ASSESSING THE IMPACT OF PHYSICIANS' SOCIAL CAPITAL ON DECISION MAKING QUALITY MEDIATED BY KNOWLEDGE SHARING IN A VIRTUAL COMMNUITY OF PRACTICE: AN EMPIRICAL QUANTITATIVE ANALYSIS

Thesis submitted for the degree of Doctor of Philosophy By

Anjum Razzaque

Brunel Business School

Brunel University

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Thesis supervised by:

Dr. Tilal Eldabi

Dr. Akram Jalal-Karim

ABSTRACT

Purpose - Healthcare (HC) is a globally expensive investment, suffering from service quality, due to medical errors caused by physicians' poor decisions making (DM). Current published literature: (1) encourages clinical DM research to reduce diagnostic errors and (2) stresses on the dearth of means for practitioners' knowledge shared DM; this research focuses on knowledge sharing for improving medical DM quality through physicians' social capital (SC) in a virtual community of practice (VCoP). Physicians join a virtual community (VC) to share clinical practice knowledge to aid medical DM. This study aims to assess the effect of physicians' SC on medical DM and assess the mediating role of knowledge sharing quality, between physicians' SC and medical DM quality since research lacks to investigate the impact of knowledge management (KM) tools in a HC context. VCoP is a KM tool and medical DM quality is a HC topic of this study.

Design/methodology/approach – This positivist, quantitative research utilizes non-experimental survey to empirically assess its conceptual framework. After attaining an ethical approval, from Brunel Business School Research Ethics Committee, online survey was pre-tested and pilot tested for clarity and validity. 10 non-physician Ph.D. academics voluntarily participated during the survey's pre-test phase. The survey was amendment for its pilot study phase; conducted in "*plastic_surgery yahoo group*" VC. 31 physician VC members voluntarily participated. Again, the survey was amended and distributed for main data collection from 204 voluntary SurveyMonkey's VC's physician members.

Findings – Data was analysed using SPSS 20 and LISREL 8.80 by means of confirmatory factor analysis and Structural Equation Modeling. Empirical findings supported this study's four main hypotheses as well as supported this study's initially proposed conceptual framework.

Originality/value – This study customized the Honeycomb framework to establish a definition of professional physicians; HC VCs followed by identifying 51 VCs from social networking platforms like LinkedIn, Facebook, etc. This study also fulfilled its aim and hence proposed a structurally fit conceptual framework.

Keywords –Virtual Community of Practice; Healthcare Knowledge Management; Confirmatory Factor Analysis; Structural Equation Modeling.

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DECLARATION

During the course of this Ph.D. 16 intellectual contributions (3 journal articles and 12 conferences articles) whose content was an outcome of the derived material from the Ph.D. research carried out since 2009 to 2013.

Razzaque, A. (2009). A Transcultural Healthcare Knowledge Management Model to improve the Quality of Healthcare: A Case study of the Kingdom of Bahrain. Annual Global Business, Information Technology and Management for Economic Development Conference (BITMED 2009). Beijing, China.

Razzaque, A., Eldabi, T., & Jalal-Karim, A. (2012). An Integrated Framework to Classify Healthcare Virtual Communities. European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS 2012). Munich, Germany.

Razzaque, A., Eldabi, T., & Jalal-Karim, A. (2012). Knowledge Sharing for Medical Decision-Making in an E-Health Virtual Community of Practice. 2012 Annual Conference of Asian Group for Public Administration (AGPA). Bandos Island Resport, Maldives.

Razzaque, A., Eldabi, T., & Jalal-Karim, A. (2012). The impact of Physicians' Social Capital on Medical Decision making: The Role of Knowledge sharing behavior. Ahlia University - 3rd Doctorial Symposium. Manama, Bahrain.

Razzaque, A., Eldabi, T., Jalal-Karim, A., & Karolak, M. (2012). E-Knowledge Management Infrastructure for Supporting Adaptability and Interoperability of Electronic Health Records. 2012 Annual Conference of Asian Group for Public Administration (AGPA). Bandos Island Resport, Maldives.

Razzaque, A., Eldabi, T., & Jalal-Karim, A. (2013). Physician Virtual Community and Medical Decision-Making: Mediating Role of Knowledge Sharing. Journal of Enterprise Information Management, 26 (1).

Razzaque, A., & Karolak, M. (2010). A Quantifiable Transcultural Knowledge Management Model to Improve Quality of Health Care: A Case of the Kingdom of Bahrain. Journal of Economic Development, Management, IT, Finance and Marketing, 2(1), 113-153.

Razzaque, A., & Karolak, M. (2011). Building a Knowledge Management System for the e-Health Knowledge Society. Journal of Economic Development, Management, IT, Finance and Marketing, 2(2), 23-40.

Razzaque, A., & Karolak, M. (2013). Trends and Future Research in innocvative and collaborative e-Health. 2013 IIAS-IASIA Joint Congress. Manama, Bahrain: IIAS-IASIA.

Razzaque, A., & Jalal-Karim, A. (2010). Conceptual Electronic Healthcare Knowledge Management Infrastructure Model for Adaptability and Interoperability of EHR. Ahlia University - 2nd Doctorial Symposium. Manama, Bahrain.

Razzaque, A., & Jalal-Karim, A. (2010). Conceptual Healthcare Knowledge Management Model for Adaptability and Interoperability of EHR. European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS 2010). Abu-Dhabi, UAE

Razzaque, A., & Jalal-Karim, A. (2010). The Influence of Knowledge Management on EHR to Improve the Quality of Health Care Services. European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS 2010). Abu-Dhabi, UAE.

Razzaque, A., & Karolak, M. (2010). Knowledge Management and Electronic Heath Record Facilitate

Clinical Support to Improve Healthcare Quality. International Conference on E-business, Management and Economics (ICEME 2010). Hong Kong.: IEEE Press.

Razzaque, A., Eldabi, T., Jalal-Karim, A., & Karolak, M. (2013). Culture sustained Knowledge Management Infrastructure and Architecture Facilitate Medical Decision Making. 2013 IIAS-IASIA Joint Congress. Manama, Bahrain: IIAS-IASIA.

Razzaque, A., Mohiuddin,, Q., & Jalal-Karim, A. (2011). Semantic Web Based Tacit Knowledge Re-shapes E-Health to improve Healthcare Decision-Support. The International Conference and Exhibition on Knowledge-Based Business, Industry and Education, Management and Economics (KBIE 2011). Manama, Kingdom of Bahrain.

LIST OF ACRONUMS

Abbreviation	Meaning
BI	Business Intelligence
CBR	Case based reasoning
CDS	Clinical Decision Support
CFA	Confirmatory Factor Analyses
CFI	Comparative Fit Index
CMIN/DF	Chi square (x^2) "normalized by degrees of freedom"
CoP	Community of Practice
CPG	Clinical Practice Guidelines
DB	Database
DCoP	Distributed community of practice
DM	Decision-making
DSS	Decision Support System
EHR	Electronic Health Record
GFI	Goodness of Fit Index
HC	Healthcare
HC KM	Healthcare Knowledge Management
HID	Health Information Directorate
ICT	Information and Communication Technology
IT	Information Technology
IS	Information System
KM	Knowledge Management
KMS	Knowledge Management System
MoH	Ministry of Health
negs	Negatively significant
NFI	Normed Fit Index
NNFI	Non-Normed Fit Index
ns	Not significant
poss	Positively significant
RMSEA	Root Mean Square Error of Approximation
SDMT	Strategic Decision Making Team
TQM	Total Quality Management
TPB	Theory of Planned Behavior
SC	Social Capital
SCT	Social Capital Theory
SCoT	Social Cognitive Theory
SMC	Salmaniya Medical Complex
VC	Virtual Community
VCoP	Virtual Community of Practice
→	Relationship path

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION AND BACKGROUND

A growing reliance on information technology (IT) to support healthcare (HC) services has been observed; for example social networking supports medical decision-making (DM) quality (Ryu, Ho & Han, 2003). Such technologies help improve HC service quality when medical knowledge is exchanged using them to obtain the most effective and efficient medical judgments (Abidi, Yu-N & Curran, 2005). HC is an expensive investment and a complex service-oriented industry, which still suffers from poor service quality, due to medical errors caused by HC physician, consultants and patients (Bodenheimer & Fernandez, 2005). The HC sector has embraced Web 2.0-based social networks to foster knowledge sharing; for example Wiki (Landro, 2006). Knowledge sharing facilitates medical DM quality that in return reduces medical errors (Mansingh, Osei-Bryson & Reichgelt, 2009). This initiative aims at decentralizing problem solving and promoting medical DM through collaboration (O'Grady & Jadad, 2010). Medical errors cannot be taken lightly since they cause inaccurate diagnoses. In addition, incorrect therapy caused by poor medical DM, increases patient mortality (Kozer, Macpherson & Shi, 2002).

Implementation of social networks, a long-term HC initiative, has been stalled by policy setbacks (Sheridan, 2008) and by slow adoption due to their complex rules, plans and considerations. Patient confidentiality and privacy constitutes an additional barrier. Lack of research in ethical issues like patients' consent to virtually disclose their information is yet another obstacle in their adoptability. Such a barrier calls for creation of applications based on fundamental ethical issues that would replace national laws, given the fact that HC has become global. Designing virtual community (VC) systems, also referred to as virtual community of practice (VCoP), has been lately a popular research topic (Demiris, 2006). Recent research has approached VCs through social science theories (Chang & Chuang, 2011; Oinas-Kukkonen, Lyytinen & Yoo, 2010). Social Capital Theory (SCT) (Oinas-Kukkonen, Lyytinen & Yoo, 2010) was used to explain social participation in a VC (Chang & Chuang, 2011) where CoPs motivate knowledge, experience and best practices sharing (Bates & Robert, 2002). A CoP transforms into a VC or VCoP when it utilizes information and communication technology (ICT) in order to be referred as virtual (V) next to VC or VCoP (Dubé *et al.*, 2006).

Future research should focus on patient oriented VCs that revolve around continuous care throughout the patients' lifetime, instead of the currently focused provider-patient VCs research area. The barriers and future research demands prove VCs as a promising research topic (Demiris, 2006). It has already directed HC towards a Health 2.0 movement, through social computing, to improve physicians and patients collaboration in VC environments, for example MySpace or Facebook, "Sermo", "PeerClip" or "Patienstlikeme" (Morrison, 2009; Ives, 2007). This research area should be integrated with knowledge sharing since HC is overwhelmed with information overload, for example, databases store information about 10,000 diseases, compile 4,500 medical journals, etc. (Jaber *et al.*, 2010). The information overload has flooded HC information systems (ISs) and, in return, does not facilitate HC professionals to reduce the occurrence of wrong diagnoses (Bate & Robert, 2002). Clinicians are required to stay informed, which is why there is a need for integration between KM and ICT. This integration can tackle: information overload, rising medical errors and facilitation of collaborative knowledge creation, diffusion and utilization (i.e. KM processes). Very little research has been conducted on the diffusion of clinical KM where knowledge creation facilitates medical DM (Jaber, Sidi & Selamat, 2010) and tacit knowledge sharing facilitates new knowledge creation (Mansingh *et al.*, 2009). Knowledge sharing improves patient care (Mansingh *et al.*, 2009; Ruland, 2004) and collaborative DM (Jabar *et al.*, 2010) in a VC (Demiris, 2006). HC sector has yet to focus on KM (Mansingh *et al.*, 2009). Also, there is no defined literature driven system or model (pertaining to prognostics and monitoring area for data and knowledge visualization). Another HC KM barrier is lack of research on knowledge retrieval even though ample research is published in knowledge representation as well as advanced search engines for complex queries from knowledge repositories (Willis, Sarnikar, El-Gayar & Deokar, 2010). Out of these KM barriers, the barrier of interest to this research is tacit knowledge sharing between HC professionals (Riege, 2005) i.e. clinicians, nurses and physicians (Bentley, Browman, & Poole, 2010). Knowledge sharing is necessary for collaborative and shared medical DM (Jabar *et al.*, 2010). Finally, the importance of integrating research on social communities with knowledge sharing requires further research on informal networks and professional communities to create and transfer knowledge. This is in an effort to shift the research trend from research-based evidence to experiential and practice based wisdom (Bate & Robert, 2002).

In addition, there is limited literature on acquiring and sharing experiential tacit knowledge and there is a need for complex DM search engines (Jabar *et al.*, 2010). Tacit knowledge is mandatory

for improving HC quality by effectively reducing medical errors (Willis *et al.*, 2010) since tacit knowledge is a key role player for DM (Mansingh *et al.*, 2009). Also, little research has been done on knowledge transfer between organizations since underlying mechanisms are not widely explored. Even though many private UK companies focus on KM-based IT solutions performing knowledge storage and access, more attention is needed on knowledge sharing tools (Nicolini, Powell, Conville, & Martinez-Solano, 2008), for example community of practice (CoP). As Bate and Robert (2002) mentioned, there is limited literature on evaluating and implementing KM in the public sector. In the past, NHS focused on evidence-based medicine, while private institutions moved towards tacit knowledge to facilitate quality. New mechanisms are needed to support informal social interactions. Future research should concentrate on improving collaborative tools like CoP since current tools are information rich but knowledge poor (Bate & Robert, 2002). Bates and Robert's (2002) notion of information rich but knowledge poor still applies within the HC context as Soni, Ansari, Sharma and Soni, (2011) reported that the HC sector just recently discovered that its environment was information rich but knowledge poor.

Within a CoP, members interact to solve problems and update each other (Lai, 2010). CoPs exist in HC but minimum attention has been paid to their impact on cultural changes and intangible learning (Short, Jackson & Nugus, 2010); this is to the fact that doctors utilize more of explicit knowledge to support their medical DM but demand, the lesser used, local tacit knowledge to support their medical DM. Very few researchers have analysed the effect of KM tools on HC research topics (Nicolini *et al.*, 2008). Due to the research gap mentioned above, it is not surprising that research assessing the impact of CoP on cultural change or intangible learning is in its early stages. Even though there are social networking studies done in the area of sociology and anthropology, opportunity still exists for social sciences theories to be tested on the structure and behaviour of online social networks. Social networks are the next generation web, which can facilitate a better understanding of DM, organizing, innovating and implementing Web 2.0. In the past, social networks were researched in organizational or industrial teams but now, community-based technology-mediated behavioural aspects can also be investigated (Oinas-Kukkonen, Lyytinen & Yoo 2010).

1.2 PROBLEM STATEMENT

In 1999, numbers as high as 44,000 to 98,000 annual medical errors were reported as cause of patients' deaths. This was the eighth leading principal cause of patients' death overall (Stafford,

2000). Hence, Berner (2009) suggested that more research is needed in clinic DM research domain to aid reducing diagnostic errors. Berner (2009) also mentioned that ample literature exists in three research domains: normative DM, medical informatics i.e. diagnostic decision support systems (DSSs), and medical problem solving; with common characteristics being: (1) all three research domains focus on and (2) apply towards diagnostic errors pertinent to patient safety. Such common characteristics encouraged Berner (2009) to suggest that these three research domains should collaborate together to output more research efforts to solve the problem of diagnostic errors. After decades of conducting research on clinical DM, disagreements still exist as to how research data can be utilized to improve clinical DM. It is not surprising to note that Berner (2009) reported the need for more research in clinical DM. Indeed, medical DM (referred as clinical DM) is critical in the clinical domain since such DM is the second leading cause of diagnostic errors. This is why medical DM has remained a research interest since 2008 (Croskerry, & Nimmo, 2011; Demiris, 2006). The rationale behind this thesis's HC research topic devoted to medical DM is thus clear. It is motivated by to the lack of research analysing the effect of KM tools on a HC research topic (Nicolini *et al.*, 2008). In this case, a VCoP is a KM tool (Cook, 2010). KM is a new research study area in the public sector (Nicolini *et al.*, 2008). Since 2009, HC and social networking has been a newly emerging field. This thesis aims at assessing the effect of KM tools (i.e. VCoP) on a HC research topic (i.e. medical DM quality). In addition, it will also analyse the mediating role of knowledge sharing between VCoP and medical DM. This research trend leans towards social computing initiatives for knowledge sharing, hence improving DM (Chiu *et al.*, 2006; Chang & Chuang, 2011; Dannecker & Lechner, 2007; Lin & Chang, 2008; Jeon, Kim, & Koh, 2011) where in a VC physicians participate in knowledge sharing for DM (Puschner, Steffen, Slade, Kaliniecka, Maj, Fiorillo *et al.*, 2010; Oinas-Kukkonen *et al.*, 2010; Mansingh *et al.*, 2009). Such participative behaviour is studied using Social Capital Theory (SCT) to describe a VCoP from the perspective of its collective resources attained through its participants' sharing of assets (Huysman & Wulf, 2006).

Currently, research has highlighted the importance of KM (Bate & Robert, 2002) where tacit knowledge sharing facilitates collaborative DM (Jabar *et al.*, 2010) in a VC environment (Demiris, 2006) to improve patient care (Ruland, 2004). It is surprising that currently there is limited literature reporting a knowledge sharing barrier in HC (Riege, 2005; Abidi *et al.*, 2005; Rantaspuska & Ihanainen, 2008) even though Bate and Robert (2002) underlined the scarcity of empirical research in the KM research area in the public sector. Knowledge, in one part of an organization, does not benefit another part of an organization if the existence of a knowledge

network does not assure occurrence of knowledge flows (Bate & Robert, 2002). Similarly, knowledge gaps have also been reported in social networks, for example minimum attention is paid to assessing the impact of a CoP on cultural change and intangible learning (ASAE, 2010; Short *et al.*, 2010).

As per the researcher's knowledge, literature has yet to examine the effect of virtual CoP on medical DM quality in relation with the mediating role of knowledge sharing. This assessment is important to motivate HC professionals to utilize CoP as a KM tool for medical DM. Once the main research gap was pinpointed, this thesis systematically analyzed theories related to VCoP; for example SCT (Oinas-Kukkonen *et al.*, 2010), social cognitive theory (SCoT) (Chiu *et al.*, 2006), technology acceptance model (TAM) (Lai, 2010; Oinas-Kukkonen *et al.*, 2010), etc. Figure 1.1 depicts the relationship between all these terms, i.e. KM tools, CoP, VCoP, VC, SCT, SC, medical DM and HC research topic.

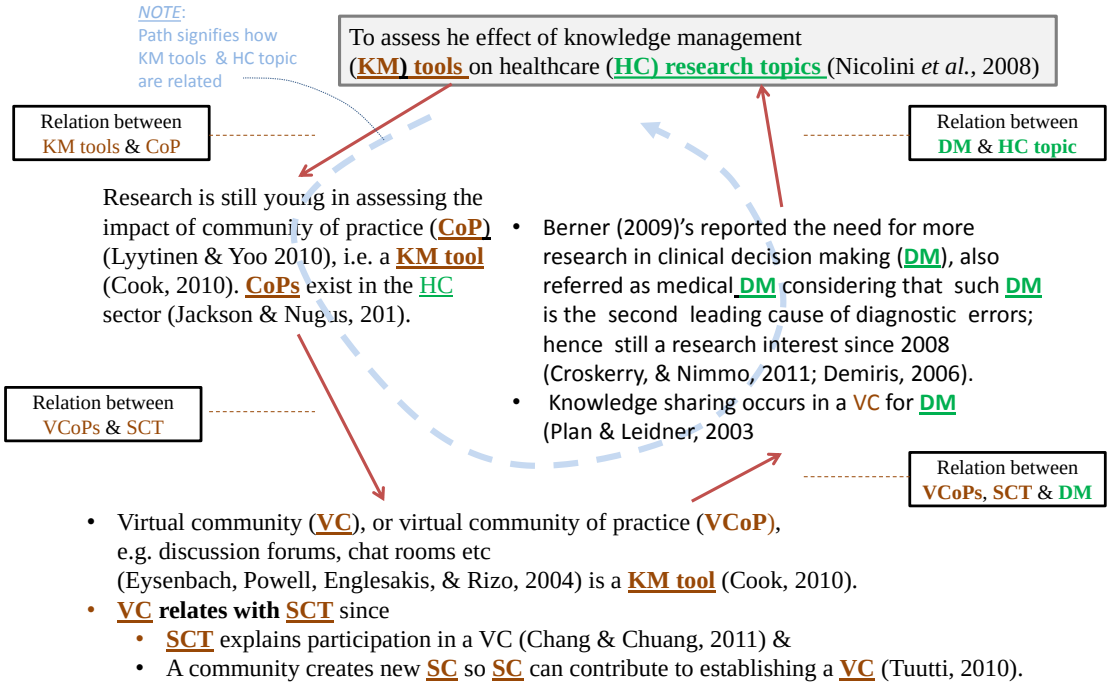


Fig 1.1. Relationship between Key Terms of the Thesis

1.3 RESEARCH AIM AND OBJECTIVES

Research Aim: to investigate (1) the effect of physicians' SC, aiding VC participation, on their DM quality and (2) the mediating role of physicians' knowledge sharing quality between their SC and DM quality. In order to understand these relations; two research questions, listed below,

guide this research:

1. What is the extent of the effect of physicians' SC on their DM quality in a VCoP environment and through what ways?
2. What is the extent of the effect of physicians' knowledge sharing quality within the relationship between physicians' SC and their DM quality, within a VCoP environment?

The following objectives assisted in answering these research questions and outlining the research structure by sequentially working through these ideas to:

- ***Objective 1:*** To critically review existing VCoP, KM and DM literature to understand associated social science theories with a particular focus on the HC sector to identify existing knowledge and to pinpoint a gap in research.

- ***Objective 2:*** To investigate and critically evaluate influencing factors of the SCT, associated with VCoP, in relation to the mediating role of knowledge sharing quality between SCT and medical DM quality; to develop and propose a conceptual framework to assess the effectiveness of a VCoP on medical DM quality mediated by knowledge sharing quality.

- ***Objective 3:*** To test and evaluate the conceptual framework by first defining an appropriate research approach followed by implementing the research methodology through collecting and analysing data and then discussing the empirical findings.

- ***Objective 4:*** To refine and finalize the conceptual framework in order to propose a modified conceptual framework model in a research domain related to HC VCoP, knowledge sharing quality and medical DM quality.

1.4 RESEARCH METHODOLOGY

Based on the outlined objectives, this study assesses the effectiveness of VC on medical DM quality by first performing a thorough critique of the literature review of HC KM, social networking VCs and medical DM to identify the research gap (objective 1) described in Chapter

Two. After identifying the research gap, further literature review is critiqued to identify a conceptual framework (objective 2) outlined in Chapter Three. This research pattern follows the confirmatory research where pre-stated relationships are tested (Bernard, 2011). Consequently, it demonstrates a deductive approach (Johnson & Christensen, 2011) where research begins from broad theoretical research and narrows down to more specific forms of research (Chahal, 2009). While quantitative and qualitative research methods are equally valuable (Baker, 2001), this study followed a quantitative methodology. The research question of the study requires an assessment of the effectiveness of VC on medical DM quality through the mediating role of knowledge sharing behaviour by statistically testing these relationships with a non-experimental survey research strategy to support a large sample size and rigorous data analysis and generalization (Creswell, 2002). At this stage this study confirmed its research method (described in Chapter Four) and the research methodology was implemented and data was analysed and subsequently described in Chapter Five in order to achieve objective 3 (Chapter Four and Five). Empirical findings were compared with literature obtained from the objective 1 and 2. Contradicting empirical findings required further review and critique of current literature in order to achieve objective 4 (described in Chapter Six).

1.5 THESIS OUTLINE

The structure of this thesis was based on four parts as observed in Kamal (2008): (1) critiqued literature review, (2) focused theory, (3) data theory and (4) discussion and contribution. Literature review in Chapter Two described research background theory to pinpoint a research gap. This led to a focused research to integrate a conceptual framework, discussed in Chapter Three. Next, research methodology addressed the epistemological stance, research method and research strategy issues in Chapter Four. Subsequently the researcher performed: (1) data collection, (2) justifying data analysis and implementation with findings reported in Chapter Five. Chapter Six discussed the findings integrated with literature from Chapter Two and Three. Finally this study justified its innovation, contributions, limitations and future research to reflect the importance of its discipline in Chapter Seven. The thesis outline is depicted in Figure 1.2 and clarified ahead.

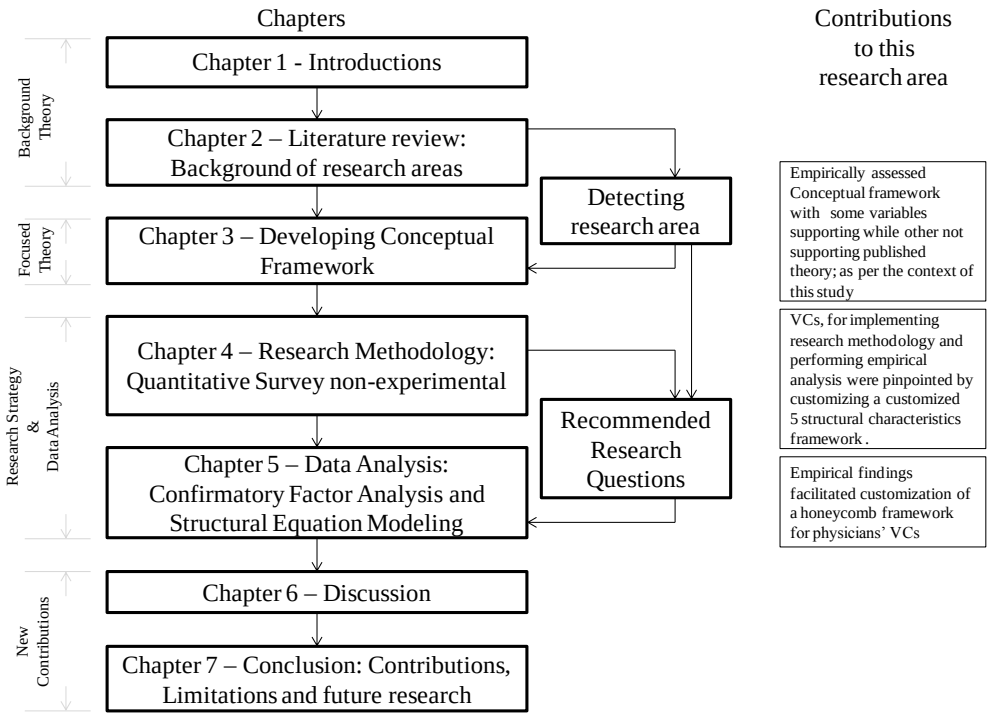


Fig 1.2. Thesis Outline

Chapter 1: Introduction

This chapter provided an introduction to the main issues of this study by focusing on HC KM, social computing, and medical DM. The background information facilitates the aim and objectives of this study to assess the effectiveness of physicians' VC on their medical DM quality through knowledge sharing.

Chapter 2: Literature Review

Now that the previous chapter provided a brief introduction to this research area to establish the scope of this study, this thesis began performing a thorough literature review on: (1) diagnostic errors, (2) KM processes, (3) social computing, (4) VCs, (5) and (6) social sciences theories pertaining to VCoPs. Finally, the chapter pinpointed various research areas, which lacked scholarly attention or required further research. This chapter critiqued such various gaps to integrate and formulate the final research gap, which reflected the aim and objective of this research study.

Chapter 3: Developing the Conceptual Framework

This chapter proposed a literature critiqued and integrated conceptual framework for assessing the relationships between SCT, knowledge sharing quality and DM quality. This model can be used as a foundation for future areas of research also in this study. This model also depicted the four hypotheses and various sub-hypotheses that needed empirical assessment.

Chapter 4: Research Methodology – Quantitative non-experimental Survey distribution

Chapter Two set the stage for the background of this research study. Chapter Three proposed the conceptual framework. These two chapters facilitated the researcher to critique and identify research issues for further empirical investigation. In order to perform an empirical assessment strategy, a strategy for research methodology was assessed and justified so it would be viable for implementation by empirically testing the conceptual framework within a practical environment, as per the context of this research study. The rationale behind the selection of the research approach, i.e. stance – positivism; methodology – quantitative; and strategy – non-experimental online survey distribution, was stated in this chapter. The innate problems in various research philosophies were stated and research suitability was critiqued and evaluated by the researcher in this chapter.

Chapter 5: Data Analysis (Confirmatory Factor Analysis and Structural Equation Modelling)

Now that this study had accomplished assessing all relative research method issues and established a suitable research method approach this thesis was ready to report a narrative of the process undertaken to practically perform data collection, cleaning missing data and analysing data using LISREL by performing first confirmatory factor analysis (CFA) and then Structural Equation Modelling (SEM). Finally this chapter published the findings categorized under four hypotheses test results.

Chapter 6: Discussion

Based on the empirical findings published in the previous chapter, this chapter summarized the knowledge-based contributions from empirical findings. Literature from Chapter Two was

connected with significant areas of empirical findings. The literature in Chapter Two that was not supported due to its insignificant findings was also mentioned. Further literature was reviewed in order to attain deeper theory-led rational explanations as to why insignificant relations were declared as such.

Chapter 7: Conclusion

This chapter summarized the research undertaken in this study. Based on this research presentation, this chapter described how the aims and objectives of this thesis were attained. This overview led to stating the research contributions and the research innovations of this study. Finally, this chapter presented further literature, which described other research areas that could be integrated with the current research area of this study pinpointing 10+ opportunities for future research.

While Figure 1.2 depicted the thesis structure, Figure 1.3 outlines the entire path taken by this Ph.D. study through its figures and tables utilized throughout this thesis.

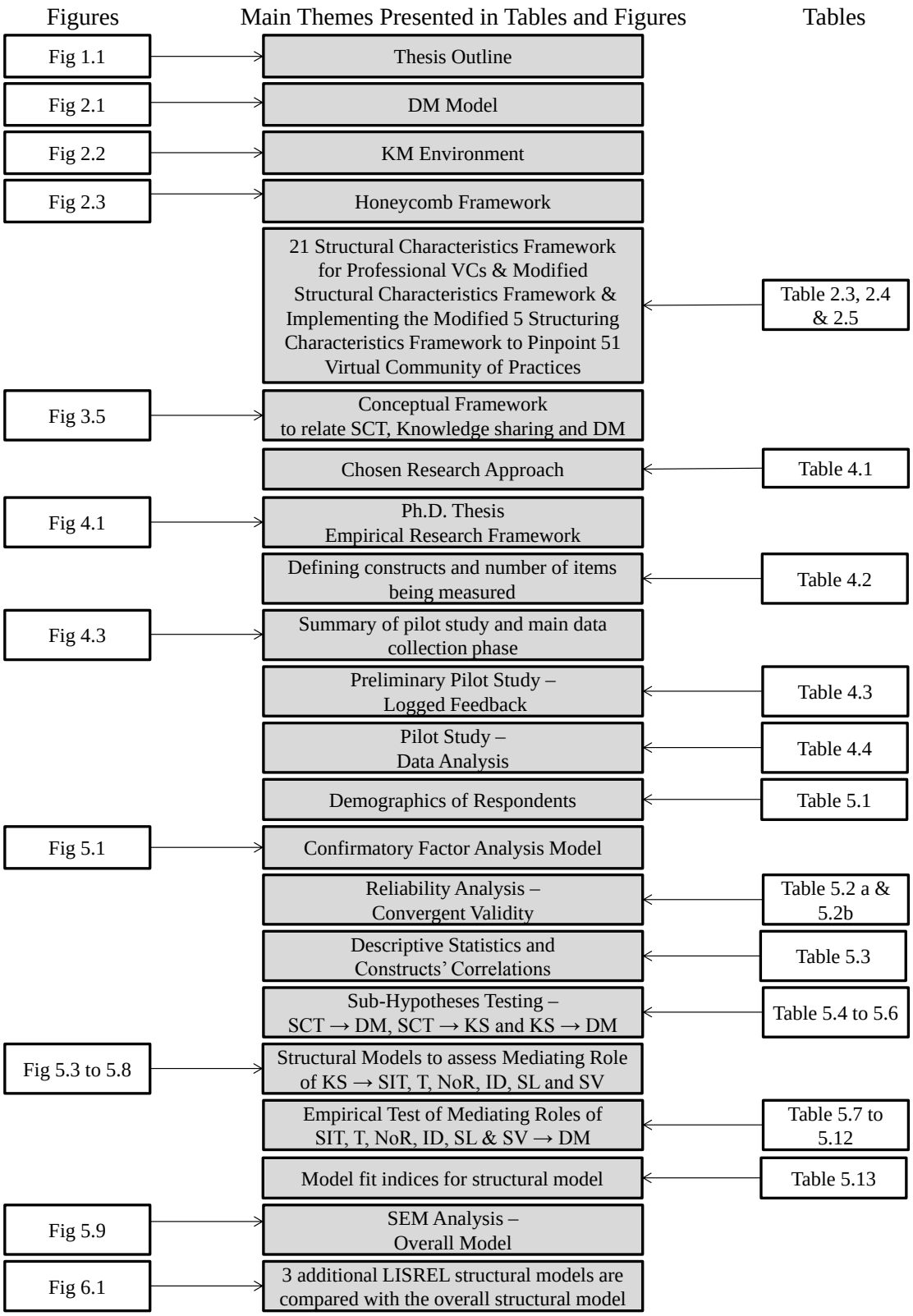


Fig 1.3. Thesis Story Outline from Figures and Tables.

1.6 SUMMARY

This chapter began by establishing a research background in the area of global HC quality by elaborating the application of ICT KM tools, for example social networking to facilitate physicians' medical DM quality through knowledge sharing. This investigation, of worldwide interest, is aided by social networking KM tools. For example, HC VCoP for physicians can allow them to utilize more of their tacit knowledge over explicit knowledge for their medical DM. Next, this study launched a problem statement to investigate a research gap, which led the researcher to formulate two research questions and seven objectives that were based on developing the outcomes of the next four chapters of this thesis (chapter Two – literature review, chapter Three – conceptual framework, chapter Four – research methodology and chapter Five – data analysis). Finally, this study described all chapters of this thesis. The outcome of this chapter was to provide an introduction to this thesis to set-up a base upon which this study will be framed, to describe and integrate various research areas (diagnostic errors – to show the root problem, KM – to set the stage for its use and utilization in facilitating HC quality, DM – to assess how medical DM can be quantified for further research in the HC sector, SCT - social science theory related with VCoP) that need to work together to define the critiqued review of literature in the next chapter. Based on the ample literature review, a literature-driven research gap will be also critiqued Chapter Two.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Chapter One introduced the healthcare (HC) context mentioning that HC services still lag in quality due to frequently occurring medical errors (Bodenheimer & Fernandez, 2005) negatively effecting medical decision-making (DM) quality (Willis *et al.,* 2010; Lin & Chang, 2008). HC institutions provide quality once their services meet/exceed patients' expectations where service quality is the outcome of the interactions between the patient and the service provider. In this case; service quality is represented by tangibles (equipment or personals), willingness to provide a service, ability to correct what is wrong, service providers' knowledge and skills, accessibility of such service providers and its ability to adjust to urgent needs (Owusu-Frimpong *et al.*, 2010).

Chapter One also expressed the importance of HC knowledge management's (KM's) knowledge sharing to facilitate medical DM quality. The HC literature dealing with the evaluation and implementation of HC KM research topic is scarce (Nicolini *et al.,* 2008). This is not surprising since it is hard for huge institutions, like HC providers, to manage knowledge (Huysman & Wulf, 2006). In addition, even though knowledge is manageable in a social network's virtual community of practice (VCoP), the analyses of this thesis's literature review, identified that little is known on the impact of VCoP on medical DM. This literature driven research concentrates on virtual social networking with an aim to investigate the impact of a HC VCoP towards facilitating medical DM quality in a HC environment. This chapter reviews and critiques relevant findings from accredited scholarly intellectual contributions, i.e. journals, governmental documents and books, which convey up-to-date research, ideas and topics related to HC KM's knowledge sharing process in VCs and their relevant social science theories to facilitate knowledge sharing and medical DM. In addition, this literature review is critiqued to reflect these research topics to pinpoint an appropriate gap in research. This research gap will facilitate the researcher to pursue a deeper literature review to develop a conceptual framework model and relevant hypotheses this study.

This chapter describes the current KM literature; prior-reported research challenges/barriers and states areas lacking research. Once the research problem is pinpointed, this research performs a

comparative analysis of theories pertaining to social networking i.e. social capital theory (SCT), social cognitive theory (SCoT), CoP etc, in relation to knowledge sharing to improve medical DM quality. HC professionals and leaders better understand the value of VCoP in HC towards facilitating medical DM quality. This chapters starts by portraying a detailed literature review on: KM, clinical DM and the knowledge sharing process. This chapter then describes the importance of social computing and VCoP along with their social theories followed by a literature critique to identify the research gap.

2.2 RELATED RESEARCH AREAS LANDSCAPE

In this section, the study critically and systematically performs literature reviews and analyses to identify the research gaps expressed in this chapter's 2.2.1 section. The next section defines data, information and knowledge based on critiqued opinions and recommendations of various studies.

2.2.1 OVERALL REALTION BETWEEN DATA, INFORMATION AND KNOWLEDGE

Data, like a number (Bates & Robert, 2002), is meaningless by itself (Riaño, 2009) such as raw facts/observations (Bates & Robert, 2002) stored in databases (DBs) (Hicks, Dattero & Galup, 2007). Information, like blood pressure of 140mmHg (Riaño, 2009) replaces data. For example: processed and organized data is classified as information since it now is in a meaningful content (Bates & Robert, 2002) stored in decision support systems (DSSs) (Hicks *et al.,* 2007). HC data and information are codified standardized concepts combined with different medical circumstances, such as patient state or therapies, to form a more complex information structure (Riaño, 2009). Health information, whether oral or recorded in a medium, created or received by a HC professional, concerns an individual's mental or physical health condition (Al Nawakda, Fathi, Ribière, & Mohammed, 2008). In addition, information is patterns made out of organized data. Knowledge is manipulated information for applicable DM (Hsia, Lin, Wu, & Tsai, 2006). The narrative presented above, supported an overall definition of data, information and knowledge to be used in this thesis.

As one study mentioned, information is a set of processed meaningful data. Applied information is knowledge, an outcome of wisdom, thought and action (Rahman, 2006). HC knowledge is retrievable from multiple sources, for example medical students, patients, educators, administrators, physicians, etc and calls for KM (Mansingh *et al.,* 2009). Knowledge is storable

in expert systems. Within the knowledge hierarchy (Hicks *et al.,* 2007), data creates information and information, in turn, creates knowledge (Antonio & Lemos, 2010). Knowledge is a collection and application of information (Belinger, Castro & Mills, 2004). At this stage, as per the definitions adopted in this thesis, information is an outcome of data while knowledge is an outcome of information. However, one author (Hicks *et al.,* 2007) contradicted this view as he reported that knowledge is attainable directly from data, such as neural networks utilize data for problem solving. Given the context, space and time, information is transformed to knowledge during social interactions between individuals and organizations (Alwis & Hartmann, 2008). In addition, tacit knowledge can be created from data rather than from information, i.e. applying raw data to test a solution. Transforming data to knowledge occurs when an expert requires only tacit knowledge, rather than also explicit knowledge, for problem solving (Antonio & Lemos, 2010). Knowledge is an asset within a social network of relationships (Chang & Chuang, 2011) where reciprocity is in association with relationships since it facilitates a relationship-based exchange (Pervan, Bove & Johnson, 2009). This is also an opinion supported by this thesis, since knowledge plays a major role in problem solving occurring during interactions between experts (Mancilla-Amaya, Sanin, & Szerbicki, 2010).

2.2.2 HEALTHCARE KNOWLEDGE MANAGEMENT AND ITS STRUCTURE

In conclusion, knowledge sharing improves patient care and medical DM when new knowledge is created (Birasnav, Rangnekar & Dalpati, 2009). It is critical for achieving high quality HC system. The HC sector has not yet focused on KM (Mansingh *et al.,* 2009). HC physicians hold ample knowledge. For example, as one study reported (Ryu *et al.,* 2003) that knowledge sharing is critical in HC groups in the tertiary care to elevate HC quality.

KM is discussed from various published sources and is classified in three possible ways. Hence, KM is a/an:

1. Business tool to sustain competitive advantage (Antonio & Lemos, 2010). With global interest for KM initiatives similar to the HC sector (Sharma, Samual & Ng, 2009), 72% of overseas American organizations began KM initiatives and 89% of European leaders consider knowledge as business power (Bates & Robert, 2002). HC KM was a research topic since 1997. In 2001, KM was reported as a soft HC area. Since HC organizations are information rich but knowledge poor; they slowly embrace KM (Perrott, 2008). HC

KM emerged strong due to its organizational and managerial processes in the industrial economy (Nicolini *et al.,* 2008)

2. Administrative process (Riaño, 2009) to convert data to information to knowledge (Hsia *et al.*, 2006) in order to systematically create, share and translate HC knowledge for improving patient-care (Abidi, 2008). Since 1990s, KM has linked people, process and technology to facilitate performance, collaboration and others' experience (Guptill, 2008). According to the researcher, integration of people, process and technologies is facilitated by organizational culture, structure and information and communication technology (ICT), i.e. three KM infrastructure elements (Jie, 2010). KM process utilizes knowledge, via KM tools, to share knowledge via socialization, externalization, combination and internalization (Mohamed, O'Sullivan & Murray, 2006) through technology to enhance DM (Mohamed *et al.,* 2006). An Internet, Intranet or Extranet is an example of KM process-enabling technology (Bali & Dwievedi (ed. 2007, p 6). Such ICT has transformed HC to e-health with portals for patient records, physician IS, hospital management system, etc. (Lai, 2010) to facilitate DM (Mohamed *et al.,* 2009).

3. Know-what – declarative knowledge to answer questions, Know-how – procedural knowledge to answer how-type questions and Know-why – evidence-based explanatory knowledge to answer why-type questions (Riaño, 2009).

The goal of KM is to redefine HC delivery system for cost effective, efficient and timely delivery of knowledge for medical DM. HC KM is utilized by HC professionals, patients and clinical workflow processes (Abidi, 2008). The KM structure forms KM process architecture and KM infrastructure. A KM architecture to acquire, document, transfer, create and apply knowledge (Birasnav *et al.,* 2009) is depicted in Figure 2.1.

