Acquisition. In P.L. Ackerman, R.J. Sternberg & R. Glaser (Eds.), *Learning and*

- Individual Differences: Advances in Theory and Research*. (pp. 255-278). New York: W.H. Freeman.
- Subramaniam, M. & Venkatraman, N. 2001. Determinants of Transnational New Product Development Capability: Testing the Influence of Transferring and Deploying Tacit Overseas Knowledge. *Strategic Management Journal*, 22, 359-378.
- Suchman, L.A. (1987). *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.
- Sullivan, W.P. & Rupp, C.A. 1991. Improving Client Outcomes: The Kansas Technical Assistance Consultation Project. *Community Mental Health Journal*, 27, 327-336.
- Sypher, B.D. (1997). *Case Studies in Organizational Communication: Perspectives on Contemporary Work Life*. New York: The Guilford Press.
- Szulanski, G. 1996. Exploring Internal Stickiness: Impediments to the Transfer of Best Practice Within the Firm. *Strategic Management Journal*, 17, 27-43.
- Szulanski, G. 1996. Unpacking Stickiness: An Empirical Investigation of the Barriers to Transfer of Best Practice Inside the Firm. *Academy of Management Review*, 17, 437-441.
- Szulanski, G. 2000. The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness. *Organizational Behaviour and Human Decision Processes*, 82, 9-27.
- Takeishi, A. 2001. Bridging Inter- and Intra-Firm Boundaries: Management of Supplier Involvement in Automobile Product Development. *Strategic Management Journal*, 22, 403-433.
- Tatikonda, M.V. & Stock, G.N. (2002). Inward Technology Transfer: A Key Link in the Technology Supply Chain. In T. Boone & R. Ganeshan (Eds.), *New Directions in Supply-Chain Management: Technology, Strategy, and Implementation*. ANACOM.
- Taylor, G.R. (2000). *Integrating Quantitative and Qualitative Methods in Research*. Lanham, MD: University Press of America.
- Te'eni, D. 2001. Review: A Cognitive-Affective Model of Organizational Communication for Designing IT. *MIS Quarterly*, 25, 251-312.
- Teece, D.J. 1977. Technology Transfer by Multinational Firms: The Resource Costs of Transferring Technological Know-How. *Economic Journal*, 87, 242-261.
- Teece, D.J. 1998. Research Directions for Knowledge Management. *California Management Review*, 4, 289-292.
- Tetroe, J. (2005). Meeting with Jacqueline Tetroe, of KT ICE Health Services Research Group.
- Thomas, L.H., McColl, E., Cullum, N., Rousseau, N. & Soutter, J. 1999. Clinical Guidelines in Nursing, Midwifery and the Therapies: A Systematic Review. *Journal of Advanced Nursing*, 30, 40-50.
- Thompson, L. Analogical Reasoning in the Transfer of Managerial Knowledge. Carnegie Mellon University. (1998). Conference on Knowledge Transfer and Levels of Learning.

- Tinetti, M.E. & Speechley, M. 1989. Prevention of Falls Among the Elderly. *New England Journal of Medicine*, 320, 1055-1059.
- Trumbell, M. (2000). Qualitative Research Methods. In G.R. Taylor (Ed.), *Integrating Quantitative and Qualitative Methods in Research*. (pp. 79-94). Lanham, Maryland: University Press of America.
- Tsai, M. & Tsai, L. 2004. Critical Success Factors of Transferring Nursing Knowledge in Hospital's Clinical Practice. *The Journal of American Academy of Business, Cambridge*, 5, 193-197.
- Tsoukas, H. & Vladimirou, E. 2001. What is Organizational Knowledge. *Journal of Management Studies*, 38, 974-993.
- Tyebee, T. 1988. A Typology of Joint Ventures: Japanese Strategies in the United States. *California Management Review*, 31, 75-86.
- Van de Ven, A. & Delbecq, A. 1974. The Effectiveness of Nominal, Delphi, and Interacting Group Decision-Making Processes. *Academy of Management Review*, 17, 605-621.
- Vernon, R. & Davidson, W.H. (1979). *Foreign Production of Technology-Intensive Products by U.S.-Based Multinational Enterprises*. Washington: National Science Foundation.
- von Glaserfeld, E. (1995). *Radical Constructivism: A Way of Knowing and Learning*. London: Falmer Press.
- von Hippel, E. 1994. "Sticky Information" and the Locus of Problem Solving: Implications for Innovation. *Management Science*, 40, 429-439.
- Von Krogh, G., Ichijo, K. & Nonaka, I. (2000). *Enabling Knowledge Creation: How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation*. New York: Oxford University Press.
- Wagner, R. (1991). Managerial Problem Solving. In R.J. Sternberg & P.A. Frensch (Eds.), *Complex Problem Solving: Principles and Mechanisms*. (pp. 159-183). Hillsdale, NJ: Erlbaum.
- Walton, R.E. 1975. The Diffusion of New Work Structures: Explaining Why Success Didn't Take. *Organizational Dynamics*, 3-21.
- Webster, J. & Watson, R.T. 2002. Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, 26, xiii-xxiii.
- Weed, L.L. 1997. New Connections Between Medical Knowledge and Patient Care. *British Medical Journal*, 315, 231-235.
- Weller, S.C. & Romney, A.K. (1988). *Systematic Data Collection*. Newbury Park, CA: Sage Publications.
- Wheatley, M. 2000. ERP Training Stinks. *CIO*, 86-96.
- Wiig, K.M. (1999). Introducing Knowledge Management into the Enterprise. In J. Liebowitz (Ed.), *Knowledge Management Handbook*. (pp. 3-1-3-41). Boca Raton: CRC Press.

- Wilkenning, E.A. Adoption of Improved Farm Practices as Related to Family Factors. (1953). Research Bulletin 183,
- Williamson, O.E. (1985). *The Economic Implications of Capitalism: Firms, Markets, Relational Contracting*. London: The Free Press.
- Williamson, O.E. Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. University of Michigan. (1990).
- Winkler, J.D., Lohr, K.N. & Brook, R.H. 1985. Persuasive Communication and Medical Terminology Assessment. *Arch Internal Medicine*, 145, 314
- Winter, S., G. (1987). Knowledge and Competence as Strategic Assets. In D. Teece (Ed.), *The Competitive Challenge--Strategies for Industrial Innovation and Renewal*. Cambridge, MA: Ballinger.
- Wolff, A.M., Taylor, S.A. & McCabe, J.F. 2004. Using Checklists and Reminders in Clinical Pathways to Improved Hospital Inpatient Care. *Med J Aust*, 181, 428-431.
- Woolf, S.H. 1993. Practice Guidelines: A new Reality in Medicine, III: Impact on Patient Care. *Arch of Intern Med*, 153, 2646-2655.
- Yin, R.K. 1981. The Case Study Crisis: Some Answers. *Administrative Science Quarterly*, 26, 58-65.
- Yin, R.K. (2003). *Case Study Research Design and Methods*. Sage Publications.
- Zahra, S.A. & George, G. 2000. Absorptive Capacity: A Review and Reconceptualization. *Academy of Management Proceedings*, K1-K6.
- Zahra, S.A. & George, G. 2002. Absorptive Capacity: A Review Reconceptualization, and Extension. *Academy of Management Review*, 27, 185-202.
- Zander, U. & Kogut, B. 1995. Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test. *Organization Science*, 6, 76-92.
- Zhao, L. & Reisman, A. 1992. Toward Meta Research on Technology Transfer. *IEEE Transactions on Engineering Management*, 39, 13-21.

APPENDIX A – KNOWLEDGE TRANSFER EMPIRICAL STUDIES

This appendix describes twenty-four knowledge transfer empirical studies. They are presented in chronological order to show the empirical progression. The initial few studies occurred prior to the formation of formal knowledge transfer theory, and build upon and extend the literature in a number of areas including: international studies by Teece (1977) and Mansfield & Romeo (1984); international technology transfer studies by Pavitt (1971), Mansfield, Romeo & Wagner (1979), and Vernon & Davidson (1979); and transfer speed and transfer costs (Inkpen & Crossan 1996; Doz 1996; Mowery, Oxley & Silverman 1996). The first three studies described in this section form the transition between work in these other disciplines and the development of KT theory and research. When they were developed KT did not exist, but looking back at these studies one can see the initiation of the KT concepts.

This summary of the empirical literature enables the identification of key concepts for KT: what knowledge was transferred (column 2) and whether the authors had a KT perspective that included Knowledge Use (column 2, *italics*); the performance measure or dependent variable (column 3); the knowledge transfer determinants used in the research with their direction of impact (+ or -) on the dependent variable and which determinants were empirically significant in the research, shown as bold where significant (column 4); and the KT research focus (either horizontal KT or vertical KT), knowledge sharing or knowledge access (in *italics*), and whether the transfer was inter- or intra-organizational (underlined, in column 5).