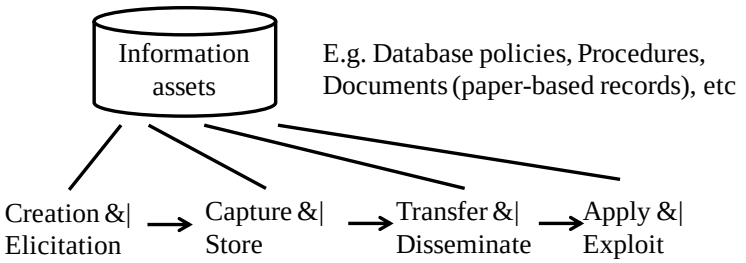


*Fig 2.*1. KM Environment
Adopted from – (Wickramasingha, Gupta & Sharma, 2005; and Bose, 2002)

As presented in the above literature, ICT facilitates KM (Mohamed *et al.,* 2006) by transforming HC to e-health (Lai, 2010), to support medical DM, within an environment that bridges the right knowledge with its need (Abidi, 2008). Medical knowledge sharing mechanisms are also referred to as KM practices. An example of such mechanisms is a CoP (Lin & Chang, 2008). A CoP was first introduced by Lave and Wenger (1991) who defined it as something that resides everywhere (i.e. social, educational sector, organization, etc). CoP is defined as a set of participants', worlds' or an activity's relations formed overtime to relate with other relations of other overlapping CoPs (Seaman, 2008). Such mechanisms can be: (1) intangible mechanisms for mentoring, formal meeting, problem-based learning and evidence-based medicine or (2) tangible mechanisms i.e. medical journals, clinical guidelines and IT for example telemedicine, Internet, e-mail, virtual community (VC), mobile technology and medical informatics (Lin & Chang, 2008). Up to this stage, the thesis critiqued literature in order to relate KM, KM tools and DM. In the next set of sections (Section 2.2.3 to 2.2.6) this thesis emphasizes how knowledge sharing, used for DM, occurs in VCs.

2.2.3 UTILIZATION OF KNOWLEDGE TYPES IN HEALTHCARE

This thesis clarified the holistic relation between data, information and knowledge. Subsequently it is essential to define different knowledge types since the contribution of each knowledge type differs in any organizational context, as well as HC. This thesis expresses a deeper theoretical understanding of knowledge since HC KM is an important project, considering that businesses have shifted from being production oriented, (physical valued assets) to service oriented (knowledge as a valued asset) (Wickramasinghe, Bali, Lehaney, Schaffer & Gibbons, 2009). Various studies categorized knowledge in various types as depicted in Table 2.1.

Table 2.1. Classification of Knowledge Types

Defined and cited Knowledge Type Knowledge is classified between:	Bibliography Reference
Tacit knowledge or explicit knowledge. (Defined below).	(Kalkan, 2008)
Tacit knowledge, implicit knowledge or explicit knowledge.	(Frappaolo, 2008)
Tacit knowledge, explicit knowledge, organizational knowledge and cultural knowledge (Mohamed et al., 2006).	(Mohamed *et al.*, 2006)
Book knowledge (facts or standards, know-how) and cultural knowledge (ones belief is ones practice).	(Hara & Hew, 2007)
Explicit knowledge (e.g. diagnoses), grey knowledge (e.g. insights of unknown diseases) and black knowledge (small important and available through vision - gut feeling).	(Liu, Jiang, Zhen, & Su, 2008)
Each piece of knowledge has a degree of tacit and explicit component. Higher degree of tacit degree, the more difficult is knowledge sharing	(Antonio & Lemos, 2010)

According to the researcher, knowledge has a degree of tacit and explicit component to it. However Liu *et al.,* (2008)'s three dimensions of knowledge (explicit, grey and black) make also sense since knowledge cannot be just tacit and explicit, or have degrees of tacit-ness or explicitness. There should also be a grey area, i.e. implicit knowledge; for example, new knowledge is created by converging implicit and explicit knowledge (Hicks *et al.,* 2007). While the studies mentioned above defined variations in knowledge types; most studies have mentioned just two knowledge types: tacit and explicit as also stated by Bates and Roberts (2002).

HC is a knowledge intensive service-oriented industry (Lin, 2008), which relies heavily on 'know-how' of community members' tacit knowledge (Jansen, Curseu, Vermeulen, Geurts & Gibcus, 2011). Tacit knowledge is important for this research for various critiqued reasons mentioned further. Doctors are unable to apply evidence in practice with so much HC information overload, such as descriptions of 10,000 diseases, 300+ radiology procedures, 1100 lab test and 400,000 articles etc. Hence, clinicians are compelled from staying informed. Such situation demands: (1) tacit knowledge (Willis *et al.,* 2010; Nicolini *et al.,* 2008), not fully utilized in HC since it is difficult to imitate (Mansingh *et al.,* 2009) and impossible to codify/transfer (Jimes & Lucardie, 2003) and (2) actionable knowledge (Mansingh *et al.,* 2009) available through collaboration during problem solving in a CoP (Grant, 2007). Tacit knowledge: (1) is intuition (Paul, 2006) - hidden (Kalkan, 2008; Abidi, Finleyb, Miliosa, Shepherda & Zitnerb, 2004) in the brain (Baskaran, Bali Arochana, Naguib, Dwivedi & Nassar, 2005) of expert's know-how and intuition or perception (Bentley, Browman, & Poole, 2010), (2) travels poorly since you know more than you can tell (Bate & Robert, 2002), for example recognizing a face in a crowd is unexpressible (Jimes & Lucardie, 2003) and (3) improves with experience (Bate & Robert, 2002) as it is difficult to express (Paul, 2006), difficult to adapt, codify distribute and capture (Kalkan, 2008; Abidi *et al.,* 2004).

Intuition is a holistic situational approach (Hancock & Durham, 2007). Explicit knowledge: (1) is evidence-based (Bentley, Browman, & Poole, 2010; Mansingh *et al.*, 2009) clinical published medical knowledge, such as clinical practice guidelines (CPG) (Mansingh *et al.*, 2009) or recommended HC procedures (Paul, 2006), (2) can be easily distributed/managed (Mansingh *et al.*, 2009) where (3) its sharing is like sharing medical resources i.e. newspaper, journals, etc (Lin & Chang, 2008). Tacit knowledge is more valuable than explicit knowledge since tacit knowledge sharing helps in problem solving and is based on skills and situations (Jimes & Lucardie, 2003) through personal experience (Antonio & Lemos, 2010). Even though some argue that explicit knowledge is not knowledge (Grant, 2007), the researcher does not agree since: (1) such argument is not empirically verified and (2) even though explicit knowledge is ample; vast untapped knowledge is tacit knowledge where tacit knowledge can be converted to explicit knowledge and vice versa through socialization, externalization, combination and internalization (Nonaka & Takeuchi, 1995; Grant, 2007); using KM system (KMS) (Bose 2003) like CoP (Rantapuska & Ihanainen, 2008).

Socialization, externalization, combination and internalization are part of the Nonaka and Takeuchi (1995)'s SECI knowledge sharing spiral model (Schneckenberg, 2009) where tacit knowledge is converted to explicit knowledge during externalization; e.g.: translating clinical trial result to clinical practice recommendation (Ciccarese, Caffi, Quaglini & Stefanelli, 2005; Nemati, Steiger, Iyer & Herschel, 2002) during narrative story telling or mentorship (Jimes & Lucardie, 2003; Girard & Lambert, 2007) to transform knowledge in expressible form (Baskaran *et al.*, 2005). New tacit knowledge is created during experts' experiences sharing during problem solving (Wu, Senoo & Magnier-Watanabe, 2010). Explicit knowledge is converted to explicit knowledge, such as fusing medical knowledge during combination and explicit knowledge is converted to tacit knowledge during internalization, such as applying CPG. Tacit knowledge is converted to new tacit knowledge, such as sharing experiences during socialization (Ciccarese *et al.*, 2005; Nemati *et al.*, 2002), i.e. during interaction. Explicit knowledge utilization, alone, fails to facilitate medical DM (Willis *et al.*, 2010; Jaber *et al.*, 2010; Nicolini *et al.*, 2008). The type of knowledge that can be transformed from tacit knowledge to explicit knowledge is another special type of knowledge being implicit knowledge, i.e. an extension to tacit knowledge and explicit knowledge (Frappaolo, 2008).

Integration of KM and technology helps to narrow the information overload challenge (Willis *et al.*, 2010). Both, tacit and explicit knowledge are needed to assess an on-hand situation since

explicit knowledge without tacit knowledge is not useful and tacit knowledge, without explicit knowledge, is limited. Hence, both types of knowledge are required to enable collaboration in order to improve medical DM (Paul, 2006). While there is amply explicit knowledge in HC, causing information overload (Willis *et al.,* 2010), HC tacit knowledge is in demand due to its insufficient utilization. Hence, tacit knowledge sharing is the key for improving medical DM (Mansingh *et al.,* 2009). This is why this thesis investigates tacit knowledge sharing through interpersonal means (Chang & Chuang, 2011), during problem solving in a CoP (Grant, 2007).

2.2.4 DECISION MAKING IN HEALTH CARE

DM is sequential activities, i.e. clearly identifying a problem, classifying different solutions, reviewing solutions as well as selecting and implementing an action plan (Puschner, Steffen, Slade, Kaliniecka, Maj, Fiorillo, Munk-Jørgensen *et al.,* 2010). DM occurs during diagnoses; yet uncertain diagnoses cause poor recommendations (Ismael, 2009). Clinical DM is a rational process based on scientific evidence and clinical experience; assuming that a patient too would make a similar decision in such circumstances (Puschner *et al.,* 2010).

Published literature on medical DM research has focused on three main areas: emergency treatment, chronic disorders treatment and palliative care. Chronic diseases like cancer have gained much interest in the medical DM research domain (Lucchiari, Masiero, Pravettoni, Vago, & Wears, 2010). Many terms describe clinical DM, for example DM, diagnostic reasoning, clinical judgment, clinical inference and problem solving (defined further). As per the researcher's observation from various reviewed sources, there are three approaches in clinical DM process being: (1) information processing model - situational analysis based evidence to rationally decide an action, (2) cue acquisition – practitioner's decision is based on available clinical information and patients' encounters and (3) hypotheses generation – interpretation, classification and weighing of multiple evidence based diagnoses. Hancock and Durham's (2007) pubilcation helped the researcher attain a deeper understanding of clinical DM and the importance of clinical DM as a HC research topic. DM pertains to patient care, as mentioned in this thesis. In addition, DM is also strategic; for example physicians' and admins' body made complex non-routine, vague and conflicting decisions for long term investments to assure hospital survival. While administrators seek feasibility physicians seek patient care quality. Research lacks in HC strategic DM and physicians' influence on such DM. Even though research on strategic DM focusing on decision effectiveness, is vast and diverse. Such research pertains to the

context of HC executive management, in relation with strategic DM, is scarce and scattered, i.e. in relation with team compensation and its impact on DM (Parayitam, Phelps, & Olson, 2007).

As per the opinion of the researcher, even though strategic DM does not add value towards the aim of this thesis research, strategic DM does express the need for joint knowledge sharing between physicians and hospital administration body. Hence, this reviewed literature adds value to this thesis since it expresses how important it is for multiple experts to share their knowledge for strategic HC DM, another form of medical DM. As one study stated (Rico, Molleman, Sanchez-Manzanares, & Van der Vegt, 2007), decision quality via breath (extent at which all problems' issues were discussed), organization (how well were different facets of the problem related) and depth (the extent a team considers all issues pertaining to the problem). According to the researcher; since physicians collaborate in a DM team, DM is an important research topic.

2.2.5 COLLABORATIVE KNOWLEDGE SHARING FACILITATES DECISION MAKING

Current academic research has stressed the evidence and not practice-based wisdom where knowledge transfer requires informal networks and professional communities (Bates & Robert, 2002). Most firms capture or utilize existing knowledge resources; while only a minority, like Ernst and Young, share knowledge and best practices (Bates & Robert, 2002). Knowledge sharing is critical for knowledge rich organizations (Lai, 2010), for example HC. Knowledge sharing occurs when perceived personal benefits overweigh perceived loss of valuable knowledge (Chang & Chuang, 2011). Knowledge transfer occurs through codification, storing and distributing explicit knowledge and personalization. Tacit knowledge transfers between people to discover know-how and best practices, (two KM strategies) (Antonio & Lemos, 2010). Physicians share knowledge to improve HC quality (Ryu *et al.*, 2003). Technology facilitates explicit knowledge sharing while interpersonal interactions aid tacit knowledge sharing (Chang & Chuang, 2011). UK's NHS has focused on evidence-based medicine (current information rich but a knowledge poor collaborative) but the private sector focused on collaborative tacit knowledge; hence further research should inquire on improving collaborative tools (Bates & Robert, 2002). Literature on experiential tacit knowledge sharing is limited (Willis *et al.*, 2010; Jabar *et al.*, 2010). Organizations transfer knowledge to prevent loss of unmanaged tacit knowledge (Antonio & Lemos, 2010; Baskaran *et al.*, 2005).

People share knowledge with people who have similar knowledge and experiences (Ciccarese *et al.*, 2005; Nemati *et al.*, 2002). In this case, experience helps provide opinions through tips (Foong & McGrouther, 2010) during medical DM where previous knowledge is utilized to select diagnostic explanations, adapt evidence-based medicine approach or formal decision analytic tools to improve doctors' reasoning quality (Lin & Chang, 2008). This is how knowledge is related with DM for knowledge shared DM where knowledge sharing facilitates medical DM since clinical practices involve MD doctorial thinking and DM (Croskerry, & Nimmo, 2011). When keeping in mind the notion of knowledge utilization for DM, it is not surprising that with various DM studies across published literature (Puschner *et al*., 2010), the researcher encountered a variety of DM terms, explained and classified in Table 2.2, expressing the importance of knowledge sharing to facilitate DM. This is why various DM terms have been classified to clarify varying yet related DM terms, as depicted in Table 2.2. Such a classification is necessary to outline the importance of knowledge sharing for the purpose of DM, i.e. knowledge-shared DM.

Table 2.2. Classifications of Knowledge-shared DM

<table>
<tr><th colspan="3">Knowledge-shared DM</th></tr>
<tr><td colspan="3">It is a time consuming DM since it is well-thought-out. Such DM requires participants to trust one another when sharing knowledge for DM (Roberts, 2006). Such DM is collaborative and patient centered (Maryland, 2003) where either: (1) a doctor decides, (2) both patient and doctor decide or (3) only patient decides (Puschner et al., 2010). This notion of collaboration in DM, is supported by Owusu-Frimpong, Nwankwo and Dason (2010) who mentioned that younger patients prefer being involved in the treatment-based DM, i.e. to collaboratively decide on a treatment, a notion contrary to the traditional notion that doctors decide on a treatment in a doctor-centred doctor-patient relationship scenario (Owusu-Frimpong, Nwankwo & Dason, 2010). It is the researcher's opinion that treatment-based DM falls under knowledge-shared DM since treatment-based decision is either: (1) professional choice - decided by clinician based on patient's consent, (2) shared DM - both clinician and patient decides or (3) customer choice - patient decides alone based upon the information shared by the clinician (Demiris, 2006). Hence, knowledge-shared DM can be categorized into three types being:</td></tr>
<tr><th>Doctor-based DM</th><th>Participative DM or shared DM</th><th>Patient-based DM</th></tr>
<tr><td>Currently clinical DM is determined less by the physician's education/experience but based more on as per case evaluation and evidence-based medicine (EBM). Physicians' knowledge and experience are weighed alongside scientific evidence through randomized controlled trials, medical literature and clinical guidelines, etc. for medical DM. Since knowledge diffuses frequently in physician's physical interactions, such interaction influence one doctor's reliance on other colleagues' opinion for clinical solutions (Mascia & Cicchetti, 2011),</td><td>Participative DM or shared DM is, since 50 years, a multi-disciplinary research (Russ, 2011) to improve HC service quality (Owusu-Frimpong et al., 2010). Shared DM is informed patient-centred DM; dependent upon a patient's treatment based beliefs and preference. Patients learn more about care while they interact more with their physician (Maizes, Rakel & Niemiec, 2009). Participative DM is a collaborative sharing responsibility at a work place to make a decision (Russ, 2011).</td><td>Ng, Lee, Lee and Abdullah (2013) introduced the term "patient based DM" where a patient consults the physician to assess the personal values of every attained option amongst options during complex DM process. It is the researcher's opinion that Ng, Lee, Lee and Abdullah's (2013) term "patient based DM" best aids in defining Owusu-Frimpong, Nwankwo and Dason's (2010)'s view that younger patients prefer to participate during collaborative DM to decide on a treatment.</td></tr>
</table>

Demiris' theory of choice (2006), mentioned in Table 2.2, was also supported by another study (Puschner *et al.*, 2010) stating that effective DM relies on accurate information of benefits and risks, of outcomes and values. Such information is decision-related data. Values are patient's

preferences that lead to a decision over a particular treatment's side-effect/s. The decision's outcomes are the status of a patient's health and treatment costs (Puschner *et al.*, 2010). This researcher's critique, depicted in Figure 2.2, helped the researcher form the classification of knowledge-shared DM, considering the fact that information is also related with knowledge as described in various studies, explained earlier (Hsia, Lin, Wu, & Tsai, 2006; Rahman, 2006; Antonio & Lemos, 2010; Hicks *et al.*, 2007; Alwis & Hartmann, 2008). Demiris' theory of choice-making supports how DM will occur. DM is active when considering what treatment to pursue. Hence, treatment DM is of three types being: (1) paternalistic DM - doctor only decides, (2) shared DM - both patient and doctor decides and (3) informed DM - patient decides on a treatment (Puschner *et al.*, 2010).

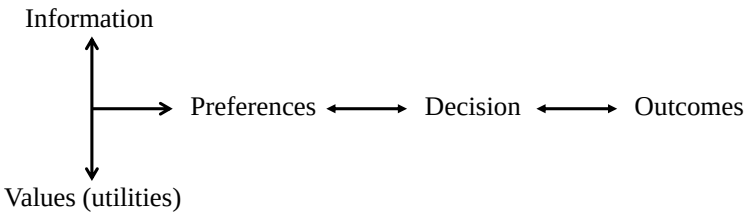


Fig 2.2. Decision-Making Model

This thesis could assess the effect of knowledge sharing on medical DM quality since:

1. Worsening patients' conditions in general wards call for patient management requiring practitioners' DM quality,
2. Future research calls for assessing influencing factors behind practitioners' performance of clinical DM, i.e. choice making from alternatives (Hancock & Durham, 2007) and
3. Research needs to examine what constitutes a clinical decision quality (Demiris, 2006).

As per the researcher's opinion; knowledge sharing quality is assessable as an influencing factor for DM, as expressed by Hancock and Durham (2007) and as supported by another study (Mansingh *et al.*, 2009) mentioning that KM environment integrates individual and organizational knowledge to enable DM. DM is facilitated by knowledge balanced between tacit and explicit knowledge (Abidi *et al.*, 2005; Baskaran, Bali, Arochana, Naguib, Dwivedi & Nassar, 2005; Wright & Sittig, 2008), so doctors need evidence-based practice for DM (Willis *et al.*, 2010). Another reason why DM is supported by knowledge is that, as a case study research reported (Mansingh *et al.*, 2009) doctors and staff can perform DM by discussing patients' cases supported by knowledge based on information from electronic health records (EHRs). Here, DM involves uncertain probabilistic view, where possible actions are common-sense knowledge based

interpretations, experience and the power of reasoning, i.e. tacit knowledge, available information (i.e. explicit knowledge) and the contextual constraints in a work setting (Anya, Tawfik, Nagar & Amin, 2010). Hence, the just-critiqued literature supports the view that DM activities are based on information transfer, discussions and treatment based DM through harmonious knowledge sharing where ideas, values, fears, assumptions, etc are shared (Slavoljub, 2006).

Slavoljub's theory (2006) proves how knowledge sharing facilitates DM and hence, adds value to Puschner *et al.,* (2010) DM theory to better understand what constitutes a DM quality, as recommended by Demiris (2006). As another study stated (Hancock & Durham, 2007), the experienced have a knowledge structure for DM where some DM applies intuition, i.e. tacit knowledge. A DM process is a learning process where new knowledge is created and distributed at an individual/organizational level. Tacit knowledge is converted to explicit knowledge, during knowledge shared DM process based on the problem solving requirements, also referred to as problem-oriented DM (Rantapuska & Ihanainen, 2008). As per the researcher's opinion, the just-mentioned literature set out a call for future research to be conducted in clinical DM facilitated especially by knowledge sharing. In conclusion as supported by another study (Lauring & Selmer, 2011), knowledge sharing improves DM and performance, since knowledge sharing facilitates cognitive resources with a community, through the conversion process (i.e. externalization, combination, internalization and socialization). Hence knowledge sharing is fundamental for DM (Rantapuska & Ihanainen, 2008).

ICT also facilitates knowledge shared DM, where advancements in ICT, e.g. social networks, have surfaced since past two decades (Anya *et al.,* 2010). Another example of how ICT facilitates DM is clinical decision support (CDS) - beneficial but not widely adapted since such technology has challenges in its integration with work-flow. Therefore, CDS has had a low impact on DM. CDS is explicit knowledge coding/storing in repositories. It is researcher's opinion that HC should shift to utilizing a more cost effective tool to collaborate in DM (Wright & Sittig, 2008). Hence, ICT supported social networks facilitated DM in the presence of the mediating role of knowledge sharing, i.e. both tacit and explicit knowledge, between social networks and DM. CDSs falls short, however, since only explicit knowledge is shared.Clinical DM is performed in a cyclical manner where a professional applies knowledge to verify prior hypothesis to get closer to the final decision. Hence HC knowledge is not a resource but a service where HC quality is improved by utilizing a patient-centered and team-care based KMS (Abidi, 2008). In addition to CDS, even though decision aids facilitate DM (Puschner *et al.,* 2010) to reduce medical errors

(Pezzo & Pezzo, 2006); such technology is a failure overall as revealed by a study that reviewed 200 decision-aids (Puschner *et al.*, 2010). Such technological aids deprive physicians from thinking. Hence, such technology is notwidespread (Pezzo & Pezzo, 2006).

As a qualitative study reported (Hara, Solomon, Kim, & Sonnenwald, 2003), collaboration is a human behaviour of coordination and cooperation to share a creation, to achieve common goals, based on shared understanding, between commonly benefiting inter-organizationally and organizationally structured relations unachievable individually. Geographic distance hampers collaboration, but Web 2.0 enables CDS collaborative environment (Wright & Sittig, 2008) where HC outcome is measurable using quality, cost and its accessibility. Telemedicine can positively impact the quality and provide access to HC with lower costs. This, economical mean, helps increase the virtual networks size, facilitated by ICT to lower the geographical gap. ICT and trust facilitates collaboration by connecting parties to pursue joint ventures. Even though ICT is cost effective and reduces geographical limitations, there are collaboration-based challenges when transferring tacit knowledge through storytelling, intuition or emotions is ICT supported; unlike explicit knowledge sharing (Paul, 2006). Up to this stage, this chapter reviewed literature pertaining to medical DM in affiliation with knowledge sharing, hence making way for this study to voice HC KM and KMS.

Literature review has expressed theory-based collaborative knowledge sharing during patient care to prevent loss of organizational knowledge by organizations internally transferring knowledge via experience and dialogue. This consumes time (a scarce resource), which is not compatible with modern business world (Hicks, Dattero & Galup, 2007). Knowledge sharing is measured by explicit and implicit knowledge sharing. Implicit knowledge sharing is sharing of know-how, know-where and know-whom as well as education and training-based expertise (Lin & Chang, 2008). Knowledge sharing improves collaboration (Mancilla-Amaya, Samin & Szerbicki, 2010). Collaboration, fundamental in telemedicine, is a joint venture between two or more participants aiming for an outcome less likely achievable if conducted alone. HC collaboration is collective diagnosing during patient-care joint knowledge is constantly built to expand medical explicit and tacit knowledge (Paul, 2006).

When examining collaboration from a KM point of view (Paul, 2006), collaboration requires complex and interactive knowledge sharing, trust, personal beliefs and other assets shared without achievement guarantees. Knowledge sharing is a pre-requisite of collaboration. Collaboration

exists in a VC (Huq, 2006) where new members participate to learn. Such HC collaborative process involves explicit and tacit knowledge. Yet, utilization of collaboration is so far low in HC (Hara *et al.*, 2003). Also, knowledge sharing facilitates DM since: (1) members' collaboration and cooperate through communication and coordination and (2) there is a difference in knowledge level between members (Feng & Gao, 2009). HC research has stressed highly distributable and quickly expandable local knowledge. Local knowledge is important, hence preferred, for medical DM. HC research prefers cross-organizational collaboration and knowledge, sharing, to improve medical DM quality. HC process for medical DM is a collaborative process since HC professionals share tacit knowledge and explicit knowledge to attain better clinical quality outcomes. Also, medical DM lies in the context of proximal knowledge (Nicolini *et al.*, 2008).

2.2.6 HEALTHCARE VITUAL COMMUNITIES NEED KNOWLEDGE-SHARED DECISION MAKING

This section describes the role of knowledge sharing in a VC KM to facilitate medical DM since DM research area has not yet systematically explored the social context of DM (Bonaccio & Dalal, 2006). Knowledge sharing occurs in a VC, for DM, through participants' motivations for knowledge sharing (Plan & Leidner, 2003) since knowledge is embedded and is constructed within the community of relationships and interactions. Here, informal relationships share common practices where within such a person-based network, people help one other to solve problems (Plan & Leidner, 2003). Social relationships and interactions, in a CoP, are information relations sharing common practices, where people help each other solving problems (Plan & Leidner, 2003).

A harmonious bonding of tacit and explicit knowledge facilitates DM (Abidi *et al.*, 2005; Baskaran *et al.*, 2005) where both types contribute to effective DM (Nicolini *et al.*, 2008) since both knowledge types are valued in a CoP (Bentley, Browman, & Poole, 2010). Knowledge is shared and crafted by members learning from one another (Bentley, Browman, & Poole, 2010) through KM tools. For example, social networking (Chua, 2004) or CoP (Parrott, 2007) – referred to as collaborative tools, is a newly emerging research area (Chua, 2004). Here collaboration creates know-how (Lindkvist, 2005) and makes a CoP hold together thanks to common interest and shared collaborative learning (Hara & Hew, 2007). Such knowledge communities manage content, user collaboration and allow searches (The Center for Association Leadership [ASAE],

2010). Collaboration is practice-based learning, i.e. HC workers interrelate learning, practice and peer input through scrutiny where organization performance is positively influenced. HC professional's knowledge, which stems from a HC professional's practice that is updated by evidence-based research and is shaped by re-considerations attained through tacit knowledge based suppositions. In HC, physicians gain education through wealth of health data, mentorship and experience and better reflect their practices through dynamic shared learning. Here in HC peer input, practice and learning are all interrelated to improve individual and organizational performance especially during peer scrutinizing scenarios. Knowledge is embedded in physicians' practice supported by research based on evidence through process of rethinking tacit assumptions (Bentley, Browman, & Poole, 2010).

Web 2.0 enables virtual initiatives and knowledge sharing, which constitutea new interest in HC (Wright & Sittig., 2008). Thanks to Web 2.0, clinical cases are discussed to share experiential knowledge and make recommendations. Hence, HC VC practitioners share, fuse, validate and transform knowledge to practice. This knowledge is practice-based but not evidence based, even though it gives focuses on best clinical practices. Medical practitioners need experiential knowledge supplemented by evidence-based knowledge from medical literature, for example PubMed (Stewart & Abid, 2011). Knowledge networking occurs in VCs (Rahman, 2006) making CoP important since knowledge is inseparable from context and communal conversations, between knowledge seekers and contributors (Plan & Leidner, 2003). Rise of e-Health led to electronic peer-to-peer community, based on a common interest to share experience, whose members emotionally support and inquire among each other. Such networks existed before Internet, i.e. at work sites, bulletin boards, etc. On the World Wide Web, with thousands of HC VCs, a VC is an electronic self-support group, for example, new groups (email messages exchanging), discussion forums, chat rooms (Eysenbach, Powell, Englesakis, & Rizo, 2004) or Weblog or blog (Efimova & Hendrick, 2005) to transform HC to e-Health (Eysenbach *et al.*, 2004).

CoP is an informal entity valuing both types of knowledge (tacit and explicit) where knowledge is a collection of their experience making CoP a social education structure where hard questions and truth is encouraged (Bentley, Browman, & Poole, 2010). Tacit knowledge is shared through interpersonal means, while a structured process or technologies facilitate the explicit knowledge sharing. In a social network, if the interactions between inter-relationships increase, them the same goes for knowledge sharing. Hence social networking has become cost effective, easier and

even faster (Chang & Chuang, 2011). Knowledge is shared during practices amongst community members where juniors trust the community for doing the right thing (Lindkvist, 2005). Virtual teams, for example, virtual conference or email, are popular considering that more ideas are generated through team interactions rather than face-to-face interactions. Empirical research has yet to investigate the relationship between team DM and communication; i.e., use and selection of media. The utilization of communication technologies facilitates organizations to support their teams to communicate virtually (Alge, Wiethoff, & Kleinc, 2003). Hence, as supported by this critiqued literature, and researcher's opinion, VCs facilitate knowledge sharing quality.

This section cites the challenges in tacit knowledge sharing, expressed in published literature, which, as a result, demand for utilizing a CoP. The properties of tacit knowledge (intangible, invisible, dynamic and actionable nature) are the factors that hinder knowledge sharing (Bates & Robert, 2002). Tacit knowledge is acquired through personal experience; reflection, internalization and talent, to constitute as personal components of sharing tacit knowledge (Antonio & Lemos, 2010). Even though language plays a vital role in knowledge sharing, this factor is inapplicable to tacit knowledge sharing, since the action of doing something may be sometimes impossible to be expressed verbally. Another study (Lindkvist, 2005) reported that tacit knowledge is unable to convert to explicit knowledge in a CoP, since one knows more than one can tell. When a CoP assists in problem solving (Bates & Robert, 2002; Hara & Hew, 2007), new tacit knowledge is created (Birasnav *et al.*, 2009). However, as per the researcher's opinion, it is not surprising why language plays no key role in tacit knowledge, as stated by Antonio and Lemos (2010). If this knowledge is codified, by keeping log of past experiences, new contextualized tacit knowledge is convertible to explicit knowledge. This logic is possible through the use of CoP, which proves that tacit knowledge can be converted to explicit knowledge in a CoP – as per researcher's opinion.

Typical clinical practice relies on knowledge that is based on opinions of collegues. Only tightly knit social networks facilitate knowledge sharing especially when HC processionals work side-by-side (Nicolini *et al.*, 2008); E.g. social networks such as Wiki, blogs (Magnier-Watanabe *et al.*, 2010), Facebook, Twitter or LinkedIn (Komito, 2011). Such platforms fall under KMS category where IS are applied to organizational KM (Magnier-Watanabe *et al.*, 2010). There is a lack of means for knowledge sharing among practitioners for DM (Hancock & Durham, 2007) since DM requires good theoretical knowledge. Here, confidence, knowledge, experience, relationships, context, hierarchy, level of a responsibility and competence are considered in the

DM process. Since clinical DM is evidence-based (true and valid proposition) and knowledge sharing facilitates medical DM quality (Hancock & Durham, 2007), medical DM quality becomes the core HC research problem in this thesis. E.g. of evidence is randomized control trials (RCT) (Hancock & Durham, 2007). RCT is an experimental study and research tool where people are randomly given one of many clinical treatments when participants' health are being studied during clinical exercises for example "presentation strategies", "diagnostic test", etc. (Stolberg, Norman & Trop, 2004).

Management, culture and technical infrastructure support a CoP. For an organization to foster a knowledge sharing culture, it should first identify a CoP, then develop it and finally practice it within the organization (van der Maijden & Jansen, 2010). Such a CoP acts as a bridge between research and practice as well as differing. In HC when professionals, i.e. clinicians, nurse and physicians converge in best practice teams they become a learning community that produces new knowledge hence improves effectiveness (Bentley, Browman, & Poole, 2010).

Up till now this study critiqued literature to establish the relationship between knowledge sharing and DM (for example Hancock & Durham, 2007). The reason why this discussion mentioned the term, VCoP is that CoPs facilitate know-how (Perrott, 2008). The next section sheds more light on the term VCs through a critiqued literature review on social networking and VCoP.

2.3 DIFFERENCE BETWEEN SOCIAL MEDIA, SOCIAL NETWORKS AND VIRTUAL COMMNUITY

Since the past section, the researcher defined social networking, social media and VC, the three terms that have a fine relationship between one another. Now that this thesis explained all its research areas, i.e. knowledge sharing, medical DM and VCoP, the next step for this thesis is to explain the varying difference between terms like social media, social network and virtual community, before moving onwards. Even though these terms sound alike, they differ in meaning. Distinguishing a relationship between social media and social networking is important before defining a VCoP.

Upon the researcher's observation, there are three terms widely used in current literature without a clear distinction of their similarities and differences. These three commonly associated terms are social media, social networking and VC:

- ***Social media*** - is a means for decision makers to search ways to increase organizational profits. The origin of social media initiated in 1979 with Usenet (discussion system for posting public messages) and evolved to open diary system. Internet acts as a bulletin board to exchange resources which transformed 1990s blog based homepages to 1995's e-commerce applications, for example Amazon or eBay. The social media trend transformed the Internet from an information facilitating platform to a virtual content sharing system (Kaplan & Haenlein, 2010).

- ***Social networks*** – DM is made possible using social media via social networking applications like Wikipedia or YouTube. In 2003, Internet introduced MySpace and Facebook in 2004, which led to the creation of the term "social media" (Kaplan & Haenlein, 2010). Web sites, like Facebook, are social network sites where colleagues discuss professional challenges on sites/blogs, for example QuantiaMD – composed of 125,000 US physician members ((Modahl, Tompsett, & Moorhead, 2011). Application of Web 2.0 in HC is medicine 2.0 or health 2.0 for collaborating and sharing experiences via social networks or online forums and blogs (Stewart & Abid, 2011). Other examples are: MedSpace, DocCheck, doctors.net (Law, 2011), Clinical Village, DocnDoc, DocBoard, DoctorsHangout, DrConnected, iMedExchange, Medical Passions, MedicSpeak, medXcentral, MomMD, New Media Medicine, Ozmosis, Relax Doc, StudentDoc and Tiromed (MD Search.com, 2011). The emergence of social networking application, like Facebook or LinkedIn, opened new discussions in VCs (Konito, 2011). Social networking first emerged in 1991 (Bates & Robert, 2002) and gained corporate attention (Nicolini *et al.,* 2008) to be considered as new ICT models (Rahman, 2006).

- ***Virtual Community*** - is a group of members who interact using ICT; for example video conferencing, Internet relay chat and private chat rooms (Demiris, 2006). By 2004 Yahoo enlisted 25,000 HC VCs (Eysenbach *et al.*, 2004). Such knowledge-based VC reside on the Internet, where a group of people who have common goals and a shared interests interact with each other to generate new knowledge during problem solving, exchange knowledge and enhance communication (Lai, 2010). They share resources and support one another (Demiris, 2006) with the know-how produced by the dynamic knowledge sharing and sociability in a CoP (Bentley, Browman, & Poole, 2010). Considering that a community's face-to-face interactions are costly, an online/VC communication is proven

advantageous (Hara & Hew, 2007). A HC VC is composed of HC providers, physicians and patients where, health cases or treatment issues are discussed while documents are shared and experts are consulted (Demiris, 2006).

In such a community, engagements of relationships are trust-based reciprocal ties, communication-based and accountability-based (Bentley, Browman, & Poole, 2010). CoP roots back nearly two centuries in villages, and the term originated in sociology, anthropology and other social sciences. A CoP is where peers consult each other in a social learning structure (Bentley, Browman, & Poole, 2010). In HC, CoP is a new concept (Bentley, Browman, & Poole, 2010). CoP is known to have reduced operational cost in HC like hospital visits or tests or improvement of patient satisfaction has shifted to a home setting keeping HC professionals updated with their patients (Demiris, 2006). CoP gained respect in recent published literature, for example current literature highly prioritized the need to assess VCs to improve HC performance (Lai, 2010) and till now CoP remains dominant (Lindkvist, 2005). A community is important since it is a knowledge resource (Plan & Leidner, 2003). Sharing occurs in such a social setting, which is aided by: (1) tradition and rituals of sharing, (2) sustained sense of belonging within a group and (3) shared moral responsibility. CoPs form on common ground for example professional disciplines or community of interests where value is gained through members' participation. Participants in VCs interact by communication systems, instead of the face-to-face interactions, without reward systems for knowledge sharing where motivation is mandatory to sustain participation. VC is a social aggregation based on feelings and relations between members' electronic communications (Rahman, 2006). VCoP is also a participants' socio-technical network (Ardichvili, 2008) and a tool, in an ICT supported cyber space, for collaborative trusting activities within social relationships for problem solving, knowledge sharing build culture and social awareness (Huq, 2006).

A VC is based on technological software, for example chat room, bulletin board or Listserv (Wang, Yu & Fesenmaier, 2002; Gupta & Kim, 2004). Gupta and Kim (2004) classified three types of VC: (1) VC attributes (i.e. shared goals, shared resources, population size, etc), (2) support software (for example Listserv, bulletin boards, etc) and (3) relationship with physician CoPs. Listserv is also a VC (Jones, 1997; Blanchard, 2008; McLellan, 1998). Facebook provides a good example of Gupta and Kim's third VC type, i.e. relationship with physician CoPs, considering that such a VC is used for

personal professional marketing and patients' communication. Physicians are concerned if such sites ensure correct information (Modahl, Tompsett, & Moorhead, 2011). Another example of HC VC is 2011's "plastic_surgery@yahoogroups.com", which is composed of 1,290 plastic surgeons' (Foong & McGrouther, 2010). A CoP is customer-centered and attains scarce expertise allowing all patients to attain standard services (Nicolini *et al.*, 2008).

In addition, a CoP is a group that shares common concerns and gains deeper knowledge through the integration of three structural elements: domain, practice and community. Domain is composed ofcommon concerns that organize members to collaboratively seek a solution over a passionate topic. Commitment is encouraged from this passion (Bentley, Browman, & Poole, 2010) where passion is devoted emotion that encourages more time investment on participation to develop a knowledge base within a VC, in addition to encouraging participation (Faraj, Jarvenpaa & Majchrzak, 2011). A CoP is measured using push and pull network. Pull networks refer to the focus on reaction time when knowledge is requested while push network concentrates on employee professional skills development. Push networks are more effective for knowledge transfer (van der Maijden & Jansen, 2010). Even though VC can be composed of HC professionals, patients, members of the public or caregivers, etc; a virtual team is made up of only HC professionals ensuring continuity of care where opinions, messages and resources are shared (Demiris, 2006). SERMO is a CoP for licensed physicians who post their findings, invite case-based challenges, discuss and collaborate in projects. An example of a consumer CoP is "the life raft group" - consumer and patient community that keeps updated with treatments, drugs and research relative to cancer disease. An example of an association-based community is "American Cancer Association" - to support and share common interest and experience related with cancer. Revenue-based networks such as "The Doctor's Channel" are communities where participants share knowledge through videos. Another example is "WenMD" – to share knowledge with an average of 41.8 million visitors monthly and aims to assists members making wellness and treatment decisions (The Center for Association Leadership [ASAE], 2010).

Published literature stared discussions on CoP for learning through acquired knowledge from expert to novice since 1991. By 1998, CoP concept refined to knowledge creation and sharing between participants. CoP was re-defined as managerial tool in 2002, i.e.

group of people sharing knowledge to solve problems and explore ideas on common passion to them becoming a CoP. In addition, it was suggested that CoP may be seen as a tool to benefit an organization. Hence, in 2002 after assessing CoP effectiveness, research concluded that this is still a research grey area (Ranmuthugala *et al.*, 2011). Now that this thesis, explained the emerging importance of CoP in HC and overall published literature as well as its ability to facilitate knowledge sharing and problem solving, the next step in this research is to critique the literature pertaining to knowledge sharing in VCs deeper.

2.3.1 DEFINING SOCIAL MEDIA USING HONEYCOMB FRAMEWORK

Social media can also be defined using the Honeycomb framework's seven functions: (identity, presence, conversations, sharing, reputation, relationships, groups and presence). Diverse social media activities focus on different sets of functional blocks. The art of sharing, modifying and discussing user generated content is possible between individual and communities through interactive platforms employed by social media, that make social media powerful, for example Six degrees, Twitter, Facebook, LinkedIn and blogs (for example "Technorati"). The researcher's review of the current VC, social networking and social media based literature performed through a review of journal articles from 2004 to 2012 and a search using Google search engine and Brunel E-library, led the researcher to pinpoint the Honeycomb framework as most appropriate framework to define social media and depicted in Figure 2.3 (Kietzmann *et al.*, 2011). As per the seven functions depicted in Figure 2.3:

1. ***Identity*** - is the participants' willingness to reveal their identity within a social media tool, for example name, gender, location, etc. Facebook is built around user identities.
2. ***Conversations*** - are the extent of users' communication for all possible reasons with a social media tool.
3. ***Sharing*** - is means to interact to facilitate conversations within social media and is the extent of receiving, distributing and exchanging content,
4. ***Presence*** - when one user is aware of the accessibility (availability) of another, i.e. his/her location in VC and/or real life,
5. ***Relationships*** - is the extent of one user related to another hence associating two or more users so all can converse, for example association of users to communicate using Skype,
6. ***Reputation*** - reflects trust since it is the ability to identify one's own and anthers' standing in a social media context, for example rating on YouTube and "likes" on Facebook, etc.

7. ***Groups*** **-** define the extent users can form sub/communities, for example 150 is cognitive limit of social relationships. A higher number of sub/communities is or is not achievable and can be facilitated by relationships management tools (Kietzmann *et al.*, 2011).

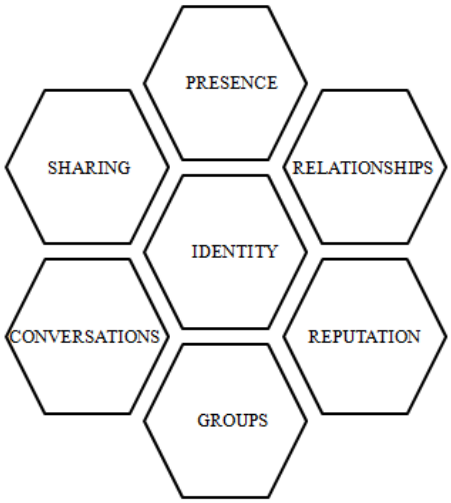


Fig 2.3. Honeycomb framework
Source – (Kietzmann *et al.*, 2011)

Variances in the application of differing blocks were observed in two cases, for example Facebook, *Linked*In. Since not all seven functional blocks of the Honeycomb framework, apply to every social media platform, social media tools focus not only on only one but on three to four blocks, for example Facebook and LinkedIn - Figure 2.4. The darkest shade identifies the highest functional level. Lighter shade represents a less functional level. No shade identifies absence of any functionality (Kietzmann *et al.*, 2011).

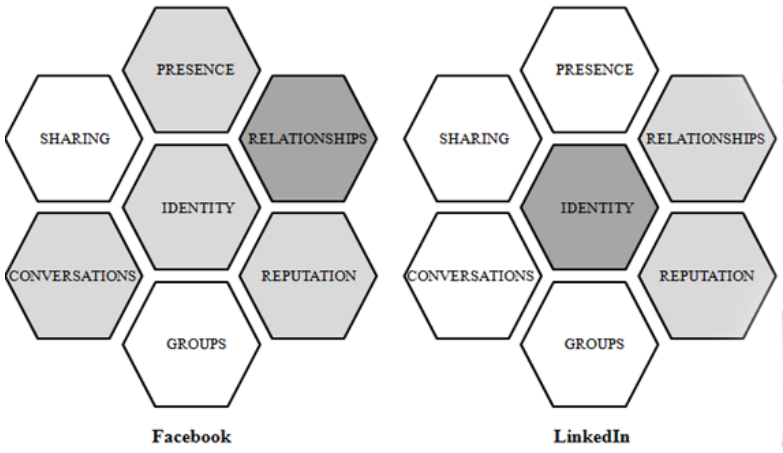


Fig 2.4. Honeycomb framework functionalities for Facebook and LinkedIn
Source – (Kietzmann *et al.*, 2011)

There is a fine relation between VCs, social networking and social media. An example of a social media development is social networking web-based applications. An example of social networking virtual application is Facebook, which is a stimulant (i.e. boosting agents), for a VCoP (Komito, 2011). Hence, based on the analyses of this thesis, a VCoP is hosted through social networking application/s. These three terms are so closely related to each other that making a difference between them was essential.

2.3.2 DEFINING A VIRTUAL COMMUNITY OF PRACTICE, USING 21 STRUCTURING CHARACTERISTICS FRAMEWORK

An appropriate VC can be identified from a plethora of social media platforms using the same process that is applied to develop VCs. This study decided to adapt the 21 Structuring Characteristics from Dubé *et al.,* (2006) since, as per the knowledge of the researcher's review of VC related literature, these characteristics conform well with this study's context and setting as this framework model caters to VC development and defining a VC. The 21 Structuring Characteristics are organized into four technological environments being:

1. ***Demographics*** – described by orientation, age, life span and level of maturity,
2. ***Organizational context*** – characterize the creation process, boundary crossing, environment, organizational slack, degree of institutionalized formalism and leadership,
3. ***Member characteristics*** – based on size, geographic dispersion, members' selection process, members' enrolment, members' prior community experience, membership stability, members' ICT Literacy, cultural diversity and topics relevance to members as well as
4. ***Technology environment***, i.e., a degree of reliance on ICT and ICT availability as depicted in Table 2.3 (Dubé *et al.,* 2006).

Each of the 21 just-mentioned Structuring Characteristics is depicted in bold and defined in Table 2.3 for greater clarity. Table 2.3 organizes and defines the 21 characteristics. For example, age, which is part of demographics of Table 2.3, is composed of two properties: young and old where a CoP is young if less than one year but considered old if it exists more than five years. These properties were the bases upon which this framework is customized in the next section.

Table 2.3. 21 Structuring Characteristics framework to develop a Virtual Community of Practice

DEMOGRAPHICS	ORGANIZATIONAL CONTEXT	MEMBER CHARACTERISTICS	TECHNOLOGY ENVIRONMENT
Orientation -	Creation process -	Size -	Degree of Reliance on ICT
VCoP created for: **Operational** purpose or **strategic organizational** purpose	**Spontaneous** - if few interested participants jointly developed a CoP **Intentional** - if management selected members to perform a purpose.	**Small** - very few members. **Large** with more than 1000 members	**High** –VCoP utilizes ICT 90% of times with one annual face-to-face-meeting. **Low** monthly face-to-face meeting
Age -	Boundary crossing -	Geographic dispersion -	ICT availability -
Young – CoP is <1 year. **Old** - CoP is > 5 years.	**Low** - for knowledge sharing if members are within one unit of same organization. **Medium** - if members interact across units but within the same organization. **High** - if members cross units/ organizations	**Low** - members are in same physical location, M**edium** – members are scattered throughout a city/state or H**igh** – members are dispersed worldwide.	**High variety** –VCoP have wide range of assets. **Low variety** - VCoP have only single functioning software for managing documents and hosting discussions.
Life span:	Environment -	Members' selection process	
Temporary: - VCoP is initiate for a single purpose or **Permanent**| - VCoP is for information/ knowledge sharing,	CoP is shaped by its organizational environment that is either: **facilitating** or **obstructive**.	**Closed membership** - for control like specific criteria or **Open membership** - for anyone to join.	
Level of maturity -	Organizational slack -	Members' enrolment -	
Potential| - when members plan CoP development. **Coalescing** - setting CoP values, after its start-up. **Maturing** – members trust and creating new knowledge, **Stewardship** – upholding CoP momentum. **Transformation** –CoP re-start or phase-out.	CoP resources for participants to learn in order to sustain a community where is resources are **high** then CoP is more likely facilitated than when resources are **low**.	**Voluntary** - members join when interested, **Strongly encouraged**: joining is compulsory as made by management:	
	Degree of institutionalized formalism -	Members' prior community experience -	
	Invisible - visible to group within organization. **legitimized** - permitted, resources or **Institutionalized** - integrated with organizational structure.	**Prior experience** e.g. face-to-face and then virtual or **None:** no experience in VCoP.	
	Leadership -	Membership stability -	
	Assigned during CoP initiation i.e. members take on leadership roles within a CoP.	**Stable** – like a closed community or **Fluid** – like an open community.	
		Members' ICT Literacy	
		High only few members are inexperienced with ICT **Low:** many members are inexperienced with ICT	
		Cultural diversity	
		Homogenous members are	

		from similar culture and profession even though differing organizations **Heterogeneous:** members differ in culture, background, organizations.	
		Topics relevance to members	
		High Topic is important and relevant with define objectives and themes in mind. **Low:** Topic is not important or relevant with no defined themes in mind.	

Adapted from Dubé *et al.*, 2006.

2.3.3 RATIONALE TO CUSTOMIZE AND APPLY FRAMEWORKS TO REDEFINE SOCIAL MEDIA AND VIRTUAL COMMNUITY OF THIS THESIS

This thesis applied the Honeycomb framework and customized the 21 Structuring Characteristics as inspired by Kaplan and Haenlein's three criteria (2010): i.e. target population, medium target population uses and a suggestion that joining existing application is better than building a new one considering that (1) social media applications hamper members participation in all applications since dozens take birth daily and (2) certain social media attract certain groups. Hence, these three criteria can be summarized as this thesis's research scope, context and pinpoint a VC for testing this thesis's conceptual framework (introduced in Chapter three) as observed from Chiu *et al.*, (2006). This study applied Kaplan and Haenlein, (2010) steps as follows:

- ***Research Scope*** - i.e. target population = VC physicians - closed groups
- ***Research Context*** - 2nd criteria, i.e. medium it uses = HC closed VC
- ***Pin-pointing a VC*** - 3rd criteria: to select existing application over new one = this thesis can pinpoint an appropriate social media platform via Honeycomb framework. This finding will be a pre-requisite for pinpointing a VC medium.

2.3.3.1 Applying the Honeycomb framework to define Physicians' Professional virtual community to identify a Social Media platform:

As per the researcher's opinion, the Honeycomb framework can be applied to define a professional physicians' VC, a requirement as per Kaplan and Haenlein's three criteria for framework customization. When selecting a social media platform, six, out of the seven

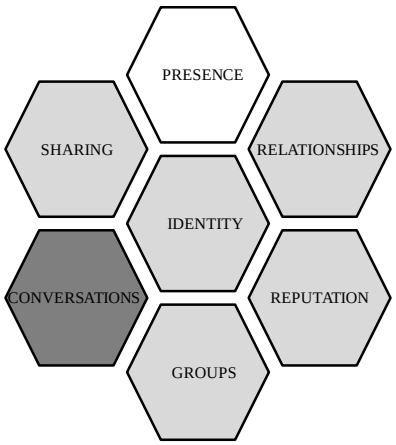
Honeycomb framework elements, are important for physicians based on the following rationale being:

1. ***Identity***: is important since a participant prefers to associate his/her identity with a community's identity - (Bhattacharya & Sen, 2003).
2. ***Repute***: is important since it is associated with identity (Austin, 2003).
3. ***Sharing***: of resources is important since it is facilitated by trust that is reflected by repute (Kietzmann *et al.,* 2011).
4. ***Relationship***: is also important since the mutual interest to share relates one physician to another during knowledge sharing, problem solving or experience seeking (Kietzmann *et al.,* 2011).
5. ***Group***: is where knowledge sharing and problem-solving occurs and is the reason for joining a trusted group (Rao, 1998).
6. ***Conversation***: is most important since it is essential for knowledge sharing during discussions (Kietzmann *et al.,* 2011) and during interactions (Reckrey *et al.,* 2011); where interaction, the word as the variable, social interaction ties, is from the structural dimension of the social capital theory (SCT) (Chang & Chuang, 2011).

Presence (the seventh criterion) was not selected since:

1. Within VCs knowledge contributors are aware of free-riders who gain knowledge but do participate in knowledge sharing. Still knowledge contributors perform knowledge sharing (Wang & Lai, 2006).
2. It is fine if a participant observes silence and only listens in a VC making presence irrelevant as it is un-necessary to know participants' availability, considering that knowledge sharing is an act of participants' convenience (Kietzmann *et al*., 2011).

Based on this argument, first, the selected social media platform will be a HC physicians' only professional VC. This is another social media platform, customized as per the scope and context of this study. In addition, HC physicians' only professional VC has been critiqued based on published literature and hence defined by a Honeycomb framework, which has been customized for this study (a new contribution) depicted in Figure 4.2.



Professional VCoP

Fig 2.5. Honeycomb framework for a Professional Virtual Community

As stated in another study, some examples of social media platforms are Facebook, LinkedIn and professional VCs (Kaplan & Haenlein, 2010) as well as Listserv (Blanchard, 2008; McLellan, 1998). Generally speaking; professional VCs are platforms such as Facebook, LinkedIn etc. However, VCoP is a participants' group of discussion with a common purpose. This opinion is similar to Demiris', (2006) who defined a VC by technologies for example Internet, video conferencing, blogs, etc. (Chang & Chuang, 2011). Hence, as per the researcher's opinion, a VC reflects a social media platform and VCoP reflects a social network application. This is why a professional VCoP was deemed as an appropriate social media platform, as depicted in Figure 4.2 (this study's contribution). In conclusion, this study pinpointed Facebook, LinkedIn, Listserv and professional VC as four appropriate social media platforms for selecting VCoPs.

2.3.3.2 Modifying the 21 Structuring Characteristics framework to identify Virtual Communities

As mentioned in the previous section, the Honeycomb framework was applied for a physicians' professional VC, which was selected as a social media platform along with Facebook, LinkedIn and Listserv. However, for the selection of VCoPs based on these four social media platforms, the 21 Structuring Characteristic framework needs customization. Next, each of the 21 Structuring Characteristics were assessed, and rejected or accepted as a criterion for selecting appropriate VCs on social media platforms with associated values that were also justified, as depicted in Table 2.3. For example, one of the accepted characteristic was "Level of maturity" whose accepted value was "Maturing stage". A characteristic was deemed acceptable if it facilitated answering this study's two research questions. Out of 21 characteristics the customized

Structured Characteristic Framework reflected five Structuring Characteristics, being: (1) Level of maturity, with "maturing stage" as the associated value, (2) Size, with "small or large" as its associated value, (3) Geographical dispersion, with "high" as its associated value, (4) Members' selection process, with "closed group" as its associated value and (5) Cultural diversity, with "Homogenous" as its associated value. Just as how Thakkar, Hassan, Hamann and Flora (2008) customized a framework to tackle performance modelling challenges based on an implementation plan, this study too customized first the Honeycomb framework to pinpoint a professional VC platform (Figure 2.5) followed by implementing 5 customized criteria of a 21 Structured Characteristics customized down to 5 Structured Characteristics framework (described in Table 2.4) to pinpoint 9 professional VCs (Table 2.5). In summary, first, the Honeycomb framework was applied to represent a physicians' professional VCoPs. Another study already proposed a Honeycomb framework for Facebook and LinkedIn (Kietzmann *et al.,* 2011) depicted in Figure 2.4. 21 Structuring Characteristics framework was customized to a 5 Structuring Characteristic framework to pinpoint VCoPs based on LinkedIn, Facebook, Listserv and physicians' professional VCoPs. By searching four social media platforms, the researcher came across many VCoPs. Based on the five criteria from the five Structuring Characteristics the researcher pinpointed: (1) 29 LinkedIn VCoPs, 9 Facebook VCoPs, 4 Listserv VCoPs and 9 Professional VCoPs, depicted in Table 2.5.

Table 2.4. Modified 5 Structuring Characteristic framework from the 21 Structuring Characteristics Framework

	21 Structuring Characteristic	Criteria	Selected/Rejected Criteria	Definition of characteristic	Justification for selecting/rejecting a characteristic for this study
Demographics	Orientation	Operational, Strategic	Rejected Criteria	• Explains why VCoP is created, • **Strategic VC** - is to support organization's mission or • **Operational VC** - focuses on daily organizational operations e.g. answering customer's questions (Dubé *et al.*, 2006).	• Assessing orientation, mission or operations of a VC will not help answering the research questions (note 1 and 2 below) since this study is assessing the physicians' SC in relation with DM and with knowledge sharing as a mediator. Hence, this criterion is out of the scope of this study.
	Life Span	Temporary, Permanent	Rejected Criteria	• Explains VC life span, • **Temporary VC** - is alive only to accomplish a task or • **Permanent VC** - is created without duration in mind & for sharing information (Dubé *et al.*, 2006).	• This characteristic is not relevant to this study's research questions (note 1 and 2 below) since based on these research questions, this characteristics does not assess the effectiveness of a VC but pertains to its life span – an irrelevant characteristic for assessing the effectiveness of a VC to perform DM. So this characteristic is out of the scope of this study.
	Age	Old, Young	Rejected Criteria	• Focuses on how long a VC has established. • **Old VC** - is more than 5 year old and • **Young VC** - is less than 1 year old (Dubé *et al.*, 2006).	• VC age is not necessarily correlated with its maturity, since even a young VC could be more mature than an old one (Dubé *et al.*, 2006) so age is irrelevant to answering this study's research questions (note 1 and 2 below).
	Level of maturity	Transformation stage, Coalescing stage, Maturing stage, Stewardship stage, Potential	**Accepted** Criteria – associated value "*Maturing stage*"	• Deals with a part of a 5 stage VC life cycle: • **Stage 1: potential** - i.e. loose set of members just get together to form a VC • **Stage 2: coalescing** - i.e.VC is officially opened and establishing a VC is the main focus • **Stage 3: maturing** - i.e. practices of VC are defined by now where tips sharing is	• Stage 3 of this criterion helps answering this study's research questions (note 1 and 2 below) since this study assesses knowledge sharing quality and DM quality in relation with physicians' SC in a VC.

		stage		transformed to knowledge sharing within an environment of trust and knowing one another, • **Stage 4: stewardship** - i.e. a CoP is facing its greatest challenge to keep up its momentum and • **Stage 5: transformation** - i.e. a CoP needs a renewal due to any possible reason such as leadership change, high intake of members, major practice changes, etc (Dubé *et al.,* 2006).	
Organizational Context	Creation process	Spontaneous, Intentional	Rejected Criteria	• Deals with establishment of a VCoP, • **Intentional** - is consistent establishment of a community by an organization, for example, management, where purpose and members are defined, i.e. top-down approach or • **Spontaneous** - means interest-based VC establishment, i.e. bottom-up approach (Dubé *et al.,* 2006)	• This characteristic is not relevant as knowledge sharing and DM occur within an established VC regardless of what is its creation process.
	Boundary crossing	Low, High	Rejected Criteria	• Deals with information sharing and collaboration across organizational boundaries. • **Low** - is when members are involved only within their own organizational group, • **Medium** - is when group members are involved with other group members but all are part of one organization or • **High** - is when members of different organizations get involved within one VC (Dubé *et al.,* 2006).	• Boundary crossing, whether low, medium or high does not assist in assessing the effectiveness of a VC on knowledge sharing and DM hence has no weight in answering this study's research questions (note 1 and 2 below). So this characteristic is out of the scope of this study.
	Environment	Facilitating, Neutral, Obstructive	Rejected Criteria	• Deals with how a VC is shaped by the organizational environment in which it exists. Environment could be economic, organizational culture like management style. Hence, environment can be: • **Facilitating**, • **Neutral** or	• Firstly, this study needs to assess a HC VC environment and not how a VC's organizational environment shapes such a VC and secondly, what environment a VC is shaped by, in which it exists, has no relation to this study's research aim, i.e. to

				• **Obstructive** to a VC's making and progressing (Dubé *et al.*, 2006).	assess the effectiveness of a VC on knowledge shared DM. • Hence, this characteristic does not assist answering this study's research question (note 1 and 2 below) making it out of the scope of this study.
	Organizational slack	High, Low	Rejected Criteria	• Deals with how a VC is supported by the organization within which it exists, i.e. • **High** - when resources are available to establish a newly started-up VC or • **Low** - when a VC lacks support (Dubé *et al.*, 2006).	• This criterion is irrelevant. Organizational support to establish a VC does not help answering this study's research questions (note 1 and 2 below). So this characteristic is out of the scope of this study, • In addition, identifying what organizational processes motivate successful development of VCoP is a research gap (Ranmuthugala *et al.*, 2011) not pertaining to this study aim, i.e. assessing the effectiveness of VCs on knowledge shared DM. So this criterion has no relation to this study's research questions (note 1 and 2 below).
	Degree of institutionalized formalism	Unrecognized, Bootlegged, Legitimized, Supported, Institutionalized	Rejected Criteria	• Deals with the degree a VC is integrated within the formal organizational structure, • **Unrecognized** - VC is not visible to an organization, • **Bootlegged** - VC is only known by a group, • **Legitimized** - VC was officially permitted by organization, • **Supported** - VC starts receiving organizational resources or • **Institutionalized** - VC holds official status (Dubé *et al.*, 2006).	• Even though, as per the opinion of the researcher, VC's integration, within an organization's structure, plays an important role in assessing the effectiveness of a VC on knowledge shared DM (this study's research aim), it does not assist in answering this study's research questions (note 1 and 2 below) where the evaluated variables are SC, knowledge sharing and DM but not the degree of institutionalized formalism. So, this characteristic is out of this study's scope; however, it is recommended for future research, as per the opinion of the researcher.

	Leadership	Clearly Assigned, Continuously negotiated	Rejected Criteria	• It is the initial outlining of a VC to form a governance structure, which can be • **Clearly assigned** - members are assigned clear roles or • **Continuously negotiated** - members' roles are based on their needs as a VC grows in size and importance (Dubé *et al.*, 2006).	• This criterion is irrelevant since leadership is not part of this study's scope as this study is not concerned with how VC members' roles are set but how effective HC physicians' VCs are in utilizing SC for knowledge sharing and DM. Even though leadership facilitates knowledge sharing (Bryant, 2003), this characteristic does not help answering this study's research questions (note 1 and 2 below). Effect of leadership on knowledge sharing and DM can be a research aim of future research, as per the researcher's observation (also stated in chapter Seven - Conclusion).
Membership Characteristics	Size	Small, Large	**Accepted** Criteria – associated value "*Small & Large*"	• Deals with the count of VC members where this count could be: • **Small** when there are only few members in a group or • **Large** when there are more than 1000 members with diverse interests + lasting relationships + no guarantee to meet all members' needs due to limited knowledge sharing and free riding self-interested members (Dubé *et al.*, 2006).	• This criterion is relevant as a VC is classified by its size, i.e. VC attributes (Gupta & Kim, 2004) and group size influences members' behaviour, determining a social context of a VC (Jones, 1997). Based on this argument size is a VC attribute, similar to other attribute characteristic such as shared goal, reciprocity (SCT factors) (Gupta & Kim, 2004), hence affiliating size with SCT factors. This characteristic relates with physicians' SC, as per this thesis's context.
	Geographic dispersion	Low dispersion, High dispersion	**Accepted** Criteria – associated value "*High dispersion*"	• Deals with the members' physical location such as: • **Low dispersion** - all group members reside in one location like a building making it less feasible for establishing a VC considering that meeting is only possible through face-to-face or	• An associated value of "*high dispersion*" motivates participation (Dubé *et al.*, 2006) and participation is explained by SCT (Chang & Chuang, 2011), which is the independent variable of this study's conceptual framework (depicted in Chapter Three). Hence, this is why

				• **High dispersion** - members are scattered globally which makes this factor a motivating factor for improving members' participation (Dubé *et al.*, 2006).	this characteristic is relevant for this study.
	Members' selection process	Closed, Open	**Accepted** Criteria – associated value "*Closed group*"	• Deals with the member selection process, • **Open group** - is open membership for any participant and • **Closed group** - is open only to members who meet admission criteria based on their characteristics, interests (Dubé *et al.*, 2006).	• This criterion is relevant since a VC needs to be closed to make it available for physician members; and this study aims at assessing the effectiveness of a VC for physicians on knowledge sharing and DM quality.
	Members' enrollment	Voluntary, Strongly encouraged, Compulsory	Rejected Criteria	• Deals with how members are asked to participate that could be: • **Voluntary participation** - where participants decide for themselves on participating based on incentives and contributions, • **Strongly encouraged participation** - if participant cannot turn down an offer to participant since he/she is being asked to do so by management or • **Compulsory participation** - is when VC is built by management and in a top-down hierarchy not participating could lead to unintended negative outcomes (Dubé *et al.*, 2006).	• This study aims at assessing the effectiveness of a VC, based on physicians' SC on knowledge sharing and DM, which does not assess how participation is encouraged within a VC. Hence, this characteristic is irrelevant to this study.
	Members' prior community experience	Extensive, medium, low, none	Rejected Criteria	• Deals with prior experience of members in another VC to henceforth be part of a new VC where experience can vary from: • **Extensive** - when a new VC evokes from an existing VC, • **Medium** - when participants of the new VC were part of groups before or • **Low** - or none when a CoP evolves to a VCoP transitioning from face-to-face meeting to virtual meetings (Dubé *et al.*, 2006).	• This criterion is irrelevant since membership prior experience for joining a VC is not necessary as members only need to be physicians. This criterion has no relationship with membership prior community experience.

	Membership stability	Stable, Fluid	Rejected Criteria	• Deals with membership staying status being either:
				  • **Stable** – permanent membership or
				  • **Fluid** – changing membership over time.
				• Closed groups have more stable membership than open groups (Dubé *et al.*, 2006)
					• Criterion is irrelevant since the length of members' membership in VC is not associated with this study's aim to assess the correlation between physicians' SC and knowledge sharing and DM. Hence, it is irrelevant to this study's scope.

	Members' ICT literacy	High, Low	Rejected Criteria	• Deals with how comfortable members are in using ICT, which is essential for VC, since their comfort level is proportional to articulation
				  • **Low ICT literacy**- is when many are inexperienced with ICT
				  • **High ICT literacy** - is when only few members are ICT inexperienced (Dubé *et al.*, 2006)
					• This criteria is not relevant since comfort level is not an independent variable of physicians' SCT, as per this study's conceptual framework

	Cultural diversity	Homogenous, Heterogeneous	**Accepted** Criteria – associated value "*Homogenous*"	• Cultural influence in assessing a CoP of three levels: national, organizational and professional – i.e. cultural diversity involves transcultural participating community members with varying leadership, management, decision making, diverse language, communication problems causing resistance in participation, varying behaviour of knowledge sharing, etc. causing varying professional cultures in one community evolving cultural diversity to:
				  • **Homogeneous** - where VC members could be from same or differing organizations but share the same culture and profession and
				  • **Heterogeneity** - is when VC members are from differing backgrounds, organizations and cultures, which are an asset for preventing a group think. However, such type of cultural diversity is challenging for knowledge sharing and participating (Dubé *et al.*, 2006)
					• This criterion is relevant since assessesing the effectiveness of a VC on knowledge sharing and DM, is based on a VC of only physicians. Hence it is mandatory, as per this study's case to be homogeneous.

	Topic's relevance to	High, Low	Rejected Criteria	• VC are established with distinct objectives where relevance could be:	• This criterion is not relevant since the topic relevance does not pertain

	members			• **High relevance** – when topics of discussion within a VC could be closely related to the daily work of the VC members or • **Low relevance** – when topics of discussion within a VC are loosely related or far from related to the daily work of the VC members (Dubé *et al.,* 2006).	to the scope of this study but physician members' SC does.
Technology Environment	Degree of reliance on ICT	Low, High	Rejected Criteria	• Deals with sharing knowledge using UCT. However VC could be using ICT at varying levels. Hence: • **High relevance** – refers to when a VC utilizes ICT 98% of the time with one annual face-to-face meeting, • **Medium relevance** – refers to when a VC often uses ICT but its face-to-face meeting occur three to six time annually or • **Low relevance** – refers to when face-to-face meetings are once monthly (Dubé *et al.,* 2006)	• This criterion is not relevant since a VCoP is not assessed for its effectiveness based on its degree of reliance on ICT. This study's aim is to assess effectiveness of physicians' SC on knowledge sharing and DM; hence, this characteristic will not help answering this study's research questions (note 1 and 2 below).Reliance on ICT is not a factor of the SCT reported by Chiu, Hsu and Wang (2006). SCT is an independent variable of this study's conceptual framework portrayed in chapter Three.
	ICT availability	High Variety, Low variety	Rejected Criteria	• Deals with the means for a VCoP to interact besides fax, telephone, etc where array of media can increase participation within a VCoP i.e.: • **Low variety**- is when VCoP has only simple and single function software to manage documents and host discussions or • **High variety** - when it has a wide range of software facilitating synchronous and asynchronous discussions along with document management (Dubé *et al.,* 2006)	• This criterion is not relevant since a VCoP is not assessed for its range of ICT availability but factors of physicians' SC, knowledge sharing quality and DM.

Note 1: This study's Research question 1: What is the extent of the effect of physicians' SC on medical DM quality in a VCoP and through what ways?
Note 2: This study's Research Question 2: What is the extent of the effect of physicians' knowledge sharing quality within the relationship between physicians' SC within a VCoP and medical DM quality?

*Table 2.5.*Implementng the Modified 5 Structuring Characteristics framework to Pinpoint 51 Virtual Community of Practices.

5 STRUCTURING CHARACTERISTIC from Table 4.3's Framework

1 = Level of Maturity, 2 Size, 3 = Geographic dispersion, 4 = Members' selection process, 5 = Cultural diversity

No.	Virtual Community of Practices	Member count	Source	1	2	3	4	5
LinkedIn								
1.	AAPI Health Network-For Doctors Physicians Nurses Hospitals	6,638	(Fernandes, 2008)	√	√	√	√	√
2.	American Association of Physician Specialists	30	(Ramirez, 2008)	√	√	√	√	√
3.	American Board of Physician Specialists (ABPS)	108	(Marzano, 2009)	√	√	√	√	√
4.	American College of Emergency Physicians (ACEP)	1,262	(ACEP Membership, 2008)	√	√	√	√	√
5.	American College of Physicians	3,043	(Majewski, 2008)	√	√	√	√	√
6.	American Doctors	1,462	(B, American Doctors, 2010)	√	√	√	√	√
7.	Astute Physician	35	(Jones, 2009)	√	√	√	√	√
8.	Chinese Doctors	77	(B, 2010)	√	√	√	√	√
9	Doctors Overseas	17	(Fubiani, 2011)	√	√	√	√	√
10.	Indian Doctors	1,844	(B, 2010)	√	√	√	√	√
11.	Indian doctors in UK	12	(Kumar J. , 2009)	√	√	√	√	√
12	Global Physician Network	159	(Tornos, 2008)	√	√	√	√	√
13.	Global Surgeons and Physician Professional Network	97	(ProNet, 2009)	√	√	√	√	√
14.	Japan Medical Doctor Network	28	(Raven, 2011)	√	√	√	√	√
15.	Medical Doctor (MD) Network	11,286	(Ellis, 2008)	√	√	√	√	√
16.	MCMS Physician Members	10	(Dantoni, 2009)	√	√	√	√	√
17.	MDSNe - Medical Doctors Social Networking	35	(Abimbola, 2010)	√	√	√	√	√
18.	Middle East Critical Care Assembly	17	(Kherallah, 2012)	√	√	√	√	√
19.	Middle East Doctors	974	(B, 2010)	√	√	√	√	√
20.	Middle East Pediatric Group	12	(Said, 2011)	√	√	√	√	√
21.	Middle East Spine Doctors	3, 759	(American Spine Center, 2012)	√	√	√	√	√
22	National Association of Physician Advisors	343	(Li, 2009)	√	√	√	√	√
23.	New England Physician Network	16	(McLane, 2010)	√	√	√	√	√
24.	Northshore University Healthsystem Physician Group	14	(Oh, 2011)	√	√	√	√	√
25.	Physician Alignment, integration and Operations	35	(Tamir, 2011)	√	√	√	√	√
26.	Physicians	57	(Kumar A. , 2008)	√	√	√	√	√
27.	The Medical Informatics Physician	1,239	(Wilson, 2008)	√	√	√	√	√
28	The Physician Network	903	(Hinds, 2012)	√	√	√	√	√

29.	UK Doctors	992	(B, 2010)	√	√	√	√	√
Facebook								
1.	American Board Certified Doctors for Egypt (ABCDE) - Associates	779	(Facebook, 2012)	√	√	√	√	√
2.	APPNA Young Physicians	725	(Facebook, 2012)	√	√	√	√	√
3.	Egyptian Women Physicians and Scientists	187	(Facebook, 2012)	√	√	√	√	√
4.	Naturopathic Physicians	578	(Facebook, 2012)	√	√	√	√	√
5.	Physicians + Facebook Marketing - How to do it correctly!	177	(Facebook, 2012)	√	√	√	√	√
6.	PIT Physicians Support Group	304	(Facebook, 2012)	√	√	√	√	√
7.	Residency Ready Physicians	388	(Facebook, 2012)	√	√	√	√	√
8.	Thai American Physicians Foundation	354	(Facebook, 2012)	√	√	√	√	√
9.	Thai Physicians (Mor Thai)	8,259	(Facebook, 2012)	√	√	√	√	√
List Serv								
1.	Canadian Anthropology Society La Societe Canadianne Danthropologe	500+	(Canadian Anthropology Society, 2011)	√	√	√	√	√
2.	KT Clearinghouse		(Canadian Institute of Health Research (CIHR), 2011)	√	√	√	√	√
3.	SurveyMonkey	600	(SurveyMonkey, 2012)	√	√	√	√	√
4.	PNG Doctors Group	40	(PNG Medical Doctors, 2010)	√	√	√	√	√
Physicians' Professional Virtual Communities								
1.	Doc2doc	> 50,000	(BMJ Publishing Group, 2011)	√	√	√	√	√
2.	DocBoard		(Administrators in Medicine, 2012)	√	√	√	√	√
3.	Epocrates	200,000	(Epocrates, Inc, 2012)	√	√	√	√	√
4.	MomMD		(MomMD, LLC, 2012)	√	√	√	√	√
5.	Ozmosis		(Ozmosis, 2012)	√	√	√	√	√
6.	Plastic_survery Yahoo Group	1,290	(plastic_surgery@yahoogroups.com, 2009)	√	√	√	√	√
7.	QuantiaMD	40,000	(Wuantia Communications, Inc, 2012)	√	√	√	√	√
8.	Relax Doc	10,000	(Relax Doc, 2012)	√	√	√	√	√
9.	SERMO	100,000	(Sermo, 2012)	√	√	√	√	√

2.3.5 SOCIAL SCIENCE THEORIES RELATED TO VIRTUAL COMMUNITY OF PRACTICE

VCs are a widespread phenomenon (Chang & Chuang, 2011). Their members report satisfaction by gaining ample from resource sharing by being members of such communities (Foong & McGrouther, 2010). Recent studies have concentrated on CoPs (Chang & Chuang, 2011) using theories like SCT (Oinas-Kukkonen, Lyytinen & Yoo, 2010), SCoT (Chiu, Hsu & Wang, 2006) or technology acceptance model (TAM) (Lai, 2010; Oinas-Kukkonen, Lyytinen & Yoo, 2010), etc.

VCs are not only facilitated by technology, but technology causes adoption issues. Technology adoption is observed in the TAM theory, whose adoption factors are: (1) perceived ease of use – perception that using this technology will be effortless and (2) perceived usefulness – users' belief that the technology will bring improvement (Davis, 1989; Venkatesh & Davis, 2007; Lai, 2010). VCs can produce information. However, knowledge sharing is not expected without an incentive to gain something in return, i.e. organizational citizenship behaviour (OCB). Current research has studied such user behaviours using SCT to explain social participation. Relationships in social networking facilitate knowledge sharing. SCT is helpful to understand why individuals volunteer to share knowledge and participate, how can SC and individual motivation facilitate knowledge sharing and how can participation make less extreme the relationship between individual motivation and knowledge sharing (Chang & Chuang, 2011). SC is a network of relationships between community members expressing their unity when virtually sharing knowledge within a VCoP application (Huysman & Wulf, 2006; Widén-Wulff & Ginman, 2004). Here, SCT explains the participation within a virtual social network. SC is an asset of resources between interpersonal relationships between social networks with three dimensions: (1) structural – overall pattern of relationships, (2) relational – nature of the relations, for example, trust, obligation or norm and (3) cognitive – common understanding, for example, common language. Here, social interaction is adapted as a variable for structural dimension. Trust, identification and reciprocity are adapted as variables for relational dimension and shared language along with shared vision that are adapted as a variable for cognitive dimension; to examine how these resources affect a VC (Chang & Chuang, 2011).

In another study, it was reported that CoP uses the social learning theory to motivate sharing knowledge (Bates & Robert, 2002) where respondents answer knowledge seekers' questions by conversational stories (Hara & Hew, 2007) and express their experience to assist in problem solving, sharing best practices or development of professional skills (Bates &

Robert, 2002; Hara & Hew, 2007). Another study (Chiu *et al.,* 2006). Investigated why individuals get motivated to voluntarily share knowledge in a CoP. Based on the SCoT (Chiu *et al.,* 2006) found out that human behaviour means personal cognition, composed of core affecting factors (being self-efficacy theory and outcome expectation theory). Besides the SCT. Self-efficacy categorises one's ability to plan and execute performances, while outcome expectation is judging performance consequences. SCT's structural dimension refers to participants' connections. Relational dimension refers to participant relationship development. The shared resources define the cognitive dimension. In this study, self-efficacy is ignored since a participant will not perform a sharing behaviour, if he/she is not confident. Strong community ties introduce a knowledge-exchanging environment with trust, norms and identification as network assets. Social influence is important when investigating motivations promoting knowledge sharing. Satisfaction from interactions with trust is a key element positively affecting VC participation towards knowledge sharing. Identity also plays a positive role in participation. Group norms have a positive effect on group intentions. Reciprocity has a positive effect on weak knowledge sharing norms, while using knowledge repositories and reciprocal relationships has a positive effect on knowledge sharing attitude and intention. In SC, social networking relationships can be productive to cooperation and coordination provided there is a mutual benefit. This study considers two outcomes being: (1) personal outcome – what will participant gain from sharing knowledge and (2) community related outcome – what accomplishments will a VC gain from a participant's knowledge sharing behaviour (Chiu *et al.,* 2006).

2.3.6 RELATIONSHIP BETWEEN SOCIAL CAPITAL THEORY, KNOWLEDGE SHARING AND DECISION MAKING

This section critiques literature to explain how SCT, knowledge sharing and DM are related. VCs are independent of structural mechanisms like shared goals or feelings of inter-dependence among participants (Faraj *et al.,* 2011). Within the KM discipline; SC is an adapted concept (Huysman & Wulf, 2006). Knowledge sharing relates SCT to a VC. The relationship between VC and SCT is bidirectional where VC is the source of SC. A community creates new SC but SC contributions establish a VC (Tuutti, 2010). Three other dimensions express motivation for knowledge sharing: (1) utilitarian – collective deed to develop expertise, (2) normative – cultural perspective to voluntary participation in knowledge sharing and (3) collaborative dimension – trust and reciprocity accounting for knowledge sharing. Another factor for VC participation in knowledge sharing is member's ability to be comfortable when using Internet, i.e. a computer mediated environment. Levels of knowledge sharing differ due to challenging cultural boundaries, for example

collaboration, learning, disagreeing with experts, asking the wrong question, etc. (Ardichvili, 2008).

KM tools facilitate DM quality, where its efficiency requires the human element. An individual can only utilize knowledge for DM (Rantapuska & Ihanainen, 2008). Preference is a predecessor of DM. Preference is an integration of information and value, where information is decision-relevant data, for example belief (Puschner *et al.,* 2010). Here, a belief is an example of black knowledge (Liu *et al.,* 2008). Tacit knowledge is a form of belief, for example intuition (Kalkan, 2008; Abidi *et al.*, 2004) and cultural knowledge is another example of belief (Hara & Hew, 2007). Culture knowledge is felt when knowledge sharing involves values and ideas (Slavoljub, 2006). As per the researcher's opinion, this indirectly paves the relationship between knowledge sharing and DM. Various other studies advocated that when assessing knowledge sharing for medical DM, SCT facilitates knowledge sharing (Chow & Chan, 2008; Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006) and SCT acts as a facilitator for collaborative and participative DM (Mascia & Cicchetti, 2011; Dovey & White, 2005; Sifer-Rivière *et al.,* 2010; Roberts, 2006; Almedom, 2005) and tacit knowledge sharing is a key role player for DM (Mansingh *et al.,* 2009). Knowledge is informally shared within a VCoP where SC is a requirement of and for a group to exist within a community. This is termed the second generation of KM (Huysman & Wulf, 2006). In addition, research has shown significant interest in VCs where participants can make contributions due to motivational factors like SC, social exchange and self-interest (Faraj *et al.,* 2011).

In addition, another study (Mew, 2006) assessed if the introduction of social networking sites is a fad. Even though features of such social networking sites are dynamically changing, there exists an academic research opportunity to validate whether these new online applications fit traditional social networking models (Mew, 2006). This suggestion strengthens the researcher's resolve to assess the effectiveness of KM tools on HC topics observed in Nicolini *et al.* (2008). In addition, various just-mentioned studies support the relationship between SCT and knowledge sharing as well as SCT and DM. So far, they have been cited but left unexplained as they will be referenced in the next chapter that proposes a conceptual framework and hypotheses of this thesis. In conclusion, it is clear that SCT is related to knowledge sharing (Tuutti, 2010). Since knowledge sharing facilitates physicians' communication for medical DM since clinicians' communicates indirectly during collaborative DM when performing complex patient care (Naik & Singh, 2010), knowledge sharing in turn relates to medical DM.

Even though this literature review supports the relationship between KM tools, knowledge sharing and DM, addition literature is still critiqued to distinguishes a relation between decision aids and DM to reflect a clearer relationship between SC and medical DM. When decision aids were assessed by Cook (2010) for diagnostic DM and when human aid was challenged against a decision aid to suggest a challenge; each case would justify different predicting rules for varying management approaches. This investigation reported that physicians pay more attention to decision aids since failure to do so was deeper than humanely advice. This study differs from other studies that concentrated on diagnostic DM (Cook, 2010). This study concentrated on patient management. There is a difference between management and diagnoses. First, a physician does practical management before concluding a diagnosis. This relationship is complex and dynamic since it is also possible that a physician could formulate a wrong diagnosis but lead the right management approach. There is no single solution that is correct with multiple paths to the right management, prescribed by evidence in medicine. Whether a decision is diagnostic or management, it needs multiple inputs from other physicians, nurses, patients, etc. A physician can decide to ignore a decision aid when, (1) he/she gains opinion from another experienced physician and (2) when he/she trusts the experienced physician more than the decision aid (Cook, 2010). It is clear that since the application of HC decision aids is new, more trust is needed for adapting decision aids. In addition, multiple inputs are required for diagnostic DM. A VC is a well adaptable KM tool where trust is an assessed factor for attaining others' opinion/input and a decision aid can facilitate medical DM considering that not much research investigated trust factor on decision aids (Cook, 2010). SC is a prospective decision aid allowing DM to facilitate organizational performance. Decision makers create SC when utilizing their social ties during the process of DM (Jansen *et al.*, 2011). Right DM requires efficient information processing. Here, human information processors interconnect through networks, norms and social trust to assist management and have participants co-operate in order to mutually benefit; within a SC of inter-personal and inter-organizational interaction ties, between individuals (Magnier-Watanabe, Yoshida & Watanabe, 2010). The just mentioned literature clearly described how decision aids facilitate medical DM and since decision aids are examples of SC, hence SC theoretically facilitates medical DM.

2.4 IDENTIFYING THE RESEARCH GAP

The reason why this thesis described the relationships between: (1) SCT and knowledge sharing, (2) knowledge sharing and medical DM and (3) SCT and medical DM is because gaps in research motivated the researcher to follow this research path. In this section, critiqued literature expresses how the researcher identified the gaps in research, which hence

formed a research path for this thesis.