Table A-1: Summary of Knowledge Transfer Empirical Research

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Davidson & McFetridge (1985)	new manufacturing products <i>knowledge use</i>	Transfer to a wholly owned affiliate	<ul style="list-style-type: none"> • age of the technology since US introduction (-) • prior technology transfer (-) • transferor's principal LOB (+) • transferor's R&D (+) • affiliate in receiving country (+) • prior transferor activity (+) • innovative (+) 	horizontal transfer <i>share via license or ownership</i> <u>inter and intra org.</u>
Kogut & Zander (1993)	designs of Swedish technology innovations; the capability to manufacture the product. <i>knowledge use</i>	transfer to a wholly owned affiliate (a diffusion perspective)	<ul style="list-style-type: none"> • codifiability (+) • complexity (-) • teachability (+) • knowledge age (-) • transfer frequency (-) 	horizontal transfer <i>share via license or ownership</i> <u>inter and intra org.</u>
Grilli & Lomas (1994)	practice guidelines <i>knowledge use</i>	changes in clinical practice according to guideline (a diffusion perspective)	<ul style="list-style-type: none"> • trialability (+) • complexity (-), • observability (+) 	vertical and horizontal transfer <i>share</i> <u>inter-org.</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Zander & Kogut (1995)	designs of Swedish technology innovations <i>knowledge use</i>	time to transfer (a diffusion perspective)	<ul style="list-style-type: none"> • codifiability (+) • teachability (+) • complexity (-) • system dependence (-) • product observability (+) 	horizontal transfer <i>share via license or ownership</i> <u>inter and intra org.</u>
Szulanski (1996a, 1996b, 2000)	technical practices involving more than one individual and administrative practices <i>knowledge use</i>	stickiness (difficulties encountered in the transfer)	<ul style="list-style-type: none"> • causal ambiguity (-) • unprovenness (-) • source motivation (+) • source reliability (+) • recipient motivation (+) • absorptive capacity (+) • receiver retentive capacity (+) • supportive organizational context (+) • sender-receiver relationship (+) 	horizontal transfer <i>access</i> <u>intra-firm</u>
Appleyard (1996)	technical information <i>internalize</i>	public and private knowledge sharing	<ul style="list-style-type: none"> • longer industry tenure (+) • high level education (+) • higher inter-firm turnover (+) • members professional societies (+) • consulted outside company (+) 	horizontal and vertical transfer <i>share</i> <u>interfirm</u>
Mowery, Oxley & Silverman (1996)	citations and patents <i>internalize - understanding</i>	changes in alliance partners' technological capabilities	<ul style="list-style-type: none"> • equity relationship (+) • absorptive capacity (+) • firm nationality (Japanese +) 	horizontal transfer <i>access and sharing</i> <u>inter-org. (alliances)</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Lyles & Salk (1996)	Marketing, product development, managerial, and manufacturing processes <i>internalize</i>	International Joint Venture performance (business, human resources, and general)	<ul style="list-style-type: none"> • learning capacity (+) • documented goals (+) • parental administrative support (+) • parental technology support (+) • training (+) • cultural differences (-) • parental conflict (-) 	horizontal transfer <i>sharing</i> <u>interfirm</u>
Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998)	practice guidelines <i>knowledge use</i>	changes in clinical practice according to guideline	<ul style="list-style-type: none"> • codifiability (precisely described) (+) • trialability (+) • complexity (-) • observability (+) • sender-receiver distance (compatible) (-) • fits patient expectations (+) • prior related knowledge (requires new knowledge or skills) (+) • unlearning capacity (requires changed routines) (+) • perceived knowledge value (addresses common issue, key feature, has a high profile) (+) • perceived source reliability (based upon sound evidence) (+) • requires organizational change (+) 	Vertical and horizontal transfer <i>share</i> <u>inter- org</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Simonin (1999)	technology or process know-how marketing know-how <i>internalize</i>	<ul style="list-style-type: none"> • causal ambiguity • know-how knowledge transfer 	<ul style="list-style-type: none"> • tacitness(-) • specificity (-) • complexity (-) • experience (+) • partner protectiveness (+) • cultural distance (-) • organizational distance (-) 	horizontal transfer <i>access</i> <u>inter-org.</u>
Hansen (1999, 2002)	project hardware and software knowledge <i>internalize</i>	development time	<ul style="list-style-type: none"> • codified (+), • dependent (-), • sender-receiver relationship (+/-) 	horizontal transfer <i>search</i> <u>intra-org.</u>
Bresman, Birkinshaw & Nobel (1999)	technological know-how and patents <i>internalize</i>	active transfer to or from the acquired unit	<ul style="list-style-type: none"> • communication frequency (+) • frequency of visits and meetings (+) • knowledge articulability (+) 	vertical and horizontal transfer <i>sharing (a sender perspective)</i> <u>intra-org, acquisitions</u>
Darr & Kurtzberg (2000)	production processes or procedures <i>knowledge use</i>	production learning curve	<ul style="list-style-type: none"> • strategic similarity (+) • customer similarity (+) • geographic similarity (+) 	horizontal transfer <i>sharing</i> <u>inter-org.</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Gupta & Govindarajan (2000, 483)	Marketing, distribution, design, purchasing, and management systems and practices <i>internalize</i>	know-how knowledge flow	<ul style="list-style-type: none"> • knowledge value (+) • source unit motivation (+) • richness of transmission channels (+) • target unit motivation (-) • absorptive capacity (+) 	horizontal transfer <i>share and receive</i> <u>intra-org.</u>
Takeishi (2001)	elements of integrated problem solving (e.g., technical knowledge) <i>internalize</i>	higher component development performance (design quality)	<ul style="list-style-type: none"> • problem solving (+) • communication (+) • product knowledge (experience) (+) • internal coordination (+) • inter-firm relations (+) 	horizontal transfer sharing <u>inter-org. and intra-org.</u>
Crone & Roper (2001)	11 best practice techniques (e.g., computer-aided design) <i>knowledge use</i>	<ul style="list-style-type: none"> • use of best practice techniques • improved performance and competitiveness 	<ul style="list-style-type: none"> • characteristics of MNE plants (ownership nationality, industrial sector) • collaborative supplier relationships (+) • strategic autonomy (+) • knowledge type (know-how)(+) • facilitating environment (+) 	horizontal transfer <i>sharing</i> <u>inter-org.</u>
Subramaniam & Venkatraman (2001)	product introduction knowledge <i>knowledge use</i>	product development capability	<ul style="list-style-type: none"> • cross-national teams (+) • prior experience (+) • communication frequency (+) 	horizontal transfer <i>sharing</i> <u>intra-org.</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
George, Zahra, Wheatley & Khan (2001)	<i>Internalize and knowledge use</i>	<ul style="list-style-type: none"> • absorptive capacity • innovative and financial performance 	<ul style="list-style-type: none"> • absorptive capacity(+) • power sharing (+) 	horizontal transfer <i>sharing</i> <u>inter-org.</u>
Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002)	practice guidelines <i>knowledge use</i>	changes in clinical practice according to guideline	<ul style="list-style-type: none"> • codifiability (precisely described) (+) • trialability (+) • complexity (-) • observability (+) • sender-receiver distance (compatible) (-) • fits patient expectations (+) • prior related knowledge (requires new knowledge or skills) (+) • unlearning capacity (required changed routines) (+) • perceived knowledge value (addresses common issue, key feature, has a high profile) (+) • perceived source reliability (based upon sound evidence) (+) • requires organizational change (+) 	horizontal transfer <i>sharing</i> <u>inter-org.</u>
Shearer (2002)	Telecommunications equipment specifications <i>knowledge use</i>	achieve innovation goals	exploratory study, no variables pre-defined or substantively defined after observation	vertical transfer <i>sharing</i> <u>intra-org.</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Cummings & Teng (2003)	11 knowledge transfer activities <i>internalize</i>	transfer success (satisfaction with and positive attitude about transferred knowledge)	<ul style="list-style-type: none"> • knowledge embeddedness (-) • knowledge articulability (+) • physical distance (-) • knowledge distance (-) • norm distance(-) • organizational distance (-) • learning culture (+) • project priority(+) • transfer mechanisms (+) 	vertical transfer <i>sharing</i> <u>inter-org.</u>
Kotabe, Martin & Domoto (2003)	a set of related techniques, methods, and designs <i>internalize - communication and capability</i>	supplier performance (product development efficiency, process improvements, quality conformity, short lead time)	<ul style="list-style-type: none"> • link duration(+) • knowledge tacitness (-) 	vertical transfer <i>sharing</i> <u>inter-org.</u>
Kalling (2003)	production methods and procedures <i>knowledge use</i>	<ul style="list-style-type: none"> • transfer effect (average machine speed, machine productivity and waste) • receiver motivation 	<ul style="list-style-type: none"> • supportive organizational context (+) (local perceptions, strategic ambitions, internal competition view) • knowledge transmission (+) • tacit knowledge (-) 	horizontal transfer <i>sharing</i> <u>intra-org.</u>

Author(s)	Knowledge Transferred, <i>KT perspective</i>	Performance Measure (Dependent Variable)	KT Determinants (Independent Variables)	Transfer Types
Edmondson, Winslow, Bohmer & Pisano (2003)	minimally invasive cardiac surgery know how <i>knowledge use</i>	<ul style="list-style-type: none"> • decreases in procedure time • increases in number of grafts performed per procedure. 	<ul style="list-style-type: none"> • group stability (+) • tacit knowledge (-), measured as codified knowledge (+) 	horizontal transfer <i>access</i> <u>inter-org.</u>
Ko (2002); Ko, Kirsch & King (2005)	ERP implementation knowledge <i>knowledge use (performance)</i> but measured learning and understanding	training (documents), configuration (tables), test (scripts) knowledge	<ul style="list-style-type: none"> • relationship quality (+) • shared understanding (+) • knowledge observability (+) • source credibility (+) • communication encoding competence (+) • communication decoding competence (+) • intrinsic motivation (+) • extrinsic motivation (+) • absorptive capacity (+) 	vertical and horizontal transfer <i>sharing</i> <u>inter-org.</u>
Sarker, Sarker, Nicholson & Joshi (2005)	IS development knowledge between Norway and U.S. students <i>knowledge internalization</i>	Learned skills	<ul style="list-style-type: none"> • source experience (+) • source credibility (+) • communication volume (+) • individualism (a component of sender-receiver distance) (-) 	vertical <i>sharing and access</i> <u>inter-org.</u>

APPENDIX B – KT DETERMINANT DEFINITION AND BASIS OF SELECTION

This appendix presents the list of potential KT determinants, with one table for each determinant category. In each table the list of proposed determinants is shown in Column 1 along with association with the dependent variable (positive or negative impact), and the various other terms or aliases used to represent each potential determinant. The determinant definition is presented in Column 2 while Column 3 identifies whether the determinant was selected according to the above inclusion criteria, and where it was not selected the reason for its exclusion. Column 4 references the empirical support (bolded) or lack of support for the construct (not bolded), from Table A-1 Summary of Knowledge Transfer Empirical Research, Appendix A. The final column identifies the theoretical basis for considering the determinant applicable to the health services environment.

Table B-1: Basis for Knowledge Transfer Framework Determinants – Knowledge Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Tacitness (negative) <knowledge type>	“Implicit and non-codifiable accumulation of skills that results from learning by doing” (Reed & DeFillippi, 1990, 89).	No Too broad a concept	Simonin (1999) Kotabe, Martin & Domoto (2003) Kalling (2003) Edmondson, Winslow, Bohmer & Pisano (2003)	Yes Personal knowledge (Polanyi, 1967)
Knowledge Codifiability (positive) <knowledge articulability, knowledge age, precisely described>	The degree to which knowledge is fully documented at the time of transfer (Hansen, 1999).	Yes (KN1)	Kogut & Zander (1993) Kogut & Zander (1995) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Hansen (1999) Bresman, Birkinshaw & Nobel (1999) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003) Edmondson, Winslow, Bohmer & Pisano (2003)	Yes Diffusion of innovations theory - communicability (Rogers, 1983) Explicit knowledge (Polanyi, 1967) Articulability (Winter, 1987) Precise description Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Teachability (positive)	“The ease by which know-how can be taught to new workers” where the more teachable this know-how the more feasible and faster the transfer (Kogut & Zander, 1993, 633).	No Weak theoretical and empirical support	Kogut & Zander (1993) Kogut & Zander (1995)	Yes Diffusion of innovations theory aspect of communicability (Rogers, 1983)
Knowledge Complexity (negative) <system dependence, embeddedness>	The extent to which the knowledge is an element of a set of interdependent components (Winter 1987), dependent on the number of individuals, interdependent technologies, organizational routines and organizational resources linked to some particular knowledge that is to be transferred (Simonin, 1999, 622).	Yes (KN2)	Kogut & Zander (1993) Grilli & Lomas (1994) Kogut & Zander (1995) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Simonin (1999) Hansen (1999) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003)	Yes Definition of complex system (Simon, 1962) Diffusion characteristic of complexity (Rogers, 1983) Definition – conditional factors (Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink, 1998)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Causal Ambiguity (negative) <task analyzability>	How successful replication of knowledge in a different setting may be compromised by an incomplete understanding of the receiver context, specifically any idiosyncrasies that would change how this new knowledge would be put to use at the receiver location (Szulanski, 1996b, 438)	No Similar to Knowledge Complexity Assimilated into Knowledge Complexity	Szulanski (1996b) (significant for each transfer stage but not in aggregate) Ko (2002) (when studying observability, but measures were much closer to causal ambiguity, complexity and codifiability)	Yes Uncertain imitability (Lippman & Rumelt, 1982) Typology of causal ambiguity (Mosakowski, 1997)
Knowledge Observability (positive)	The ability to see the effects of the knowledge once it has been applied (Meyer & Goes, 1988).	No Similar to Knowledge Codifiability Assimilated into Knowledge Codifiability	Grilli & Lomas (1994) Kogut & Zander (1995) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Ko (2002) (actually measured complexity/ causal ambiguity)	Yes Observable / not observable in use diffusion characteristic (Rogers, 1962) Lower observability of people embedded knowledge (Hakanson & Nobel, 1998)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Specificity (negative)	The “ease with which an asset can be redeployed to alternative uses and by alternate users without loss of productive value” (Williamson, 1990).	No No empirical support	Simonin (1999)	Partial Transaction Cost theory (Williamson, 1985)
Trialability (positive)	Knowledge whose application can be tried out and easily discarded without any damaging impacts on the health of patients (Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink, 1998, 860).	No Weak theoretical and empirical support	Grilli & Lomas (1994) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002)	Yes Diffusion characteristic of trialability or divisibility (Rogers, 1983)