1. ***Pursuit of research in the area of HC KM*** - There is limited literature on evaluating and implementing KM in the public sector (Bate & Robert, 2002), with very little research in the clinical domain concerning knowledge transfer based on a KMS (Willis *et al.*, 2010). This is why this thesis pursues its research in HC KM.

2. ***The need to assess effectiveness of KM tools on a HC research topic*** - Importance of this research gap arises due to limited published literature on public sector KM evaluation and implementation. Researchers have not yet analysed the effectiveness of KM tools on HC topics (Nicolini *et al.*, 2008). Considering that few authors researched on such a KM tool (Huysman & Wulf, 2006), it makes it an important reason for assessing the effectiveness of KM tools.

3. ***The need to quantitatively assess HC VCs as KM tools*** - Research lacks in the area of VCoPs as stressed by Eysenbach *et al.* (2004). Ranmuthugala *et al.* (2011) suggested the need to quantitatively assess the effectiveness of HC CoP since research lacks in this area. There is no quantitative empirical evidence from 1991 to 2005 assessing how, why and when a CoP facilitates HC performance. VC is an example of a KM tool (Chua, 2004; Huysman & Wulf, 2006). KM publications are still at a theoretical level, with unclear consensus, with very little empirical or theoretical research reported in KM field (Hlupic, Pouloudi, & Rzevski, 2002). While qualitative research should shed light on self-help processes of VC participants, quantitative research should assess for whom VC are effective and how this support can be exploited since very few studies have assessed the effectiveness of a CoP. This should be based on robust evidence (Eysenbach *et al.*, 2004). This is why this study chose VCoP as a KM tool. Another reason for analysing a VC as a KM tool is due to the existing opportunity to validate whether new online applications fit with traditional social networking models (Mew, 2006). Also, since research lacks to assess the success factors of a VC (Ardichvili, 2008) and since current HC is information rich but knowledge poor, future research should improve VCs (Bate & Robert, 2002).

4. ***The need to assess DM quality as a HC research topic*** - Other studies confirmed Ranmuthugala *et al.*,'s research gap (2011) by claiming: (1) the need for new mechanisms to support informal social interactions (Bate & Robert, 2002) and (2) testing the effect of social networking theories on virtual social networks, for

example VC, on medical DM (Oinas-Kukkonen, Lyytinen & Yoo, 2010). It is necessary since medical DM is essential due to its impact on the HC services and their outcomes. Also, KM tools facilitate medical DM (Rantapuska & Ihanainen, 2008). In addition, future research should be conducted in the area of clinical DM (Berner, 2009) Even though social networking studies relate to sociology and anthropology; their theories, assumptions, structures and behaviours can still be tested using web-based and real-time tools for online social networks since social network is the next generation web for DM (Oinas-Kukkonen, Lyytinen & Yoo, 2010). Since 2008, various initiatives are being launched to provoke awareness of medical DM (Berner, 2009). The need for to assess DM quality becomes a necessity since medical DM quality improvement is required to reduce medical errors (Willis *et al.,* 2010) where medical DM is a seldom addressed and an under-performed research area (Slavoljub, 2006; Croskerry, & Nimmo, 2011). HC suffers from failing diagnostics hence DM is still an invisible process in future research (Berner, 2009). In addition, the researcher agrees with Huysman and Wulf (2006), who reported that research lacks in the area of assessing KM tools, such as VCoP, on clinical DM. This is why this study chose medical DM as a HC topic following the research gap pinpointed by Nicolini *et al.,*, i.e. the effectiveness of KM tools on HC topics.

5. ***The need to evaluate a HC VC using the SCT –*** As per the researcher's observation of the current research trends, recent HC KM literature followed three themes: (1) nature of HC knowing, (2) consequences of HC knowledge on management, i.e. disadvantage or advantages of KM tool and initiatives and (3) HC KM barriers (Nicolini *et al.,* 2008). Present literature investigated CoP as a KM tool (Chow & Chan, 2008; Chiu *et al.,* 2006) or a collaborative tool (Bate & Robert, 2002). Such literature considered SCT in relation with knowledge sharing (Chow & Chan, 2008; Chiu *et al.,* 2006; Chang & Chuang, 2011). Also, future research steers to social ware, aiming at adapting HC KM models for HC from other industrial sectors (Nicolini *et al.,* 2008) where VC can be evaluated using SCT or SCoT, etc. (Dubé, Bourhis & Jacob, 2006). This is why this thesis aims at describing VC through SCT, which exemplifies KM tools that can be assessed for its effectiveness towards medical DM, i.e. HC research topic.

6. ***The need to evaluate the role of SCT on medical DM quality -*** It is irrational as to how SCT concentrated research presumes that its contribution to knowledge will ultimately improve medical DM even though it has left out the assessment of SCT in the presence of VCoP to improve medical DM. Investigating this research gap would

be an important step for future research considering that there is a need for research in various areas of HC DM such as: (1) understanding and developing DM styles of HC providers and patients as well as processes for DM for daily outcomes in routine care, (2) improving HC DM measures for mental disorders where repetitive and multiple decisions are mandatory and (3) the need to assess the impact of HC DM results in similar and clashing outcomes (Slavoljub, 2006). Another study (Demiris, 2006) ,also stressed, from another perspective that research lacks to assess the impact of VCs on clinical outcomes where a clinical outcome is the status a patient's health treatment consequence.

7. ***The need to assess the mediating role of Knowledge sharing quality between SCT and medical DM quality*** **-** Current literature discusses members' participation and VC sustenance and future research should focus on knowledge collaboration's ideas capturing (Faraj *et al.*, 2011). Also, current studies that assess the relationship between SCT and knowledge sharing, report a positive relationship between them (Birasnav *et al.*, 2009). Knowledge sharing mediating role, between SC and DM, is an under-researched area (Magnier-Watanabe *et al.*, 2010). Hence, the direct relationship between SC and DM mandatory since research lacks to relationship of SCT's norm of reciprocity and identification and DM. The reason why the research assesses knowledge sharing quality and DM quality is because controlling physicians' quality for improving HC quality has always been a research topic of many studies (Anderson & Shields, 1982).

   During such a mandatory role, knowledge sharing facilitates DM through SC to encourage new knowledge creation and transfer (Magnier-Watanabe *et al.*, 2010). Research lacks to assess KM and DM process (Nicolas, 2004). The first conference on diagnostic DM was held in US in 2008. The second was organised in UK in 2011. This shows that this new research topic finally attracted scholarly attention (Croskerry, & Nimmo, 2011). Various other empirical studies stressed and empirically tested the effects of SC on knowledge sharing within a VC (Chiu *et al.*, 2006; Chang & Chuang, 2011) and tested the impact of knowledge sharing quality on medical DM quality (Lin & Chang, 2008). As per the analyses and arguments of this this study, research yet has to empirically assess the direct relationship between physicians' SC and medical DM, while taking into account their mediating role of sharing knowledge. Upon the researcher's observation, the current research trend investigated reasons behind participant's volunteering action of knowledge sharing. Such an act is motivated by the SCT and other social theories for example TRA. In

addition, as per the knowledge of the researcher, ample studies focused on SCT in relation with the online environment (Li & Li, 2010; Huysman & Wulf, 2006; Widén-Wulff & Ginman, 2004).

Research has not yet considered the importance of assessing the extent and nature of the mediating role of knowledge sharing in the relations between SCT and medical DM quality in presence of a VCoP. The same is true with regards to assessing the impact of SCT on medical DM, within a VCoP. It is necessary to do so considering that social computing has become an important research area, especially in HC. Even though there is one study, which empirically assessed the relationship between knowledge sharing and medical DM quality (Lin & Chang, 2008), the researcher has noticed that even this publication did not measure the extent and nature of the impact of SC on medical DM within a VCoP. This study did confirm the importance of our observation towards the research gap since this study's empirical conclusions evidenced the importance of knowledge sharing on medical DM quality.

8. ***The need to assess SCT, Knowledge sharing quality and medical DM quality together*** - It is important to assess the relationship between SCT and medical DM quality, since past research failed to do so. First, HC quality needs improvement (Willis *et al.*, 2010) by utilizing an evidence-based approach (Bates & Robert, 2002) and reducing medical errors (Bodenheimer & Fernandez, 2005. Secondly, as per the suggestion of Bates and Robert (2002), future research should concentrate on improving collaborative processes based on KM to ensure the transference from local knowledge to organizational knowledge. Therefore this research aims to assess the relationship between SCT and medical DM quality and the mediating role of knowledge sharing within a VCoP, since VCs are promising and advantageous to patients (Demiris, 2006) and to the improvement of medical DM quality. This view is also supported by other studies that mentioned that Web 2.0's social networking is a promising initiative (Landro, 2006), a VC patient-care improvement (Demiris, 2006; Willis *et al.*, 2010); hence mandatory for reducing medial errors. Even though one study may have assessed the role of knowledge sharing on medical DM to show that knowledge sharing facilitates DM, no study has yet investigated the impact of the new environment of CoP as a KM tool (Parrott, 2007).

2.5 SUMMARY

The chapter introduced the research area and explained why HC service quality suffers. It also stressed the importance of KM tools for medical DM. Next, the reviewed literature was systematically critiqued to define and relate various social science theories with HC VCs environment, physicians' knowledge sharing and medical DM. Finally, the researcher critiqued the reviewed literature to pinpoint this thesis's research gap. The outcome of this chapter is critiqued literature that allowed the researcher to explain why this thesis's research aims at assessing the effectiveness of physician's SC on knowledge shared medical DM quality in a VC environment. This reviewed literature and the pinpointed research gap lay ground for the next chapter, which will: (1) propose hypotheses and sub-hypotheses and a (2) conceptual framework.

CHAPTER 3

DEVELOPING THE CONCEPTUAL FRAMEWORK MODEL

3.1 INTRODUCTION

The first objective presented in Chapter Two was to conduct a literature review in the area of SCT, VCoP, KM and medical DM, to pinpoint and critique the research gaps. The second objective was to identify from literature theory expressing the relationship between VCoP, knowledge sharing quality and medical DM quality to recognize the effectiveness of a VCoP on medical DM quality through physicians' knowledge sharing behaviour. The aim here was to describe the relationship between VC physicians' SC, their knowledge sharing behaviour and their DM quality. At this point Chapter Two also expressed the need for a conceptual framework model. As explained, following SCT, physicians' SC lies between the VC individuals' relationships and connections (Huysman & Wulf, 2006). Consequently, this study analyzed a VCoP through the SCT, which is further described in this chapter. Chapter Two also introduced: (1) the Honeycomb framework to define social media and evaluate a VC and (2) the 21 Structuring Characteristics Framework to define and identify appropriate VCs from a plethora of social media platforms. These two frameworks were applied and customized to pinpoint 51 VCs from 9 Facebook, 29 LinkedIn, 4 List Serv and 4 physicians' professional VCs.

Furthermore, this chapter describes and critiques various arguments set-forth from numerous research studies that described the relationship between SCT, knowledge sharing and medical DM quality. These theories are critiqued to support four research hypotheses presented in Sections 3.2.1 – 3.2.3 and 3.3. At this stage, this study was able to accomplish its third objective, i.e. developing an integrated model based on theory to depict the relationship between physicians' SC and medical DM quality along with the mediating role of knowledge sharing quality between these two constructs through a conceptual framework model (Figure 3.5), to support of the four main hypotheses. A conceptual framework provides the researcher with a foundation that the study will be built on (Omachonu & Einspruch, 2010).

3.2 THEORY DEVELOPMENT

This section systematically critiques literature to identify various relationships between SCT, knowledge sharing and medical DM. Physicians' SC is a decision aid for DM where decision makers create SC while utilizing their social ties during DM process (Jansen *et al.*, 2011). SC is vital in DM since it is a source of organizational learning where knowledge capital is mandatory for organizational competitive advantage (Dovey & White, 2005). As mentioned in Chapter Two, the SCT is composed of six factors (social interaction ties, trust, norms of reciprocity, identification, shared language and shared vision) and these factors are describable through the three dimensions of SCT:

- **Structural dimension** - Social interaction ties (absence or presence of participants' ties during connections),
- **Relational dimension** – Trust (i.e. accepted values/principles by members that promote a resource sharing atmosphere), norms of reciprocity (i.e. members feel a sense of fairness when they favour another member or receive favours; hence they are motivated to share resources as this act is seen as an investment) and identification (i.e. SC exists when members identify themselves with a group and hence, they are willing to contribute to resource sharing within that group) and
- **Cognitive dimension** - Shared language (i.e. shared understanding between participants so each knows what one knows and does not know) and shared vision (i..e shared understanding where group goals bond a group to integrate or combine its resources),

The SCT factors and their dimensions have been expressed in various literature theories and conceptual frameworks, such as by Chiu *et al.*, (2006) and Chang & Chuang (2011).

The next few sub-sections, including the section 3.3, express the four main hypotheses based on various relationships being:

- Section 3.2.1 discusses the relationship between physicians' SC and medical DM quality, to introduce the first hypothesis of this thesis,
- Section 3.2.2 discusses the relationship between physicians' SC and knowledge sharing quality, to introduce the second hypothesis of this thesis,
- Section 3.2.3 discusses the relationship between knowledge sharing quality and medical

DM quality, to introduce the third hypothesis of this thesis and

- Section 3.3 discusses the mediating role of physicians' knowledge sharing quality between their SC and DM quality, to introduce the fourth hypothesis of this thesis

3.2.1 PHYSICIANS' SOCIAL CAPITAL AND MEDICAL DECISION MAKING QUALITY

Social interaction ties facilitate medical DM since relationships are influenced by social interaction ties (Mascia & Cicchetti, 2011). In risky situations trust is a pre-requisite for taking an action. Trust is characterized by vulnerability as "a subjective belief" and the readiness of the trusting person to be vulnerable and thus rely on some other party other than himself/herself (Kim, Ferrin, & Ra, 2008). E-Health and e-commerce related research has stressed the importance of learning trust from its behavioural and social perspective (Lai, 2010; Kim, Ferrin, & Ra, 2008). Such research has reported the need to assess DM process in order to better understand the trust phenomenon in an online discussion (Kim, Ferrin, & Ra, 2008). Trust is characterized by the expectation to form a stable insight of one member into the intentions and motives of another. Others studies have considered trust as cement for a society (Edelenbos & Klij, 2007). Trust is a facilitator of DM (Sifer-Rivière *et al.*, 2010) where participants are able to utilize social interaction ties and take other participants' verdicts seriously (Mascia & Cicchetti, 2011).

As per the researcher's opinion, it is not surprising that a group's verdict is taken seriously in the problem solving process. Groups, through their norms/standards, influence DM (Postmes, Spears, & Cihangir, 2001). Groups have a shared vision, which also facilitates DM (Collins-Camargo & Hall, 2010). Shared language is also a facilitator of DM (Rantapuska & Ihanainen, 2008). In addition, this thesis supports the view of Rantapuska and Ihanainen, (2008) who reported that new tools, which identify utilization of tacit knowledge, are required to facilitate improvement of DM towards the ICT investments. In this case, KM tools are tools like VCoP, as per context of this thesis. However as noted by Rantapuska and Ihanainen, the human element is critical for the effectiveness, since an individual utilizes the knowledge for DM. Hence, in the context of this study, the interpretation would be that it is the physician who will utilize the knowledge from the social networks within a VCoP for his/her DM purposes. The facilitation of SCT, i.e. expressed through physicians' SC, on DM is an even better strategy when compared to other almost similar strategies like clinical decision support (|CDS), which revealed to be ineffective. Even though

CDS is beneficial, it has showed to have no impact on DM due to a low rate of end-user adaptability as well as CDS challenges during integration with work flow (Wright *et al.*, 2008). It comes as no surprise that such a decision aid is ineffective. Similarly, a review of 200 decisions aids concluded that they had no impact on DM improvement (Puschner *et al.*, 2010). In addition,

HC should turn towards a more cost effective tool to share and collaborate when developing decision support content. With geographic distance hampering collaboration, Web 2.0 enables collaborative environment for CDS. Web 2.0 fosters online resource sharing and collaboration through VCs when the web is used as a platform to deploy content and applications, a VC is all about participation rather than publishing and a community's key role facilitates diffusion of valuable content. Here, users are considered as co-developers in supporting each another through common interest rather than through an administrative central control. Web 2.0 has opened new research interest areas in HC (Wright *et al.*, 2008) where SC is valuable in facilitating DM quality in a VCoP. Based upon the just-mentioned arguments the first proposed hypothesis is:

Hypothesis 1:	Physicians' SC is significantly and positively associated with the quality of medical DM in a VCoP environment

3.2.2 PHYSICIANS' SOCIAL CAPITAL AND KNWOLEDGE SHARING QUALITY

Assessing the relationship between physicians' SC and knowledge sharing quality is fundamental in this study since research has not clearly defined what factor motivates one to help another during knowledge sharing. A CoP has become a popular tool for collective learning from experts through social interaction by sharing knowledge. CoP is where members with common interests, goals and concerns share their concerns, information, knowledge; advice, ideas and passion (Ardichvili, 2008). The SCT explains social participation in social networks where participants share knowledge (Chang & Chuang, 2011). There are two types of outcomes of SC: behavioural and attitudinal. These two outcomes originated from two theories: social contagion perspective and structural holes perspective. Social contagion perspective refers to what influences behaviours of participants while structural holes perspective explains knowledge sharing and other resources (Mascia & Cicchetti, 2011).

Experts who believe in giving back to society give back by sharing their experience gained knowledge and are not afraid of being criticized or mislead. On the one hand, SCT explains that

the willingness of knowledge sharing is motivated by a personal gain. On the other hand, the applied theory of collective action states that SC is an influencing factor for knowledge sharing without immediate reciprocity (Ardichvili, 2008). SC is a network of relationships between community members based on what unites them together to facilitate the alignment of VCoP applications with virtual knowledge sharing (Huysman & Wulf, 2006; Widén-Wulff & Ginman, 2004). Knowledge needs to be transculturally managed, within a rigorous network of relations to aid knowledge sharing and resources exchanging (Lin, 2008). Knowledge conversion occurs when participants share knowledge in a CoP. There are four types of knowledge conversions occur, being: socialization, externalization, combination and internalization (Rantapuska & Ihanainen, 2008). Knowledge sharing supports (1) an increase in connections between VC members, (2) advances in careers or (3) protection from a threat (Ardichvili, 2008).

Through the physicians' SC, VC members share knowledge where: (1) socialization converts tacit knowledge to new tacit knowledge, (2) externalization converts tacit knowledge to new explicit knowledge, (3) combination converts explicit knowledge to new explicit knowledge and (4) internalization converts explicit knowledge to new tacit knowledge. In addition, various research studies (write names of authors in bracket) have contributed towards empirically testing how SC facilitates knowledge sharing from the perspective of each of the variables of the SCT, which will be explained further in this chapter. All in all, this study supports the view of Alwis and Hartmann (2008) that information is converted to knowledge within the context of time and space by means of the SC between individuals and organizations where in this study's case the observation goes to physicians as individuals. In a VC, knowledge is shared, for example through Wiki (Landro, 2006), to help collaborative medical problem solving (O'Grady & Jadad, 2010) by applying KM tools such as CoP (Bate & Robert, 2002).

The disadvantages of social networks with tightly knit SC are: firstly, its members hold similar redundant knowledge, secondly, they resist adapting information and knowledge from outside of their network, and thirdly, they are not willing to expand interpersonal networks outside of the network since the norms discourage participations with non-members (Mascia & Cicchetti, 2011). Up till now the just-critiqued argument has related physicians' SC with them sharing knowledge but not with the quality of their shared of knowledge. Chang and Chuang (2011) as well as Chiu *et al.* (2006) also assessed the relationship between SCT and the quality of knowledge sharing. They defined the quality of knowledge sharing as a self-reporting measure, which is reflected through timely, complete, reliable, accurate and easily understanding form of

shared knowledge. Hence, based on the above argument, hypothesis 2 (also depicted in Figure 3.1) is:

Hypothesis 2:	**Physicians' SC is significantly and positively associated with the quality of knowledge sharing in a VCoP environment.**

3.2.3 PHYSICIANS' KNOWLEDGE SHARING AND MEDICAL DECISION MAKING QUALITY

From the angle of performing patient treatment, DM is of three types: (1) paternalistic DM - doctor only decides, (2) shared DM – both, patient and doctor, decide and (3) informed DM - patient decides on a treatment (Puschner *et al.,* 2010). Various studies (Puschner *et al.,* 2010), whether in HC discipline or not have termed DM as either: knowledge shared DM, treatment DM, collaborative DM, participative DM or shared DM, etc. Knowledge shared DM should never be made in haste; hence it is time consuming and should be well thought out. During this time knowledge is shared during a DM process (Roberts, 2006). Treatment DM, as described by Puschner *et al,* (2010), takes place during problem solving within a VCoP, aiming at reduced diagnostic errors reflected by improved DM quality. This study stresses the necessity to reduce medical errors since, as in Chapter Two, Berner, (2009) reported 44,000 to 98,000 patient annual deaths in 1999 due to significant medical diagnostic errors (majority being medication and surgical errors, i.e. therapy based errors). However, DM in a VC consists not only of treatment DM, shared DM, participative DM or knowledge shared DM, as portrayed by Robert, (2006) but all these types of DM occur within a VC. The reason behind this is since in a VCoP participants collaborate to share knowledge (Huysman & Wulf, 2006) towards treating a patient's case, i.e. a current research focus of DM (Lucchiari *et al.,* 2010). Knowledge-shared DM comes closest to the context of this research. HC industry is not only service-oriented but also knowledge intensive. Such an industry needs to foster an open learning environment, facilitated by knowledge sharing, to encourage individualized DM power (Lin, 2008). It should be noted that this view is supported by Rantapuska and Ihanainen (2008).

In addition, it is no wonder why the CDS tool failed to have an impact on medical DM considering that it only shared explicit knowledge; while literature advised the HC sector to utilize more cost effective knowledge sharing and collaborating Web 2.0 tools (Grant, 2007). This is a viable suggestion since vast amount of untapped knowledge is still tacit (Grant, 2007) and

such knowledge type is shared in a VCoP (Dubé, Bourhis, & Jacob, 2006) even though, both, explicit and tacit knowledge are valued in a CoP (Bentley, Browman, & Poole, 2010). It is no surprise that CDS fell short since it is not only explicit knowledge but a combination of tacit and explicit knowledge that facilitates DM (Abidi *et al.,* 2005). In conclusion, as one study mentioned, tacit knowledge sharing facilitates collaborative DM (Jabar *et al.,* 2010) where knowledge-shared decisions are made with caution (Roberts, 2006). This is when new knowledge is created (Mansingh *et al.,* 2009). Hence these arguments go to propose the second hypothesis being: Based upon the arguments above, hypothesis three (as illustrated also in Figure 3.1) is:

Hypothesis 3: Physicians' quality of knowledge sharing is significantly and positively associated with the quality of medical DM in a VCoP environment.

3.3 MEDIATING ROLE OF PHYSICIANS' KNWOELDGE SHARING BETWEEN THEIR SOCIAL CAPITAL AND MEDICAL DECISION MAKING QUALITY

The assessment of the mediating role of knowledge sharing quality between the SCT and medical DM quality is essential as it has not been fully researched (Magnier-Watanabe *et al.,* 2010). It is not surprising considering that research still has not assessed the KM and DM process (Nicolas, 2004). This too is no wonder considering that diagnostics is a proven failure and DM is an invisible process (Croskerry, & Nimmo, 2011). In addition, the DM process is based on hidden knowledge (Rantapuska & Ihanainen, 2008), i.e. tacit knowledge (Paul, 2006), such as experience, intuition, values or attitude. Such knowledge cannot be disconnected from the human element of DM. The human element is critical for DM efficiency since it is an individual who utilizes knowledge for the process of DM (Rantapuska & Ihanainen, 2008). Knowledge is informally shared within a VCoP, with the SC as a requirement of, and for, the group within such a community (Huysman & Wulf, 2006). This study supports the argument of Huysman and Wulf, (2006) that the SC is needed for knowledge sharing to make sound decisions (i.e. clearly showing knowledge sharing mediating role). The significant and positive associations of hypothesis 2 and 3 will support the mediating role of knowledge sharing to reach the right quality of medical DM, through the interactions within physicians' SC. This is when new knowledge is created and transferred (Magnier-Watanabe *et al.,* 2010).

CoP enables collaborative medical DM where social networking social media platforms like Wiki or blogs fall under the KMS category where IS are applied to organizational KM (Magnier-Watanabe *et al.,* 2010). In addition, it was observed in other studies (Arnold, Turner, & Barling, 2007; Hahn & Kim, 2009; Peng, Fang, & Lim, 2011) that the mediating role of knowledge sharing quality, between physicians' SC and medical DM quality, was not illustrated in this study's conceptual framework (like in Figure 3.1). As a result that is why, the mediating role was separately illustrated (as in Figure 3.2). The mediating role has been discussed in the literature review as well as in this section and expressed through data analyses results in the following Chapter. The hypothesis 2 and 3 of this research make up jointly the mediating role of knowledge sharing between physicians' SC and medical DM quality. Consequently, the fourth hypothesis is:

Hypothesis 4:	Physicians' SC significantly and positively affects knowledge sharing through which SC significantly and positively improves the quality of medical DM in a VCoP environment.

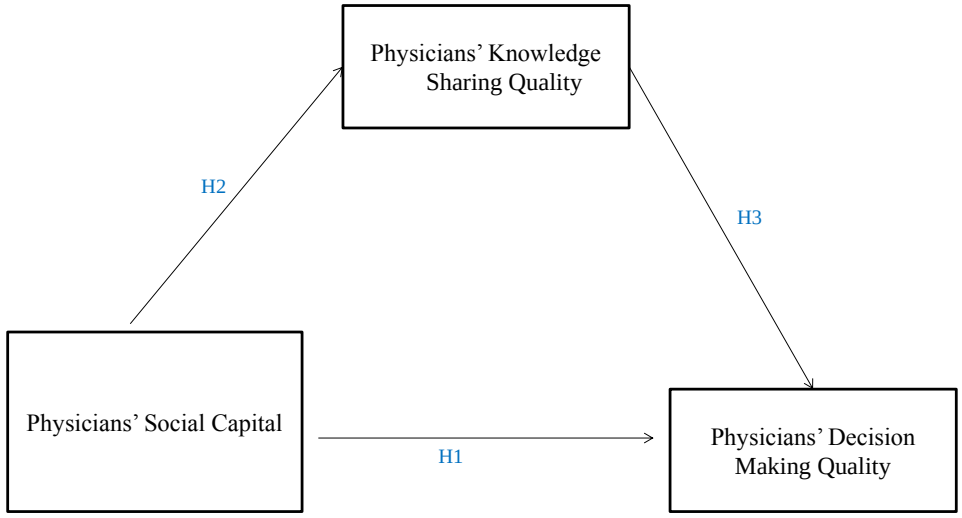
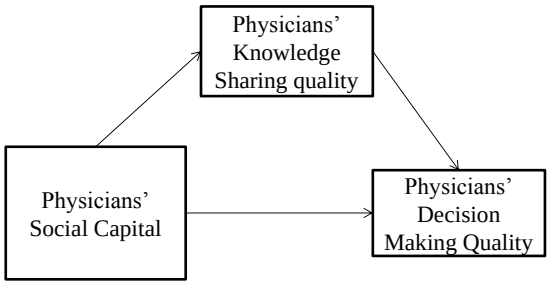


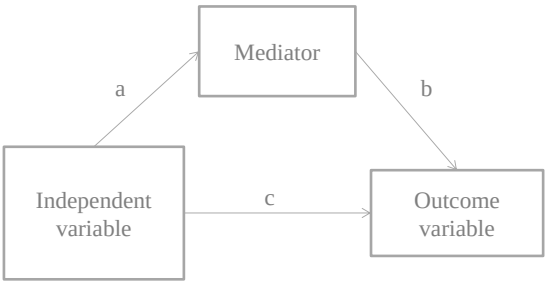
Fig 3.1. Relation between Physicians' Social Capital Theory, Knowledge Sharing Quality and Medical Decision Making Quality.

Fig 3.2's Conceptual Framework



Note 1: Fourth hypothesis is not explicitly pointed out as 'H4' in this Figure
Note 2: This model is developed as a path model depicted by Baron and Kenny (1986)

Path model observed by the researcher to design Figure 3.2's model to signify H4's mediating role of knowledge sharing between social capital and medical decision making quality.



Source – (Baron & Kenny, 1986)

Fig 3.2. Mediating Role of Knowledge Sharing Quality between Social Capital Theory and Medical Decision Making Quality.

Figure 3.2 illustrates the fourth hypothesis. This figure was depicted in the same manner as also depicted by Baron and Kenny (1986). In this Figure the fourth hypothesis is not explicitly pointed out as H4, since it is portrayed in Figure 3.2 in the form of a path model as also explained by Baron and Kenny (1986) – similarly to Baron and Kenny (1986); Kelloway and McKee (2007) as well as Hahn and Kim (2009). The model in Figure 3.1 was drawn-up by the researcher as observed from the path model from Birasnav, Rangnekar, and Dalpati (2009) as well as Chiu *et al.*, (2006); it only illustrates the main hypotheses of this study.

Through a further literature review, it was observed that physicians' SC, is described through three dimensions (structural, relational and cognitive) of the SCT (Huysman & Wulf, 2006) - detailed in chapter Two – section 2.2.7. Since SCT is comprised of three dimensions, various sub-hypotheses need to be introduced to conclude a complete conceptual framework of this chapter. SCT will be considered from its variables point of view. The three dimensions assessed the SCT (Peng, Fang & Lim, 2011).

3.4 SUB-HYPOTHESES DEVELOPMNET FOR RELATIONSHIP BETWEEN PHYSICANS' SOCIAL CAPITAL AND MEDICAL DECISION MAKING QUALITY

The SC is associated with DM where democracy and decentralization play a major role in a DM process (Almedom, 2005). SC is vital for DM since it is a source of organizational learning within the knowledge capital mandatory for organizational competitive advantage. Even though structural and cognitive dimension are important, the relational dimension is critical for learning (Dovey & White, 2005). Besides the relational dimension, when considering the two remaining dimensions, shared language, social interaction ties and trust are the most influential SCT factors when it comes to facilitating DM. All three dimensions of the SCT facilitate DM. Another study supporting this view (Sifer-Rivière *et al.,* 2010), pointed out that decision-makers hold forethought of progress where DM emphasizes collaboration, essential in HC networks or integrated care (D'Amour, Goulet, Labadie, San Martín-Rodriguez & Pineault, 2008). Hence, shared vision facilitates collaborative DM (Roberts, 2006). Now that this thesis portrayed a general description of SCT → DM, literature is critiqued to describe sub-hypotheses.

3.4.1 PHYSICIANS' SOCIAL INTERACTION TIES AND MEDICAL DECISION MAKING QUALITY

While other SCT factors facilitate DM, social interaction ties are very important, during collaborative patient care, hence patient-care related DM (Sifer-Rivière *et al.,* 2010). Another study (Mascia & Cicchetti, 2011) reported empirically supported evidence that networks with low social interaction ties highly support medical DM rather than networks with high relational associations between members. In relation to physicians adapting evidence based medicine (EBM) (to apply evidence in practice) (Nicolini *et al.,* 2008) along with personal education and experience (Mascia & Cicchetti, 2011) are unable to effectively make medical decision due to overwhelming rate of journal publications (Mascia & Cicchetti, 2011). This situation increased the demand for tacit knowledge creation through peers' experiences and opinions supported by EBM to validate explicit knowledge. Such tacit knowledge creation is possible through interpersonal interactions through VCoP's social interaction ties (Mascia & Cicchetti, 2011) influential for DM through community relations. Decision makers create SC when utilizing social interaction ties during a DM process (Jansen *et al.,* 2011). In this case, decision quality is improved by SC and intelligence processing (Kopáčková, & Škrobáčková, 2009) where

information processing occurs through social interaction ties (Magnier-Watanabe *et al.*, 2010); hence, it is transformed to an outcome of DM (Easton, Vogel, & Nunamaker, 1992). Since social relationships-based networks surround physicians to represent a form of SC, their impact on physicians' attitudes to adapt evidence based clinical knowledge is facilitated by the diffusion of information and social influence. Physicians are able to pick-up and infer useful information through the structured set of relationship-based resources available within such professional networks (Mascia & Cicchetti, 2011).

This study supports this argument since if physicians are overwhelmed with too many journals it is peers' opinions that can facilitate their DM through other VCoP participants' opinions through their social interaction ties within professional VCoPs. Hence a physician chooses what experiences are shared and what information is selected and inferred during experience and education based DM. Therefore, social interaction ties facilitate a physician's DM process when a physician wants to establish relations influential for DM (Mascia & Cicchetti, 2011). Even though empirical evidence of Mascia and Cicchetti (2011) suggested that members of a network prefer members with no associations over members with densely connected member since members who are densely connected with other member facilitate redundancy in knowledge and resistance to attaining knowledge out of the network. Even though one study advocated the need for the SC for DM, its empirical analysis evidenced negative effect of the SC on DM (Jansen *et al.*, 2011). Empirical findings by this thesis will shed light on interesting new contribution. This argument is the foundation of the first sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1a*: Physicians' social interaction ties significantly and positively affect the quality of medical DM in a VCoP environment.*

3.4.2 PHYSICIANS' TRUST AND MEDICAL DECISION MAKING QUALITY

Trust is the readiness of the trusting participant to engage in a risky behaviour and take action based on the information received. Since, trust is measured after an event's outcome and important for DM quality (Parayitam, 2010; Jøsang, 1999); this factor is, more than any other factor of SCT, a facilitator of DM (Sifer-Rivière *et al.*, 2010). Trust is important not only for relationships where exchange is involved but also a key factor for the SC affiliated with competitive advantage, performance, satisfaction and outcomes; e.g.: transaction cost. Also, trust

gives confidence to members during the process of risky DM (Kim, Ferrin, & Ra, 2008). Trust enhances performance during a DM process (Edelenbos & Klij, 2007) and assists participants, such as managers, to achieve mutual benefits within the SC of interpersonal individuals'/organizations; interaction ties (Magnier-Watanabe *et al.,* 2010), triggering trust to facilitate DM (Alge, Wiethoff, & Kleinc, 2003). Therefore trust is a pre-requisite of DM (Kim, Ferrin, & Ra, 2008).

Trust reduces uncertainty among members', improves innovation and fosters commitment sharing, confidence and transaction costs reduction during DM. Trust also increases satisfaction, frequency and density of members' interaction during information sharing (Edelenbos & Klij, 2007). A decision maker trusts the group verdict, in certain cases even more than the rest of the means for verifying his/her verdict in his/her surroundings (Mascia & Cicchetti, 2011) where experienced members convey valuable information to one another (Alge *et al.,* 2003). Team members collaboratively and carefully make strategically risky, uncertain, vague and complex HC decisions based on diverse perspectives. Competence-based trust allows one member to not dismiss an idea of another member. The more complex a decision, the more information is exchanged and applied. Such uncertain and risky decisions require members' trust as a standby for information reliability and unevenness (Parayitam, 2010). On the other hand, within inter-organizational inter-dependent networks where resources are distributed among different participants, trust negatively facilitate DM when a decision is jointly made between collaborators, since such networks are unpredictable and obscure. Research in this area, i.e. application and influence of trust during complex DM, has largely been ignored (Edelenbos & Klij, 2007).

Also, it has been reported that the interpersonal aspect of electronic networks makes it difficult to assess trust (Jøsang, 1999). The researcher does not agree with Parayitam, (2010) who stated that trust is a measure of an events' outcome as it seems unclear. At least within the HC context, one physician may trust another during problem solving where decision is based on judgment (Mascia & Cicchetti, 2011) and reliability over the trusted other (Edelenbos & Klij, 2007). This statement is supported by this study. Trust is important as stated by Kim *et al.* (2008) and does enhance performance as reported by Edelenbos and Klij (2007) since it facilitates DM. However, the researcher believes that the extent of positive association of trust on DM has yet to be empirically justified (Edelenbos & Klij, 2007; Sifer-Rivière *et al.,* 2010) where team members collaborate and carefully make strategic HC decisions, due to their riskiness, uncertainty,

vagueness and complexity. Such decisions are formulated through diverse perspectives whose pros and cons are first evaluated. Since research has established various links like: trust with team efficiency, trust between team members is important for DM quality - a role that is minutely considered in the HC context. It is the competence-based trust that allows one member not to dismiss the idea of another member when assessing requirements.

The more a decision is complex; the more information is exchanged and applied. Such uncertain and risky decisions require members' trust as a standby for information reliability and unevenness (Parayitam, 2010). This study also agrees with Edelenbos and Klij, (2007) that more information is shared when DM is complex since the rate of enquiry would be higher. In addition, it still should be assessed whether the interpersonal aspect of electronic networks makes assessing trust difficult, as reported by Jøsang, (1999). In addition, another study stated that trust is the belief, i.e. likelihood of trusted DM on the behaviour of other DM community member (Roberts, 2006). Henceforth, the second sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1b*: Physicians' trust significantly and positively affects the quality of medical DM in a VCoP environment.*

3.4.3 PHYSICIANS' NORMS OF RECIPROCITY AND MEDICAL DECISION MAKING QUALITY

Group norms are members' accepted group standards (Postmes, Spears, & Cihangir, 2001). Effective DM involves effective information processing where human information processors interconnect via network's norms of reciprocity (Magnier-Watanabe *et al.,* 2010). In this case, even though groups may be considered less effective than individuals for DM processes, a group can make better decisions when their participants share information openly than when some information is held back within the group. Information sharing, supported by computer systems, is a proven robust and a pre-requisite to DM. The degree of its correct outcome is a measure of its DM quality. DM quality can be improved within a group via group norms, which are an important factor for sustaining regulations within a group that is formed through its history to shape such norms for better problem solving. While a group requires norms to exchange resources, the pre-requisite for norms of reciprocity are group discussions and a pre-requisite for DM is group norms (Postmes, Spears, & Cihangir, 2001).

So, since information sharing that Postmes, Spears, and Cihangir, (2001) referred to, for better DM quality is not knowledge sharing as per the context of this study. Rational for still considering this theory was due to this study's observation that current VCoP, KM and DM studies could be inclined more towards knowledge sharing than information sharing. Still, Postmes, Spears and Cihangir (2001)'s theory holds strong ground on a sole argument that information sharing is supported by a group norms, which is a pre-requisite for DM quality. In addition, while norms of reciprocity need to be assessed for its impact on DM quality, it is interesting how group norms, in general, are reported to facilitating better group DM outcomes. Another analysis is this study was that the term "*group norm*", referred by Postmes, Spears and Cihangir, (2001), means norm of that group while reciprocity is one of those norms. Hence, based upon these arguments, the third sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1c*: Physicians' norms of reciprocity significantly and positively affect the quality of medical DM in a VCoP environment.*

3.4.4 PHYSICIANS' IDENTIFICATION AND MEDICAL DECISION MAKING QUALITY

Identification is a facilitator of communication where members share a mutual purpose. Members can engage in sharing emotions and values as well as DM. Within the complex process of social identification, members define themselves by interacting with each other. For instance, within an organization, employees identify themselves with its values, goals and objectives to support their organization. Appropriate decisions made by such employees aid them in establishing their identity with their organizational goals. Not only organizations like employees strongly identified with their goals but employees too, favour being identified with their organization. This is a characteristic encouraged by organizational leaders, since low employee identification leads to communication isolation and negative employee attitude, damaging to the organization. High employee identification is beneficial for organizational leadership thanks to higher employee satisfaction and lower turnover. Such employees, with higher identification with the organization, tend to make decisions in line with top management without management control. Such decisions can be made on their own. Careful selection, orientation and encouragement in participatory DM, are examples of various methods that foster higher member identification within an organization,

where communication is facilitated through newsletters, training or other means of communication (Gossett, 2002).