Table B-2: Basis for Knowledge Transfer Framework Determinants – Sender Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recommended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
---	------------------------	---	-----------------	--

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recommended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Positive Sender Motivation (positive)	Being willing to devote time and resources to support the transfer of the knowledge (Szulanski, 1996a, 31)	No Insufficient theoretical and empirical support	Szulanski (1996b, 2000) Gupta & Govindarajan (2000)	Partial Technology transfer (Davies, 1977) Information monopoly (Cyert, 1995)

Table B-3: Basis for Knowledge Transfer Framework Determinants – Receiver Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Absorptive Capacity (positive)	An organization's ability to value, assimilate and apply new knowledge (Cohen & Levinthal, 1990, 128)	No Too broad a concept overlapping with other potential determinants, especially prior related knowledge	Szulanski (1996b) Mowery, Oxley & Silverman (1996) (one of three measures) Gupta & Govindarajan (2000) (but measurement difficulties) George, Zahra, Wheatley & Khan (2001) Ko, Kirsch & King (2005)	Yes Absorptive Capacity (ACAP), shared language (Cohen & Levinthal 1990) Gatekeepers (Allen, 1977) Organizational flexibility (Lyles & Salk, 1996) Broader ACAP conceptualization (Zahra & George, 2002)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Prior Related Knowledge (positive) <retentive capacity, long industry tenure, experience, product knowledge, low knowledge distance, requires new knowledge or skills, learning capacity, problem-solving>	The basic skills and possibly a shared language and knowledge of the most recent technical and scientific developments in a field (Cohen & Levinthal, 1990, 128)	Yes (RE1)	Appleyard (1996) Lyles & Salk (1996) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Simonin (1999) Takeishi (2001) Subramaniam & Venkatraman (2001) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003)	Yes Learning theory (Hall & Johnson 1970; Pavitt 1985) Memory development (Bower & Hilgard, 1981) Linguistics (Lindsey & Norman, 1977) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Organizational memory (Zahra & George, 2002)
Retentive Capacity (positive)	The ability of a knowledge recipient to institutionalize the utilization of new knowledge (Szulanski (1996b, 438).	No Weak theoretical and empirical support	Szulanski (1996b)	No
Group Stability (positive)	Stable group membership	No Still undefined and unproven	Edmondson, Winslow, Bohmer & Pisano, 2003)	No Group learning (Moreland, 1999)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Unlearning Capacity (positive) <receiver retentive capacity, requires changed routines>	The need to change existing routines and habits and leaving what is seen as common practice (Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink, 1998)	Yes (RE2)	Szulanski (1996b) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002)	Yes Planned organizational change (Glaser, Abelson & Garrison, 1983) Organizational Learning theory Negative effect of knowledge retention - Diffusion of Innovations (Rogers, 1983)
Positive Receiver Motivation (positive) <extrinsic motivation, intrinsic motivation, fits patient expectations>	Willingness to support the transfer of knowledge (Szulanski, 1996)	Yes (RE3) But an umbrella construct so care must be taken in using this concept	Szulanski (1996b) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) Gupta & Govindarajan (2000) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Ko, Kirsch & King (2005) (extrinsic motivation) Ko, Kirsch & King (2005) (intrinsic motivation)	Yes Education theory (Perkins 1992; Campione, Shapiro & Brown 1995; Holyoak & Thagard 1997) Definition – contradicting patient expectations (Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink, 1998) <i>Perceived knowledge value identified theory</i>

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Perceived Knowledge Value (positive) <less unprovenness, addresses common issue, key feature, has a high profile, project priority>	“Degree to which an innovation is perceived as better than the idea it supersedes” (Rogers, 1995, 15)	No Insufficient empirical support; Subsumed in receiver motivation	Szulanski (1996a, 1996b, 2000) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) Gupta & Govindarajan (2000) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003)	Yes Habernas (1987) Diffusion of Innovations, relative advantage (Rogers, 1962) Perceived usefulness – Technology Acceptance Model (Hu, Chau, Liu Sheng & Tam, 2001)
Perceived Credibility of Source (positive) <source credibility, based upon solid evidence>	The believability and trustworthiness of source (Walton, 1975)	Yes (RE4)	Szulanski (1996b) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink (1998) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Ko, Kirsch & King (2005)	Yes Conditions for a communicative act (Habernas, 1987) Attribution theory (Eagley, Wood & Chaiken, 1978) Communications metaphor (Arrow, 1971) Persuasion theory (Perloff, 1993) Reliability (Foy, MacLennan, Grimshaw, Penney, Campbell & Grol, 2002)

Table B-4: Basis for Knowledge Transfer Framework Determinants – Sender-Receiver Relationship Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
<p>Sender-Receiver Distance (positive) <compatible, cultural differences, cultural distance, customer similarity, organizational distance, shared understanding, strategic similarity></p>	<p>The degree of similarity between the senders' and receivers' "business practices, institutional heritage, and organizational culture" (Simonin, 1999, 603)</p>	<p>Yes (SR1)</p>	<p>Lyles & Salk (1996) Mowery, Oxley & Silverman (1996) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokka (1998) Simonin (1999) Hansen (1999) Darr & Kurtzberg (2000) (customer similarity) Darr & Kurtzberg (2000) (strategic similarity) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003) (organizational distance) Ko, Kirsch & King (2005)</p>	<p>Yes Diffusion of Innovations – homophily (Rogers, 1983) Social Psychology (Sabini, 1992) Social network theory (Hansen, 1999) Organizational Learning theory (Neilson, 2002)</p>

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Relationship Quality (positive) <collaborative relationship, communication frequency, frequency of visits and meetings, cross national teams, inter-firm relations, norm distance, parental conflict, partner protectiveness, power sharing, transfer frequency>	An emotionally non-laborious, close and good relationship between a source and a recipient (Szulanski, 1996)	Yes (SR2)	Kogut & Zander (1993) Szulanski (1996b) Lyles & Salk (1996) (parental conflict) Bresman, Birkinshaw & Nobel. (1999) Simonin (1999) (partner protectiveness) Takeishi (2001) (communication, inter-firm relations) Crone & Roper (2001) George, Zahra, Wheatley & Khan (2001) Subramaniam & Venkatraman (2001) Cummings & Teng (2003) Ko, Kirsch & King (2005)	Yes Group norming (Bettenhausen & Murnighan, 1985) Power asymmetry (Tyebjee, 1988) Communications theory (Arrow, 1971)
Link Duration (positive)	The often long time required to complete the knowledge transfer	No Vague concept, weak support, redundant	Kotabe, Martin & Domoto (2003)	Yes Teece (1977)

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Physical Distance (negative) <geographic similarity>	The “difficulty, time requirement and expense of communicating and getting together face- to-face (Cummings, 2001, 91).	No Weak concept, weak empirical support	Darr & Kurtzberg (2000) Cummings & Teng (2003)	Yes Innovation diffusion (Rothwell, 1978) Neighbourhood effect (Brown, 1981)

Table B-5: Basis for Knowledge Transfer Framework Determinants – Transmission Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recommend ed for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
<p>Richness of Transmission Channels (positive) <transfer frequency, prior transferor activity, transfer mechanisms></p>	<p>Communication contextualization, interactivity and adaptiveness of the knowledge (Te'eni, 2001, 263),</p>	<p>Yes (TR1)</p>	<p>Gupta & Govindarajan (2000) Cummings & Teng (2003) Kalling (2003)</p>	<p>Yes Media richness theory (Daft & Lengel, 1986) Information processing theory (Van de Van & Delbecq, 1974).</p>
<p>Communication Competence (positive) <prior technology transfer, transfer frequency, communication encoding competence, communication decoding competence></p>	<p>The ability to use the appropriate communication behaviour in an organizational setting (Brandt 1979)</p>	<p>No Weak concept, not yet well defined Weak empirical support (different things being measured)</p>	<p>Davidson & McFetridge (1985) Kogut & Zander (1993) Ko, Kirsch & King (2005) (communication encoding competence) Ko, Kirsch & King (2005) (communication decoding competence)</p>	<p>Yes Communication theory (Krone, Jablin & Putnam, 1987)</p>

Table B-6: Basis for Knowledge Transfer Framework Determinants – Context Category

Determinant/ (Association)/ <Alias(es)>	Determinant Definition	Recom- mended for Knowledge Transfer Framework	Empirical Basis	Universal Concept / Theoretical Basis
Supportive Organizational Context (positive) <documented goals, internal coordination, parental administrative support, partner protectiveness, cross-national teams, project priority, learning culture>	Representing aspects of the task environment, organizational structure and organizational cultural in terms of its supportiveness of learning and change, for example, sufficient organizational slack to experiment with new methods and embed new capabilities (Cummings, 2001, 56).	Yes (EN1)	Davidson & McFetridge (1985) Szulanski (1996b) Lyles & Salk (1996) (goals and admin. Support) Lyles & Salk (1996) (training and tech. Support) Grol, Dalhuijsen, Thomas, Veld, Rutten & Mookink (1998) Simonin (1999) Subramaniam & Venkatraman (2001) Foy, MacLennan, Grimshaw, Penney, Campbell & Grol (2002) Cummings & Teng (2003) (learning culture, project priority) Kalling (2003)	Yes Value and norm setting (Kostova, 1999) Incentives or fiat (Leonard-Barton & Deschamps, 1988) Support and counsel (Attewell, 1992)

APPENDIX C – DATA COLLECTION INSTRUMENT

This appendix presents the Data Collection Instrument of questions for the dependent variables and each of the independent variables or knowledge transfer determinants. Each questions is coded with the proposition keys to reference these variables.

KN1: Knowledge Codifiability	RE4: Perceived Credibility of Source
KN2: Knowledge Complexity	TR1: Richness Transmission Channels
SR1: Sender-Receiver Distance	EN1: Supportive Organizational Context
RE1: Prior-Related Knowledge	O1: Outcome – Knowledge Internalized
SR2: Relationship Quality	O2: Outcome – Knowledge Used
RE2: Unlearning Capacity	O3: Outcome – positive outcome of
RE3: Positive Receiver Motivation	knowledge use

The literature source of the questions is also provided to enhance instrument reliability. Questions applicable to physicians are identified by <P> after the question code. Questions applicable to the Hospital are identified with <H>. This questionnaire was approved by the Carleton University and University of Ottawa Heart Institute ethics committees. It was used only with valid, completed consent forms (see Appendix D). Note that question O2-1 details was only asked of Hospital K Manager and Educator.