Such a case of an organization exemplifying a social network, i.e. CoP, was described by Kogut and Zander, (1992). Such an organization's employees are like members of a CoP (Fiol & O"Connor, 2005). Another study identified the notion of "customer-company identification" based on the social identification theory. Identity of a company is constituted by its repute, image and characteristics, such as its mission, culture and skills. A consumer's identification is his/her perception of an organization's characteristics. The more similar the identity between customer and company, the higher is the likelihood of customer-company identification. Such customer identification with the company is based on his/her sense of belonging; i.e. when one distinguishes himself/herself within a social context, with the company in his/her quest upon a self-defining need to figure out who he/she is, in an attempted to be similar with others. For example, a customer interested in animal rights would be more inclined to be interested in a company that deals with animal testing. Such a sense is dependent on the membership with an organization/group. From the perspective of social identity, an individual tends to pass from personal identification to social identification by categorizing oneself to a context; i.e. social category. For example sports team regardless of ones interaction in a community as long as self-worth is enhanced when identifying oneself with a prestigious identity (Bhattacharya & Sen, 2003). Hence, DM is performed better within a group when members are aware of the expertise of one another so each knows who is good at what (Austin, 2003). In addition, even though, VC research currently got a lot of attention, especially in the case of virtual teams, social identification has still not been fully assessed in the virtual context. Social identification is a personal sense of belonging or being motivated to belong with a group/social category to self-improve to increase self-worth, reduce uncertainty, improve clarity and promote similarities between group members and hence facilitate group union (i.e. togetherness) even if that means lack of face-to-face interaction in a VC (Fiol & O'Connor, 2005). Yet, research does lack in the area of social identification, a factor of the SCT, with respect to VCoP. Based on these arguments, the fourth sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1d*: Physicians' identification significantly and positively affects the quality of medical DM in a VCoP environment.*

3.4.5 PHYSICIANS' SHARED LANGUAGE AND MEDICAL DECISION MAKING QUALITY

In a study where managers were assessed on how they use knowledge to make ICT investment related decisions (Mascia & Cicchetti, 2011), it has been reported that common language is mandatory for problem-based DM,. Personal thinking and analyses are at play where first, the problem needs to be understood by the decision maker who then has to communicate it in the right expressible form. Here communication and shared language are critical between decision makers and/or decision users. A DM process is more of a learning process where knowledge is created and distributed at an individual and organizational level. 'Organizational' refers to the community of suppliers, outside experts and/or workers participating in the DM process (Rantapuska & Ihanainen, 2008). Within multinational corporations (MNCs), for example Ford Motor Company, knowledge is shared within communication networks where language integrates the organization's information exchange. While language is an observed barrier during communications in, for instance, a Citigroup network which globally houses 60% non-English speaking employees; language is still an effective tool for (1) managing conflicts in cross-cultural teams, (2) transferring knowledge and (3) developing and implementing policies and strategies. A MNC is a multilingual community, where proper language facilitates an intra-network communication. Such a corporation applies linguists to interpret information along within its culture context to improve learning to transfer knowledge for collaboration (Austin, 2003). As per the analyses of this study, if decisions are defined by strategy (Oxoby & McLeish, 2004), the notion that shared language affects strategy sheds light on the relationship between shared language and DM. Yet, it can be assumed after Lauring and Selmer (2011) that common language, i.e. shared language as in the case of this study in a group interaction, is a largely ignored literature topic. Based on the arguments above, the fifth sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1e*: Physicians' shared language significantly and positively affects the quality of medical DM in a VCoP environment.*

3.4.6 PHYSICIANS' SHARED VISION AND MEDICAL DECISION MAKING QUALITY

|While a generic decision-maker hold foresight of progress, a clinician need to bring changes into their practices that should be integrated with new concepts. Hence clinicians could feel threatened by their own decisions (Sifer-Rivière *et al.,* 2010). DM emphasizes on collaboration. Collaboration is essential in the HC networks (D'Amour *et al.,* 2008). HC DM performed by hospital administration requires a collaboratively shared vision between the staff since clinicians manage risks and expectations of referees. DM occurs in constraints and interpretations and is based on what is relevant and the possibly associating choices (i.e. personal meanings and values). The considered courses of actions, their harms and future relations as well as past experiences and negotiations need to be finalized before a taking a decision. Hence, admission-based decision is complex. Difficult decisions have been based on one of many factors, i.e. one being insufficient patient information. More than 75% of DM participants wish they had made different decisions. Within such limitations, clinicians have recommended that team working with staff, could be essential in achieving a common goal through a collaborative approach with a united shared vision that would form a collective view. DM was also influenced by the quality of relationships (Grounds *et al.,* 2004). Grounds *et al.* (2004) stated that shared vision is necessary for HC service delivery. Shared vision is possible when partnership can implement strategies like effective leadership, communication lines and planning. Based on the analyses conducted by the researcher, it can be assumed that DM leads to a shared vision. This view contradicts, however, the findings of several other studies, which suggest that shared vision supports DM (Collins-Camargo & Hall, 2010). When the researcher attempted a query for intellectual resources, which would discuss the relation between shared vision, or common goal, with DM, hardly any literature discussed this topic nor did any research discuss this relation within a VC. Hence this relationship is based on a minimal argument and requires empirical assessment, which will show whether there is any significance in this relationship or not. Based on the argument above, the sixth sub-hypothesis, a sub-predictor of hypothesis one (depicted in Figure 3.3) is:

Sub-hypothesis 1f*: Physicians' shared vision significantly and positively affects the quality of medical DM in a VCoP environment.*

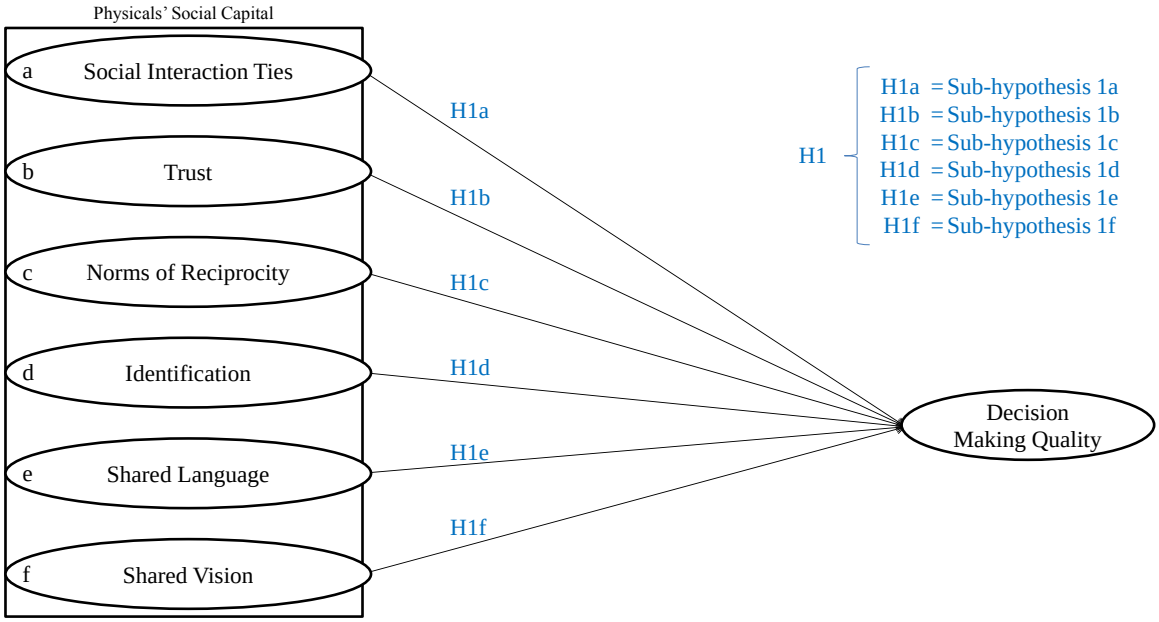


Fig 3.3. Physicians' Social Capital Theory and Medical Decision Making Quality - Hypothesis 1's sub-hypothesis 1a to 1f.

3.5 SUB-HYPOTHESES DEVELOPMENT FOR RELATIONSHIP BETWEEN PHYSICANS' SOCIAL CAPITAL AND KNOWLEDGE SHARING QUALITY

This subsection describe critiqued literature to develop sub-hypotheses relating to the six factors of the SCT (social interaction ties, trust, norms of reciprocity, identification, shared language and shared vision) and knowledge sharing quality.

3.5.1 PHYSICIANS' SOCIAL INTERACTION TIES AND KNOWLEDGE SHARING QUALITY

Given the context, space and time; information is converted to knowledge through social interactions between individuals and organizations (Alwis & Hartmann, 2008) through knowledge sharing (Girard & Lambert, 2007). As also stated in another study (Robertson, 2011), VC members share concerns, passion on a topic and interact with one another to deepen their knowledge and expertise. Intelligence processing can occur on an online platform, such as, social networks supporting an organization to acquire and process intelligence through warning indicators. Due to the cultural composition of a VCoP and its unique collection of members, knowledge is shared to support intelligence processing to assure knowledge is usefully processed.

Knowledge is shared from a knowledge source where information and knowledge are delivered. The social ways of a VCoP support social interaction ties to facilitate intelligence processing (Tarn, Wen, & Shih, 2008). The diffusion of clinical information depends on environmental, organizational, clinician collaborative and interaction-based factors. Social influences refer to innovative behaviours commissioned among physicians; for example adaptation of EBM. Other resources besides information could be a physician's skills and knowledge transfer within network ties, considering that physicians depend on their peers' opinions and judgments for daily clinical solutions when evaluating evidence-based knowledge. Hence, such networks serve as a form of a beneficial SC that is interdependent and interlinked by social exchanges via trusted and supportive network participants to achieve their goals (Mascia & Cicchetti, 2011). It is clear that social interaction ties facilitate knowledge sharing but upon the analyses in this study, the mediating role of knowledge sharing between social interaction ties and DM needs empirical assessment based on the initial theory relating social interaction ties and knowledge sharing. Hence, based on these just-mentioned arguments, the first sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

Sub-hypothesis 2a*: Physicians' social interaction ties significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment.*

3.5.2 PHYSICIANS' TRUST AND KNOWLEDGE SHARING QUALITY

Strong community ties form knowledge exchanging environment with trust and satisfaction positively affecting VCoPs where trust is specific feelings of integrity and in its presence there is willingness to be cooperative, leading to good quality knowledge sharing (Chiu *et al.*, 2006). Hence, trust is very important in creating an atmosphere of knowledge sharing (Chang & Chuang, 2011). It is competence-based trust, i.e. trustworthiness, that one member knows that the other member is knowledgeable. Consequently, the other is trusted for knowing what he/she is talking about (Parayitam, 2010). Trust is the belief (i.e. the likelihood of trusting a DM person on the behaviour of the other member of a DM community) where knowledge-shared decisions are made in a cautious and helpful manner. Trust and credibility play a major role (Roberts, 2006) when knowledge and other resources sharing are based on trust (Mascia & Cicchetti, 2011) and knowledge is shared during a DM process between the party who is sharing knowledge and the DM party that seeks knowledge (Roberts, 2006). As per the analyses conducted in this study, this theory does not only support the belief that there is a relation between the SC and knowledge

sharing but also the mediating role of knowledge sharing between the SC and DM, which still needs to be empirically tested. Based upon this argument, the second sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

Sub-hypothesis 2b*: Physicians' trust significantly and positively affects the quality of physicians' knowledge sharing within a VCoP environment.*

3.5.3 PHYSICIANS' NORMS OF RECIPROCITY AND KNOWLEDGE SHARING QUALITY

Norms of reciprocity positively affect weak knowledge sharing attitude through knowledge repositories and relationships. The SC becomes important within a VC where it is different from conventional organizations since in a VC context, there is no motivation to reinforce trust, interaction and reciprocity mechanisms between individuals. Norms of reciprocity are hence, a driving factor for knowledge sharing within a VCoP; it is referred to as indulging in a rewarding behaviour. If this expectation drops so does the behaviour of knowledge sharing (Chiu *et al.*, 2006). Norms of reciprocity (i.e. favouring and expecting knowledge sharing in return) is also another variable for relational SC motivating knowledge sharing quality in a VC (Chang & Chuang, 2011). Even though various studied empirically assessed norms of reciprocity with knowledge sharing, the mediating role of knowledge sharing between SCT and DM lacked sufficient research since very scarce literature even discussed such a mediating role. Based upon this argument, the third sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

Sub-hypothesis 2c*: Physicians' norms of reciprocity significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment.*

3.5.4 PHYSICIANS' IDENTIFICATION AND KNOWLEDGE SHARING QUALITY

During group DM, how teams coordinate, solve complex problems and use their expertise has been assessed through team-based structures within the organizations. Various frameworks have depicted group knowledge processes to explain problem solving and coordination. For example, such theoretical models explaining group knowledge are: team mental model, transactive memory system, etc. When performing group DM, knowledge of who is good at what within a group is when members are aware of the expertise of one another. Group performance is affected by

transactive memory systems, through group dynamics, i.e. task coordination activity showing that members trusted each other's expertise. While the group members build awareness of each other's identity, their knowledge gets shared across their joint tasks within their group. A transactive memory system helps identifying new task specific knowledge during a knowledge sharing activity; hence aiding group performance in various ways, for example, providing solutions of higher quality (Austin, 2003). Hence, the fourth sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

***Sub-hypothesis 2d**: Physicians' identification significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment.*

3.5.5 PHYSICIANS' SHARED LANGUAGE AND KNOWLEDGE SHARING QUALITY

Guidelines and frameworks exist for computerized tools, for example CoWeb, for collaborative creativity where social interactions, collaboration and mentoring encourage creative working where problem solving occurs through collaboratively working in teams. In this environment, ideas are shared through shared language to achieve a shared and commonly understood shared vision by participating members learning each other's common task-dependent jargons that have been developed over time while various projects got executed. In this case, a common vision is achievable through open communication. Even though collaboration is hampered in such types of groups, due to differences in concepts and common vocabulary, similar groups can share information, within a CoP, through storytelling. An effective work relationship is achieved through shared knowledge sources (for example exchanging case-studies) to facilitate creative collaboration so complimentary skills shared during knowledge sharing are an asset and hence support DM (Mamykina, Candy, & Edmonds, 2002). Shared language is a notion deeper than language and expresses the underlying daily exchanges such as shared codes for joint understanding to benefit the exchange of intellectual capital to combine knowledge between parties for learning purposes within a CoP (Chiu, Hsu & Wang, 2006). When participants communicate through commonly shared language, the outcome is mutual knowledge that improves participants' understanding as well as creates their common vocabulary and improves their communication (Chang & Chuang, 2011). Consequently, information sharing can be affiliated with knowledge sharing as; in the previous sections the relation between information and knowledge has been already described. In addition, not only the just-portrayed argument supports the relationship between SCT and knowledge sharing, but also supports the mediating

role of knowledge sharing between SCT and DM – a role that still requires an empirical assessment. Another study (Oxoby & McLeish, 2004) that assessed how managers shared knowledge for ICT related DM reported that common language is compulsory for DM (Rantapuska & Ihanainen, 2008). Another study mentioned that decisions are defined strategies where strategies are affected by shared language, a notion that reflects a positive relationship between shared language and DM. During collaborative DM, the team work exchanges resources using shared language and open communication facilitates a common vision in a CoP. Any differences in vocabulary hamper collaboration, which requires skills to support DM (Mamykina *et al.,* 2002). Interactive group' common language is a largely ignored topic in the literature (Lauring & Selmer, 2011) where, personal thinking and analyses play a major role. At first, the problem needs to be understood for DM (Rantapuska & Ihanainen, 2008). Based on this argument, the fifth sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

Sub-hypothesis 2e*: Physicians' shared language significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment.*

3.5.6 PHYSICIANS' SHARED VISION AND KNOWLEDGE SHARING QUALITY

Shared vision is a type of understanding required for sharing knowledge. Motivation to share knowledge arises when members in a community have similar perceptions for interacting (Li & Li, 2010). Within an organization, united members' goals and aspirations form common vision, a bonding instrument for integration and related resources. In other words, those who share a common vision are most likely willing to share resources with one another. So, within a VC, where participants bond by common goals and interests, shared values and goals comparatively bond each other in such a VC to share knowledge. Common vision gives them meaning and value for sharing their knowledge within a VC (Chiu, Hsu & Wang, 2006). Problem solving requires common language and shared language for DM (Rantapuska & Ihanainen, 2008). So far, one empirical study showed a positive association between a shared vision and knowledge sharing (Chiu *et al.,* 2006). In addition, shared vision has a greater impact on DM. Leaders inspire in others around them a shared vision and the right decision (i.e. a timely and accurate) can transform this shared vision into reality. Outcome of a right decision raises the level of trust among those who shared the vision. DM is one of the most difficult components in any industrial sector, even if DM processes (i.e. adaptability, authority and responsibility being its essential elements) may vary from one industry to another but time pressure on DM is the same. These DM

processes are not enough to determine DM of the acquired quality. Even though technology advice and support is more readily available in the current era, DM is still handling a responsibility and one has to push on and make a decision since a wise leader will be able to recognize when he/she is able to benefit from someone else's knowledge and experience. To make a decision, unity is essential in order to pool in wider array of sharable experience. This is within the checks and balances of scrutinizing key decisions before ultimately reaching a quality decision (Nicholson, 2006). This argument proves that there is: (1) not enough research assessing the relationship between shared vision and knowledge sharing, and (2) not enough theory expressing the relationship between SCT, knowledge sharing and DM. This proves that mediating role of knowledge sharing exists between the SCT and DM but requires empirical assessment. Based on this argument the sixth sub-hypothesis, a sub-predictor of hypothesis 2 (depicted in Figure 3.4) is:

Sub-hypothesis 2f*: Physicians' shared vision significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment.*

In addition, as per the researcher's observation and analyses, current research lacks a description of the mediation role of knowledge sharing quality between the physicians' SC and medical DM quality. This is the reason why this role is considered essential in this research but only can be empirically tested upon data collection and analyses.

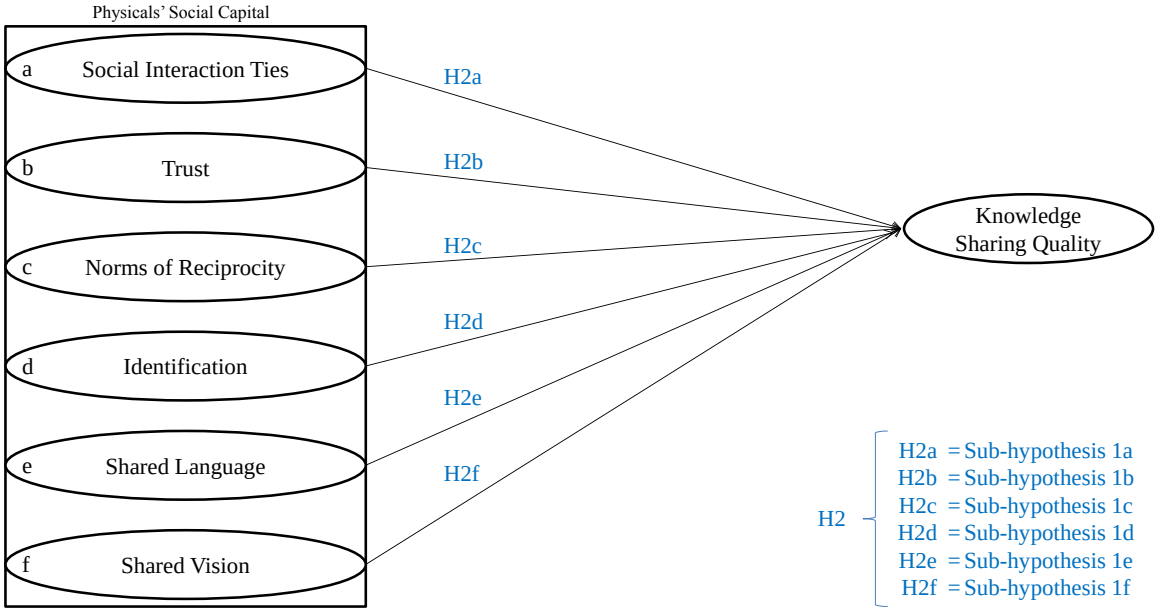


Fig 3.4. Physicians' Social Capital Theory and Knowledge Sharing Quality - Hypothesis 2's sub-hypothesis 2a to 2f.

3.6 ESTABLISHING THE STANCE OF THIS STUDY'S RESEARCH APPROACH

Since the research philosophy steers research strategy (Amaratunga, Baldry, Sarshar & Newton, 2002) and influences how research is conducted (Thornhill, 2009), it is important now to establish this study's research philosophy, before defining its conceptual framework. Considering that, this study research path began with a (1) literature review that (2) critique of a research gap to assesses the effectiveness of a VCoP on medical DM quality by associating: (a) physicians' SC, (b) knowledge sharing quality and (c) medical DM quality and hence (3) expressed four hypotheses; this research path is confirmatory. The rationale behind this choice is that confirmatory research also tests pre-stated relationships (Bernard, 2011) where associations help formulate hypotheses that are then tested to verify theory. Exploratory research, on the other hand, assesses data patterns, where descriptive foundations generalize hypotheses (Kamal, 2008). This argument also confirms that this study is deductive, since deductive research begins with a broad theoretical research and narrows down to specific hypothesis/es for empirical testing (Chahal, 2009). Henceforth, this study follows a deductive approach; unlike inductive research, which follows an inverse pattern, beginning with the specific and ending with wider theory generalization (Chahal, 2009). Keeping this section's overall argument in mind, this study is a confirmatory and deductive research; not surprising since confirmatory research is more likely deductive while exploratory research, i.e. where relationships between similar variables are statistically testing revealing this study is also an explanatory research (Saunders, Lewis & Thornhill, 2009), is more likely inductive (Bernard, 2011). This thesis's research philosophy is positivism as positivism is confirmatory and deductive (Kamal, 2008). Positivist research, unlike other approaches, i.e. Positivism, post positivism, constructivism & critical theory (Saunders, Lewis & Thornhill, 2009; Creswell, 2002; Said, 2006) assumes the following:

- Positivism examines the causes that influence outcomes (Creswell, 2002), i.e. assesses the effectiveness of KM tools i.e. VCoP from the point of view of physicians' SC (causes) on HC topics on i.e. medical DM quality (outcomes),
- In a positivist research, the research first makes claims that are later refined or abandoned (Creswell, 2002), i.e. the initial claims are theory that are later quantitatively tested,
- Knowledge is shaped from data and evidence (Creswell, 2002), i.e. thesis's literature driven adapted instruments where data was collected from VC physician participants (so non-experimental) and

- Research is based on true statements that explain the relationships between variables posed as hypotheses (Creswell, 2002), i.e., the four hypotheses as in the case of this thesis.

3.7 CONCEPTUAL FRAMEWORK MODEL

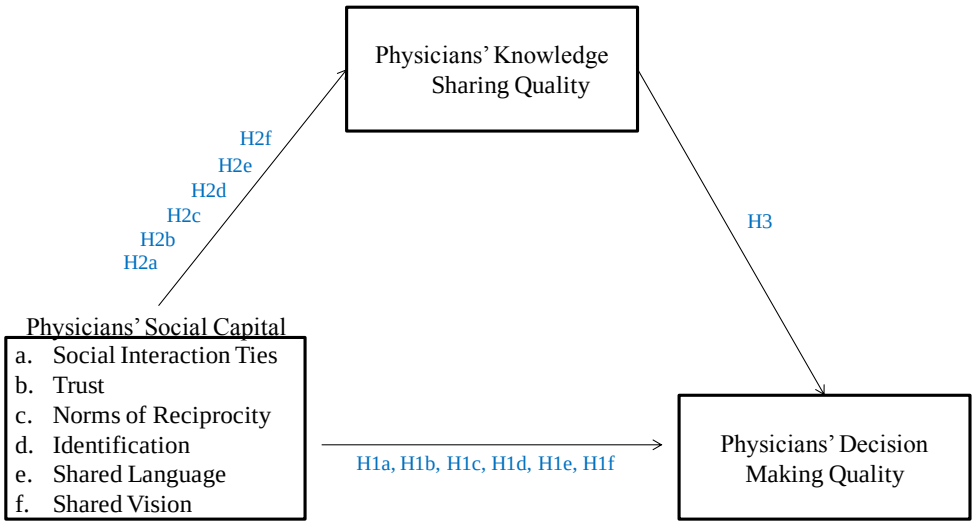


Fig 3.5. Relation between Physicians' Social Capital Theory, Knowledge Sharing Quality and Medical Decision Making Quality.

Figure 3.5 is the final proposed conceptual framework model. It is composed of the just-mentioned sub-hypotheses 1a to 1f of hypothesis 1 and sub-hypotheses 2a to 2f of hypothesis 2. In addition, this figure does not show the mediating role of knowledge sharing. The purpose of this model is to illustrate how hypothesis one, two and three relate to each other. This model does not however depict hypothesis four, which expresses knowledge sharing mediating role between the SCT and medical DM quality since fourth hypothesis was depicted in Figure 3.2. The Figure 3.5 was developed based on a model developed by Chiu, Hsu and Wang (2006). In the next chapter this thesis critiques and justifies its research methodology to empirically test its Figure 3.5's conceptual framework.

3.7 SUMMARY

This chapter was a focused research that concentrated on three research areas: (1) SCT, (2) knowledge sharing and (3) medical DM quality after a literature critiqued research gap was described in Chapter Two. In conclusion, this chapter proposed 4 hypotheses with 6 associating sub-hypotheses for hypothesis 1 and 2 described in Sections 3.2 to 3.5. These 4 hypotheses and the 12 sub-hypotheses were also depicted in this study's conceptual framework (Figure 3.1 – showing hypotheses 1 to 3 and Figure 3.2 – representing hypothesis 4). The sub-hypotheses related to hypotheses 1 and 2 are depicted in Figure 3.5, while Figure 3.2 presented how the mediating role of knowledge sharing quality, between SCT and medical DM quality (hypothesis 4), was assessed (i.e. by applying Baron and Kenny (1986)'s theory). Next, the researcher designed an appropriate literature driven research methodology, described in Chapter 4, by comparing this chapter's critiqued literature with literature associated with the research methodology to systematically critique out an appropriate research approach design for this thesis to empirically test Figure 3.2 and 3.3 conceptual frameworks.

CHAPTER 4
RESEARCH METHODOLOGY

4.1 INTRODUCTION

In Chapter Three, a conceptual framework was developed to assess the relationship between physicians' social capital (SC), knowledge sharing quality and medical decision making (DM) quality. The aim of this framework was to help assist the researcher to better understand the effectiveness of physicians' VCs on medical DM quality. The researcher was motivated to assess this research gap since literature encouraged further research in diagnostic DM, considering that it is diagnostic DM that is the cause of diagnostic errors (Bodenheimer & Fernandez, 2005). In addition, poor DM quality has led to poor HC quality (Lin & Chang, 2008) and research has been encouraged in clinical DM to reduce medical errors and improve HC quality (Berner, 2009).

This Chapter aims at developing a research methodology to empirically test the conceptual framework proposed in the previous Chapter. The researcher concluded on a research methodology after reviewing, critiquing the research philosophy and research strategy. The researcher chose a research methodology after comparing pros and cons of critiqued research philosophies and strategies in published journals and books with frequently observed research methodologies in various knowledge management (KM), and information systems (ISs) literature, such as those critiqued in Chapter Two and Three, and doctorial theses; for example Kamal (2008).

This Chapter is laid out as follows:

- Section 4.1 and 4.2 aims at justifying this thesis's research type (confirmatory and deductive), methodology (quantitative), data collection strategy (i.e. non-experimental survey) and research philosophy (positivism);

- Section 4.3 aims at justifying this study's choice of quantitative methodology over qualitative and mixed methodology, using four core studies of similar nature. This justification comes after the researcher confirmed the research type, research methodology and research philosophy in section 4.1 and 4.2.

- Section 4.4 aims at describing and justifying its research context (professional VC) by sequentially implementing its adapted and customized frameworks. Honeycomb framework, in Chapter Two – section 2.3.2 was customized and 21 Structuring Characteristics, introduced in this section, was customized to fit the context of this thesis;

- Section 4.6 and 4.7 describe the organizational settings of its two selected professional VCs. One VC was selected to pilot this thesis's survey instrument, i.e. "plastic_surgery@yahoogroups.com", introduced in Chapter Two, section 2.3, while the second VC was selected for main data collection. Also, these sections explain how appropriate sample sizes were calculated for the pilot study and for the main data collection and how the data collection procedures took place using an online posted and distributed survey;

- Section 4.8 justifies the design of its survey instrument, its pilot testing and its distribution procedure for data collection within the three VCs. In addition results of reliability and validity of the questionnaire were also mentioned in this section;

- Section 4.9 describes the data collection procedure and its response results.

4.2 JUSTIFYING THE RESEARCH METHOD AND STRATEGY OF THE RESEARCH APPROACH

This section justifies this study's rationale for its research method and strategy. As, first explained in Chapter Three, the research philosophy adopted in this thesis is positivism. Table 4.1 justifies this stance, method and strategy, quantitative method and non-experimental survey strategy.

Table 4.1. Chosen Types of Approaches with their Justified Decisions

Approach	Different Approach Types	Thesis selected Approach	Justification
Stances	Positivism, Post positivism, constructivism & critical theory (Saunders, Lewis & Thornhill, 2009; Creswell, 2002; Said, 2006).	Positivism	• As explained in Chapter Three

Methods	Quantitative, Qualitative, Mixed (Baker, 2001; Creswell, 2002).	Quantitative	• Methodology and conclusions should examine biasness through reliability and validity (Creswell, 2002), • Used to test or verify theoretical relationships between variables (independent, i.e. medical DM, and dependant, i.e. SCT factors, to rigorously test in explanatory research (Creswell, 2002), • Statistical standards needed to test instrument's reliability and validity (Creswell, 2002), • Data analyses should be statistically tested (Creswell, 2002), • Mixed method is time consuming, while research questions can be answered quantitatively (Creswell, 2002), • This thesis followed a quantitative, over qualitative, research methodology, even though both strategies are equally valued (Baker, 2001). This choice was driven by this study's two research questions: (1) What is the extent of the effect of physicians' SC on clinical DM in a VCoP and through what ways? and (2) What is the extent of the effect of physicians' knowledge sharing quality within the relationship between physicians' SC within a VCoP and medical DM quality? These two research questions' assessments of the extent of the relationships between constructs require statistical techniques that classify facts and relationships through a quantitative, over qualitative, methodology. Qualitative method just determines what exists rather than quantifying how much exists (i.e. extent). Qualitative is less structures and more based on the situation of a research (Bogdan & Taylor, 1975; Nissen, 1985), • Quantitative method supports explanatory and deductive what-type research questions (Creswell, 2002), • Since this thesis is deductive, considering that deductive research studies a natural phenomenon to statistically analyse meaning (Chahal, 2009), it adapted a quantitative methodology, in order to apply statistical and mathematical techniques to identify relationships and facts from represented samples to generalize results over a larger population (Chahal, 2009) and • This thesis made its choice between qualitative and quantitative - two distinguished methodologies in the (information systems) ISs area (Chahal, 2009) and a third type - mixed-methodology (Creswell, 2002). Even though the researcher has a choice on what research approach to take (Baker, 2001), this study's research philosophy supports a quantitative deductive approach.
Strategies	Experiment, Non experimental, i.e. survey, observation (Baker, (2001)	Survey - non experimental	• Quantitative non-experimental design, like survey (Creswell, 2002) facilitates large sample size needed to generalize over VC physicians from all over US, • Data collection is performed on hard data through passive interactions, i.e. questionnaire, large population (described in section 4.9) few research variables (Chapter Three - Figure 3.3), controlled research context (HC VC based research context) and procedure based statistical data analyses is (Sogunro, 2002) and • "What" type research questions; are linked to statistical surveying to collect and analyse data using data collection techniques (Khalifa, 2011). Consequently, this thesis's research questions are what-type questions.

Further to justification in Table 4.1, this study also adapted a quantitative research approach due to the connection between the research philosophy in this study and the various research approaches. The positivist belief is that the world conforms to standards and rules of cause and effect. Reductionism, unlike interpretivism (antipositivism), means non universal truth where

inter-relation and understanding is comprehended from the research's point of view (Bogdan & Taylor, 1975). This is why the choice of the research methodology was positivism supported by a quantitative research strategy. It is the decision of this study to deal with KM and knowledge sharing within a VCoP. This decision is also supported by Wallace, Fleet, and Downs, (2010) who argue that such a methodology (i.e. deductive and positivist) is heavily applied in KM literature. This approach of this study is supported by Chahal, (2009) stated that it is up to the researcher to decide what research approach he/she wishes to pursue. However, Chahal, (2009)'s view contradicts with Galliers (2011) who argues that there is a greater need for a balance between two research approaches in IS research, (qualitative and quantitative method). Based on the above critiqued argument, this study agrees with Chahal, (2009), hence confirms to integrating positivism with a quantitative approach.

4.2.1 ASSESSING FOUR STUDIES TO JUSTIFY THE RESEARCH METHOD

The literature critiqued in this section justifies further the research approach and the method, described in the section 4.2. The critique in this subsection is possible, at this stage, once the research approach and the method was confirmed through the fundamental research methodology theories critiqued earlier in section 4.3 and depicted in Table 4.1. This provided a sound rationale to choose the four observed core studies presented in this section. Even though the researcher justified the research approach; additional justification is provided by assessing four studies: Chiu, Hsu and Wang (2006), Chang and Chuang (2011), Lin and Chang (2008) and Parayitam (2010). They are considered core studies from the point of view of this research since they are: (1) of similar nature and hence, were closely followed during the development of the hypotheses of this study and during the conceptual framework development and (2) sources for adopting various parts of this study's survey. In addition, Chiu, Hsu and Wang, (2006) and Chang and Chuang (2011) empirically assessed the association between virtual community of practice (VCoP) members' participation (based on social capital theory - SCT) and knowledge sharing quality; while Chiu *et al.*, (2006) and Chang & Chuang (2011) revised SCT to explain CoP members' participation – similarly to this thesis, which assesses the impact of HC VCoP physicians' SC on knowledge sharing quality. Hence this thesis adapted measures of physicians SC based on SCT factors and knowledge sharing quality from these two studies. Lin and Chang (2008) assessed the relationship between knowledge sharing quality and medical decision making (DM) quality within a hospital context. DM quality was based on social and economic exchange theories. Parayitam (2010) assessed the relationship between trust and decision quality according

to the information processing theory. Even though, Parayitam's study was not conducted within a VCoP, this thesis adapted its medical DM quality measure, since it was utilized within a HC context. As a result, this thesis is hence able to assess the impact of physicians' SC on medical DM quality.

4.2.2 CRITIQUING THE RESEARCH METHODS OF FOUR CORE STUDIES

All four studies reviewed literature, reported a gap in research and proposed a conceptual framework. While, Lin & Chang (2008) interviewed interested physicians to construct literature-supported propositions, three other studies followed a quantitative research strategy (Chiu, Hsu, & Wang, 2006; Chang & Chuang, 2011; Parayitam, 2010) using an adapted survey that was pilot tested. At this stage, Chiu, Hsu and Wang (2006) tested their instrument by information system (IS) area participants and PhD students while Chang and Chuang (2011) pilot tested by VC members. Parayitam (2010) did not mention a pilot testing procedure. During data collection phase: (1) Chiu, Hsu and Wang (2006) distributed their survey in a VC, (2) Chang and Chuang (2011) posted their questionnaire online for any VC member participants and (3) Parayitam (2010) mailed survey to members of a strategic hospital DM team. During data analyses phase, instrument reliability and validity was assessed using confirmatory factor analysis (CFA) by Chiu, Hsu and Wang (2006), Chang and Chuang (2011) and Parayitam (2010) followed by: (1) Chiu, Hsu and Wang (2006) performing Structured Equation Modeling (SEM), (2) Chang and Chuang (2011) performing multiple regression analyses and (3) Parayitam (2010) performing correlation analyses. As compared to Chiu, Hsu and Wang (2006), Chang and Chuang (2011) and Parayitam (2010); Lin and Chang (2008) defined their research as exploratory.

4.2.3 ASSESSING THE FOUR STUDIES

So far, the research approach and the method to test the conceptual framework were presented earlier in the section 4.3. This section explains the top-down approach, expressed in the layout of all chapters of this thesis, helping the adaption of a quantitative methodology. As observed, Lin and Chang (2008) assessed the relationship between knowledge sharing factors and DM quality by qualitatively interviewing physicians to explore immature concept to develop a theory, i.e. they applied a bottom-up approach (Creswell, 2002). In comparison, this thesis employs a top-down approach, characteristic for quantitative methodology. In this case, the research problem is understood through factors/variables leading towards an outcome (Creswell, 2002).

Consequently, the researcher: (1) performed literature review to express relationships between physicians SC, knowledge sharing quality and medical DM quality, (2) proposed hypotheses and conceptual framework and (3) adapted a survey instrument. This research approach was similar to as observed in other studies mentioned previously (Chiu *et al.,* 2006; Chang & Chuang, 2011; Parayitam, 2010).

This top-down approach contrasts with Lin and Chang (2008)'s study, which is an exploratory research. Lin and Chang (2008) applied mixed-methods strategy, i.e. implementation based inquiry as stated by Creswell (2002), in order to sequentially collect qualitative data during the first research phase followed by quantitative data during the second and third phase. In this case, the qualitative interviewing allowed the authors to expand their understanding in the second phase. This a mixed method approach aims at gaining a deeper understanding of the research problem, by converging qualitative and quantitative method to later triangulate for instrument development (Creswell, 2002). However, in the case of this thesis; the research problem was already identified followed by adopting a survey instrument.

Based on research approach and methodology, justified by this study, the study design, depicted in Figure 4.1, is:

1. An introduction in Chapter One, followed by
2. Literature review and research gap described in Chapter Two, which led to
3. A conceptual framework and hypotheses development reported in Chapter Three.
4. Chapter |Four justifies and reports this study's research methodology,
5. Chapter Five expresses the process and findings of data analysis followed by
6. Discussion of the analysis in a critiqued comparison with reviewed literature in Chapter Two is reported in Chapter Six; finally,
7. Chapter Seven concludes this study by summarizing this thesis, highlighting its contributions, limitations and opportunities for future research.

As depicted in Figure 4.1, black boxes indicate chapter numbers with their titles. White boxes signify outcomes of chapter One, Two, Three and Four. Also, Chapter One, Two, Three and Four reflect the research design of this thesis. Data Collection followed data analysis reported in Chapter Five and Chapter Six to Seven discussed and concluded the analysis of collected data.

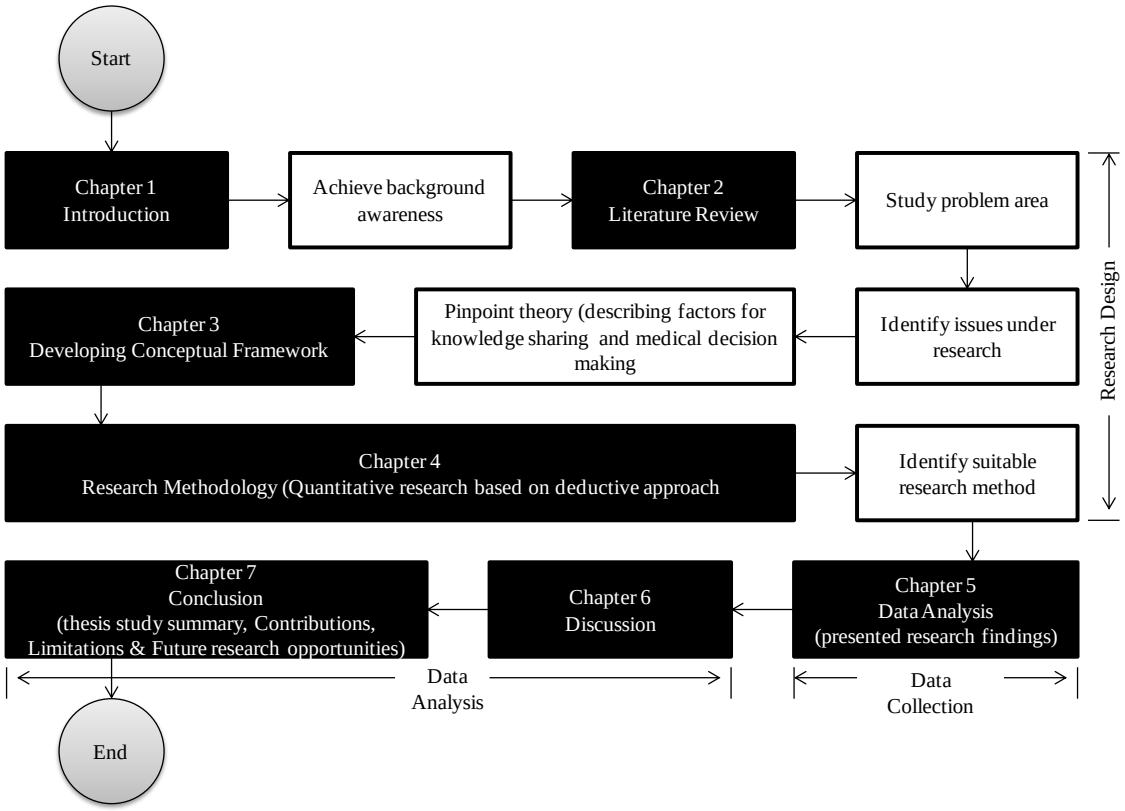


Fig 4.1. Empirical Research Framework for Ph.D. Study

4.3 RESEARCH CONTEXT

Since this study empirically assesses the: (1) impact of a VC on DM and (2) mediating role of knowledge sharing between physicians' SC and DM; the research context is a VC operating on a social media platform. This study previously defined social media and VCs given the unclear variations in the definitions and literature published differences between these two terms. Hence, these terms are defined using two literature-adapted frameworks: (1) one framework described a social media platform (Honeycomb framework reported in section 2.3.1) and (2) the other defined VCs (21 Structuring Characteristics framework reported in section 2.3.2). To fit this study's context, the Honeycomb framework was applied to define physicians' professional VC and the 21 Structuring Characteristics framework was customized to 5 Structuring Characteristics framework to define VCs (as reported in section 2.3.3.1 and 2.3.3.2). The aim was to apply the Honeycomb framework to define physicians' professional VCs and then pinpoint VCs on this physicians' professional VC platform along with others, i.e. Facebook, LinkedIn and ListServ (as depicted in Table 2.4 and 2.5). From this list, any VC can be selected for empirically assessing this study's conceptual framework.

4.4 OPERATIONALIZATION, MEASUREMENTS, INSTRUMENTS, RELIABILITY AND VALIDITY

The questionnaire quality is important (Saunders, Lewis and Thornhill, 2009). In this explanatory research, questionnaires facilitate understanding of a phenomenon. Self-administered questionnaires can be distributed online and filled out by respondents through the Internet, email or by hand if distributed in person or through the mail. The research instrument in this study is developed using close-ended items on a 5-point Likert scale as observed in Wang and Wei (2011). The rationale for using 5, not 7-point Likert scale is discussed in the next section. According to the conceptual framework in Chapter Three, medical DM is influenced by the mediating role of knowledge sharing quality, determined by physicians' SC. To empirically test this framework, this study applied measures adapted from various related studies to design and develop its questionnaire (Razzaque, 2012) (Appendix A). This process is described in section 4.7.1. The nature of a survey can be cross sectional or longitudinal (Creswell, 2002). This study selected the cross sectional type, i.e. data will be collected during a predefined period of time rather than having a various sets of data collection procedures extends couples of times during a much longer stretch of time (longitudinal nature). As observed in Demiris, (2006), HC is associated with various technology types i.e. the Internet, video conferencing, blogs, video sharing, bulletin board, etc. As suggested by Saunders, Lewis and Thornhill, (2009), a questionnaire is accompanied by a cover letter, (in Appendix A) clarifying the participant's expectation, thanking them and furbishing contact reference for further inquiries.

4.4.1 CONSTRUCT DEFINITION AND MEASURE DEVELOPMENT

Just as a conceptual framework, is composed of key variables, factors or constructs (Jabareen, 2009), so is the conceptual framework, depicted in Figure 3.8. It is composed of three variables (physicians SC, knowledge sharing quality and DM quality). Physician's SC is an independent variable, while knowledge sharing quality and DM quality are dependant variables in relation to the independent variable. Regoniel (2012) stated that, while cause is represented by an independent variable, the dependent variable reflects an outcome. Controlling the quality of physicians to improve HC quality (a topic of many studies), has always been based on methods that measured quality improvement (Anderson & Shields, 1982). Hence, even in this study, all constructs were measured at their existing scale and all the items were measured on a 5-point Likert scale, ranging from 1 being "*strongly disagree*" to 5 being "strongly agree". This study

adapted portions of its survey items (as depicted in Table 4.2) from other authors (NAMES). Even though, two studies (Chang & Chuang, 2011; Lin & Chang, 2008) utilized a 7 point scale for their survey items, Chiu, Hsu and Wang (2006) utilized a 5 point Likert scale. The researcher utilized a 5 point Likert scale since there is no evidence of a difference in responses generated from 5 point or 7 point Likert scale (Lee, Jones, Mineyama & Zhang, 2002).

As depicted in Table 4.2, the independent variable was the physicians SC through 9 items in the questionnaire. This study adapted scales, which were developed and tested by Chiu *et al.* (2006). The reported acceptable reliability of adapted items was as follows:, social interaction ties - Cronbach's $\alpha = 0.90$, trust - Cronbach's $\alpha = 0.89$, norms of reciprocity - Cronbach's $\alpha = 0.82$, identification Cronbach's - $\alpha = 0.90$, shared language Cronbach's - $\alpha = 0.84$; shared vision - Cronbach's $\alpha = 0.88$. These Chronback α values are essential to justify that the items adapted for this study were statistically reliable to begin with.

Knowledge sharing quality is an:

1. Independent and mediating variable between physicians' SC and DM quality and
2. Independent variable in relation with DM quality.

Knowledge sharing quality was adapted from Chiu, Hsu and Wang (2006). The reported acceptable reliability was Cronbach's $\alpha = 0.92$. Medical DM quality was the dependant variable; adapted from Lin and Chang (2008), who reported this variable as reliable, i.e. Cronbach's $\alpha = 0.90$. In addition, Table 4.2 also listed and defined all these variables as constructs (i.e. physician's SC, knowledge sharing quality and medical DM quality) with their associated count of items cited with their sources from where these constructs and their items were adapted from. This study followed a similar format to Chang and Chuang (2010). As also depicted in Table 4.2, the items were modified from their original sources to fit the context of this study since the studies from which these items were adapted differed from the context of this study. This study aims at assessing the effectiveness of a VC on DM. Its context is a HC VC environment.

Table 4.2. Defining Constructs and Number of Items Being Measured

Construct	Definition pertaining to this study	Count of Items	Resources
Independent Variables			
Social Interaction Ties (SIT)	Deep interactions and relationships within a virtual community (Chang & Chung, 2011).	4	(Chang & Chung, 2011; Chiu *et al.*, 2006)
Trust (T)	Personal belief and expectation of other participants' consistent performing behaviour within norm of a virtual community (Chang & Chung, 2011).	5	(Chang & Chung, 2011; Chiu *et al.*, 2006)
Norms of Reciprocity (NoR)	Personal insight of the fairness upon which resource sharing can occur within a virtual community (Chang & Chung, 2011).	2	(Chang & Chung, 2011; Chiu *et al.*, 2006)
Identification (ID)	Personal realization of being involved with a recognized Virtual community (Chang & Chung, 2011).	4	(Chang & Chung, 2011; Chiu *et al.*, 2006)
Shared Language (SL)	Dissimilar terms used among virtual community participants (Chang & Chung, 2011).	3	(Chang & Chung, 2011; Chiu *et al.*, 2006)
Shared Vision (SV)	Collective goal and ambitions of participants to combine resources within a virtual community (Chiu *et al.*, 2006).	3	(Chiu *et al.*, 2006)
Dependent Variables			
Medical DM Quality (DM)	I.e. decision quality (Raghunathan, 1999) wanting accuracy for evidence-based practice to improving DM accountability (Hancock & Durham, 2007). Physicians' DM quality is assessed by the level of diagnosis certinity, an outlook of treatment plan and diseases, side-effects, beliefs as well as risks (Lin & Chang, 2008). In this case, physicians' DM quality is a subjective judgement since such a decision is based on preferences of alternating decisions (Yan, Chen & Khoo, 2002).	6	(Lin & Chang, 2008; Parayitam, 2010)
Independent and Mediating Variables			
Knowledge sharing quality (KS)	Contributing tacit and explicit knowledge through individuals willing to share socially by integrating information, theory and experience via structured or technology-driven processes (Chang & Chuang, 2011)	6	(Chang & Chung, 2011; Chiu *et al.*, 2006)

Note 1: 4 Items of SIT:

- I maintain close social relationships with some members in a virtual community (VC).
- I spend a lot of time interacting with some members in the VC on a personal level.
- I know some members in a VC on a personal level.
- I have frequent communication with some members in the VC.

5 Items of T are:

- Members in a VC will not take advantage of others even when the opportunity arises.
- Members in a VC will always keep the promise they make to one another.
- Members in a VC would not knowingly do anything to disrupt the conversation.
- Members in a VC behave in a consistent manner.
- Members in a VC are truthful in dealing with one another.

2 Items of NoR are:

- I know that other members in a VC will help me, so it's only fair to help other members.
- I believe that members in the VC would help me if I need it.

4 Items of ID are:

- I feel a sense of belonging towards the VC.
- I have the feeling of togetherness or closeness in the VC.
- I have a strong positive feeling towards the VC.
- I am proud to be a member of the VC.

3 Items of SL are:

- Members in the VC use common terms or jargons.
- Members in the VC use understandable communication pattern during the discussion.
- Member in the VC use understandable narrative forms of post messages or articles.

3 Items of SV are:

- Members in the VC share the vision of helping others solve their professional problems.
- Members in the VC share the same goal of learning from each other.
- Members in the VC share the same value that helping others is pleasant.

6 Items of knowledge sharing are:

- The knowledge shared by members in VC is relevant to the topic.
- The knowledge shared by members in VC is easy to understand.
- The knowledge shared by members in VC is accurate.
- The knowledge shared by members in VC is complete.
- The knowledge shared by members in VC is reliable.
- The knowledge shared by members in VC is timely.

6 Items of DM are:

- I am very certain of the diagnoses after my interaction with members in the VC.
- I am very certain of the treatment after my interaction with members in the VC.
- I am very certain of the health benefits after my interaction with members in the VC.
- I am very certain of the side effects after my interaction with members in the VC.
- I am very certain of the risks after my interaction with members in the VC.
- I am very certain of the use of evidence-based knowledge after my interaction with members in the VC.

4.4.2 JUSTIFICATOIN OF SURVEY DEMOGRAPHICS

In Table 4.5, this study justified survey variables. Survey's demographics section is composed of four items (Appendix A), i.e. survey questions, being: "*gender*" and "*work experience (in years)*" were adapted from Chiu *et al.,* (2006). Specialty was adapted from Lin and Chang (2008) considering that the same study stated that knowledge sharing occurs among physicians of differing specialties. Demographics describe survey's target population to attain an analysis of influencing factors on participants' answers (Snap Survey Software, 2012). As observed in Lin and Chang (2008), this study described its four demographic items as demographic characteristics (Table 5.1 – next chapter). This was another reason behind utilizing these four demographic questions. Also, including a demographic item such as the number of the participant's years of experience can shed important information on how experienced VC participants are. Next, to assure that participants are VC members, first a definition VC was posted before the next item: "*I am part of a Virtual Community because: I am part of a/an*". Either the participant is part of: (1) professional email list, which is hence being part of a VC as defined by Eysenbach *et al.* (2004); (2) professional group like social media, which means being part of a VC as defined by Kietzmann *et al.* (2011); (3) professional platform like QuantiaMD, which means being part of a VC as defined by Modahl, Tompsett, & Moorhead (2011) or video conferencing, which is being part of a VC as defined by Demiris (2006). As observed in literature, these three categories define all social media platforms (Facebook, Linked, Listserv and professional VCs depicted in Table 4.4.

4.4.3 INSTRUMENTATION

Table 4.5 depicted sources from which independent variable (physician's SC), independent and mediating variable (knowledge sharing quality) and dependent variable (DM quality) were adapted and integrated to develop the survey for this study. In addition, in the previous section, the presence and function of items in the survey demographics section were also justified. In summary, this survey instrument is composed of four parts: (1) demographics, (2) physicians' SC, (3) knowledge sharing quality and (4) medical DM quality. The demographics aspect of the questionnaire is composed of four items (item no, 1 - 4), already explained earlier in this chapter. As depicted in Table 4.3, physicians' SC is represented by six sub-sections being: social interaction ties, trust, norms of reciprocity, identification, shared language and shared vision. Social interaction ties, is composed of four items (item no. 5 -8) with a sample item such as "*I maintain close social relationships with some members in a virtual community.*" Trust is composed of five items (item no. 9 - 13) with sample item such as "*Members in the virtual community will not take advantage of others even when the opportunity arises.*" Norms of reciprocity is composed of ŧwo items (item no. 14 and 15) with sample item such as "*I know that other members in the virtual community will help me so it's only fair to help other members.*" Identification is composed of four items (item no. 16 - 19) with sample item such as "*I feel a sense of belonging towards the virtual community.*" Shared language is composed of three items (item no. 20 - 22) with sample item such as "*Members in the virtual community use common terms or jargons.*" Shared vision is composed of ŧhree items (item no. 23 - 25) with sample item such as "*Members in the virtual community share the vision of helping others solve their professional problems,*" The third part of the questionnaire was knowledge sharing quality composed of six items (item no. 26 - 31) with sample item such as "*The knowledge shared by members in virtual community is relevant to the topic.*"The fourth part of the questionnaire was medical DM quality composed of six items (item no. 32 - 37) with sample item such as "*I am very certain of the diagnoses after my interaction with members in the virtual community*." This study also provides a sample item, from each part and each sub-part of the instrument, a technique favoured by this study for its clarity (i.e. to show the reader a sample of an actual item used), which was recommended by Creswell, (2002). The questionnaire was administered as hard copy and soft copy where soft copy was posted in form of a Google Document (Razzaque, 2012). In addition, as suggested by Saunders *et al.* (2009), the last seven questions of the survey (item no. 38 – 44) were added in the survey to gather feedback from the non-physician participants when survey was pre-tested and from physician participants when the survey was pilot-tested for

its validity and reliability (explained next in section 4.5.3). A sample item from the last seven questions is "*What questions you felt un-easy to answer?"*.

In the next sections, the researcher justifies the strategy for pre-testing, pilot testing and main data collection. However, before doing so, it is important to justify and explain the organizational setting during which these three phases (pre-test, pilot test and main data collection) occurred (next - section 4.6) such as how many participants were required for the success of each phase, i.e. determining sample size (section 4.7).

4.5 ORGANIZATIONAL SETTING

Some studies have recommended network analyses, such as in this study, which assesses the effectiveness of VC on knowledge sharing and DM to conduct research within an organizational setting (Lin & Huang, 2005; Mascia & Cicchetti, 2011). As a result, these three phases are as follows, as also summarized in Figure 4.3:

1. ***Phase 1*** - As mentioned in the previous section, survey (Razzaque, 2012) was pre-tested during May, 2012 on ten faculty volunteers.

2. ***Phase 2*** - Online pilot study took place in July 2012. An online survey (Razzaque, 2012) was emailed to all physician members of *"plastic_surgery@yahoogroups.com"* VC (listed in Table 4.4). First, the administrator of this VC' was contacted by email, introduced to this study along with its survey (Razzaque, 2012), furnished a copy of an ethical approval (Appendix B) and requested to grant permission to conduct pilot study. Upon attaining his approval, the administrator was provided with a pre-written e-mail, which he later forwarded to his peer-members requesting their participation. Pilot study data collection initiated in March 2012. In addition, the researcher was also added to this VC to conduct non-participant observation. After two weeks, the administrator sent everyone a reminder about the survey. Further explanation is also furbished in the section 4.8.4. After completing this step, the following pilot study data collection procedure was applied by the researcher:

    a. E-mailed advance notice to the admin of this VC,
    b. A week later forwarded the actual survey that was e-mailed to all VC members and
    c. After 4-8 days sent another follow-up reminder e-mail, as advised by

(Creswell, 2002).

Further amendments needed to be made after pilot study results were analysed (reported ahead in section 4.8).

3. ***Phase 3*** - Main data collection took place in August 2012 by distributing an online survey (SurveyMonkey, 2012) to 600 SurveyMonkey's (SM's) panel of doctors (Table 4.4) (Wilner, 2012).

A similar 3-phased survey administration technique was also observed in Chiu *et al.* (2006). Just as Demiris (2006) assessed the effectiveness of a VC in HC, this study, too, empirically investigated the impact of VCoP in a HC context.

Based on the 3-phased approach, the second phase (pilot study) and the third phase (main data collection - main survey distribution before data analysis, there were two organizations ("*plastic_surgery@yahoogroups.com"* and SM) that staged a VC setting being:

1. ***Pilot Study Phase*** – The researcher got aware of "*plastic_surgery@yahoogroups.com*" VC, the sixth VC under professional community of physicians - depicted in Table 4.4, was established in 2001 from Foong and McGrouther (2010). Foong and McGrouther, (2010) also mentioned that this yahoo based VCoP is composed of 1,290 members. These physician members provide consultation and training in the area of plastic surgeons. The discussions within this VC are utilized for educational purposes and sharing experience.

2. ***Main data collection phase*** - SM, third VC under the Listservs category, is composed of 600 physician members (Wilner, 2012), as depicted in Table 4.4. SM was established in 1999 by Ryan Firley (Helft, 2011) and holds 10 years of survey methodology and web technology experience (SurveyMonkey, 2012). Each month, approximately 33 million participants respond to surveys from 200 countries (Helft, 2011). SM is a survey-based tool. All responses get coded and are exportable in various file formats from SM online portal (Symonds, 2011). After launching an online survey via SM (Razzaque, 2012), a SM audience product was launched to reach out to the target audience of this study, i.e. physicians. These target audience were purchased from SM and SM assumed responsibility to distribute the online survey to them. There are nineteen reported types of participants categorized by industry and all are only from US (SurveyMonkey, 2012). "*HC and pharmaceuticals*" and doctors (SurveyMonkey, 2012) were the chosen target population of this study's interest.

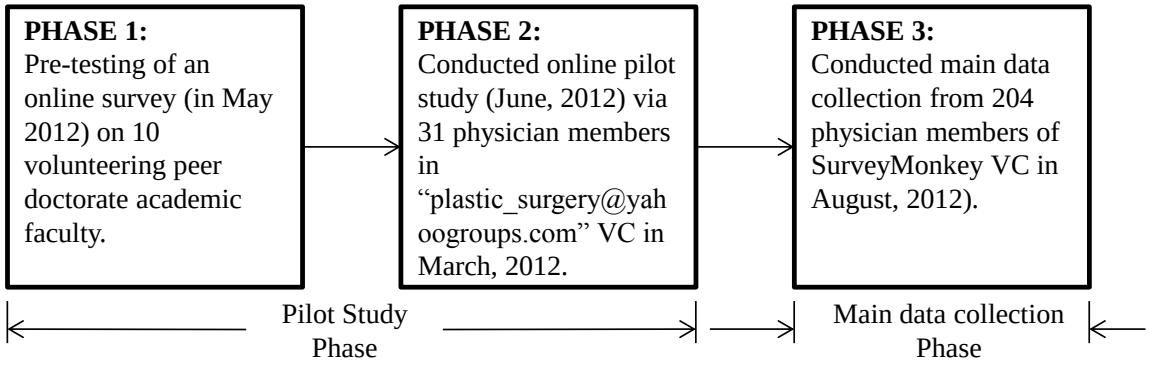


Fig 4.3. Summary of pilot study and main data collection phase

4.6 SURVEY PRE-TEST AND PILOT STUDY

This study followed two types of resources to form an implementable pre-test, pilot study followed by its data analyses strategy being: (1) books followed by (2) journal articles and web-based documentation to formulate a pilot study plan and to understand how to analyse and interpret data collected in this pilot stud. Publications that were used for this assessment:

1. Published their pilot study strategies and findings to enable this study to adapt their pilot study and data analyses methods and
2. Distributed parts of this study's adapted and customized questionnaire (Razzaque, 2012) for data collection, as observed from Wang and Wei (2011).

The researcher pre-tested the survey in May, 2012 for academic effectiveness to assess its clarity and content validity by conducting face-to-face discussion with ten experts. Each of these experts read through all survey items, as advised by Kim *et al.* (2011). These were PhD holding non-physician volunteers, a strategy also observed in Chiu *et al.* (2006) and in Wang & Wei (2011). |Such a procedure assures the comprehensiveness and appropriateness of the instrument for its target population (Gupta & Kim, 2007). This procedure was implemented follows:

1. Many PhD holding faculty were emailed invitations introducing them to this study and inviting them to assess the questionnaire for its clarity and validity,
2. The first five voluntary participants discussed the survey's ambiguities, Table 4.5,
3. The questionnaire was amended accordingly based on the most relevant and common feedback,

4. Steps 2 and 3 were repeated for the next five voluntary participants. The amended survey after concluding this pre-test is accessible in Razzaque (2012).

4.6.1 PRE-TEST RESULTS

Feedback from 10 non-physician PhD holder participants was documented in Table 4.4, Based on their feedback, the questionnaire was: (1) amended for grammatical errors and (2) clarified by defining terms, for example VCoP.

*Table 4.3.*Log of Feedback on Survey Clarity and Quality - from 10 Non-Physician Academic Ph.D. Holding Participants

	Participants				
	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Common Concerns	• Edit grammar • Make all items non-mandatory • Define terms like VC, social capital, etc • Q8 is unclear – advantages is not clear	• Edit grammar • Make all items non-mandatory • Define terms like VC, social capital, etc • Q3 should make it clear if primary virtual community, to which respondent belongs to, pertains to one or all he/she belongs to	• Edit grammar • Make all items non-mandatory • Define terms like VC, social capital, etc	• Edit grammar • Make all items non-mandatory • Define terms like VC, social capital, etc	• Edit grammar • Make all items non-mandatory • Define terms like VC, social capital, etc • Q 3 should make it clear if primary virtual community, to which respondent belongs to, pertains to one or all he/she belongs to.
Unique Concerns		• Clarify all DM quality section: for one or many instance (e.g. risk in one case directly correlate with side effects but opposite in another instance).		• Got confused at the end of the survey, • Survey needs to better cater to busy physicians' schedules.	• Q 4: Clarify as all VCs seem tame. • What is meant by: Q 12 "*consistent*", Q 13,"*dealing*" as this is a function, i.e. offer information, Q 26" *topic*", Q 21 "*pattern*"& Q 33 "*treatment*" •
	Participant 6	Participant 7	Participant 8	Participant 9	Participant 10
Common Concerns	• Edit grammar but much less than before	• Edit grammar but much less than before	• Edit grammar but much less than before	• Edit grammar but much less than before	• Edit grammar but much less than before
Unique Concerns		• Be more kind in my rhetoric, e.g. thank you etc • Fine tune Q 5 to	• Title must be in quotes, • Q 3's s specialty needs	• Clarify phrase "*personal relationship*" in "social	

		be short simple and • Q 6 is confusing.	clarification as 1 department can have multiple specialties, • Q 12 & 26 should be clarified • Replace '*shared vision*' with shared interests.	interaction ties" section.	

4.6.2 PILOT-TEST PROCEDURE

After the pre-test phase, the instrument reliability and validity was assessed. There are three types of reliability:

1. Internal consistency – assessment of the degree to which an instrument's multiple items measuring a common variable or concept – assessed using the α value,
2. Stability – assessment of the degree to which an instrument attains similar results during its multiple applications – assessed if administration of an instrument varies every time of multiple times data collection occurs and
3. Equivalence – assessment of the degree to which an instrument (of similar or differing forms) used by multiple data collectors attains similar results when both cases are measuring similar variables (Selby-Harrington, Rn, Mehta, Jutsum, Riportella-Muller & Quade, 1994).

Upon analysis, the internal consistency is relevant to this study but not stability and equivalence since this study's survey instrument was distributed only by the researcher and in one single attempt whether during its pilot study phase or data collection phase. As a result, based on the three types of reliability, in this study reliability was measured using Cronbach's α, assuming that the scores should be greater than 0.6. If factor analysis is not performed, this value should be greater than 0.7. If factor analysis is performed, then α value should be greater than 0.6. Since all questionnaire items were adapted from other literature (Table 4.2), it was unnecessary to measure the four types of instrument validity: (1) face validity, (2) content validity, (3) criterion validity and (4) construct validity (Selby-Harrington *et al.*, 1994). By classification:

1. **Face validity** - occurs when a researcher feels the survey he/she developed seems valid based on his/her knowledge of the literature review. Hence, the researcher is confident of the survey and pursues to use the survey,
2. **Content validity** – assures that each item measures its concept at study. The instrument should be confirmed by an expert. If not, then instrument should be looked over by the researcher (Selby-Harrington *et al.,* 1994), i.e. there needs to be an assurance that items relate to their construct and represent appropriate content to measure its study (Field, 2003; Radhakrishna, 2007),
3. **Criterion validity** – assesses a high degree of correlation between two similar measures of one concept (Field, 2003; Selby-Harrington *et al.,* 1994) being measured through the application of a 'correlation coefficient'. This assessment is performed after the instrument is assured for its content validity (Selby-Harrington, et. al, 1994) and
4. **Construct validity** - applies factor analysis to assess this most superior form of instrument validity reflecting that instrument surely measures the studied concept; i.e. the instrument measures what it is supposed to measure (Selby-Harrington *et al.,* 1994).

However this study's research context/environment differs from other studies. As a result, the researcher opted to pilot test this study's instrument for validity and reliability. As a result, the 37-item online survey (Razzaque, 2012) was pilot tested via 31 "plastic_surgery yahoo group" VC members (VC is listed in Table 4.4) during May, June and July, 2012. This study pilot tested its online survey to assess its clarity, consistency in logic, contextual relevance, etc. as recommended by Chiu, Hsu and Wang (2006). This questionnaire was also accompanied by seven short questions (Razzaque, 2012) to attain additional explicit feedback of the participants, for example: "Which question was unclear or ambiguous?", as observed in Saunders *et al*. (2009). A sample size of 30 participants was satisfactory for this pilot study since:

1 10-30 is a sufficient pilot testing sample (Hertzog, 2008) to assess survey instrument's internal consistency, i.e. type of instrument reliability (Selby-Harrington *et al.,* 1994; Koh & Kim, 2004; Radhakrishna, 2007; Radhakrishna, 2007) for instrument purification (Deng, 2011). Constructs' response-based completeness and reliability (Gupta & Kim, 2007) is the accuracy of the consistency of what it measures (Radhakrishna, 2007; Jackson, 2008),

2 Lancaster, Dodd and Williamson (2002) recommended a rule of thumb for determining minimum sample size for pilot study, i.e. 30 or more participants; hence this study is satisfied

with 31 “plastic_surgery yahoo group” participants for its pilot study.

3 Even though, Connelly (2008) recommended 10% of sample size, i.e. (1290 “plastic_surgery yahoo group” members – Table 4.4) = 129. This study concluded that 30+ to be a satisfactory pilot study sample size in support with Hertzog (2008) and Lancaster, Dodd and Williamson, (2002) and

4 An appropriate pilot sample can attain acceptable item-to-total correlation (Zhao, 2009), i.e. 0.3 - 0.7 (Ferketich, 1991). Item-to-total correlation assesses survey validity (Zhao, 2009), i.e. truthfulness (Jackson, 2008) - important for the earlier-mention four validity (Selby Harrington, Rn, Mehta, Jutsum, Riportella-Muller & Quade, 1994).

So far this study elaborated and verified steps taken to conduct the pre-test and pilot study. Instrument reliability and validity was briefly introduced. This study will statistically describe the instrument reliability and validity to verify data collection analyses and findings of the pilot study. Instrument reliability and validity are explicit, dynamic and decisive indicators assessing scientific and rigorous research quality of the questionnaire for data collection. Such assessments are needed every time an instrument is used (Selby-Harrington *et al.,* 1994). This study acknowledged the importance of both reliability and validity since a reliable questionnaire is not necessarily valid but a valid questionnaire is always reliable. Instrument validity assesses its theoretical construct to predict item performance over total scale for its content gentility, criteria and construct (Jackson, 2008).

From a statistical point of view, reliability is assessed by Cronbach's ά (Chang & Chuang, 2011) whose acceptable value should not be less than 0.75 (Hertzog, 2008), 0.7 (Wang & Wei, 2011), 0.605 (Yu, Lu, & Liu, 2010) or 0.6 or 0.605, i.e. "*normally acceptable reliability thresholds*” (Gliem & Gliem, 2003; Yu *et al.,* 2010; Chang & Chuang, 2011; Chang & Chuang, 2011). As just observed, various studies have stressed different values but this study adopted Cronbach's ά at ≥ 0.6 considering that this is an acceptable value, in accordance with the studies from which the questionnaire was adapted, i.e. Chang & Chuang (2011). Construct validity cannot be assessed at the stage of the pilot study since construct validity requires a minimum pilot study sample size of 100 (Zhao, 2009). However, content validity was assessed by pre-testing the questionnaire by 10 PhD holders. Criterion validity is accessed by item-to-total correlation (Selby-Harrington *et al.,* 1994). Item-to-total correlation acceptable range is 0.3 to 0.7 (Lin & Chang, 2008; Ferketich, 1991). If item-to-total correlation is less than 0.35, relevant items should

be deleted to increase Cronbach's ά for the remaining items (Deng, 2011). Hence, this study considered 0.3 as acceptable value for item-to-total to assess questionnaire's validity.

4.6.3 PILOT-TEST RESULTS

Data analyses results (Table 4.5) depict internal consistency of all items, based on Cronbach's ά of 0.9. As observed in Wang and Wei, (2011), Table 4.5 depicted:

1. Cronbach's ά values for 8 constructs' 33 items,
2. Deleted items (i.e. item that got deleted),
3. Item-to-total correlation,
4. Total items count after deleted items and
5. New Cronbach's ά after deleted items. Questionnaire was accordingly amended for main survey distribution.

Following items were deleted since item-to-total correlation was below 0.3, when an acceptable value should be between 0.3 - 0.7 (Ferketich, 1991):

6. SI_3 – "*I know some members in the virtual community on a personal level*",
7. T_5 – "*Members in the virtual community are truthful in dealing with one another*",
8. SL_3 – "*Members in the virtual community use understandable narrative forms of post messages or articles",*
9. SV_1 – "*Members in the virtual community share the vision of helping others solve their professional problems"* and
10. KQ_6 – "*The knowledge shared by members in virtual community is timely*".

The survey was amended after the pilot study and hence was composed 32 items for main data collection in SM as referenced in Appendix A and SurveyMonkey (2012). This was an improvement considering that Cronbach's ά was 0.913 before the above-listed 5 items were deleted. This followed strategy was as observed in Deng (2011).

Table 4.4. Pilot Study Data Analysis and Findings

Note 1: Item-to-total correlation – should be between 0.3 - 0.7 (Ferketich, 1991). Item-to-total correlation is utilized to assess survey instrument's validity (Zhao, 2009).
Note 2: Cronbach's ά – should be > 0.6 (Chang & Chuang, 2011). Cronbach's α assessed construct's internal consistency to assess constructs' reliability (Chow & Chan, 2008).
Note 3: Unacceptable values due to unacceptable Item-to-total correlation and/or Cronbach's ά have been highlighted and in are marked red

Constructs	List of Items before amending questionnaire	Cronbach's ά before amending pilot study questionnaire	Deleted Items	Count of remaining Items after amending questionnaire	Cronbach's ά after amending pilot study questionnaire	Correlated Item-to-total correlation
Social Interaction Ties	SI_1	0.637	SI_3	3	0.670	0.570
	SI _2					0.399
	SI _3					0.250
	SI _4					0.489
Trust	T_1	0.503	T_5	4	0.630	0.325
	T_2					0.416
	T_3					0.427
	T_4					0.473
	T_5					-1.77
Norms of Reciprocity	N_1	0.686	No items were removed			0.535
	N_2					0.535
Identification	I_1	0.889	No items were removed			0.694
	I_2					0.757
	I_3					0.803
	I_4					0.830
Shared Language	SL_1	0.526	SL_3	2	0.710	0.395
	SL_2					0.654
	SL_3					0.103
Shared Vision	SV_1	0.707	SV_1	2	0.856	0.286
	SV_2					0.818
	SV_3					0.547
Knowledge Sharing Quality	KQ_1	0.783	KQ_6	5	0.794	0.589
	KQ_2					0.628
	KQ_3					0.669
	KQ_4					0.404
	KQ_5					0.669
	KQ_6					0.241
Medical DM Quality	DMQ_1	0.922	No items were removed			0.722
	DMQ_2					0.776
	DMQ_3					0.835
	DMQ_4					0.830
	DMQ_5					0.724
	DMQ_6					0.800

4.7 DATA COLLECTION PLAN

To formulate a strategy for data collection this thesis first describes the participants, their sampling and the procedure for data collection followed by the schedule during which data collection was performed for this thesis. In order to generalize over the SM panel of 600 US physicians (Wilner, 2012), this study chose probability sampling, over non-probability sampling, since statistically-based generalization is not possible through non-probability sample and surveying the entire population is impractical. As recommended by Saunders *et al.* (2009), this sampling technique was performed by:

1. Identifying sample frame from the research objectives / questions -
   i.e. sample frame is 600 physicians who are members of SM's panel of physicians,
2. Deciding sample size. i.e. 202 responses (justified below),
3. Assuring sample represents the population, i.e. physicians were the target population.

As recommended by Saunders *et al.,* (2009), determining sample size was based upon:

1. Confidence of data i.e. data collection certainty level representative of total population (normally advised is 95%),
2. Tolerating an error margin (recommended default confidence interval = 5.6%),
3. Undertaking analyses type (count of categories to sub-divide data = none) and
4. Based on a total population of 600 SM physicians (Wilner, 2012), the roughly estimated sample size (Table 4.5) on 5% confidence interval is between 217 and 354. A more accurately computed estimate was 203 as per the calculated results of Creative Research Systems (2012).

Following the works of Chiu *et al.* (2006) and Lin and Chang (2008), this study's target population was the SM physicians' population from all over US. Population here is exclusive of supporting service staff such as nurses, lab technicians, etc and as voluntary participants only as also observed in Lin & Huang (2005).

Table 4.5. Rough Computation of Sample Size Based on Population Size.

Population	Margin of error			
	5%	3%	2%	1%
50	44	48	49	50
100	79	91	96	99
150	108	132	141	148
200	132	168	185	196
250	151	203	226	244
300	168	234	267	291
400	196	291	343	384
500	217	340	414	475
750	354	440	571	696
1,000	278	516	706	906
2,000	322	696	1091	1655
5,000	357	879	1622	3288
10,000	370	964	1936	4899
100,000	383	1,056	2,345	8,762
1,000,000	384	1,066	2,395	9,513
10,000,000	384	1,067	2,400	9,595

Source. (Saunders *et al.*, 2009)

4.7.1 SCHEDULE FOR MAIN DATA COLLECTION

After the pilot study data phase during July 2012 from 31 random voluntary physician members of "plastic_surgery@yahoogroups.com" and making amendments to the survey (described in section 4.8), main data collection got initiated in August 2012 to empirically test this study's conceptual framework (Figure 3.8) by an online survey instrument (SurveyMonkey, 2012). The survey received 204 voluntary responses out of 600 SM panel of US physician members, from all American states (Wilner, 2012), i.e. 33%. Of the 204 responses, 10 responses had some missing data. Even though some studies, for example Chang & Chuang (2010), eliminated cases with some missing data, this study chose not to do so and hence screened all collected data for missing values. The missing data was treated using maximum likelihood as advised by Howell (2009).

4.8 SUMMARY

In this chapter the researcher initially justified the type of research, i.e. confirmatory and deductive, followed by research methodology, i.e. quantitative and then research strategy, i.e. non-experimental online survey distribution within a professional physicians' VCs environment. Next, appropriate social media platforms (i.e. professional VCs, Facebook, LinkedIn and Listserv) were pinpointed by implementing a customized Honeycomb framework (Figure 4.2) followed by pinpointing 51 professional VCoPs (Table 4.4) by implementing a customized 5 Structured Characteristics Framework. At this stage, the researcher described the adapted online survey instrument construction and its assessment for its clarity through a pre-test, and then screening for validity and reliability through a pilot test. In addition, the researcher justified the count of the number of target population required for pre-test, pilot study and sample size for main data collection, all described based on critiqued recommendations from literature. Finally, the researcher introduced the procedure of main data collection. In the next chapter, the collected data will be analysed and these techniques for data analysis will be justified by literature-driven statistical analysis techniques using SPSS and LISREL since this study will perform confirmatory factor analysis (CFA) followed by Structured Equation Modeling (SEM).

CHAPTER 5:
DATA ANALYSIS

5.1 INTRODUCTION

Chapter Four described the research methodology to be applied in this study. This is a positivist and quantitative study, which utilizes a non-experimental adapted online survey to empirically assess the effectiveness of physicians' virtual community (VC) on medical decision making (DM) in absence and presence of the mediating role of knowledge sharing (KS) quality. Hence, to perform its empirical assessment, first, this thesis pinpointed 51 VCs (Table 2.5), based on four professional VC social media platforms (LinkedIn, Facebook, Listserv and physicians' professional VCs). This list of 51 VCs set the scope and boundary so the researcher could selected a VC from this list to empirically assess the effectiveness of a physicians' VC on medical DM. Then, the researcher outlined a data collection procedure for distributing the online survey in SurveyMonkey (SM) VC (part of the list of 51 VCs), and calculated the sample size (depicted in Table 4.6) for a minimal count of physicians in SM VC of physician members.

Chapter Five proposes a literature-driven and critiqued the data collection and data analysis strategy. Data was collected from SM VC physicians using an adopted online survey instrument. This chapter systematically and comprehensively described the data analysis procedure to report the empirical findings of this thesis, jointly with their hypotheses related to assessing the effectiveness of physicians' VC on medical DM quality in presence and absence of the mediating role of knowledge sharing quality. This chapter is outlined as follows:

- Section 5.2 described how this study obtained the collected data from SM; what resources were utilized to critique a data analysis strategy and what software applications were applied in this data analysis phase. In this section, the study also systematically described how missing data was treated and the data analysis process and appropriate data analysis techniques, which were implemented and the results, which were described statistically,
- In section 5.3 the researcher critiqued published literature to define and describe the procedure undertook in this study to implement confirmatory factor analysis (CFA) to assess construct, convergent and discriminant validity,

- Section 5.4 listed the main and sub-hypotheses test results, which were statistically supported or not supported,
- Section 5.5 described how this study interpreted the main hypotheses from the su-hypotheses and
- Section 5.6 critiqued published literature to define and describe the procedure this study undertook to implement structural equation modelling (SEM) to propose this study's overall fit structural model (depicted in Figure 5.9).

5.2 STATISTICAL PROCEDURE, DATA ANALYSIS STRATEGY AND RESULTS

Data was collected using an online survey, which was distributed in the SM VC of physicians. After the data collection phase, collected data was downloaded from SurveyMonkey (2012). This section describes the procedure for treating missing data followed by data analysis. This procedure was entirely driven by researcher's critiqued literature. Quantitative data analysis tools used in this study were SPSS version 20 and LISREL version 8.80. Section 5.5 describes the procedure for testing this thesis's 4 main hypotheses, through a data analysis process. The statistical results of the tested hypotheses were also represented in this section. In addition, this section also describes the data analysis process. Data analysis was carried out after data was collected from SM physicians' VC (n = 204). The process was literature driven (Chiu, Hsu, & Wang, 2006; Chang & Chuang, 2011; Howell, 2009; Hox & Bechger, 1998; Fornell and Larcker, 1981; Churchill, 1979; etc.) and was as follows:

1. ***Treating missing data*** - First, any data missing during the data collection phase was treated using SPSS by expectation-maximization, i.e. a maximum likelihood procedure. This is one of the most important procedures advised by Howell (2009) and demonstrated by how2stats (2011).

    a. Nature of missing data – There were 12 cases where (1) 10 participants failed to answer the last few questions related to knowledge sharing and DM quality and (2) 2 participants left out the demographics questions. In such cases, data could be completely missing at random, which is possibly due to any natural reason or incorrect handling of the online survey (Howell, 2009).

b. ***Relation between expectation-maximization and the nature of missing data –*** There are two treatments used for data missing at random are maximum likelihood or multiple imputations. Even though both methods are almost similar, maximum likelihood is more efficient. Even time this maximum likelihood method is applied, it provides similar results, unlike the multiple imputations, etc. (Allison, 2012).

2. ***Performing descriptive data analysis*** - Second, descriptive analysis was performed to summarize the respondents' characteristics (Table 5.1). Table 5.1 is made up of three categories:

   a. ***Measure*** - pertains to the four general questions in the survey,
   b. ***Items of the measure*** – pertain to the options for every general question in the survey and
   c. ***Frequency*** - is made up of two columns:

      i. **Response** - weighing one item over others items in its group, for example 278.9% of female responded in comparison with 72.1% of male who responded and
      ii. **Responded count** – count of responses for the given item, for example 147 of 204 responded specified male as their gender while 57 out of 204 participants specified their gender being female.

   This was followed by the outcomes of research variables depicted in Table 5.2, using SPSS, as observed in Chang and Chuang (2011). Table 5.2 is composed of 9 columns:

   a. ***Measured items*** – are the abbreviations provided for each survey construct, item, for example SIT, i.e. social interaction ties (construct) and SI_1 is the first item representing SIT. These abbreviations are later used when describing constructs in tables and figures. These abbreviations were used to reference each item (survey question) and conceptual framework's construct (independent or dependant variable) in SPSS and LISREL,
   b. ***Items*** – each survey's item was quoted in this column and every items was statistically assessed for instrument reliability and validity - based on the seven indicators (item-to-total correlation, factor loading, etc) mentioned subsequently (to analyse the conceptual measurement model (Chiu, Hsu, & Wang, 2006),
   c. ***Item-to-Total Correlation*** – (explained in the next step), was generated using SPSS.

d. ***Factor Loading*** – is one of CFA results to assess convergent validity, recommended (Chiu, Hsu, & Wang, 2006). This was generated using SPSS. Convergent validity is defined in Section 5.3.

e. ***Composite Reliability*** – referred as construct reliability, is one of CFA results (Chiu, Hsu, & Wang, 2006; Bacon, Sauer, & Young, 1995) mentioned in step 4, measures internal consistency (Churchill, 1979); generated using a formula in the next step.

f. ***AVE*** – referred as average variance extracted, to measures internal consistency (Churchill, 1979). This was generated using formula in the next step.

g. ***Cronbach's ά*** – (explained in the next step), was generated using SPSS.

h. ***Mean*** – is one of CFA results (Chiu, Hsu, & Wang, 2006) and was generated using SPSS.

i. ***Std Dev*** – referred as Standard Deviation: – is one of the CFA results (Chiu, Hsu, & Wang, 2006) and was generated using SPSS.

3. ***Statistical assessment of items' consistency of the survey*** - Values of Coefficient ά (or Cronbach's ά) and item-to-total correlations were generated using SPSS. These indicators assess the internal consistency of a set of items. If any item's Coefficient ά and/or item-to-total correlation falls below the acceptable value, the item should be removed. In other words, if Cronbach's ά is < 0.6 and/or item-to-total correlation is close to zero, then item is not consistent, so it should be removed (Chang & Chuang, 2011). As per these criteria, advised by Chang and Chuang (2011), none of the items in this study needed to be removed (results depicted in Table 5.2). In addition, as Churchill (1979) recommends, internal consistency is measured by construct reliability and average variance extracted (AVE); (findings depicted in Table 5.2) calculated using two formulas, by Fornell and Larcker (1981), being:

   a. Construct reliability, i.e. scale reliability =

$$\frac{\left(\sum_{i=1}^{p} \mathrm{fli}\right)^2}{\left(\sum_{i=1}^{p} \mathrm{fli}\right)^2 + \sum_{i=1}^{p} var(ei)^2}$$

   and

   b. AVE =

$$\frac{\sum_{i=1}^{p} \mathrm{fli}^2}{\sum_{i=1}^{p} \mathrm{fli}^2 + \sum_{i=1}^{p} var(ei)^2}$$

   where factor loading value (fl).

4. ***Statistical techniques used to assess instrument reliability and validity*** - Two techniques were applied to analyse the instrument's reliability and validity being: (1) CFA and (2) SEM as observed from Chiu, Hsuand Wang (2006).

Table 5.1. Demographics of Respondents (n=204)

Measure	Items	Frequency	
		Response % from n=204	Responded count
Gender	Male	72.1%	147/204
	Female	27.9%	57/204
Work experience (in years)	Less than 5	20.1%	41/204
	5 – 10	9.3%	19/204
	11 – 15	7.4%	15/204
	16 – 20	13.7%	28/204
	Above 20	49.5%	101/204
Specialty (i.e. department)	Internal Medicine	12.5%	24/204
	General Surgery	3.6%	7/204
	OBS/GYN	5.2%	10/204
	Pediatrics	8.9%	17/204
	Family Medicine	12.5%	24/204
	Ophthalmology	1.6%	3/204
	Dermatology	1%	2/204
	ENT	0.5%	1/204
	Radiology	0.5%	1/204
	Anesthesiology	3.1%	6/204
	Physiotherapy	1%	2/204
	Urology	0.5%	1/204
	Neurology	1%	2/204
	Emergency	4.7%	9/204
	Other (please specify)	43.2%	83/204
I am part of a virtual community (VC) because I am part of a/an:	Professional Email list	59.5%	103/204
	Professional group in a social media platform, e.g. Facebook, LinkedIn or Twitter	24.5%	50/204
	Professional platform on the Internet e.g. SERMO, QuantiaMD, Epocrates, etc	22.5%	46/204
	Video conference for joint discussion or collaboration between two or more physicians	2.5%	5/204

5.3 IMPLEMENTING CONFIRMATORY FACTOR ANALYSIS

One of the main advantages of using CFA was to assess the latent constructs' uni-dimensionality, i.e. one item only explains one construct that it is supposed to explain. This feature minimises any likelihood of a survey item explaining multiple constructs, since one item is supposed to explain one construct, when it needs to explain just one construct (Burton & Mazerolle, 2011). Therefore, factor loading for all items met the recommended value, i.e. > 0.5 (Chang and Chuang, 2011). As a result, reliable factors will be obtained. If factor loading is less than 0.5 then more data should be excluded from further analysis and other variables should be included (Bot, Terwee, van der Windt, Feleus, Bierma-Zeinstra & Knol, 2004; Field, 2005). It is interesting to note that, however, that one study recommended acceptable factor loading values to be > 0.3 (Burton &

Mazerolle, 2011). This factor loading acceptable value was accepted by the researcher since this was the lowest advocated thresh-hold value, hence the most tolerant benchmark for factor loading. Furthermore, Churchill (1979) recommended data analysts to:

1. Determine the extent a measure correlated with other measures designed to measure the same via convergent validity and discriminant validity and
2. Assess if the measure behaves as per expectation through criterion validity.