1. Who is being interviewed?

IDENT-1: What is the interviewee's name, hospital name and hospital role at the time of the knowledge transfer (e.g., emergency patient care manager) and decades of experience? <H, P>

IDENT-2: What was the interviewee's role in the transfer of this knowledge (e.g., participant on March 4 STEMI Symposium at the Heart Institute, helped develop hospital tools, approver)? <H, P>

2. Control Variables

CON-1: How many AMI/ACS patients are treated a year in this hospital (use exact medical records terminology)? Under what service(s) <H>

CON-2: Do Cardiologists care for these patients? How many physicians care for these patients (FTEs)? <H>

CON-3: What priority did improvements to AMI/ACS patient care have in your organization in comparison with other areas of organizational change (high, medium, low) (Cummings & Teng, 2003, 62)? <H, P>

CON-4: Approximately how many clinical pathways or care maps currently exist in your organization? <H>

3. Knowledge Codifiability

KN1-1: Was all the knowledge about the AMI guidelines provided to your team in writing (procedures)? Are there some aspects of this knowledge that are not readily documentable (Hansen, 2002, 246)? About what percentage is explicit knowledge? <H, P>

KN1-2: How easy is it to comprehensively understand and communicate the needed AMI care through these written documents(Subramaniam & Venkatraman, 2001, 377)? <H>

KN1-3: For the changes you made to AMI patient care in the last year, how much training was required (Simonin, 1999, 621)? <H>

KN1-4: If this knowledge was less codified would the degree of AMI change been different? <H, P>

4. What was the sender-receiver distance

SR1-1: How similar are the processes, approach, corporate culture and management style of the sender and receiver hospitals (Simonin, 1999, 622)? <H, P>

SR1-2: When you communicated with Heart Institute staff did you have a common language (Szulanski, 1996b, 43)? <H>

SR1-3: If there was more of a culture gap would the communications with the Heart Institute have been different? <H, P>

SR1-4: What impact did any of these differences have on your understanding of the Heart Institute ACS documentation? What impact did any of these differences have on your understanding of the associated AMI guideline subtleties or tacit knowledge? Are there any differences for the documentation and for the subtleties? <H>

5. Prior-Related Knowledge

RE1-1: Could personnel from your hospital easily independently publish substantially the same scientific articles on AMI care as the staff of the Heart Institute (Cummings & Teng, 2003, 61)? <H, P>

RE1-2: Does your organization have information and expertise on the state-of-the-art of AMI care (Szulanski, 1996b, 43)(Simonin, 1999, 622)(Takeishi, 2001, 427) (Cummings & Teng, 2003, 61) (Subramaniam & Venkatraman, 2001, 377)? <H, P>

RE1-3: Did you have the necessary skills to implement the changes suggested by the Heart Institute (tools and procedures) (Szulanski, 1996b, 43), including the technical and managerial competence (Szulanski, 1996b, 43)? <H>

RE1-4: If there was more of a knowledge gap would the communications with the Heart Institute have been different? <H, P>

RE1-5: What impact did any of these differences have on your understanding of the Heart Institute ACS documentation? What impact did any of these differences have on your understanding of the associated AMI guideline tacit knowledge? Are there any differences for the documentation and for the subtleties? <H>

6. Relationship Quality

SR2-1: How close was this working relationship with the Heart Institute (Hansen, 2002, 246; Szulanski, 1996b, 43)? <H, P>

SR2-2: How often did you communicate with Heart Institute staff in the last year about AMI knowledge? <H>

SR2-3: How well did the Heart Institute staff you communicated with understand your definition of the situation, your environment and needs (Cummings & Teng, 2003)? <H>

SR2-4: If there was more of a relationship gap would the communications with the Heart Institute have been different? <H, P>

SR2-5: From your perspective has the closeness/or lack of closeness of your relationship with the Heart Institute made any difference to your understanding the ACS Pathway and the associated subtleties? Is a different level of closeness required for the two different levels of knowledge? <H>

7. Ability To Unlearn

RE2-1: To what degree did your hospital already have ACS tools and processes in place prior to the start of the transfer? How large a change was required to become more compliant with the AMI guidelines? <H>

RE2-2: How has the existence of pre-existing physician orders, pathways and processes enabled or created a barrier to changes in these tools and processes? <H, P>

RE2-3: If there was more of an unlearning gap would the degree of AMI change been different? <H, P>

RE2-4: From your perspective has the required level of unlearning made any difference to your understanding the ACS Pathway and the associated subtleties? Is a different level of unlearning required for the two different levels of knowledge? Would the degree of AMI change been different? <H, P>

8. Positive Receiver Motivation

RE3-1: Did you analyze the feasibility of making the ACS program changes? Did you plan the changes (Szulanski, 1996b, 42)? <H>

RE3-2: Have you and the hospital staff significantly invested their time, ideas, skills, and physical, psychological and intellectual energies in these changes (Cummings & Teng, 2003, 62) (Szulanski, 1996b, 42)? <H,P>

RE3-3: Are staff proud they are working on these changes? Do they really care about the implementation of these changes (Cummings & Teng, 2003, 62)? <H>

RE3-4: Was there external motivation for you to make these ACS program changes (e.g., EFFECT Study, Macleans 2003) (Ko, 2002, 91)? <H, P>

RE3-5: Who has championed any changes for ACS patients since the transfer start (i.e., other potential interviewees)? <H><P> What has been the effect of this champion? Impact if champion removed?<H, P>

RE3-6: If there was more of a motivation gap would the communications with the Heart Institute have been different? <H, P>

RE3-7: From your perspective has your level of motivation made any difference to your understanding the ACS Pathway and the associated subtleties? Is a different level of motivation required for the two different levels of knowledge? <H>

9. Perceived Credibility of Source

RE4-1: How would you rate the Heart Institute's expertise in ACS care (tools and procedures) (Szulanski, 1996b, 41)? <H, P>

RE4-2: To what degree was the credibility of the Heart Institute an influence to making these changes to the ACS tools and processes? (Grewal, Gotlieb & Marmorstein, 1994, 152) <H, P>

RE4-3: To what degree was the credibility of the ACA/AHA AMI practice guidelines an influence to making these changes to the ACS tools and processes? <H, P>

RE4-4: If there were more of a credibility gap would the communications with the Heart Institute have been different? <H, P>

RE4-5: What impact did any of these differences have on your understanding of the Heart Institute ACS documentation? What impact did any of these differences have on your understanding of the associated AMI guideline tacit knowledge? <H>

10. Supportive Organizational Context

EN1-1: To what degree has there been organizational support for the ACS changes (tools, processes, informal leaders) (Szulanski, 1996b, 43)? <H>

EN1-2: Were you able to free personnel from regular operations so they could be properly trained (Szulanski, 1996b, 41)? <H>

EN1-3: What barriers have you faced in implementing new processes for AMI patients in the last year? What further barriers do you expect to encounter? <H, P>

EN1-4: How innovative is your organization (O'Reilly, Chatman & Caldwell, 1991) (High, Medium, Low)? <H, P>

EN1-5: If there were more of an organizational gap would the degree of AMI change been different? <H, P>

EN1-6: From your perspective has the required level of environmental support made any difference to your understanding the ACS Pathway and the associated subtleties? Is a different level of organizational support required for the two different levels of knowledge? Would the degree of AMI change been different? <H,P>

11. Knowledge Complexity

KN2-1: To get high quality AMI patient outcomes, is it very important that staff have long experience with this organization and client group (Zander & Kogut, 1995, 88)? Do new staff have to work with experienced personnel as apprentices for a long time to learn to care for these patients (Cummings & Teng, 2003, 61)? <H>

KN2-2: What unforeseen changes did you have to make to the AMI patient knowledge received from the Heart Institute due to differences in this environment (Szulanski,

1996b, 41) (e.g., rehabilitation, smoking cessation, diet counselling) (tools and procedures)? <H>

KN2-3: Does AMI patient care involve many interdependent techniques, processes, individuals and resources (Simonin, 1999, 622) (Szulanski, 1996b, 42)? <H,P>

KN2-4: From your perspective has the level of AMI care complexity made any difference to your implementation of the AMI guidelines? CHF Differences?

KN2-5: From your perspective has this complexity been more associated with the ACS Pathway documentation or with the associated subtleties? Why? <H>

12. What was the transmission channel richness?

TR1-1: What has been the role of the Heart Institute staff in supporting you in making these changes (for the tools and for the procedures) (Szulanski, 1996b, 41)? <H, P>
What has been the transfer process, over what time period, with what steps? <H>

TR1-2: How did you communicate with the Heart Institute to receive the necessary ACS (tool and procedure) knowledge and support? Were there document exchanges, clarifying communications, presentations, problem solving meetings, site visits/tours, joint project teams (Cummings & Teng, 2003, 63)? <H>

TR1-3: How often did the Heart Institute staff contact you with AMI knowledge? How often did you contact Heart Institute staff for AMI knowledge (tools and procedures)

(Szulanski, 1996b, 43) (Takeishi, 2001, 426)(Hansen, 2002, 246)(Subramaniam & Venkatraman, 2001, 378)? <H>

TR1-3b: How did others in your organization (e.g., the medical staff) communicate with the Heart Institute to receive the necessary ACS knowledge and support? <H, P>

TR1-4: What other sources of knowledge about ACS patient care have you used since the start of the transfer to improve your tools and processes? Why? <H>

TR1-5: From your perspective has the level of AMI care transmission channel richness made any difference to your implementation of the AMI guidelines?<H>

TR1-6: Was the means of communicating different at different times in the transfer process? <H>

13. What knowledge transfer occurred?

O1-1: How much of the ACA/AHA AMI Practice Guidelines are you currently familiar with (All, Most, mUch, Some, None)? For the familiar guidelines, which areas have you become familiar with recently in response to the recent activities of the Heart Institute (Y/N)? <H>

O2-1: What is your organization's current implementation of, and compliance with the AMI/STEMI practice guidelines? How has this changed in the last 2 years (Simonin, 1999, 621)? What are your plans to become more compliant? <H,P>

- First 24 hours:
 - Oxygen, - previously familiar (AMUSN), recently familiar AMUSN), adopted

- IV Nitroglycerin, - previously familiar (AMUSN), recently familiar AMUSN)
- Analgesia, - previously familiar (AMUSN), recently familiar AMUSN)
- Aspirin, - previously familiar (AMUSN), recently familiar AMUSN),
- Atropine, - previously familiar (AMUSN), recently familiar AMUSN)
- ECG, - previously familiar (AMUSN), recently familiar AMUSN)
- imaging for confirmation of diagnosis, - previously familiar (AMUSN), recently familiar AMUSN)
- Beta blockers, - previously familiar (AMUSN), recently familiar AMUSN)
- ACE inhibitors, - previously familiar (AMUSN), recently familiar AMUSN)
- insulin, - previously familiar (AMUSN), recently familiar AMUSN)
- Heparin/anticoagulants, - previously familiar (AMUSN), recently familiar AMUSN)
- Hospital management:
 - Bed Rest - previously familiar (AMUSN), recently familiar AMUSN)
 - Oxygen, - previously familiar (AMUSN), recently familiar AMUSN)
 - IV Nitroglycerin, - previously familiar (AMUSN), recently familiar AMUSN)
 - Analgesia, - previously familiar (AMUSN), recently familiar AMUSN)
 - Aspirin, - previously familiar (AMUSN), recently familiar AMUSN)
 - Beta blockers, - previously familiar (AMUSN), recently familiar AMUSN),
 - ACE inhibitors, - previously familiar (AMUSN), recently familiar AMUSN)
 - anticoagulants, - previously familiar (AMUSN), recently familiar AMUSN)
 - statins, - previously familiar (AMUN), recently familiar AMUSN),
 - anxiolytics, - previously familiar (AMUSN), recently familiar AMUSN)
 - patient education, - previously familiar (AMUSN), recently familiar AMUSN),
 - management of lipids, - previously familiar (AMUSN), recently familiar AMUSN)
 - smoking cessation, - previously familiar (AMUSN), recently familiar AMUSN)
 - diabetes management, - previously familiar (AMUSN), recently familiar AMUSN)
 - ECG to measure reperfusion success, - previously familiar (AMUSN), recently familiar AMUSN)
 - exercise testing, - previously familiar (AMUSN), recently familiar AMUSN)
 - echocardiography- previously familiar (AMUSN), recently familiar AMUSN),
- Secondary prevention:

- lifestyle modification, - previously familiar (AMUSN), recently familiar AMUSN),
- cardiac rehabilitation, - previously familiar (AMUSN), recently familiar AMUSN)
- aspirin, - previously familiar (AMUSN), recently familiar AMUSN),
- Beta blockers, - previously familiar (AMUSN), recently familiar AMUSN)
- ACE inhibitors, - previously familiar (AMUSN), recently familiar AMUSN)
- anticoagulants, - previously familiar (AMUSN), recently familiar AMUSN)
- statins, - previously familiar (AMUSN), recently familiar AMUSN),
- return to prior levels of activity, - previously familiar (AMUSN), recently familiar AMUSN)
- diabetes management, - previously familiar (AMUSN), recently familiar AMUSN),
- follow-up visit with provider- previously familiar (AMUSN), recently familiar AMUSN)

O1-2: Have you seen the Heart Institute Acute Coronary Syndrome (ACS) clinical pathway, related physician orders and protocols, the ACS patient discharge information (Y/N)? If not, why not? (Was the explicit knowledge received?). Are there any parts of the pathway you do not understand? <H>

O1-3: How much of the AMI Guideline tacit knowledge are you familiar with, the subtleties of the ACS Pathway and guidelines (e.g., When to stop O2, nitro, ACE inhibitors? Contraindications to Beta Blockers? When not give ACE within first 24 hours? Level of anxiolytics? Need for stress echo? Plavix on discharge?)? **O1-3b:** What was the source of your understanding of this tacit knowledge? **O1-3c:** Has your understanding of the AMI guideline tacit knowledge changed since the transfer (Simonin, 1999, 621)? Describe any changes. <H> <how was knowledge internalized?>

O1-3d: What informal knowledge related to, but not documented in, the ACS Pathway was needed for receiving staff to **implement** the ACS Pathway? What informal knowledge would a new nurse require? How did your training material address this need?

(Aspects could include: anticipation of events, problem finding and solving, and opinions and judgement)(Shearer, 2002, 272-277).<H>

O2-2: What documentation describing Acute Myocardial Infarction (AMI) patient care existed before the transfer in your organization (Zander & Kogut, 1995, 88) describing what people actually do (Szulanski, 1996b, 42) (Simonin, 1999, 621) in general and for each of the AMI practice guidelines? **Please provide copies** <H,P>.

O2-3: What changes to AMI patient care have been made since the transfer (e.g., internal processes) (Szulanski, 1996b, 41)? Have any of these changes been based on input or material from the Heart Institute (Cummings & Teng, 2003, 62)? <H, P>

O2-4: Are you satisfied with the quality of the ACS guideline knowledge (tools and processes) you received (Szulanski, 1996b, 41)(Takeishi, 2001, 425)? Do you consider this change a success? <H, P>

O2-5: As you have gained experience with the Heart Institute provided knowledge, has your satisfaction with the tacit knowledge increased (Cummings & Teng, 2003, 62)? Explain. <H, P>

O2-6: How long has it taken you to make these changes from when you decided to make these changes? What enabled you to progress at this speed? Why were you not able to move faster? Why are you making these changes now? <H>

APPENDIX D –INFORMED CONSENT

Informed Consent Form

The researcher, Doug Orendorff, has invited _____ to participate in a research study to determine which of the determinants for successful knowledge transfer can be demonstrated in the transfer of cardiovascular disease in-hospital process of care best practice knowledge from the University of Ottawa Heart Institute to the Ontario Champlain District hospitals. I understand this research is being undertaken in fulfillment of the researcher's Ph.D. thesis requirements for the Carleton University Sprott School of Business.

I agree to be interviewed for between 90 to 120 minutes via a data collection instrument of approximately 60 questions. I agree that this interview may be recorded via Dictaphone and then transcribed for analysis. I further agree to a follow-up phone call if necessary to clarify certain interview information, as indicated via my initials: _____.

I understand that study benefits will relate to an improved understanding of the elements of successful and unsuccessful knowledge transfer of clinical practice guidelines and associated implementation processes to inform and improve future such knowledge transfers. I understand there are no foreseen risks to my participation in this study.

I understand that the researcher, via locked storage of interview transcripts and related material, will treat all interview material confidentially until this material is shredded. I understand that no third party study participants will have access to the interview material. I understand that reporting of the interview will be done anonymously for both the interviewee and the interviewee organization.

I understand study participation is voluntary and I may withdraw from this study and have my data withdrawn at any time by contacting Doug Orendorff at 613-728-9563.

I understand that this study has been reviewed and received ethics clearance through the University of Ottawa Heart Institute Ethics Committee and the Carleton University Research Ethics Committee and that study participants with concerns or questions about their involvement in the study may contact either or both ethics committees.

I understand that if I have any questions about this study I can contact Doug Orendorff, thesis supervisor Alex Ramirez at 613-520-2600 extension 2397 or alex_ramirez@carleton.ca, Heart Institute sponsor Heather Sherrard at 613-761-4708 or hsherrard@ottawaheart.ca. I understand the Carleton University Ethics Committee Coordinator, Leslie MacDonald-Hicks, can be contacted at 613-520-2517 or via e-mail at Leslie_MacDonald-Hicks@carleton.ca and the University of Ottawa Heart Institute Ethics Committee Coordinator, Amy Pell, can be contacted at 613-761-4585 or apell@ottawaheart.ca.

Doug Orendorff

Study Participant

Date of Consent

APPENDIX E – KNOWLEDGE TRANSFERRED

The knowledge transferred was the Acute Coronary Syndrome clinical pathway, associated physician orders, supporting protocols, and the ACS Discharge Tool is presented in Table E-1 – column titled ‘Knowledge To Be Transferred – Explicit Heart Institute Application’. An element of the tacit portion of each guideline recommendation is presented in the third column - ‘Tacit Elements’. It represents the portion of the overall contextual or tacit knowledge associated with this explicit knowledge. It was derived from the associated ACC/AHA Practice Guidelines that were not explicitly stated in the ACS Clinical Pathway, related physician orders, nursing protocols, or ACS Discharge Tool. Each element of tacit knowledge is located next to the associated explicit knowledge and its Heart Institute documentation location. These items are a part of the technical elements of tacit knowledge, the definite skills and know-how in a specific context (Lahti & Beyerlein, 2000, 66). The other aspect of tacit knowledge, the cognitive elements (the mental model, paradigms, schemata and beliefs that assist people in understanding their environments (Johnson-Laird, 1983)), is assumed to have been developed through professional training and is therefore not transferred at this time. Key elements in this list that were deemed by the Heart Institute staff to be essential to be understood by the knowledge receiver are highlighted with **bolded text** below.

Table E-1: Practice Guideline Standards – Explicit and Tacit Knowledge

ACC/AHA AMI Practice Guideline Standard	Knowledge To Be Transferred - Explicit Heart Institute Application	Tacit Elements
---	--	----------------

ACC/AHA AMI Practice Guideline Standard	Knowledge To Be Transferred - Explicit Heart Institute Application	Tacit Elements
First 24 Hours		
Oxygen – “1. Overt pulmonary congestion. 2. Arterial oxygen desaturation less than 90%...Routine administration to all patients with uncomplicated MI during the first 2 to 3 hours” (Ryan, Antman, Brooks et al., 1999, 1017).	Clinical Pathway – Assessments/Treatments, Day 0 – O ₂ , titration protocol; Physician’s Admission Orders #15	“In patients with severe chronic heart failure, pulmonary edema, or a mechanical complication of acute MI, significant hypoxemia may not be corrected with supplemental oxygen alone... For patients without complications, it should be recalled that excess administration of oxygen can lead to systemic vasoconstriction, and high flow rates can be harmful to patients with chronic obstructive airway disease ” (Ryan, Anderson, Antman, et al., 1996, 1343)
<p>Intravenous Nitroglycerin – “Patients with ongoing ischemic discomfort should receive sublingual nitroglycerin (0.4 mg) every 5 minutes for a total of 3 doses, after which an assessment should be made about the need for intravenous nitroglycerin” (Antman, Anbe, Armstrong, et al., 2004b, 35)</p> <p>Intravenous Nitroglycerin – “1) For the first 24 to 48 hours in patients with AMI and congestive heart failure, large anterior infarction, persist ischemia, or hypertension. 2) Continued use (beyond 48 hours) in patients with recurring angina or persistent pulmonary congestion” (Ryan, Antman, Brooks et al., 1999, 1018)</p>	<p>Physician’s Admission Orders #4</p> <p>Clinical Pathway – Day 0 - Assessments/Treatments - Chest Pain Protocols</p> <p>Clinical Pathway – Day 0 - Assessments/Treatments Fluid balance</p>	<p>Do not use with “patients with systolic blood pressure less than 90 mm Hg or severe bradycardia” (Ryan, Antman, Brooks et al., 1999, 1018).</p> <p>“Long acting oral nitrate preparations should be avoided in the early management of acute MI” (Ryan, Anderson, Antman, et al., 1996, 1343)”</p>
Analgesia - “Careful attention to maximum pain relief” (Ryan, Antman, Brooks et al., 1999, 1021). “Morphine sulphate (2 to 4 mg IV with	Physician’s Admission Orders - Morphine #5,	“Efforts to control pain therefore may reasonably involve use of anti-ischemic interventions, including, in addition to

ACC/AHA AMI Practice Guideline Standard	Knowledge To Be Transferred - Explicit Heart Institute Application	Tacit Elements
increments of 2 to 8 mg IV repeated at 5- to 15-minute intervals) is the analgesic of choice for management of pain associated with STEMI” (Antman, Anbe, Armstrong, et al., 2004b, 35) “Effective analgesia (e.g., intravenous morphine) should be administered promptly at the time of diagnosis and should not be delayed...” (Ryan, Anderson, Antman, et al., 1996, 1343)	Dimenhydrinate (anti-nausea), #6, Acetaminophen #11	reperfusion, oxygen, nitrates, Beta-adrenoceptor blocking agents, and in some circumstances, intra-aortic balloon counter pulsation” (Ryan, Anderson, Antman, et al., 1996, 1343).
Aspirin – “A dose of 160 to 325 mg should be given on day 1 of the AMI and continued indefinitely on a daily basis” (Ryan, Antman, Brooks et al., 1999, 1018).	Physician’s Admission Orders #1 - ECASA	“Other antiplatelet agents such as dipyridamole, ticlopidin or clopidogrel may be substituted if true aspirin allergy is present or if the patient is unresponsive to aspirin” (Ryan, Antman, Brooks et al., 1999, 1018). “The use of aspirin is contraindicated in those with a hypersensitivity to salicylate and should be used with caution in patients with active ulcer disease” (Ryan, Anderson, Antman, et al., 1996, 1344) “chewed...more rapid absorption occurs with non-enteric-coated formulations” (Antman, Anbe, Armstrong, et al., 2004b, 17)
Atropine, lidocaine, transcutaneous pacing patches and epinephrine “Atropine is the drug of choice for the occasional treatment of type I second-degree AV block, especially when complicating inferior MI” (Ryan, Anderson, Antman, et al., 1996, 1344)	This is not on the Pathway or physicians orders since a short-duration complication	“The recommended dosage of atropine for bradycardia is 0.5 to 1.0 mg intravenously, repeated every 3 to 5 minutes to a total dose of no more than 2.5 mg, the amount that produces complete vagal blockade” (Ryan, Anderson, Antman, et al., 1996, 1344-5).
ECG – “Patients with acute MI should	Clinical Pathway	“based on infarct location and