Considering that an adapted instrument should be assessed for its reliability and validity (Burton & Mazerolle, 2011), CFA is a more appropriate technique, in comparison with exploratory factor analysis (EFA). While CFA is for hypotheses testing, as it is the case of this thesis, EFA helps determine latent constructs. Since, the latent variables are already defined in Figure 3.3's conceptual framework; EFA does not apply to this thesis. CFA does apply since the research approach taken by this study began by literature review to determine the conceptual framework followed by data collection and then data analysis. Also, CFA is utilized to estimate model parameters and assess model fitness) (Suhr, 2006). This approach is similar to the approach undertaken in this thesis. i.e. Chapter Two described literature review, Chapter Three determined the conceptual framework (Figure 3.3), Chapter Four outlined data collection process and after data collection, data analysis was performed in order to assess the model fitness by using SEM. Such an approach requires CFA considering that CFA is applied to analyse data for hypotheses testing (Suhr, 2006).

In addition, since CFA allows hypotheses testing (Suhr, 2006). It is also appropriate for assessing instruments' validity through construct validity, convergent validity and discriminant validity (Chiu, Hsu, & Wang, 2006) where:

- ***Construct validity*** assesses factor validity of survey questions that make-up a construct (for example SIT - social interaction ties, etc) (Dancey & Reidy, 2011).

- ***Convergent validity*** - if two measures (survey items) of one construct, measure the same construct, as they are supposed to (by reflecting a moderate magnitude of correlation); then these two items reflect convergent validity (Kline, 2005).

- ***Discriminant validity*** - in contrast to convergent validity; discriminate validity measures the opposite, i.e. if two measures are supposed to measure differing constructs; they reflect discriminant validity if their inter-correlation is not excessively high (Kline, 2005).

While the difference between convergent and discriminant validity are explained in their associating definitions; their similarity is that both validity types evaluates two items against one another, to check if they measure the same construct (Kline, 2005).

5.3.1 PERFORMING CONFIRMATORY FACTOR ANALYSIS AND ASSESSING INSTRUMENT VALIDITY

Several CFA models (also referred as path models) were assessed using LISREL, to obtain a satisfactory fit model, as observed in Chang and Chuang (2011) and Nguyen (2011). In this case, path analysis assessed the effects between observed variables (Kline, 2005) with an aim to remove those observed variables, which load across more than one factor. In other words; it aimed at removing those observed variables that are deluding clarity of a true relationship. In factor analysis, a group of variables should associate with one another rather than load on another factor; rather than correlating with variables of other groups (Walker & Maddan, 2009). Such a process of removing unwanted variables is repeated again and again until a satisfactory fit model is achieved; as also observed in Chang and Chuang (2011) as well as Nguyen (2011). In addition to the 5 items removed during the pilot study phase, depicted in Table 4.7, 9 more items were removed in accordance with the just-recommended path analysis procedure (Chang & Chuang, 2011; Nguyen, 2011), i.e. unwanted observed variables being: SIT_4, T_2, I_4, KQ_1, KQ_2, KQ_5, DM_2, DM_4, and DM_6, as depicted in Table 5.2a and 5.2b.

Confirmatory factor analysis (CFA) was performed on the questionnaire's eight scales, depicted through a path model (Figure 5.1), as in Hox & Bechger (1998):

1. Social interaction ties (SIT) - independent variable,
2. Trust (T) - independent variable
3. Norms of reciprocity (NoR) - independent variable,
4. Identification (ID) - independent variable,
5. Shared language (SL) - independent variable,

6. Shared vision (SV) - independent variable,
7. Knowledge sharing (KS) - mediating variable and
8. Decision making quality (DM) - dependent variable.

As depicted in Figure 5.1:

- ***Observed variables*** – also referred as observed factors, i.e. measured variables, are symbolized by rectangles,
- ***Latent variables*** – also referred as latent factors, i.e. unmeasured latent factors, i.e. constructs, are symbolized by ellipses,
- ***Residual error*** – associated standard error value, which is followed by a tiny arrow pointing into the observed variable. This error value is associated with a observed variable since there is always the expectation that latent variables will not fully forecast the observed variable,
- ***Paths*** - are symbolized by single headed arrows to depict relationships within this model symbolizing regression coefficients, also referred as path coefficient (Hox & Bechger, 1998). Regression coefficient assesses the strength of a relationship between a dependant and an independent variable (Saunders, Lewis, & Thornhill, 2009),
- ***Arrow*** – in this model has a tail point to variables that cause (or are reason for) the variables at the head of the arrow.
- ***Double headed arrows*** signify correlation or covariance (Hox & Bechger, 1998).

In Figure 5.1 measured variables are observed variables while unmeasured variables are latent variables (Hox & Bechger, 1998). In other words, as the observed variables or empirically assessed, hence measured variables for example SI_1 - I maintain close social relationships with some members in a VC and SI_2 - I spend lot of time interacting with some members in VC on personal level are the two observed variables as depicted in Figure 5.1 of this thesis. On the other hand, latent variables are unmeasured since they represent constructs, for example SIT - the independent variable whose two observed variables are SI_1 and SI_2. So, during CFA, SI_1 and SI_2 are empirically assessed, i.e. measured, and hence represent their latent variable, which is the construct SIT.

Hence, instrument validity was assessed via CFA's convergent validity and discriminant validity where empirical findings suggested assessing the: (1) instrument's Convergent Validity and (2) instrument's Discriminant Validity (explained in section 5.3).

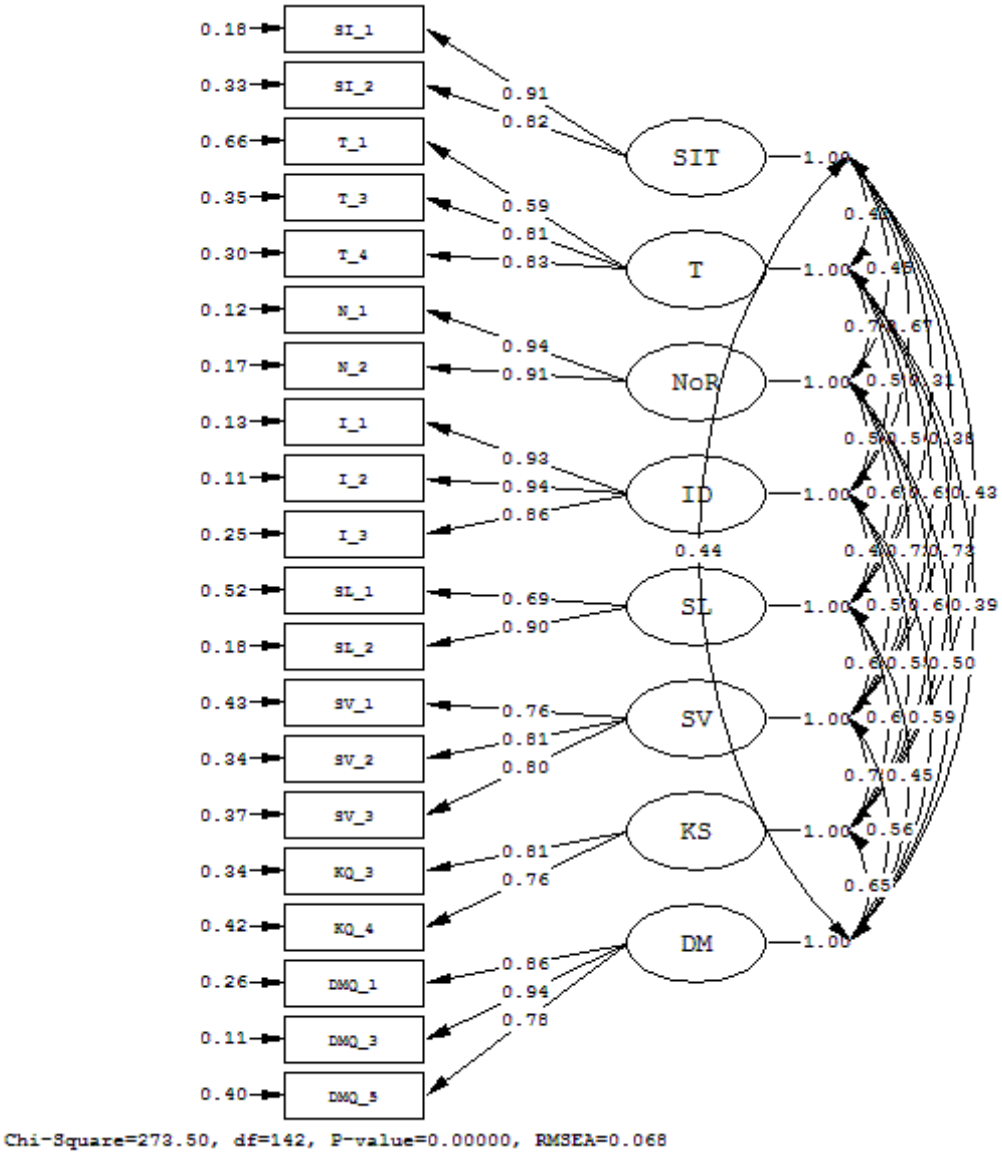


Fig 5.1. Confirmatory Factor Analysis Model (Standard Evaluation) using LISREL.

5.3.2 ASSESSING THE INSTRUMENT'S CONVERGENT VALIDITY

At this stage, the researcher assessed the Instrument's Convergent Validity due to its significant factor loadings, considering that all items' factor loading values exceeded 0.3 (Burton & Mazerolle, 2011) - Table 5.2a and Table 5.2b.

Table 5.2a. Reliability Analysis (n=204) to Assess Convergent Validity.

***Each note (1 to 6) listed many referenced acceptable values. M*ost tolerant values, in each note, is adapted by this thesis to best aid the Table\s empirical findings**

Note 1: Item-to-total correlation - minimal acceptable value of 0.5 (Lin & Chang, 2008). Item-to-total correlation is utilized to assess survey instrument's validity (Zhao, 2009)

Note 2: Factor loading value is > 0.5 (Chang & Chuang, 2011) or > 0.7 (Chiu, Hsu, & Wang, 2006) or > 0/3 (Burton & Mazerolle, 2011). Factor loading was utilized to assess constructs; convergent validity (Chow & Chan, 2008),

Note 3: Composite reliability – minimal acceptable value being 0.7 (Jeon, Kim, & Koh, 2011) or > 0.8 (Chiu, Hsu, & Wang, 2006).This is to measure construct reliability (Chiu, Hsu, & Wang, 2006). As another study stated, composite reliability is a measure for assessing convergent validity (Ryu, Hee Ho & Han, 2003; Jeon et al. 2011).

Note 4: Cronbach's ά – should be > 0.6 (Chang & Chuang, 2011). Cronbach's α assessed construct's internal consistency to assess constructs' reliability (Chow & Chan, 2008).

Note 5: AVE - minimal acceptable value being 0.5 (Jeon et al. 2011) or be > 0.5 (Chang & Chuang, 2011). AVE is utilized to assess to measure internal consistency (Churchill, 1979) as well as convergent validity (Ryu, Hee Ho & Han, 2003; Jeon et al. 2011).

Note 6: Minimum reliability (CR) should exceed 0.7 (Chang & Chuang, 2011).

Measured items	Items:	Item-to-total correlation	Factor loading	Composite reliability	AVE	Cronbach's ά	Mean	Std Dev
		(by using SPSS)		(via a formula in section 5.2)		(by using SPSS)		
Social Interaction Ties (SIT)								
SI_1	I maintain close social relationships with some members in a VC.	0.745	0.91	0.86	0.75	0.851	2.59	1.149
SI_2	I spend lot of time interacting with some members in VC on personal level.	0. 745	0.82				2.36	1.021
Trust (T)								
T_1	Members in the VC will not take advantage of others even when the opportunity arises.	0.532	0.58	0.79	0.56	0.782	3.07	0.857
T_3	Members in the VC would not knowingly do anything to disrupt the conversation.	0.721	0.80				3.11	0.784
T_4	Members in the VC behave in a consistent manner.	0.621	0.84				3.29	0.825
Norms of Reciprocity (NoR)								
N_1	I know that other members in the VC will help me, so it's only fair to help other members.	0.855	0.95	0.92	0.86	0.921	3.67	0.683
N_2	I believe that members in the VC would help me if I need it.	0.855	0.90				3.72	0.655
Identification (ID)								
I_1	I feel a sense of belonging towards the VC.	0.879	0.93	0.94	0.84	0.936	3.04	0.925
I_2	I have the feeling of togetherness or closeness in the VC.	0.816	0.94				2.88	0.884
I_3	I have a strong positive feeling towards the VC.	0.827	0.86				3.09	0.879
Shared Language (SL)								
SL_1	Members in the VC use common terms or jargons.	0.627	0.71	0.78	0.64	0.766	3.83	0.637
SL_2	Members in the VC use understandable communication pattern during the discussion.	0.627	0.88				3.81	0.554

Table 5 2b. Reliability Analysis (n=204) to Assess Convergent Validity (Continuation of Table 5.2a).

***Each note (1 to 6) listed many referenced acceptable values. M*ost tolerant values, in each note, is adapted by this thesis to best aid the Table\s empirical findings**

Note 1: Item-to-total correlation - minimal acceptable value of 0.5 (Lin & Chang, 2008). Item-to-total correlation is utilized to assess survey instrument's validity (Zhao, 2009)

Note 2: Factor loading value is > 0.5 (Chang & Chuang, 2011) or > 0.7 (Chiu, Hsu, & Wang, 2006) or > 0/3 (Burton & Mazerolle, 2011). Factor loading was utilized to assess constructs; convergent validity (Chow & Chan, 2008),

Note 3: Composite reliability – minimal acceptable value being 0.7 (Jeon, Kim, & Koh, 2011) or > 0.8 (Chiu, Hsu, & Wang, 2006).This is to measure construct reliability (Chiu, Hsu, & Wang, 2006). As another study stated, composite reliability is a measure for assessing convergent validity (Ryu, Hee Ho & Han, 2003; Jeon *et al.*, 2011).

Note 4: Cronbach's ά – should be > 0.6 (Chang & Chuang, 2011). Cronbach's α assessed construct's internal consistency to assess constructs' reliability (Chow & Chan, 2008).

Note 5: AVE - minimal acceptable value being 0.5 (Jeon *et al.*, 2011) or be > 0.5 (Chang & Chuang, 2011). AVE is utilized to assess to measure internal consistency (Churchill, 1979) as well as convergent validity (Ryu, Hee Ho & Han, 2003; Jeon *et al.*, 2011).

Note 6: Minimum reliability (CR) should exceed 0.7 (Chang & Chuang, 2011).

Measured items	**Items:**	**Item-to-total correlation**	**Factor loading**	**Composite reliability**	**AVE**	**Cronbach's ά**	**Mean**	**Std Dev**
		(by using SPSS)		**(via a formula in section 5.2)**		**(by using SPSS)**		
Shared Vision (SV)								
SV_2	Members in the VC share the same goal of learning from each other.	0.703	0.83	0.83	0.62	0.831	3.64	0.637 0.711
SV_3	Members in the VC share the same value that helping others is pleasant.	0.701	0.78				3.54	0.714
knowledge sharing Quality (KS)								
KQ_3	The knowledge shared by members in VC is accurate.	0.616	0.81	0.76	0.62	0.762	3.41	0.696
KQ_4	The knowledge shared by members in VC is complete.	0.616	0.76				3.02	0.698
Medical DM Quality (DM)								
DMQ_1	I am more certain of diagnoses after my interaction with members in the VC.	0.791	0.86	0.90	0.75	0.892	3.18	0.657
DMQ_3	I am more certain of health benefits after my interaction with members in VC.	0.848	0.94				3.22	0.685
DMQ_5	I am more certain of the risks after my interaction with members in the VC.	0.730	0.78				3.20	0.707

Convergent validity was also assessed using composite reliability and AVE (also depicted in Table 5.2), as observed in Jeon *et al.* (2011). Cronbach's ά may be used to assess instrument reliability, as advised by Lin and Chang (2008). Hence, Cronbach's ά was applied to assess the instrument's quality (Churchill, 1979). Cronbach's ά value should exceed 0.7, as observed in Chang and Chuang (2011). As Lin and Chang (2008) recommended, criterion validity should be accessed via item-to-total correlation. The minimal composite reliability (CR) was 0.76, i.e. > 0.7 (for knowledge sharing) and AVE, over all constructs was > 0.5 as also observed in Chang and Chuang (2011). Smallest depicted AVE, in Table 5.2 was 0.56 (for Trust). Convergent validity is also generated after applying SEM on the research model. However, further indicators, reflecting instrument convergent validity, are also presented in section 5.3.

5.3.3 ASSESSING THE INSTRUMENT DISCRIMINANT VALIDITY

Instrument's Discriminant Validity was assessed using the square root of a construct's variance extracted (VE), which should be a greater correlation between that construct and other constructs of this study's measurement model (Chang & Chuang, 2011; Jeon, Kim, & Koh, 2011; Chiu, Hsu, & Wang, 2006). Results of discriminant validity were depicted in Table 5.3's correlation matrix generated using LISREL once SME implementation was complete. In this matrix, all diagonal values are the square root of a construct's VE, for example for SIT is 0.87 (in bold) should "exceed inter-construct correlations" between other constructs (i.e. SIT's VE value should be, and is, greater than T's correlation coefficient value of 0.41, SIT's VE value is greater than correlation coefficient value of NoR (0.45), etc. For all independent and dependant variables', (SIT, T, NoR, ID, SL, SV, SL and SV) VEs, exceeded the inter-related-construct correlations. Hence this thesis's instrument reflects discriminant validity. In addition, in Table 5.3, correlation coefficients assess relationship between two variables. At this stage, it is important for the reader to note that correlation coefficient is different from regression coefficient, which assesses the relationship between one dependant and one or many independent variable (Saunders, Lewis, & Thornhill, 2009).

Table 5.3. Descriptive Statistics, Correlation from Constructs and Variance extracted.

***Each note (1 to 6) listed many referenced acceptable values. M*ost tolerant values, in each note, is adapted by this thesis to best aid the Table\s empirical findings**

Note 2: SIT – Social Interaction Ties, T = Trust, NoR = Norms of Reciprocity, ID = Identification, SL = Shared Learning, SV = Shared Vision, KS = Knowledge Sharing Quality and DM = Decision Making Quality.

Note 3. Diagonal element (in bold) are square root of the variance extracted (VE). Off-=diagonal elements are correlations between constructs. To assess discriminant validity the diagonal elements need to be > off-diagonal elements.

Note 4. Correlation Coefficients are assessed via CFA measurement model and all are significant, i.e. $p < 0.05$ as observed in (Chang & Chuang, 2011).

	Mean	S.D.	SIT	T	NoR	ID	SL	SV	KS	DM
SIT	2.474	2.028	**0.87**							
T	3.154	2.060	0.41	**0.75**						
NoR	0.694	1.289	0.45	0.74	**0.65**					
ID	3.002	2.532	0.67	0.58	0.56	**0.92**				
SL	3.822	1.075	0.31	0.56	0.62	0.43	**0.80**			
SV	3.623	1.784	0.30	0.69	0.72	0.57	0.65	**0.79**		
KS	3.346	1.144	0.43	0.73	0.66	0.55	0.66	0.75	**0.69**	
DM	3.201	1.860	0.44	0.39	0.50	0.59	0.45	0.56	0.65	**0.87**

5.4 HYPOTHESES TESTING

The purpose of this section sequentially describes how empirical findings supported the four main hypotheses with twelve sub-hypotheses listed ahead. In addition, the mediating role of |KS was also described while the sequential and systematic procedure for assessing this mediating role was also methodically described in this section.

Four main hypotheses (Hs) were listed out in chapter Three (Section 3.2 and Section 3.3) being:

1. **H1**: Physicians' SC is significantly and positively associated with the quality of medical DM in a virtual community of practice (VCoP) environment
    - **H1a**: Physicians' social interaction ties significantly and positively affect the quality of medical DM quality in a VCoP environment, i.e. social interaction ties → medical DM quality.
    - **H1b**: Physicians' trust significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. trust → medical DM quality.
    - **H1c**: Physicians' norms of reciprocity significantly and positively affect the quality of medical DM quality in a VCoP environment, i.e. norms of reciprocity → medical DM quality.

- **H1d**: Physicians' identification significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. identification → medical DM quality.
- **H1e**: Physicians' shared language significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. shared language → medical DM quality.
- **H1f**: Physicians' shared vision significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. shared vision → medical DM quality.

2. **H2**: Physicians' SC significantly and positively associated with the knowledge sharing quality in a VCoP,
   - **H2a**: Physicians' social interaction ties significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. social interaction ties → medical DM quality.
   - **H2b**: Physicians' trust significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment, i.e. trust → medical DM quality.
   - **H2c**: Physicians' norms of reciprocity significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. norms of reciprocity → medical DM quality.
   - **H2d**: Physicians' identification ties significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment, i.e. identification → medical DM quality.
   - **H2e**: Physicians' shared language significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. shared language → medical DM quality.
   - **H2f**: Physicians' shared vision significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. shared vision → medical DM quality.

3. **H3**: Physicians' quality of knowledge sharing is significantly and positively associated-with the quality of medical DM in a VCoP environment

4. **H4**: Physicians' SC significantly and positively affects knowledge sharing through which SC significantly and positively improves the quality of medical DM in a VCoP environment.

Next, the hypothesized relationship between physicians' SCT, knowledge sharing quality and medical DM quality was assessed. To test the four hypotheses and their sub-hypotheses, the overall model (Figure 5.2) was re-assessed to first test hypotheses, 1, 2 and 3. Once simple regression was done these empirical findings led to the assessment of the mediating role of knowledge sharing quality to test hypothesis 4.

5.4.1 HYPOTHESIS 1 TESTING – PHYSICIANS' SOCIAL CAPITAL AND DECISION MAKING QUALITY

To test the first hypothesis, the overall structural model was re-assessed so each of the SCT's 6 independent variables (SIT, T, NoR, ID, SL and SV) were independently examined in relation to the dependant variable, medical DM quality, in order to assess the direct role (SCT and medical DM quality) reflecting the first hypothesis. Table 5.4 depicts that all 6 sub-hypotheses of hypothesis 1, i.e. H1a – H1f. All of them were positively supported since t-value was greater than 1.96 (Diamantopoulos and Siguaw, 2000) as also stated in note 1 in Table 5.4. Positively (referred as to as "poss" in Table 5.4) was reported in the fifth column of this Table's five columns table (estimate coefficient, standard error and t-value, all sub-hypotheses of hypothesis 1 were listed along with their empirically supported results). Note 1 shows acceptable values of t-value, which tests significance, t-values are calculated using estimated BETA coefficient and standard error (t value = parameter value) (Diamantopoulos and Siguaw, 2000). All these three values depicted in the left three first columns were generated using LISREL. The sub-hypotheses can be reported as positively and significantly supported if t-value is greater than 1.96, and negatively and significantly supported if t-values is less than 1.96 or not supported if t-values falls between the range of -1.96 to 1.96 (Diamantopoulos and Siguaw, 2000). Since all sub-hypotheses were positively supported, this thesis concludes that hypothesis 2 is supported.

Table 5.4. Significance of Relations between Social Capital Theory → Medical Decision Making Quality – generated using LISREL.

Note 1: t-value shows negative significance if t is < - 1.96, no significance is if t is between 1.96 to - 1.96 and positive significance is if t > 1.96 (Diamantopoulos and Siguaw, 2000).

Note 2: Standard error for each parameter estimate, i.e. reflection of how precise the parameter value is, Smaller the value of standard error, better is the parameter estimate (Diamantopoulos and Siguaw, 2000). Parameter estimate is generated LISREL: in its standard solution output.

Note 3: If t-value is outside of ± 1.96 then it is significant $p < 0.05$, i.e. represented by the symbol *. If outside of ± 2.58 then it is at $p < 0.01$, (i.e. represented by the symbol **. If outside of ±3.29, then it is at $p < 0.001$, i.e. represented by the symbol *** (Field, 2009). The t value = parameter value / standard error (Diamantopoulos and Siguaw, 2000).

Note 4: β - BETA value is third of eight parameter matrices in LISREL output format shows parameter estimates, standard errors and t-values for n (n = 8 variables, i.e. SIT, T, NoR, ID, SL, SV, KS and DM in this thesis, variables (Diamantopoulos and Siguaw, 2000).

Note 5: poss – Positively significant, negs - negatively significant and ns – not significant

Based on the following 3 values			**Sub-Hypotheses test with SCT → DM structural model:**	**Results of Sig.**
Estimated Coefficient	**Standard error**	**t-value**		
β 0.41	0.08	5.24	**H1a**: Physicians' social interaction ties significantly and positively affect the quality of medical DM quality in a VCoP environment, i.e. SIT→ DM.	poss: hence supported
β 0.37	0.08	4.76	**H1b**: Physicians' trust significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. T → DM.	poss: hence supported
β 0.49	0.07	6.57	**H1c**: Physicians' norms of reciprocity significantly and positively affect the quality of medical DM quality in a VCoP environment, i.e. NoR reciprocity → DM.	poss: hence supported
β 0.59	0.07	8.03	**H1d**: Physicians' identification significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. ID → DM.	poss: hence supported
β 0.46	0.08	5.71	**H1e**: Physicians' shared language significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. SL → DM.	poss: hence supported
β 0.56	0.08	7.30	**H1f**: Physicians' shared vision significantly and positively affects the quality of medical DM quality in a VCoP environment, i.e. SV → DM.	poss: hence supported

5.4.2 HYPOTHESIS 2 TESTING – PHYSICIANS' SOCIAL CAPITAL AND KNOWLEDGE SHARING QUALITY

To test the second hypothesis, each of the SCT's 6 independent variables (SIT, T, NoR, ID, SL and SV), was now independently assessed in relation to the mediating variable, physicians' knowledge sharing quality. Table 5.5 depicts that all 6 sub-hypotheses of hypothesis 2, i.e. H2a – H2f were positively supported since t-value was greater than 1.96 (Diamantopoulos and Siguaw, 2000) as also stated in note 1 in Table 5.5. Positively (referred as "poss" in Table 5.4) was reported in the fifth column of this Table's 5 columns (estimate coefficient, standard error and t-value, all sub-hypotheses of hypothesis 1 were listed and their empirically supported results). While note 1 shows acceptable values of t-value, which tests significance; t-values are calculated using estimated BETA coefficient and standard error (t value = parameter value) (Diamantopoulos and Siguaw, 2000). All these three values depicted in the left three first columns were generated using LISREL. The sub-hypotheses can be reported as positively and significantly supported if t-value is greater than 1.96, negatively and significantly supported if t-values is

less than 1.96 or not supported if t-values falls between the range of -1.96 to 1.96 (Diamantopoulos and Siguaw, 2000). Since all the sub-hypotheses were positively supported, this thesis concludes that hypothesis 2 is significantly supported.

Table 5.5. Significance of relations between Social Capital Theory → Knowledge Sharing Quality

Based on the following 3 values			Sub-Hypotheses test with SCT → KS structural model:	Results of Sig.
Estimated Coefficient	Standard error	t-value		
β 0.42	0.11	3.92	**H2a**: Physicians' social interaction ties significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. SIT → KS.	poss: hence supported
β 0.73	0.08	8.54	**H2b**: Physicians' trust significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment, i.e. T → KS.	poss: hence supported
β 0.66	0.09	7.73	**H2c**: Physicians' norms of reciprocity significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. norms of reciprocity → KS.	poss: hence supported
β 0/56	0.09	6.29	**H2d**: Physicians' identification ties significantly and positively affects the quality of physicians' knowledge sharing in a VCoP environment, i.e. ID → KS.	poss: hence supported
β 0.61	0.08	7.48	**H2e**: Physicians' shared language significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. SL → KS.	poss: hence supported
β 0.75	0.08	9.90	**H2f**: Physicians' shared vision significantly and positively affect the quality of physicians' knowledge sharing in a VCoP environment, i.e. SV → KS.	poss: hence supported

5.4.3 HYPOTHESIS 3 TESTING – KNOWLEDGE SHARING QUALITY AND DECISION MAKING QUALITY

To assess the third hypothesis the relationship between knowledge sharing quality → medical DM quality was under assessment.

Table 5.6. Significance of relations between Knowledge Sharing Quality → Medical Decision Making Quality

Based on the following 3 values			Sub-Hypotheses test with (KS → DM structural model:	Results of Sig.
Estimated Coefficient	Standard error	t-value		
β 0.66	0.08	8.36	**H3**: Physicians'' quality of knowledge sharing is significantly and positively associated with the quality of medical DM in a VCoP environment, i.e KS → DM.	poss: hence supported

5.4.4 HYPOTHESIS 4 TESTING – MEDIATING ROLE OF PHYSICIANS' KNOWLEDGE SHARING QUALITY

In order to assess the mediating role of knowledge sharing quality between the physicians' SC six independent variables and medical DM quality dependant variable, the researcher applied the mediating role testing theory by Baron and Kenny (1986). This thesis chose this model for assessing the mediating

role of knowledge sharing quality since Baron and Kenny (1986)'s mediation process and theory was also adapted by other studies; for example Lin (2011), Avolio, Zhu, Koh and Bhatia (2004), etc.

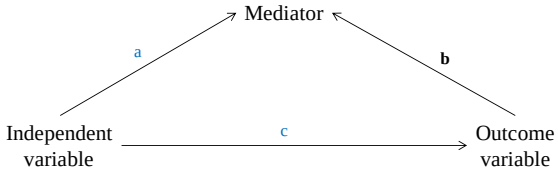


Fig 5.2. Hypothesis 4 testing used a mediating role testing theory based on Baron and Kenny (1986)'s model

Baron and Kenny (1986)'s model is explained as follows:

> "*A variable functions as a mediator when it meets the following conditions: (a) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., Path c), (b) variations in the mediator significantly account for variations in the dependent variable (i.e., Path b), and (c) when Paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path c is zero. In regard to the last condition we may envisage a continuum. When Path c is reduced to zero, we have strong evidence for a single, dominant mediator. If the residual Path c is not zero, this indicates the operation of multiple mediating factors."* (Baron & Kenny, 1986).

Figure 5.3 depicts the overall path SIT → KS → DM and another path SIT → DM and Table 5.7 depicts the assessment results of the mediating role of knowledge sharing quality between SIT and DM quality; assessed based on a Baron and Kenny (1986)'s four step procedure where path a, b and c are depicted in the first column to the left. Baron and Kenny's four step procedure (1986) was the clearest process of analysing a mediating role the researcher came across, in comparison to other authors who also empirically assessed mediating role (Dur a´n-Narucki, 2008). Hence, Baron and Kenny's was chosen as a benchmark standard. The values showing levels of significance were generated using LISREL. Since path c lost its significance from SIT → DM (0.41***) to SIT → DM in the overall model (0.19**); i.e. SIT → DM to SIT → KS → DM, this evidence suggests partial mediation of knowledge sharing quality between physician's SIT and medical DM quality. Partial mediation is reached when X → Y (X being the independent variable and Y being the dependant variable) reduces in its path confident significance but differs from zero when M (mediating variable) is introduced between X and Y (Kenny, 2012). Here, mediating role is assessed by comparing the magnitudes of the path coefficients significance (Iacobucci, 2010). Note: the path/regression coefficient was identified as a path diagram format by using LISREL's standardized solution view beneath the estimates menu (Joreskog, 1999). Please note, in Table 5.7 left first column's SIT → KS significance is 0.42*** which is in the absence of medical DM quality. In

Figure 5.2 the path a SCT → KS shows significance of 0.41***, which is in presence of medical DM quality.

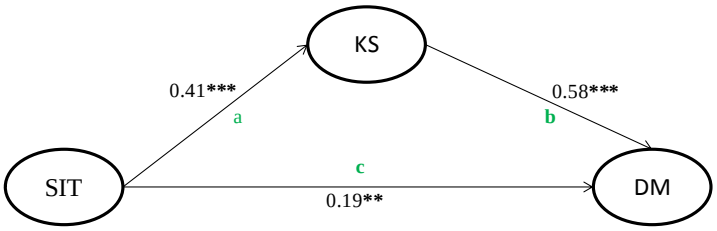


Fig 5.3. Structural Model between Social Interaction Ties → Knowledge Sharing → Decision Making and Social Interaction Ties → Decision Making

Table 5.7 Empirical tests of mediator effects with their regression coefficients: mediating effect between SIT → KS → DM and SIT → DM

Path A	**Path B**	**Path C (during the absence of KS)**	**Path C (during the presence of KS)**
SIT → KS	**KS → DM**	**SIT → DM**	**SIT** $\xrightarrow{KS}$ **DM**
0.42***	0.66***	0.41***	0.19**

Figure 5.4 depicts the overall path T → KS → DM and T → DM path and Table 5.8 depicts the assessment results of the mediating role of knowledge sharing quality between trust and DM quality; assessed according to a four step procedure suggested by Baron and Kenny (1986) where path a, b and c depicted in the first left column. Since path c lost its significance from T → DM (0.37***) to T → DM in the overall model (-0.20), i.e. T → DM to T → KS → DM, (-0.20); this evidence suggests full mediation of knowledge sharing quality between physician's trust and medical DM quality. The evidence suggested that knowledge sharing quality fully mediated between T and medical DM quality; hence trust also supports hypothesis 4. Full mediation is reached when X → Y is no longer affected when M (mediating variable) is introduced between X and Y (Kenny, 2012).

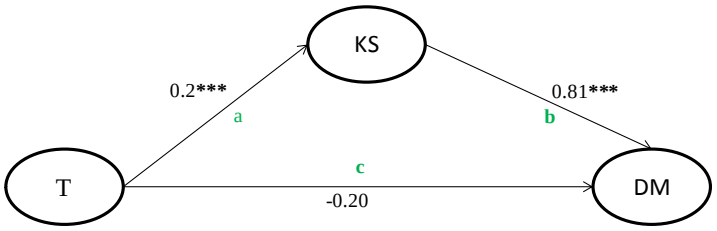


Fig 5.4. Structural Model between Trust → Knowledge Sharing → Decision Making and Trust → Decision Making

Table 5.8. Empirical tests of mediator effects with their regression coefficients: mediating effect between T → KS → DM and T → DM

Path A	Path B	Path C (during the absence of KS)	Path C (during the presence of KS)
T → KS	**KS → DM**	**T → DM**	**T $\xrightarrow{KS}$ DM**
O.73***	0.66***	0.37***	-0.20

Figure 5.5 depicts the overall path NoR → KS → DM and NoR → DM path and Table 5.9 depicts the assessment results of the mediating role of knowledge sharing quality between NoR and DM quality; assessed according to a four step procedure suggested by Baron and Kenny (1986) where path a, b and c depicted in the first left column. Since path c lost its significance from NoR → DM (0.49***) to NoR → DM in the overall model (0.01), i.e. NoR → DM to NoR → KS → DM, (0.11); this evidence suggests full mediation of knowledge sharing quality between physician's norms of reciprocity and medical DM quality. Henceforth this empirical evidence suggests knowledge sharing quality fully mediated between norms of reciprocity and medical DM quality; hence supports hypothesis 4.

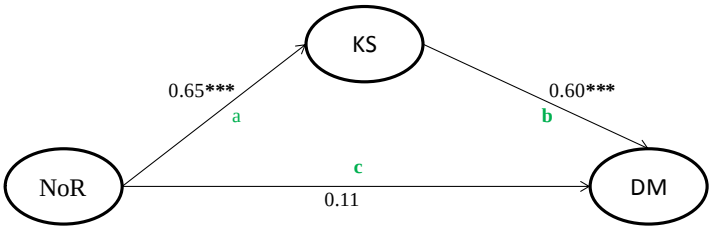


Fig 5.5. Structural Model between Norms of Reciprocity → Knowledge Sharing → Decision Making and Norms of Reciprocity → Decision Making

Table 5.9. Empirical tests of mediator effects with their regression coefficients: mediating effect between NoR → KS → DM and NoR → DM

Path A	Path B	Path C (during the absence of KS)	Path C (during the presence of KS)
NoR → KS	**KS → DM**	**NoR → DM**	**NoR $\xrightarrow{KS}$ DM**
O.66***	0.66***	0.49***	0.11

Figure 5.6 depicts the overall path ID → KS → DM and ID → DM path and Table 5.10 depicts the assessment results of the mediating role of knowledge sharing quality between identification and DM quality; assessed according to a four step procedure suggested by Baron and Kenny (1986) where path a, b and c depicted in the first left column. Since path c lost its significance from ID → DM (0.59***) to ID → DM in the overall model (0.32***), i.e. ID → DM to ID → KS → DM, (0.32***); this evidence suggests partial mediation of knowledge sharing quality between physician's identification and medical DM quality; hence too supporting hypothesis 4.

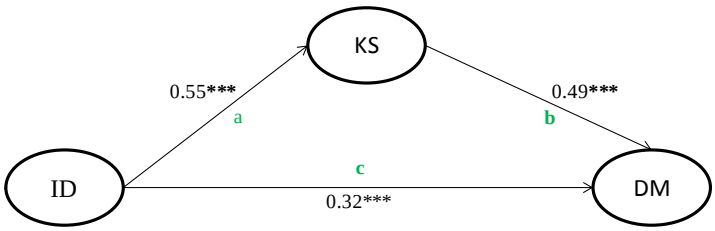


Fig 5.6. Structural Model (Identification → Knowledge Sharing→ Decision Making and Identification → Decision Making)

Table 5.10. Empirical tests of mediator effects with their regression coefficients: mediating effect between ID → KS → DM and ID → DM

Path A	**Path B**	**Path C (during the absence of KS)**	**Path C (during the presence of KS)**
ID → KS	**KS → DM**	**ID → DM**	**ID $\xrightarrow{KS}$ DM**
O.56***	0.66***	0.59***	0.32***

Figure 5.7 depicts the overall path SL → KS → DM and SL → DM path. Table 5.11 depicts the assessment results of the mediating role of knowledge sharing quality between shared language and DM quality; assessed according to a four step procedure suggested by Baron and Kenny (1986) where path a, b and c depicted in the first left column. Since path c lost its significance from SL → DM (0.46***) to SL → DM in the overall model (0.01), i.e. SL → DM to SL → KS → DM, (0.01); this evidence suggests full mediation of knowledge sharing quality between physician's shared language and medical DM quality; hence also supporting hypothesis 4.

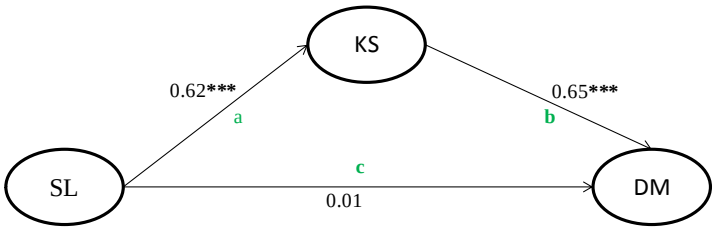


Fig 5.7. Structural Model between Shared Language → Knowledge Sharing → Decision Making and Shared Language → Decision Making

Table 5.11. Empirical tests of mediator effects with their regression coefficients: mediating effect between SL → KS → DM and SL → DM

Path A	**Path B**	**Path C (during the absence of KS)**	**Path C (during the presence of KS)**
SL → KS	**KS → DM**	**SL → DM**	**SL $\xrightarrow{KS}$ DM**
O.61***	0.66***	0.46***	0.01

Figure 5.8 depicts the overall path SV → KS → DM and SV → DM path. Table 5.12 depicts the assessment results of the mediating role of knowledge sharing quality between shared vision and DM quality; assessed according to a four step procedure suggested by Baron and Kenny (1986) where path a,

b and c depicted in the first left column. Since path c lost its significance from SV → DM (0.56***) to SV → DM in the overall model (0.15), i.e. SV → DM to SV → KS → DM, (0.15); knowledge sharing quality fully mediated between shared vision and medical DM quality.

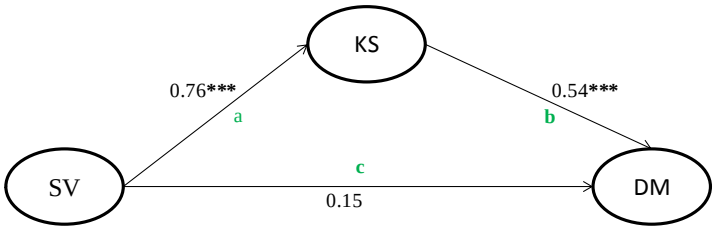


Fig 5.8. Structural Model between Shared Vision → Knowledge Sharing → Decision Making and Shared Vision → Decision Making

Table 5.12. Empirical tests of mediator effects with their regression coefficients: mediating effect between SV → KS → DM and SV → DM

Path A	**Path B**	**Path C (during the absence of KS)**	**Path C (during the presence of KS)**
SV → KS	**KS → DM**	**SV → DM**	**SV** $\xrightarrow{KS}$ **DM**
O.75***	0.66***	0.56***	0.15

Pertaining to Hypothesis 4, physicians' SC significantly and positively affects knowledge sharing through which SC significantly and positively impacts the quality of medical DM in a VCoP environment. This hypothesis was completely supported by all physicians' SCT variables. Knowledge sharing quality mediated (1) fully between physicians' SC and medical DM quality, i.e. trust, norms of reciprocity, shared language and shared vision and (2) partially between physicians' SC and medical DM quality, i.e. social interaction ties and identification.