ACC/AHA AMI Practice Guideline Standard	Knowledge To Be Transferred - Explicit Heart Institute Application	Tacit Elements
be continuously monitored by electrocardiography” (Ryan, Anderson, Antman, et al., 1996, 1333)	– Tests, Day 0 Clinical Pathway – Assessments / Treatments – cardiac monitor	rhythm” (Ryan, Antman, Brooks et al., 1999, 1021).
Confirm diagnosis – “the diagnosis of acute MI confirmed by serials ECGs and measurements of serum cardiac markers of myocyte necrosis, such as creatine kinase isoenzymes or cardiac specific troponin T or I” (Ryan, Anderson, Antman, et al., 1996, 1333) Imaging – “1) Patients with STEMI should have a portable chest X-ray. 2) Imaging studies such as a high-quality portable chest X-ray...should be used for differentiating STEMI from aortic dissection in patients for whom this distinction is initially unclear” (Antman, Anbe, Armstrong, et al., 2004b, 34)	Clinical Pathway – Tests, Day 0 - CK and troponin markers (T used) Clinical Pathway – Tests, Day 0 - CBC, platelets, Na, K, Cl, Cr, glucose, INR, PTT – to create baseline Clinical Pathway – Tests, Day 0 – Chest x-ray (Chest X-ray also to make sure lungs clear)	
Beta-Adrenoceptor Blocking Agents – “1) Patients without a contraindication to Beta-adrenoceptor blocker therapy who can be treated within 12 hours of onset of infarction, irrespective of administration of concomitant thrombolytic therapy or performance of primary angioplasty. 2) Patients with continuing or recurrent ischemic pain. 3) Patients with tachyarrhythmias. 4) Non-ST-elevation MI” (Ryan, Antman, Brooks et al., 1999, 1026).	Physician’s Admission Orders – Betablocker #7	Contraindications “Patients with moderate LV failure or other relative contraindications to Beta-adrenoceptor blocker therapy provided patients can be monitored closely” (Ryan, Antman, Brooks et al., 1999, 1026).
Angiotensin Converting Enzyme (ACE) Inhibitors – “1) Patients within the first 24 hours of a suspected AMI...2) Patients with MI and LV ejection less	Physician’s Admission Orders – ACE inhibitors #8	“1) Patients within the first 24 hours of a suspected AMI with ST-segment elevation in ≥ 2 leads or with clinical heart failure

ACC/AHA AMI Practice Guideline Standard	Knowledge To Be Transferred - Explicit Heart Institute Application	Tacit Elements
than 40% or patients with clinical heart failure on the basis of systolic p. dysfunction during and after convalescence from AMI” (Ryan, Antman, Brooks et al., 1999, 1026).		in the absence of hypotension (systolic BP >100 mm Hg) or known contraindications to use of ACE inhibitors” (Ryan, Antman, Brooks et al., 1999, 1026).
Diabetes Management - “An insulin infusion to normalize blood glucose is recommended for patients with STEMI and complicated courses” (Antman, Anbe, Armstrong, et al., 2004b, 78)	Physician’s Admission Orders This Heart Institute protocol is still in draft..	
Antithrombotics/Anticoagulants – Heparin – “Patients undergoing Percutaneous or surgical revascularization” (Ryan, Antman, Brooks et al., 1999, 1025). “Patients undergoing Percutaneous or surgical revascularization should receive unfractionated heparin” (Antman, Anbe, Armstrong, et al., 2004b, 68)	Physician’s Admission Orders – Heparin/ SC Enoxaparin #3, Clopidogrel #2	“Class IIa – Intravenous in patients undergoing reperfusion therapy with altephase... Intravenous unfractionated heparin...subcutaneous...intravenous with patients treated with...” (Ryan, Antman, Brooks et al., 1999, 1025).
Vital Signs – “every 1.5 h until stable, then every 4 h and as needed” (Antman, Anbe, Armstrong, et al., 2004b, 85)	Clinical Pathway – Assessments / Treatments – VS per thrombolytic protocol	“Notify physician if HR is less than 60 bpm or greater than 100 bpm” (Antman, Anbe, Armstrong, et al., 2004b, 85)
IV – “Normal Saline or D5W to keep vein open. Start a second IV if IV medication is being given. This may be a saline lock” (Antman, Anbe, Armstrong, et al., 2004b, 85)	Clinical Pathway – Assessments / Treatments – insert saline lock if necessary	

APPENDIX F – ACS PATHWAY PACKAGE

Figure F-1: ACS Clinical Pathway

UNIVERSITY OF OTTAWA HEART INSTITUTE
CLINICAL PATHWAY
Acute Coronary Syndrome

Patient Name _____
Unique # _____

UNIVERSITY OF OTTAWA HEART INSTITUTE
CLINICAL PATHWAY
Acute Coronary Syndrome

Patient Name _____
Unique # _____

	Day of Admission (ER - HI)	Day 1	Day 2	Day 3	Day 4	Additional Days (Repeat Day 4)	Discharge Day	Intervention Day
Date entered								
Consent	<ul style="list-style-type: none">• Cardiology May Cardiovascular PMN• Smoking Cessation: ☐ Yes ☐ No	<ul style="list-style-type: none">• Social work contact PMN• Registry Form Completed: ☐ Yes ☐ No	<ul style="list-style-type: none">• Cardiac Rehabilitation• Registry Form Completed: ☐ Yes ☐ No	<ul style="list-style-type: none">• Dietician for T Update & PMN• Physiotherapy PMN• Registry Form Completed: ☐ Yes ☐ No	<ul style="list-style-type: none">• Registry Form Completed: ☐ Yes ☐ No			<ul style="list-style-type: none">• Post Cath Care• Follow Post cath orders• Visit signs & 1b x 4 from GIC• Vascular Assessment q 1b x 4 & PMN
Tests	<ul style="list-style-type: none">• ECG• Chest x-ray• CBC, phlebotomy, Na, K, Cl, O₂, glucose, urea, PT• Troponin q 6h x 2• CK-MB q 6h x 3• If patient is treated with aspirin, clopidogrel, or ticagrelor, then do capillary glucose monitoring (CGS) QID	<ul style="list-style-type: none">• ECG• CBC• JWH 1 & 2• Consider Echo (ECHO) for day 3-4• Fasting cholesterol, HDL, LDL, triglycerides, fasting glucose & HbA1c as of Day 1	<ul style="list-style-type: none">• ECG• CBC• Confirm P.A.B. & Labial Chest x-ray done	<ul style="list-style-type: none">• CBC• JWH 1 & 2	<ul style="list-style-type: none">• Redo echocardiogram: ☐ Yes ☐ No ☐ Not		<ul style="list-style-type: none">• CBC PMN• JWH if not completed	<ul style="list-style-type: none">• Blood work according to Hospital/Integrative protocol PMN• CBC PMN
Assessment/Interventions	<ul style="list-style-type: none">• Cardiac Monitor• O₂ by Titration Protocol• VS q 4h while awake or as per thrombolytic protocol• Chest pain protocol• Fluid balance as required• Assess intake/output if necessary	<ul style="list-style-type: none">• Cardiac Monitor• O₂ by Titration Protocol• VS QID• Chest pain protocol• Fluid balance as required• Assess activity ability	<ul style="list-style-type: none">• Ask Physician as Monitor• O₂ by Titration Protocol• VS QID & PMN• Chest pain protocol	<ul style="list-style-type: none">• VS QID & PMN• O₂ by Titration Protocol• Chest pain protocol	<ul style="list-style-type: none">• VS QID & PMN• O₂ by Titration Protocol• Chest pain protocol		<ul style="list-style-type: none">• Patient discharge assessment	<ul style="list-style-type: none">• Post PCI Care• ICG Post Procedure• CK (total) 4-6 hrs post procedure• Blood work according to Hospital/Integrative protocol PMN• CBC PMN• Cardiac monitor• VS 1 in x 4 hrs then QID
Mobility/Safety	<ul style="list-style-type: none">• Activity as tolerated when symptoms low	<ul style="list-style-type: none">• Activity as tolerated• Shower as tolerated	<ul style="list-style-type: none">• Activity as tolerated• Shower as tolerated	<ul style="list-style-type: none">• Activity as tolerated• Shower as tolerated• Assess re stairs	<ul style="list-style-type: none">• Activity as tolerated• Shower as tolerated• Stairs accompanied as required		<ul style="list-style-type: none">• Continue Day 4• Shower as tolerated	<ul style="list-style-type: none">• Forward Health Assessment• Bathing required _____ hrs post procedure• Climb set @ _____• Climb set @ _____• Vital signs/monitor assessment as per protocol
Medication	<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet	<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet	<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet	<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet	<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet		<ul style="list-style-type: none">• Heart Institute Diet• Patient Specific Diet	<ul style="list-style-type: none">• Dressing change _____• While on bed-rest, turn to affected side, HOB 30 degrees, repodent• q 1-2 hr• Ambulate 4 hrs post stent removal• Diet as tolerated
Psychosocial Support	<ul style="list-style-type: none">• Identify & address psycho-social concerns• Identify contact person• Assess patient behaviour re activity	<ul style="list-style-type: none">• Ongoing assessment/community support needs• Communicate with contact PMN• Identify & support individual's cultural values	<ul style="list-style-type: none">• Ongoing assessment/community support needs• Communicate with contact PMN	<ul style="list-style-type: none">• Ongoing• Communicate with contact PMN	<ul style="list-style-type: none">• Ongoing• Communicate with contact re discharge		<ul style="list-style-type: none">• Ongoing	<ul style="list-style-type: none">• Radial Artery Removal Procedure• Clamp release start _____• Clamp release finish _____• Vital signs/monitor assessment as per protocol• AAT _____• Diet as tolerated
Patient Education	<ul style="list-style-type: none">• Physical Environment• Pain Assessment/management• Explain medications & use• Discuss starting medicines with patient & family• Review expectations for next 24 hrs• Advise patient to quit smoking: ☐ Yes ☐ No	<ul style="list-style-type: none">• Assess patient/family perception of condition• Provide Cardiology book• Review activity tolerance• Pre-discharge Teaching PMN• Assess patient's quit smoking: ☐ Yes ☐ No	<ul style="list-style-type: none">• Review patient/family perceptions• Review Cardiology Book• Review Cardiac Risk Factors• Review Pre-discharge Teaching PMN• Review pain assessment/management• Reinforce activity tolerance• Re-ask Discharge Clinic• "Eat For Your Heart's Content" handout given: ☐ Yes ☐ No	<ul style="list-style-type: none">• Reinforce Cardiology book info• Teach use of Nitroglycerine• Highlight dates PMN• Review patient medications• "Eat For Your Heart's Content" handout given: ☐ Yes ☐ No	<ul style="list-style-type: none">• Reinforce Cardiology book info• Review use of Nitroglycerine• Discuss 24 hr telephone call in service• Review patient medications• Discuss follow-up possibilities• Review "Eat For Your Heart's Content" handout		<ul style="list-style-type: none">• Ensure patient has prescriptions• Ensure patient has discharge letter• Has attended DIC class: ☐ Yes ☐ No• Plans to return for clinic: ☐ Yes ☐ No• Complete the Patient Discharge Information form	<ul style="list-style-type: none">• Patient Education• Ambulation expectations• Stent removal• PCI results (after 48 hrs post PCI)
Discharge Planning	<ul style="list-style-type: none">• Identify discharge concerns as per patient history• Identify/Document family physician name on admission sheet	<ul style="list-style-type: none">• Discuss pending discharge concerns• Assess discharge concerns re drug costs• Discuss has drug plan: ☐ Yes ☐ No• Review discharge plan	<ul style="list-style-type: none">• Discuss pending discharge concerns	<ul style="list-style-type: none">• Review discharge plan• Discuss & plan transportation arrangements	<ul style="list-style-type: none">• Review medication• Reassess discharge concerns re drug costs		<ul style="list-style-type: none">• Review discharge plan• DIC expected by 0800	<ul style="list-style-type: none">• Discharge Planning• Review discharge plan
Problem List	<ul style="list-style-type: none">• Initial Problem List	<ul style="list-style-type: none">• Review/Update	<ul style="list-style-type: none">• Review/Update	<ul style="list-style-type: none">• Review/Update	<ul style="list-style-type: none">• Review/Update		<ul style="list-style-type: none">• Review/Update	<ul style="list-style-type: none">• Review/Update
PN Signature	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>	<div><div></div><div></div></div>

UOH 214 (PAGE 2)

© 2004 UNIVERSITY OF OTTAWA HEART INSTITUTE

Figure F-3: ACS Discharge Tool

PATIENT DISCHARGE INFORMATION ACUTE CORONARY SYNDROME

I know I need to do the following because I have had ☐ HEART ATTACK
☐ ANGINA

1. Take medicine. I understand that there are certain medications which may help prevent a future heart attack and may help to extend my life. I will be taking:

Aspirin	☐ Yes	☐ No	Does not apply to me because
ACE Inhibitor or ARB	☐ Yes	☐ No	Does not apply to me because
Beta Blocker	☐ Yes	☐ No	Does not apply to me because
Cholesterol Lowering Agent	☐ Yes	☐ No	Does not apply to me because
Clopidogrel (Plavix)	☐ Yes	☐ No	Does not apply to me because
Nitroglycerin (Spray/pills/patch)	☐ Yes	☐ No	Does not apply to me because

Medications

Medication Name Trade / Generic	Dose	AM	Noon	PM	Bed Time

2. Quit Smoking. I understand that smoking is a major risk factor in the development of obstructions in arteries and it increases my chances of suffering from a future heart attack. Smoking may also cause other illnesses which may shorten my life.

I smoke and have been counseled to stop ☐ Yes ☐ I do not smoke

I have been given medication to help me stop smoking ☐ Yes ☐ No

If I am interested in the smoking cessation program I can call 761-4753

3. Eat a Low Fat Diet. I understand that a diet low in cholesterol and fat may help to reduce my chances of suffering a future heart attack.

I have received the "Eat for My Heart's Content" Diet Education Handout and I am aware of my lipid profile ☐ Yes ☐ No

4. Exercise Regularly. I have received activity instructions for the next few weeks, before I start cardiac rehabilitation. ☐ Yes ☐ No

I have been referred to a cardiac rehabilitation program ☐ Yes ☐ No

If I haven't heard from the cardiac rehabilitation program within 4 – 6 weeks and I would like information I can call 761-4572.

5. Learn about heart disease.

I have received cardiac education (Discharge book & Resource materials) during my hospitalization ☐ Yes ☐ No

I know what to do if I have a recurrence of my symptoms.

I understand how to take my nitroglycerine spray when I have symptoms.

I have received instructions on my discharge medications.

6. Follow-Up with my physician.

☐ I have a follow-up appointment made with a cardiologist at ____ on ____.

☐ I need to call Dr. _____ @ _____ for an appointment within ____ weeks.

I should make an appointment with my family physician within 2 – 3 weeks.

RN Initials / Date
Date

Patient Signature /

2004/04/25
University of Ottawa Heart Institute
Best Practice ACS

APPENDIX G – DETAILED KNOWLEDGE TRANSFER FINDINGS

The Data Collection Instrument responses coded in NVIVO were structured by outcome (Successful, Partial and Unsuccessful Transfer); determinant; determinant question; and hospital respondent. One to three tables were created to capture the related answers from the interview questions, the number of tables depending on the number and type of questions asked about that determinant in the Data Collection Instrument (Appendix C). This material was rated according to the rating scale shown in Table G-1 by three raters: this researcher (denoted as R) and two other experienced and available raters (R1, R2). The purpose for having two other raters was to minimize the researcher impact on the identification of which determinants of the KT Framework were significant.

Table G-1: Rating Table

Rating Name	Rating Score	Rating Description
Low	1	Quotation uses diminutive adjectives like 'small', 'some', or 'partial' in answering the question being asked. In quantitative terms less than 34%
Low+	2	Combined rating between Low and Low-Medium
Low-Medium	3	Combined rating half way between Low and Medium
Low-Medium+	4	Combined rating between Low-Medium and Medium
Medium	5	Quotation uses adjectives such as 'more' or 'increase' which do not suggest a size of large or small, an indeterminate amount in answering the question being asked. In quantitative terms between 33% and 67%.
Medium+	6	Combined rating between Medium and Medium-High
Medium-High	7	Combined rating half way between Medium and High
Medium-High+	8	Combined rating between Medium-High and High

Rating Name	Rating Score	Rating Description
High	9	Quotation uses adjectives like 'significant', 'high', or 'substantial' or other positive indicators of large size in answering the question being asked. In quantitative terms greater than 66%.
No Rating		Any quotation for which there is insufficient information to determine its rating.

Five sets of ratings were performed for each of the interview answers: R1, R2, combined R1 and R2, R (the researcher) and combined R1, R2 and R3. Ratings R1, R2 and R were performed independently by two research assistants and the researcher respectively according to the following instructions:

- Use Table G-1 to rate each Hospital Determinant question response unless there are specific rating instructions for that question, e.g., External Motivation
- If there are multiple respondents to a question, rate each person's response separately then average these ratings for the hospital, using the approach provided below. Varying dimensions in a single response can also be averaged.
- Rate all impact questions where possible as High for implementation stops, Medium for implementation shows down, Low for very little or no impact.
- For Sender-Receiver Distance a Low distance means alike, the opposite of the other determinants
- For Knowledge Transmission rate according to the actual transmission if possible, else rate as future transmission

- The minimum Prior Relationship due to the transfer of patients is Medium.
- Do not make a determination on a single word if answer contains more than a few words
- Where a rating uses criteria not in this list describe these criteria in a 'Rationale' comment after the rating
- When ratings are combined they should be rounded down, e.g., two Medium ratings and a Medium-High rating would score 17/3 or a Medium rating in aggregate.

Once each rater had completed their rating of all items two more ratings occurred. First, the two research assistants compared their ratings and came to an agreement for each combined rating (shown in the tables in parentheses after the R2 rating). The researcher did not participate in these discussions. Then all three raters reviewed each rating and came to a three way agreement (shown in the tables in parentheses after the R rating). Note that in each of these processes the discussion at times resulted in an averaging of rater views and at other times resulted in a new result higher or lower than all three of the individual ratings due to the discussion revelations.

A comparison of the 100 rated elements (ten determinants, actual/perceived ratings, for five outcomes) between the combined R1 and R2 with the researcher ratings R indicates 74% of ratings differed by less than 1 point on the rating scale; 18% by between 1 and 1.99 points, and 8% by more than 2 points. These differences were equally split between perceived and actual interview question results. This difference is considered to be the researchers greater tacit understanding of each answer due to the much greater familiarity through participating in all the interviews. The comparison of the R1 and R2 ratings with the three way rating showed 97% of

ratings differed by less than 1 point on the rating scale; 4% by between 1 and 1.99 points, and 1% by more than 2 points. Three of these differences of more than one point were for perceived impact question answers.

- An example of the Next-Step table with ratings is shown below. The level of credibility of the Heart Institute and AMI guidelines and the associated ACS Pathway Package as perceived by the interviewees is presented in the following table.

Table G-2: Perceived Credibility of Source - Successful Transfers

Hospital (Respondents)	Perceived Credibility of Heart Institute	HI Influence in Making Changes	Credibility of Guidelines
H (Lead, Educator)	<p>“<u>Definitely high</u>” (Lead). “<u>Very credible for sure</u>” (Educator). <R1> Rating: High <R2> Rating: High (High) <R> Rating: High (High)</p>	<p>“It was <u>high</u>...the Heart Institute is our primary referral area, <u>definitely</u> we would be influenced by their protocols....<u>a lot</u> of the influence would come from the HI. We <u>want</u> our practice to reflect what they are doing.” (Lead). <R1> Rating: High <R2> Rating: High (High) <R> Rating: High (High)</p>	<p>“<u>Very credible</u> because they are evidence based” (Educator). <R1> Rating: High <R2> Rating: High (High) <R> Rating: High (High)</p>

Hospital (Respondents)	Perceived Credibility of Heart Institute	HI Influence in Making Changes	Credibility of Guidelines
K (Manager, Director, Cardiologist)	<p>“They have <u>incredible</u> credibility” (Director)</p> <p>“Oh <u>high</u>...HI is an <u>amazingly</u>. ...I have <u>lots</u> of respect for them (Manager).</p> <p>“One would perceive they would be more likely to adhere to guidelines because they are the Heart Institute” (Cardiologist).</p> <p><R1> Rating: Medium+</p> <p><R2> Rating: Medium-High+ (Medium-High)</p> <p><R> Rating: High (Medium-High)</p>	<p>“<u>High</u>... it gives you <u>lots</u> of confidence that there is someone out there doing it well.”(Manager).</p> <p>“<u>Very, very</u> important. Critical” (Director).</p> <p>“It is a <u>very</u> credible, local source that has used it, developed it, thought about it. It didn't come out of thin air” (Cardiologist).</p> <p><R1> Rating: Medium-High</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>	<p>“Just vaguely (familiar)” (Manager).</p> <p>“They used guidelines that are <u>well accepted</u>” (Cardiologist).</p> <p><R1> Rating: Low-Medium</p> <p><R2> Rating: Medium (Medium)</p> <p><R> Rating: High (Medium-High)</p>
L (Educator)	<p>“<u>Very</u> credible.</p> <p><R1> Rating: High</p> <p><R2> Rating: Medium (High)</p> <p><R> Rating: High (High)</p>	<p>“Integrilin is new, but it was instigated from the Heart Institute for patients that go for angios...Very rare we would put a patient on Integrilin here otherwise.” (Educator).</p> <p><R1> Rating: Low</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>	<p>“<u>Very</u> credible.</p> <p><R1> Rating: High</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>

Hospital (Respondents)	Perceived Credibility of Heart Institute	HI Influence in Making Changes	Credibility of Guidelines
N (Manager)	<p>“<u>Very high</u>”.</p> <p><R1> Rating: High</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>	<p><u>We are converting over to the concentrations the Heart Institute uses.</u> We <u>need to be</u> on the same page because their assessment is depending on what we are saying.”.</p> <p><R1> Rating: Medium</p> <p><R2> Rating: High (Medium-High)</p> <p><R> Rating: High (Medium-High)</p>	<p>“<u>Very high</u>”.</p> <p><R1> Rating: High</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>

- The impact of lower Perceived Credibility of Source on acquiring the knowledge and on KT success is presented in this table.

Table G-3: Perceived Credibility of Source Impact - Successful Transfers

Hospital (Respondents)	Change if Lower Credibility of Source	Perceived Impact on KT Success
H (Lead, Educator, Physician)	"If the Heart Institute was doing something that was not best practice they would do as they have done and canvass other areas." (Lead).	<p>"I think it would be very negative" (Educator).</p> <p>"I think you would be doing more protocols and taking <u>longer</u> to get them in place, but hopefully you would <u>still</u> strive for it" (Lead).</p> <p><R1> Rating: Medium</p> <p><R2> Rating: High (Medium)</p> <p><R> Rating: Medium-High (Medium)</p>
K (Manager, Director, Cardiologist)		<p>"If the guidelines did not come from a credible institution ...then we would be stupid to use these guidelines. They <u>have to have</u> that value" (Cardiologist).</p> <p>"Makes it <u>more</u> difficult. This is a <u>high</u> linkage to transfer success. You <u>must</u> have it" (Director).</p> <p><R1> Rating: Medium-High</p> <p><R2> Rating: High (High)</p> <p><R> Rating: High (High)</p>
L (Educator)	"Will go with whatever has the most credibility"	<p>"We are <u>all</u> professionals and credibility is <u>very</u> important"</p> <p><R1> Rating: High</p> <p><R2> Rating: High (High)</p> <p><R> No Rating (High)</p>
N (Manager)	"I would think you would utilize other resources... people who have similar knowledge and experience".	<p>"If there is great credibility and you have had good success with that knowledge sharer, you are <u>more</u> likely going to utilize them</p> <p><R1> Rating: Medium</p> <p><R2> Rating: No Rating (Medium)</p> <p><R> Rating: Medium (Medium)</p>

APPENDIX H – EXPLICIT KNOWLEDGE TRANSFER

The following table presents the state of receiver knowledge in September, 2005 at each of the 14 hospitals and the Heart Institute. The knowledge state was derived from an analysis of each hospital's ACS Pathway package. These results were reviewed with Heart Institute staff along with these hospital staff to verify and substantiate these results. These guideline standards are categorized in the left column as inpatient drug orders (one asterisk), inpatient non-drug orders (two asterisks), other inpatient guidelines (three asterisks) and secondary prevention and long-term management guidelines (four asterisks).

These 29 guidelines are organized as follows, 11 are inpatient drug orders, four are inpatient non-drug orders, four are other inpatient guidelines and ten are secondary prevention and long-term management guidelines. It is assumed that hospital best practice would be to adopt all 29 guidelines (Heart Institute Manager).

This table is present in two parts with seven hospitals in each part. Hospitals H and K are presented in Part 2.

Table H-1: Receiving Hospital Use of Explicit Knowledge – Part 1

AMI Practice Guidelines	Heart Institute	A	B	C	D	E	F	G
First 24 Hours								
Oxygen *	Orders #15	Directive #2	Orders #1b	Orders #D1	Orders #1	Orders #N12	Orders #3	Treatment #2,
Intravenous Nitroglycerine *	Orders #4; 5 (Pain)	Directives #8, #11a	Orders #7a, b	Orders #D4, 5, 6	Nitro-Orders	Orders #D3, 4, 6	Orders #9	Treatment #6, 7, 13
Analgesia *	Orders - #6, #11		Orders #7 e	Orders #D13	Orders #16	Orders #D7	Orders #9	Treatment #16
Aspirin *	Orders #1,11	Directive #6	Orders #7c	Orders #D8	Orders #20	Orders #D1, 10	Orders #9	Treatment #3, 14, 15
ECG **	Pathway – Tests,	Directive #4	Orders #5, #6	Orders #N8	Orders #12	Orders #N11	Orders #11 - EKG	Tests #1
Confirm diagnosis **	Pathway day 0	Directive #12	Orders #4 - lab	Orders #N7	Orders #2, 3,6,7,8,9	Orders #N9, 10	Orders #11	Tests
Beta- Blocking Agents *	Orders #7		Orders #9d	Orders #D9 Metoprolol	Orders #17 Metoprolol	Orders #D8 Metoprolol	Consider Metoprolol	Treatment #8
ACE Inhibitors *	Orders #8			Orders #D10 -	Orders #18	Orders #D9 - Ramipril	Consider Ramipril	Treatment #9
Anticoagulants – Heparin *	Orders #3, #2		Orders #6d, 9a, b – -	Orders #D7	Retavase protocol #6	Orders #D2 Enoxaparin	Consider Enoxaparin	Treatment #4, 5
Vital Signs **	Pathway – Assess.	Directive #9	Orders #1a	Orders #N4		Orders #N6	Orders #6	Care Map
IV **	Pathway – Assess.	Directive #7	Orders #3	Orders #D2, 3	Orders #3	Orders #N7	Orders #4	Treatment #1

AMI Practice Guidelines	Heart Institute	A	B	C	D	E	F	G
Bed Rest *	Orders – #12, 13			Orders #N3	Orders #1	Orders #N5	Orders #7	Activity
Cholesterol lowering agent	Orders #9			Orders #D11	Orders #19			Treatment #10
Anxiolytics * (patient anxiety)	Orders #14	Directive #11b	Orders #7d	Orders #D12	Orders #14	Orders #D11	Orders #9	Treatment #17
Patient Education ***	Pathway – Daily		Orders #8	Care Map - Teaching	Orders #22	Care Map – Teaching		Care Map - Education
Management of Lipids ***	Pathway – Tests		Orders #4 - lab	Orders #N7	Orders #9	Orders #N9	Orders #11	Tests
Smoking Cessation ***	Pathway – Consults							
ECG – Stress **	NA - intervention							
Echo-cardiog. ***	Tests, Day 4					Care Map - observation		
Secondary Prevention								
Lifestyle modific ****	Discharge Info. 1-5		Orders #2 – cardiac diet	Orders #N5	Orders #5	Orders #N8		Diet
Cardiac Rehab. ****	Discharge Info. #4		Orders #8b		Orders #23	Care Map - consults		
Long-Term Use of Aspirin ****	Discharge Info.#1							

AMI Practice Guidelines	Heart Institute	A	B	C	D	E	F	G
ACE Inhibitors ****	Discharge Info.#1							
Beta- Blockers ****	Discharge Info.#1							
Long-term anticoag ****	Discharge Info.#1							
Cholesterol lowering ****	Discharge Info.#1							
Pain Mgmt ****	Discharge Info.#1							
Prior Levels of Activity ****	Discharge Info.#4							
Visit Medical Provider ****	Discharge Info.#6							
Guidelines Formalized	28/29	8/29	13/29	17/29	16/29	18/29	13/29	16/29
Perceived Internalization		“There is <u>no formal process</u> in place”.	“We <u>keep up to date</u> ”.	“Physicians are very gung ho into <u>getting the most up to date protocols</u> ”.	“Certainly <u>we try and keep up</u> and read all the latest standard stuff..”.	“I think (Internist) <u>would probably know</u> ”.	“(Chief) <u>quite knowledgeable</u> ”	“ <u>Very high</u> ” (Cardiologist)

AMI Practice Guidelines	Heart Institute	A	B	C	D	E	F	G
Perceived Use of AMI Guidelines		"No pathway. Chest pain MI protocol in Emergency".	"We did statistics on this a while ago I think we have <u>88%</u> beta blocker use".	"I would say <u>high</u> , ... <u>We follow it strictly</u> ".	"All the doctors are <u>pretty much</u> following the same pathway.."	"In emergency they are <u>probably</u> following them <u>relatively closely</u> ".	"Original orders were in 1988. November 2003 were last version changed".	"I think that there was a <u>high degree</u> of implementation" (Cardiologist).

Table H-1: Receiving Hospital Use of Explicit Knowledge – Part 2

AMI Practice Guideline	Heart Institute	H	I	J	K	L	M	N
First 24 Hours								
Oxygen *	Admission Orders #15	Misc. #1		Order #10	Orders #1, Orders #4	Orders #2 Caremap –	Orders - Oxygen	Orders #1
Intravenous Nitroglycerine *	Orders #4; 5 (Pain)	Meds #7, 8, 4		Order #10	Orders #6, 11, 12 Orders 4 5	Orders #9, 11, 22 Caremap –	Orders – Medication	Orders #7 Chest Pain Protocol
Analgesia *	Orders - #6, #11	Medications #9		Order #10	Orders #16 Orders - #5, #6, #11	Orders #25 Caremap - Meds		Orders #17
Aspirin *	Orders #1,11	Medications #2, 5, 10		Chest Pain protocol	Orders 2,13 Orders #1,11	Orders #10, 18, 24	Orders – Medications	Orders #2, 14

AMI Practice Guideline	Heart Institute	H	I	J	K	L	M	N
ECG **	Pathway – Tests, Day 0-2	Monitor #1, Routine		Order #3	CCU Orders #8; Day 0, 1, 2	Orders #8, Caremap - Tests	Orders – Investigations	Care Map - Diagnostic
Confirm diagnosis **	Pathway day 0	Lab Work	ACS Protocol	Order #3	Orders #6 Pathway	Orders 4-7; Caremap -	Orders – Investig.	Care Map - Diagnostic
Beta- Blocking Agents *	Orders #7	ACS Protocol	beta blocker -		Orders #9; Orders #7	Orders #13, 19 –	Orders – Metropolol	Orders #10
ACE Inhibitors *	Orders #8	ACS Protocol	ACS Protocol –		Orders #8; Orders #8	Orders 20; Caremap		Orders #9
Anti-coagulants – Heparin *	Orders 3, 2; Tests,	ACS Protocol -	ACS Protocol -	Order #10	Orders 3- 5 Orders 3,2	Heparin Protocol	Orders – Meds	Orders #4, 5, 6
Vital Signs **	Pathway – Assessments	Vital Signs		Order #9	Orders #4 Pathway – Assess.	Caremap – Outcomes	Orders – Nursing Care	Care Map - Diagnostic
IV **	Pathway – Assessments	Medications #13		Order #10	Orders #5; Pathway – Assess	Caremap – Day 3	Orders - IV	Care Map - Diagnostic
Bed Rest *	Orders – #12, 13	Activity		Order #8	Orders #3 Orders – #12, 13	Caremap – Mobility	AMI Care Plan	Care Map - Mobility
Cholesterol lowering *	Orders #9	ACS Protocol			Orders 10; Orders #9	Caremap – Med	Orders – Med	Orders #11
Anxiolytics *	Orders #14	Medications #6			Orders 17; Orders 13	Caremap – Meds	Orders – Meds	Orders #18
Patient	Pathway –	Misc. #3;		Order #2	Pathway –	Caremap –	Orders –	Care Map -

AMI Practice Guideline	Heart Institute	H	I	J	K	L	M	N
Education ***	Daily	Discharge Info.#5			Daily	Teaching	Nursing	Teaching
Management of Lipids ***	Pathway – Tests – Day 1	Lab Work		Order #3	Orders #6 Pathway – Tests –	Orders 4-7; Caremap – Tests	Orders – Investigations	Care Map - Diagnostic
Smoking Cessation ***	Pathway – Consults - Day 0	Misc. #3; Discharge Info.#2			Pathway – Consults - Day 0			
ECG – Stress **	NA intervention			Order #6		Caremap – Day 4		Care Map – Discharge
Echo-cardiog ***	Pathway – Tests, 4				Pathway – Tests, 4	Caremap – Day 4		Care Map – Discharge
Secondary Prevention								
Lifestyle modification ****	Discharge Info.#1, #2, #3, #5	Card. Diet; Discharge Info.#3		Order #7	Orders #2; Discharge Info.	Orders #17 Caremap – Nutrition,	AMI Plan – Cardiac Diet	Care Map – Nutrition
Cardiac Rehab ****	Discharge Info.#4				Discharge Info.#4			
Long-Term Use of Aspirin ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4		Care Map – Discharge
ACE Inhibitors ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4		
Beta- Blockers ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4		

AMI Practice Guideline	Heart Institute	H	I	J	K	L	M	N
Long-term anticoag ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4		
Cholesterol lowering ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4		
Pain Mgmt. ****	Discharge Info.#1	Discharge Info.#1			Discharge Info.#1	Caremap – Day 4 –		
Prior Activity Levels ****	Discharge Info.#4	Discharge Info.#4			Discharge Info.#4	Caremap – Day 4		Care Map – Discharge
Visit Medical Provider ****	Discharge Info.#6	Discharge Info.#6			Discharge Info.#6	Caremap – Discharge		Care Map – Discharge
Guidelines Formalized		18/29 27/29	4/29	14/29	16/29 28/29	27/29	15/29	22/29
Perceived Internalization of AMI Guidelines		“Good to very good, and in some ways leaders” (Physician)	“ <u>Very</u> familiar. ... Very good. I think it is <u>excellent</u> as a whole”.	“I think we are <u>pretty good</u> ” (Physician)	“ <u>relatively well</u> ... I have to teach it” (Cardiologist)	“We are <u>pretty up there</u> (Educator)	“I think the physicians are <u>very aware</u> of the AMI guidelines”	“I think the physicians are <u>aware</u> of them”
Perceived Use		“We are ahead of the Heart Institute in many ways” (Physician)	“It is not 100% compliance because they have done <u>audits</u> ”	“ <u>Everyone seems to be</u> on the map.” (Physician)	“For the important things I think we are <u>good</u> . Card-iologist).	“For the AMI it was probably sitting around <u>75-80%</u> ” (Educator).	“We use them on <u>every</u> patient who comes in here”	“The doctors are <u>quite compliant</u> , they are <u>very familiar</u> ”