5.5 INTERPRETING THE FOUR HYPOTHESES FROM THE TWELVE SUB-HYPOTHESES

1 **Hypothesis 1 Results in the absence of Knowledge Sharing Quality –** While the path model in Figure 5.1 was an output of CFA; the overall structural model (Figure 5.9) is an output of SEM. Hypothesis 1 was supported by its 6 sub-hypotheses (H1a, H1b, H1c, H1d, H1e and H1f - depicted in Table 5.4) that were positively significant, hence supported. When each of the sub-hypotheses was tested, with results depicted in Table 5.4, only the relation between independent variable (SCT: SIT, T, NoR, ID, SL and SV) and dependant variable - DM was assessed in the absence of KS.

2 **Hypothesis 2 Results in the absence of DM Quality –** Hypothesis 2 was also supported since its 6 sub-hypotheses (H2a, H2b, H2c, H2d, H2e and H2f - mentioned in Table 5.5) were positively significant with KS. When each of sub-hypotheses was tested, only the relation between independent variable (SCT: SIT, T, NoR, ID, SL and SV) and dependant variable - KS was assessed in the absence of DM.

3 **Hypothesis 3 Results in the absence of SCT -** Hypothesis 3 was also reported as independent variable - KS being positively significant with dependant variable - DM, as depicted in Table 5.6, hence was supported. In this case the relationship was between KS and DM is in the absence of the independent variables (SCT's SIT, T, NoR, ID, SL and SV).\

4 **Hypothesis 4 Results during the Mediating role of Knowledge Sharing Quality -** Hypothesis 4 was supported by full mediation of KS between independent variable (SCT: T, NoR, SL and SV) and dependant variable (DM) and partial mediation of KS between independent variable (SCT's SIT and ID) and dependant variable (DM). Since KS mediates partially or fully between all independent variables and DM, hypothesis was fully supported. Hence, all four hypotheses were supported.

5.6 IMPLEMENTING STRUCTURAL EQUATION MODELING

After implementing CFA, the next step was to apply SEM, using LISREL (Scientific Software International, Inc., 2013) as observed in Chiu, Hsu and Wang (2006). This flexible and comprehensive approach is used to model relations between variables (Hoyle & Smith, 1994) whose explicit representation is the main characteristic of SEM. This is what allows researchers to test multiple hypotheses assessing statistical significance, from a researcher's developed model, since SEM can be visualized by graphical models (Hox & Bechger, 1998) and analytically evaluated based on an exploratory tone. Hence, the researcher's model, supported by data, is tested, revised and re-tested in a continuously repeated cycle until a satisfactory modified model achieves fitness of its data. This model discovery is supported theoretically and by its data considering that it is also data driven (Kline, 2005).

SEM was preferred over multiple regression and analysis of variance (ANOVA) (Hoyle & Smith, 1994). ANOVA would be applicable if this thesis was assessing differing 3+ groups (Saunders, Lewis, & Thornhill, 2009). However, since this thesis is based on one group, i.e. 204 SM VC participating physicians; ANOVA is not applicable. Since this thesis assesses relationships amongst variables, SEM applies over multiple regression analysis since:

1. SEM can perform hypotheses testing; which is also possible with ANOVA, multiple regression analysis and CFA. SEM is a multiple statistical technique of related procedures (Kline, 2005) where SEM can generate three types of models using one statistical technique rather than using three different techniques. These three types of models are:

    a. ***General linear model*** – a regression analysis model and
    b. ***Factor analysis model*** – also referred as measurement model, which is a CFA mode (as depicted in Figure 5.1) and
    c. ***Structural Model*** – or structural model with latent variables, which is a general SEM structural model (as depicted in Figure 5.1 (Hoyle & Smith, 1994).

2. Regression analysis follows CFA (Chang & Chuang, 2011; Lin & Chang, 2008). At this stage, the researcher had the option to choose ANOVA, regression analysis or SEM. As justified earlier, ANOVA is no longer a chosen option. SEM (a multiple statistical technique is composed of related procedures), which entails first generating a measurement model (using CFA) and then a structural model (using SEM). Generally, only CFA can address a research question. If not, then SEM model also applies (Hoyle & Smith, 1994). Hence, SEM is composed of CFA and regression analysis and is depicted by a measurement model and a path modeling of theoretical constructs based on path/regression coefficient among factors (Hox & Bechger, 1998). This is one of the reasons why SEM is the chosen statistical analysis technique. The other reason is that SEM is a permutation of factor analysis and regression analysis (Hox & Bechger, 1998). Therefore, since this thesis used LISREL to perform CFA, it would be logical to also perform SEM using LISREL.

3. To add further value to the just-mentioned argument, SEM is advantageous, in comparison to multiple regression analysis, for testing a hypothesized model since such a technique can assess the extent of variation of one variable over other one/more variables through correlation coefficient. SEM can simultaneously assess multiple variables with their inter-relationships (Hoe, 2008). However, multiple regression analysis is unable to analyse such complicated models with intervening or mediating variables (Hox & Bechger, 1998). SEM is an effective tool to assess how an independent variable affects a dependent variable directly or indirectly. Indirect affect refers to the mediating role. SEM is popular for assessing fitness of three paths in one model, when assessing mediating roles (Iacobucci, 2010). The three paths (path = →) refer to the:

a. ***Direct role*** - an independent variable X directly affects dependant variable Y, i.e. X → Y and
b. **Indirect role composed of two paths** - the mediating role of M here two paths, assessed using SEM, i.e. X → M → Y (Kline, 2005).

This is possible by assessing and comparing the magnitudes of the path coefficients significance (Iacobucci, 2010). Hence, SEM is advantageous when assessing the mediating role. In the case of this study, the mediating role of KS needs to be assessed. SEM outweighs regressions when assessing a research question that entails a mediating role, i.e. hypothesis 4 of this thesis (Chou, Teng, & Lo, 2009). Series of regressions can assess these relationships but SEM has been proven superior for its ability to instantly and effectively assess such relationships, considering that all three paths (X → Y and X → M → Y) can be fit in one model, in one model (Iacobucci, 2010).

SEM assesses the linear causal relationships among constructs by assessing the model fitness. An inadequately fit model can be altered to a recommended fitness by removing insignificant parameters and/or adding significant parameters. By freeing any parameter (parameter is a path model's variances and covariance of independent and dependant variables, regression coefficient, error variance for observed variables and factor loadings), Chi-square statistics decreases, hence, improves model fitness. This pattern is employed by sequentially repeating this process multiple times to maximize the model fitness to the model's data (Hox & Bechger, 1998). Model fitness was estimated by: (1) variances of latent variables (Table 5.3), (2) overall model fitness as well as strength and significant of parameters (Weston & Gore, 2006). As depicted in Table 5.13, the overall model fitness is based on data through various fitness indices, as observed in Chiu, Hsu and Wang (2006), also referred as indexes (Kline, 2005), supported by Chi-square statistics through structural model's model fit indices being: Comparative Fit Index (CFI), Goodness-of-Fit (GIF), Non-normed-Fit-Index (NNFI), Normed-Fit-Index (NFI) and Root Mean Square Error of Approximation (RMSEA). Model fitness results, for this thesis, were at acceptable thresholds (Table 5.3). As in Table 5.3, CMIN/DF was 1.93, hence, ≤ 3, as observed in Chang and Chuang (2011); hence from the perspective of CMIN/DF the model achieved fitness. In addition, CFI, i.e. 0.98, GFI, i.e. 0.88 and RMSEA, i.e. 0.069 were significant, considering that CFI should be: ≥ 0.9 (Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006), GFI should be ≥ 0.8 (Chang & Chuang, 2011) and RMSEA should be ≤ 0.08 (Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006) to achieve model fitness. This thesis provided six evidences of fitness in its data analysis chapter, i.e. Chi square, CFI, NFI, NNFI, GFI and RMSEA to support the overall fitness of its models. These many indicators are sufficient since the

same fitness indicators were also utilized by other studies, for example (Chiu *et al.*, 2006; Chang & Chuang, 2011; Lin & Chang, 2008, etc). In addition, from the perspective of the behaviour of these fitness indices, the following properties should be taken note of:

1. Fit indexes just specify the average of the overall acceptable model fitness even though some parts of the model may indicate poor fit of data or
2. Any single fitness is only a likelihood of a particular feature of a model, thus alone is not enough to indicate an appropriate standard of model fitness (Kline, 2005).

Table 5.13. Model fit indices for Structural Model.

Structural Model\s Model fit Indices	Results of this study	Recommended values
CMIN – Minimum Coefficient	273.50	
DF – degrees of freedom	142	
Chi square (x^2) "*normalized by degrees of freedom*" (CMIN/DF)	1.93	≤ 3 (Chang & Chuang, 2011) and also stated as ≤ 5 (Chiu, Hsu, & Wang, 2006)
CFI – Comparative Fit Index	0.98	≥ 0.9 (Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006; Judge, Bono, & Locke, 2000)
NFI – Normed Fit Index	0.96	≥ 0.9 (Chang & Chuang, 2011; Judge, Bono, & Locke, 2000)
NNFI - Non-Normed Fit Index	0.97	≥ 0.9 (Chiu, Hsu, & Wang, 2006; Judge, Bono, & Locke, 2000)
GFI – Goodness of Fit Index	0.88	≥ 0.8 (Chang & Chuang, 2011; Judge, Bono, & Locke, 2000)
RMSEA - Root Mean Square Error of Approximation	0.068	≤ 0.08, i.e. sensible good fit (Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006; Yang, Watkins & Marsick, 2004) or < 0.05, i.e. very secure fit (Hox & Bechger, 1998; Yang, Watkins & Marsick, 2004; Yusoff, 2011) or 0.00 is exact fit (Weston & Gore, 2006) and between 0.05 with cutoff, i.e. poor fit value of 0.1 (Kline, 2005)

Even though, all these indices depend on the sample size, model fitness indices are approximations. Expecting perfect model fitness is highly unlikely. The aim here is approximating how closely the model being assessed reaches to a true model. Hence, Table 5.3's last indicator (RMSEA) was developed to assess such an approximation. The smaller the value of RMSEA is, the better the approximation becomes (Hox & Bechger, 1998). These indices were also observed in Lin and Chang (2008) and Chang and Chuang (2011). The strength and significance of parameters were assessed by the various nested versions of the structural research model, (Figure 5.3 to 5.8) and the overall structural model (Figure 5.9) for hypotheses testing where:

- ***Figure 5.3*** - Structural Model (SIT → KS → DM and SIT → DM) to assess the mediating role of KS between SIT and medical DM quality,
- ***Figure 5.4*** - Structural Model (T → KS → DM and T → DM) to assess the mediating role of KS between T and medical DM quality,
- ***Figure 5.5*** - Structural Model (NoR → KS → DM and NoR → DM) to assess the mediating role of KS between NoR and medical DM quality,

- ***Figure 5.6*** –- Structural Model (ID → KS → DM and ID → DM) to assess the mediating role of KS between ID and medical DM quality,
- ***Figure 5.7*** - Structural Model (SL → KS → DM and SL → DM) to assess the mediating role of KS between SL and medical DM quality,
- ***Figure 5.8*** - Structural Model (SV → KS → DM and SV → DM) to assess the mediating role of KS between SV and medical DM quality and
- ***Figure 5.9*** - overall analysed structural model after CFA and SEM were performed.

It should be noted that while Figure 5.1 was the outcome of CFA, Figure 5.2 is the outcome of SEM. In Figure 5.2, the relationships between independent variables (SIT, T, NoR, ID, SL and SV), mediating variable (KS) and dependant variable (DM) are highlighted by standardized coefficient (Lin, 2011). In Figure 5.2 depicts three paths (→), i.e.:

1. Social capital theory (SCT) → KS,
2. KS → DM and
3. SCT → DM.

The standardized coefficient value is the parameter estimate, which is composed of two indicators (number value sometimes accompanied by 1 star (i.e. represented by the symbol *), 2 (i.e. represented by the symbol **) starts or 3 stars (i.e. represented by the symbol ***):

1. ***Numerical value*** - is the regression coefficient, attained as a path diagram format when a LISREL user selects standardized solution beneath estimates menu (Joreskog, 1999) or also referred as "*standardized estimates*" by Chow and Chan, (2008) and
2. ***T-value signified by */s*** – the path's just-explained regression coefficient is accompanies by a t-value. Next step to determine whether a p value (probability) is below 0.05 (represented by * next to the regression coefficient), below 0.01 (represented by ** next to the regression coefficient) or below 0.001 (represented by *** next to the regression coefficient) which is a number. For example in Figure 5.2 the path KS → DM's 0.62 *** mean 0.62 is the regression coefficient while three stars reflect t-value's p value < 0.001.

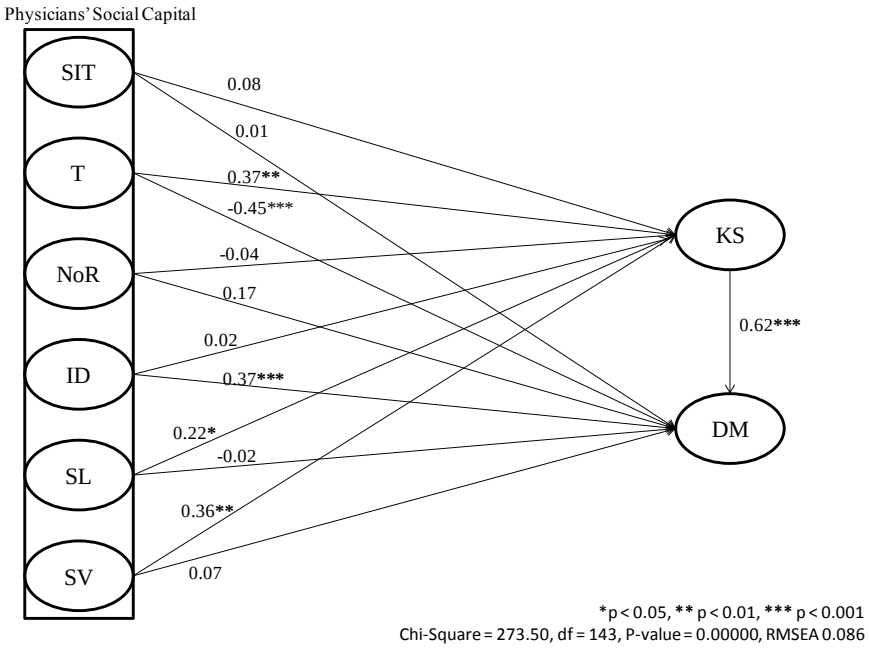


Fig 5.9. Structural Equation Modeling Analysis for Overall Research Model Fitness (Social Capital Theory → Knowledge Sharing → Decision Making and Social Capital Theory → Decision Making)

5.6.1 INTERPRETING THE HYPOTHESES FROIM THE OVERALL STRUCTURAL MODEL

It is interesting to realize that, as depicted in Figure 5.9, when independent variable (SCT's SIT, T, NoR, ID, SL and SV), mediating variable (KS) and dependant variable (DM) were all assessed in one structural model, for its fitness in relation to its data; the four hypotheses of this thesis were still supported but in the following manner:

1. ***Hypothesis 1*** - ID, SL, SV support physicians' SC significantly and positively in association with the medical DM quality, within a virtual community of practice (VCoP) environment,
2. ***Hypothesis 2*** - While SL and SV support physicians' SC significantly and positively in association with the physicians' knowledge sharing quality within a VCoP environment; T supports physicians' SC significantly and negatively in association with the medical DM quality, within a virtual community of practice (VCoP) environment,
3. ***Hypothesis 3*** - Physicians' knowledge sharing quality is significantly and positively associated with medical DM quality within a VCoP environment and
4. ***Hypothesis 4*** - Trust, shared language and shared vision significantly and positively affect knowledge sharing through which shared language and shared vision significantly and positively improve DM quality within a VCoP environment.

As observed in other studies (Chang & Chuang, 2011; Chiu, Hsu, & Wang, 2006, among others), it is the structural model whose hypotheses and sub-hypotheses lead a thesis hypotheses testing results. However, the data analysis that assessed the sub-hypotheses in the absence of various variables (Table 5.4, 5.5 and 5.6) are also important since this thesis also portrays analysis of data not only of the overall structural model, depicted in Figure 5.2, but also models tests independently in the absence of variables that were not present in various sub-hypotheses, for example H1a did not mention KS, so in Table 5.5 H1a was assessed independently of KS mediating variable.

5.6.2 IMPLICATIONS OF THE OVERALL STRUCTURAL MODEL

This study demonstrates a theoretical implication. This study's general focus was on VCs and has contributed a conceptual framework utilizing the SCT's perspective of community relations. The aspects of SC are taken into consideration to understand what core facets of SC facilitate VC physician participants to share knowledge and involvement in medical DM. The empirical findings of this study's overall structural model (depicted in Figure 5.9) imply that: (1) trust, shared language and shared vision are the main factors influencing participation in knowledge sharing, (2) knowledge sharing facilitates medical DM and (3) trust and identification are the main factors facilitating medical DM; while in the overall model where knowledge sharing mediated between physicians' SC and DM. In addition, this study shows that trust is the only factor that influenced both knowledge sharing and medical DM.

5.7 SUMMARY

This chapter described the researcher's path to derive a literature-driven data analysis strategy after the main data was collected from SM. First the researcher described how missing data was treated. Next, statistical findings were depicted in various tables. Various forms of statistics expression were comprehensively reported and interpreted as reported and/or advised by various authors. This study justified the implementation of CFA and SEM. Statistical results were weighed in association with corresponding sub-hypotheses (Table 5.5 and 56) that were related with 4 main hypotheses. The empirical evidence set stage, for thesis to successfully conclude its research aim, i.e. to assess the effectiveness of a VC on knowledge shared medical DM. Empirical findings support the four hypotheses. This chapter supports the next chapter, which integrates the empirical evidence with reviewed theoretical literature. In the next chapter, the researcher described the literature in order to better explain why certain theories, described in Chapter Two, were not supported by some of the findings in this chapter.

CHAPTER 6: DISCUSSION

6.1 INTRODUCTION

Chapter Five described a strategy for missing data treatment and data collection. Furthermore the chapter also outlined the systematic implementation of data analysis using Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM). The results were statistically expressed in tabular forms and the analysis was conducted in line with recommendations encountered in various sources. It was followed by performing and reporting the main hypotheses and sub-hypotheses test results.

The statistical results and empirical findings of Chapter Five are discussed in this chapter along with reviewed literature, which has been critiqued in Chapter Two and Three. The overview will highlight which theories supported and which theories did not support the hypotheses test results. In addition, the researcher performed an additional literature review to pinpoint the possible explanations as to why certain theories presented in Chapter Two and Three did not support certain sub-hypotheses results. This chapter is outlined as follows:

- Section 6.2 outlines the main hypotheses findings.
- Section 6.3 describes a strategy to evaluate the empirical results based on the reviewed literature in chapter Two and Three and additional reviewed literature is critiqued to explain the unsupported theories.
- Section 6.4 expresses how additional LISREL analysis confirmed that the conceptual framework, depicted in Figure 6.1, is the best structurally fit conceptual framework.

6.2 EVALUATING THESIS'S RESULTS

In order to evaluate if the previously stated research problem was fully explained, the following causes and consequences need to be assessed:

1. Direct relationships between each independent variables of physicians' social capital (SC), i.e. social interaction ties, trust, norms of reciprocity, identification, shared

language and shared vision and medial DM quality (DM), reflecting hypothesis 1 (all hypotheses are mentioned in Section 5.5),

2. Direct relationship between each independent variables of physicians' SC and knowledge sharing quality, reflecting hypothesis 2,
3. Direct relationship between knowledge sharing quality and DM, reflecting hypothesis 3 and
4. Mediating role of knowledge sharing quality between physicians' SC and DM, reflecting hypothesis 4

The data analysis, in the previous chapter, suggested three types of empirical findings:

1. Considering that LISREL structural model can relate and test multiple variables for their relationships (Kline, 2005), the overall structural model based on the empirical findings (depicted in Figure 6.1), i.e. physicians' SC theory (SCT), knowledge sharing quality and DM and SCT and DM, suggested that not all sub-hypotheses supported hypotheses 1, 2, 3 and 4,

2. The assessment of certain variables by controlling other variables during the absence of one variable from the overall structural model to test the sub-hypotheses of:

    a. hypothesis 1, knowledge sharing quality was controlled to assess the SCT and DM path,
    b. hypothesis 2, DM was controlled to assess the SCT and knowledge sharing quality path and
    c. hypothesis 3, SCT was controlled to assess the knowledge sharing quality and DM path

    revealed that all sub-hypotheses were supported and hence also supported hypotheses 1, 2, 3 and 4 testing. This empirical evidence, where all sub-hypotheses were supported (Table 5.5 and 5.6), differed from the empirical evidence. Consequently, the researcher modified the structural model (Figure 6.1) where not all sub-hypotheses supported hypotheses 1, 2, 3 and 4 since in the overall model no variables were controlled.

3. The assessment of the mediating role of knowledge sharing quality, using a four step

process suggested by Baron and Kenny (1986), required each independent variable's relation to be assessed with the mediating and dependant variable, while controlling other independent variables. For instance, the structural model in figure 5.3 presents: (1) social interaction ties and knowledge sharing quality and DM and (2) social interaction ties and DM while controlling trust, norms of reciprocity, identification, shared language and shared vision. The result, i.e. the mediating role of partial knowledge sharing quality between social interaction ties and DM was depicted in Table 5.8. Such an assessment revealed that all SCT variables supported partial or full mediation of knowledge sharing quality between SCT and DM. This assessment, done in presence of any independent variable, generated standardized coefficient results different from results of the overall model, while other independent variables were controlled (Figure 6.1).

These empirical findings add further value to Kline (2005), whose study this thesis followed when it implemented CFA and SEM in the previous chapter. Now, the researcher practically assessed these relational differences in the overall structural model versus controlled models. The next section describes the causes and consequences of these empirical findings as critiqued in the literature review in Chapter 2 and 3.

6.2.1 EMPIRICAL RESULTS OF THE SOCIAL CAPITAL THEORY → DECISION MAKING RELATIONSHIP

Various studies advocated the need for physicians' SC for medical DM, for example Kopáčková, & Škrobáčková (2009); Magnier-Watanabe, Yoshida & Watanabe, (2010). These studies motivated the researcher to empirically assess the effect of physicians SC on medical DM quality in a VC. In sections 6.2.1.1 - 6.2.1.6, the researcher discusses the role of SCT variables (social interaction ties, trust, norms of reciprocity, identification, shared language and shared vision) on DM in the presence knowledge sharing quality as a mediator - depicted in the overall structural model (Figure 6.1).

6.2.1.1 Discussing Social Interaction Ties → DM relationship

Empirical evidence for the relationship between SCT, knowledge sharing quality and DM, depicted in the overall structural model (Figure 6.1), suggested that social interaction ties are insignificant with regards to DM. Even though various studies advocated a positively significant

relationship between social interaction ties and DM (Sifer-Rivière *et al*. 2010; Mascia & Cicchetti, 2011; Jansen, Curseu, Vermeulen, Geurts & Gibcus, 2011), more empirical research is needed to assess why social interaction ties are insignificant in the context of this thesis. The concept of interaction-based medical DM, i.e. in relation to physician-patient integrations, is a new research domain, since 1970s, (Heritage & Maynard, 2006). In a shared environment, where DM is shared between physicians and patients, both parties interact for collaborative DM (Elwyn, Edwards, & Kinnersley, 1999). Hence, such collaboration mandatory between both parties (Elwyn, Edwards, Kinnersley, & Grol, 2000). On the other hand, (Chiu, Hsu, & Wang, 2006; Chang & Chuang, 2011; Tarn, Wen, & Shih, 2008; etc.) empirically assessed the effect of social interaction ties on knowledge sharing quality or intelligence processing but have not, assessed the effect of social interaction ties on DM. Some studies indirectly assessed the role of social interaction ties on DM, for example, through information sharing in a HC setting between a patient and a physician (Magnier-Watanabe, Yoshida, & Watanabe, 2010).

Additional LISREL test relating SCT and DM, when knowledge sharing quality was controlled (Figure 6.1), also revealed that social interaction ties are insignificant with regards to DM, even though the parameter coefficient rose from 0.01 to 0.06; proving social interaction ties insignificance with DM, during knowledge sharing quality as a mediator or when knowledge sharing quality was removed. Hence, the evidence proved that the theories in those studies that advocated a positively significant relationship between social interaction ties and DM (Sifer-Rivière *et al*. 2010; Mascia & Cicchetti, 2011; Jansen *et al*., 2011) were not supported in the context of this thesis.

Jansen *et al*. (2011) assessed the role of SC role on strategic DM effectiveness in small and medium organizations. Data from 434 decisions was obtained through telephone interviews and analysed using Structural Equation Modeling (SEM). The study concluded that SC negatively affected DM. The background theory mentions the positive role of SC on DM. Yet, it is interesting to observe that the context in Jansen *et al*. (2011) differs from this thesis as Jansen *et al*. performed the analysis within an organization, while this research focused on a VC.

On the other hand, Mascia & Cicchetti (2011) explored the role of professional networks on physicians' adaption of evidence based medicine (EBM) DM process. 207 physicians participated in a survey. Empirical evidence gathered by Mascia & Cicchetti suggested that SC with higher interactions among members contributed less to adaption of EBM DM process. It was interesting

to note that these authors mentioned that a network with high relational interaction negatively facilitates DM. Mascia & Cicchetti's empirical findings were similar to the empirical findings of this thesis. One explanation is that the contexts of both studies were similar. This thesis performed a quantitative survey on 204 physicians in a VC environment while Mascia & Cicchetti (2011) also conducted a quantitative survey based in a social network of hospitals in which 207 physicians participated. However, Sifer-Rivière *et al*. (2010) came to a different conclusion when qualitatively assessing physicians' collaboration process for older cancer patient care DM in a HC setting in France. They proceeded from literature review, observation of working sessions to interviews with 28 physicians. Their study assessed physicians' perception of older patients' cancer care that is a collaborative activity and the authors reported it to be important for aiding DM. In this case, however, an organization is considered a community (Rantapuska & Ihanainen, 2008). One explanation why Sifer-Rivière *et al*.'s qualitative assessment did not support the insignificant relation between social interaction ties and DM, is that this thesis tested its conceptual framework in a VC, while Sifer- Rivière *et al*. analysed a HC organization, which this falls under the umbrella of a community.

Note 1: Social Interaction Ties (SIT), Trust, (T), Norms of Reciprocity (NoR), Identification (ID), Shared Language (SL), Shared Vision (SV), Knowledge Sharing Quality (KS), Decision Making Quality (DM)

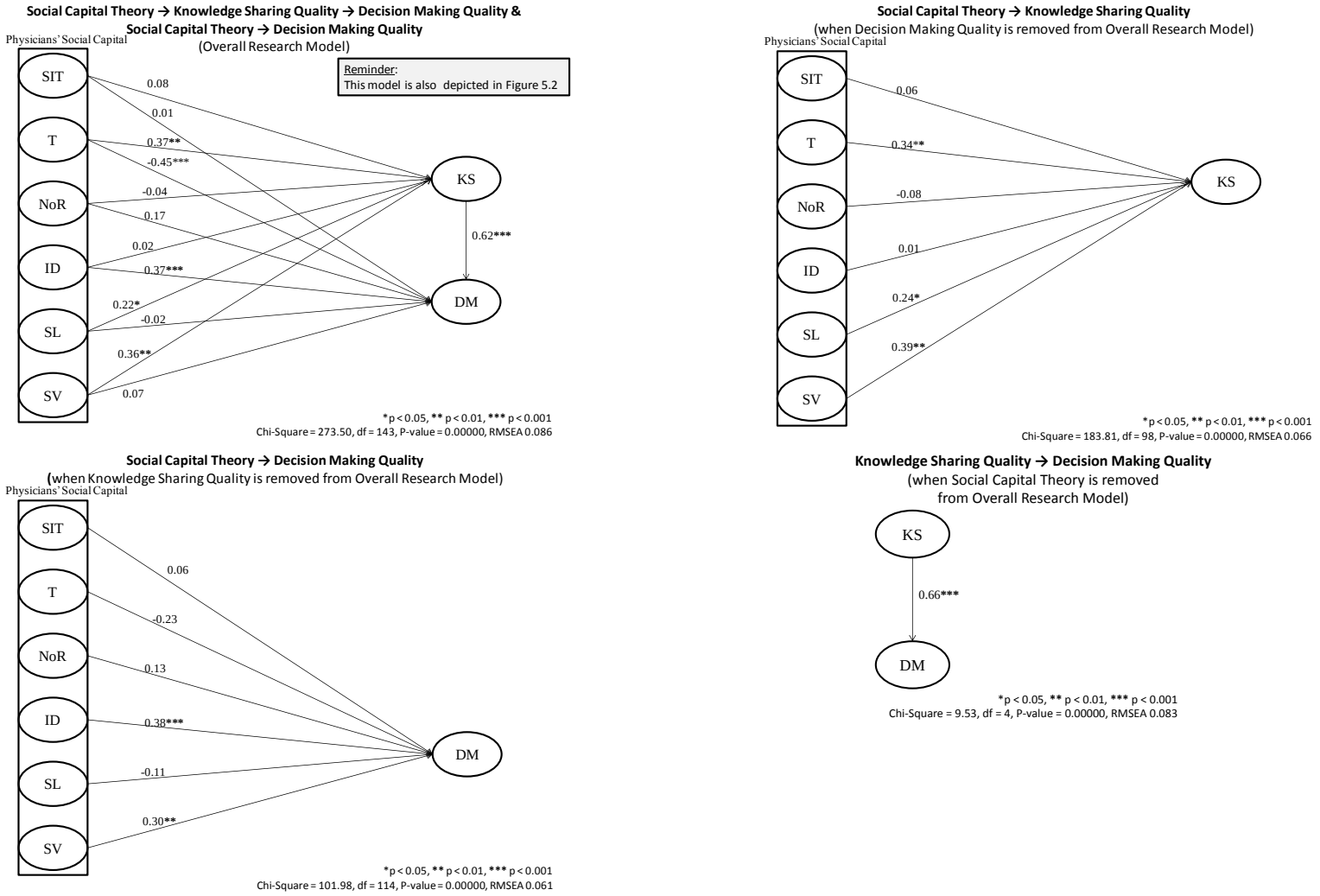


Fig 6.1. Three addition LISREL Structural Models are compared with the Overall Structural Model

6.2.1.2 Discussing the Trust → DM relationship

Empirical evidence relating SCT, knowledge sharing quality and DM in an overall structural model (Figure 6.1) suggested a negative and significant role of trust on DM. As one study reported (White, 2011), trust is a prerequisite of DM in a VC, The empirical findings of this thesis supported White's observations but indicated that trust and DM have a negative effect on one another. Hence, empirical findings of this thesis support the views of Edelenbos and Klij (2007) who mentioned that trust negatively facilitates joint DM. One possible explanation for such a result is that the interpersonal aspect of electronic networks makes the assessment of trust a challenging task (Jøsang, 1999). Indeed, even though medical professionals are among the most trusted (White, 2011), trust is vibrant and changes depending on the situations (Yaich, Boissier, Jaillon, & Picard, 2011). Changing HC delivery mediums causes trust to decline (White, 2011). As a result, Edelenbos and Klij's observations that trust negatively facilitates DM due to e-networks (Jøsang, 1999) add value to White (2011)'s theory: physicians trust each other (White, 2011) but their trust changes depending on the situation (Yaich *et al.,* 2011) such as in HC VCs. Yaich *et al.*'s observation about trust changing based on the situation is pertinent in a VC context. The constant increase of the size of the membership and information within VCs and rising issues among members lead to challenges as to whom a member can trust and whose information can be considered valuable (Zhang, *et al.,* 2012). It is interesting to note that in Slashdot, a type of VC, one member can tag another member as a friend or foe to set a trust level for resource sharing (Zhang *et al.,* 2012).

Additional LISREL tests, to assess the relation between SCT and DM relationship, when knowledge sharing quality was removed (depicted in Figure 6.1), also revealed that trust is insignificant with DM, since even though the parameter coefficient between trust and DM increased from -0.43 to -0.23, this relationship lost its significance when knowledge sharing quality was removed. However, when knowledge sharing quality was present, there was negative and significant relation between trust and DM. These empirical findings explain that trust facilitates physicians' SC to share knowledge to support medical DM quality, as also supported by Lauring and Selmer (2011). Only one study mentioned that trust facilitates DM in a VC (Zhang, *et al.* 2012), which assessed VC's trust for DM. The author quantitatively collected data from VC members. Findings of this study revealed a positive relationship between trust and interaction, in order to facilitate DM. One explanation why Zhang, *et al.*'s empirical results were not supported by the empirical results in this thesis is that a variance in the settings quantities survey-based data collection was performed where:

1. Knowledge sharing quality and SCT were not part of this study or
2. Survey's items that measures trust or integration were not the same as the one adapted in this thesis.

6.2.1.3 Discussing Norms of Reciprocity → DM relationship

Norms of reciprocity were insignificant with regards to DM in the structural model (Figure 6.1) that related SCT, knowledge sharing quality and DM. This empirical finding is not surprising, considering that norms of reciprocity are derived from trust (Pervan, Bove, & Johnson, 2009) but resource exchange seldom facilitates positive outcomes (Pervan, Bove, & Johnson, 2009). In the case of this thesis, such an outcome can be associated with medical DM quality in VCs. Since empirical evidence suggested that norms of reciprocity are insignificant with regards to DM, it also reflected the role of norms of reciprocity and DM in the presence of knowledge sharing quality, in the overall structural model.

Additional LISREL test, performed by the researcher between SCT and DM when knowledge sharing quality was removed, also suggested an insignificant relationship between norms of reciprocity and DM, even though the parameter coefficient rose from 0.17 to 0.23. However, the relationship between norms of reciprocity and DM remained insignificant. Magnier-Watanabe *et al*. (2010) was a quantitative study that suggested that that DM requires information process through norms of reciprocity during its assessment of social networks on organizational SC. Magnier-Watanabe *et al*.'s quantitative survey collected data from 1,362 Japanese company employees analysed data using factor analysis followed by moderated regression. However it did not assess reciprocity in the presence of knowledge sharing quality and other factors of SC. Consequently, its empirical assessment showed a significant relationship between norms of reciprocity and DM, while this thesis did not assess the direct role of norms of reciprocity on DM. Also, this study mentioned the role of reciprocity on DM in its literature review and during information sharing. That is another reason why Magnier-Watanabe *et al.,* (2010) advocated the role of norms of reciprocity and DM, which did not support the empirical findings of this thesis. Furthermore, Pervan, Bove and Johnson (2009) aimed at developing a measure of reciprocity.

Their study suggested a relationship between norms of reciprocity and DM, so hence was cited in this thesis. Postmes, Spears and Cihangir (2001), related group norms with DM based on group thinking. These authors considered norms of reciprocity one of the group norms. To assess how group norms facilitate group DM, they performed two pilot studies followed by two experiments based on assigned tasks that required discussions. This procedure aimed at showing that group norms are promoted by

assigning small tasks to group members to facilitate their performance. This empirical method evidenced group norms were supportive towards group DM.

6.2.1.4 Discussing the identification → DM relationship

Empirical evidence for the relationship between SCT, knowledge sharing quality and DM in the overall structural model suggested that identification had a positively significant effect on DM. This empirical evidence supports other other authors who advocated that identification is significant in relation with medical DM quality (Gossett, 2002; Bhattacharya & Sen, 2003; Austin, 2003; Kogut & Zanger, 1992). Additional LISREL tests to assess the relationship between SCT and DM when knowledge sharing quality was removed (Figure 6.1), also revealed that identification is positively significant with DM even though the parameter coefficient dropped from 0.38 (when knowledge sharing quality was removed) to 0.37 when knowledge sharing quality was present. Hence, this thesis adds further practical value to those studies that theoretically advocated a positively significant relationship between identification and DM (Gossett, 2002; Bhattacharya & Sen, 2003; Austin, 2003; Kogut & Zanger, 1992). In addition, when considering the studies that advocated a significance of identification and DM, Gossett (2002) utilized interview data to assess identification of employees with employers with a social process of their identification for shared DM. In this context a firm is seen as a community of practice (CoP) (Rantapuska & Ihanainen, 2008).

Even though Gossett qualitatively assessed the relationship between identification, i.e. employee identification and DM, i.e. shared DM, since an organization was considered a CoP, and not a VC, such an environmental difference could be one explanation why his empirical evidence differed from the empirical findings of this thesis, since face-to-face interactions are greatly preferred in a CoP over a VC (Alge, Wiethoff, & Kleinc, 2003). Furthermore, Bhattacharya and Sen (2003) assessed social identity and organizational identity that influence customers' commitment based on a company identity to attain a customer-company identity. A conceptual model was qualitatively tested through interviews. Bhattacharya and Sen assessed social identification with organizational identification where company's identification facilitated customer's DM to stay loyal or not to the company. Hence, this study did assess the role of identification on DM. However, it did not mention any presence of a community environment. Since this thesis assessed the role of identification on DM in a VC environment, it is not surprising why empirical evidences between this study and thesis differ. In addition, Austin (2003) assessed the relationship between experts' identification of skills when performing DM. Austin mentioned that groups perform better DM when members' know each other's skills. Such repute builds identification. However,

the hypotheses of this study did not assess the role of identification on DM, but quantitatively assessed the role of group task on group, members, etc. Its literature section described theory relating identification and DM. However, the theory reported by Austin was not supported by the overall structural model in this thesis during the presence of knowledge sharing quality where knowledge sharing quality was controlled.

6.2.1.5 Discussing the Shared Language → DM relationship

Studies that stated that shared language facilitates DM (Rantapuska & Ihanainen, 2008; Mamykina, Candy & Edmond, 2002; Lauring & Selmer, 2011) were not supported by the empirical evidence in this thesis since the relationship between shared language and DM was negative and insignificant (Figure 6.1). The reason for this insignificance may be due to the fact that physicians experience language problems working in different cultures, which lead to misunderstandings when giving advice. Such problem was reported to hamper shared DM between physicians and patients (Suurmond & Seeleman, 2006). The researcher agrees that more research is required in assessing why the relationship between shared language and DM is insignificant within a VC, since only one study stressed the lack of research to explore how language and culture interacts with shared DM (Suurmond & Seeleman, 2006). Since the relationship between shared language and DM was assessed in the presence of knowledge sharing quality, as depicted in Figure 6.1; the critiqued literatures may seem biased. However, additional LISREL test, which assessed the relationship between SCT and DM, when knowledge sharing quality was removed, revealed that shared language was insignificant in relation with DM. The parameter coefficient rose from -0.11 between shared language and DM to -0.02 when knowledge sharing quality mediated between shared language and DM, reflecting the role of knowledge sharing quality to be important.

However, Rantapuska and Ihanainen (2008) who aimed at assessing how the knowledge is utilized in ICT related DM, found out that language is used as a medium of expression for tackling problem-solving in DM. Data was collected through interviews in small and medium organizations. One explanation why their findings were not supported by the empirical evidence of this study's SCT and DM relationship is that the relationship between shared language and DM did not get empirically tested as it was only a supportive theory to Rantapuska and Ihanainen's aim, i.e. assessing the role of applying knowledge in DM. Another reason why Rantapuska and Ihanainen's findings did not get supported is that their study was not conducted in a VC setting, as was the case of this thesis. In addition, the relation between shared language and DM was cited by this thesis, under the consideration that an organization can be treated as a CoP (Rantapuska & Ihanainen, 2008). Furthermore, Lauring and Selmer (2011) assessed the relationship between English language diversity, knowledge sharing quality and DM. An online questionnaire

assessed these relationships based on 489 participants in a multicultural academic organization.

Lauring and Selmer's study did not mention the direct role of language on DM. Neither did any of its hypotheses. Even though the association between language and knowledge was positive, there was no hypothesis that tested the relationship between knowledge sharing quality and DM nor language and DM. This is one explanation why even though Lauring and Selmer's association between language and DM was cited in this thesis, it was unsupported by its empirical findings, i.e. the insignificant relationship between shared language and DM depicted in Figure 6.1 - the overall structural model when knowledge sharing quality was controlled. Mamykina *et al.,* (2002) described literature review theory to assess collaborative creativity where shared language and shared vision occur in teams for creative collaboration. This study provided no empirical evidence as it was a literature review. Thus the relation between shared language and DM was described through the literature review in this thesis. The empirical findings for the shared language and DM relationship, during the presence of knowledge sharing quality are depicted in Figure 5.1 structural model. However, Figure 6.1 expresses a structural model expressing the relationship between shared language and DM when knowledge sharing quality was controlled.

6.2.1.6 Discussing the Shared Vision → DM relationship

The empirical evidence on the relationship between SCT, knowledge sharing quality and DM in an overall structural model, suggested an insignificant role of shared vision on DM. One explanation why shared vision played an insignificant role in affecting DM quality was due to the mediating role of knowledge sharing quality between this shared vision and DM. Additional LISREL analysis generated by the researcher, suggested that shared vision is positively significant with DM, when knowledge sharing quality was controlled (as depicted in Figure 6.1). The only reason why studies that reported that shared vision facilitates medical DM (Grounds *et al.,* 2004) were not supported by this study's structural model was due to the influence of knowledge sharing quality mediating role. When knowledge sharing quality was controlled, as in the additional LISREL evidence, shared vision showed a positive significance on DM. It would be interesting to perform an empirical investigation of SCT and DM but this time in a reverse order (i.e. the relationship between DM and SCT signified as a path: DM → SCT), considering that one study reported that DM facilitates shared vision (Collins-Camargo & Hall, 2010). Grounds *et al.,* (2004) aimed at deeply assessing beliefs, values, insights that shape DM to admit a patient into a medium security psychiatric care. This study stressed the need for collaboration among staff shared vision for DM. This was an outcome of 34 interviewed clinicians. One possible reason why this study suggested a positive relation between shared language and DM, and this thesis's empirical evidence suggested the

opposite, was due to difference in the studied contexts. In addition, as mentioned in Chapter Three, it is the researcher's observation that there is a lack of literature that stresses on the shared language and DM relationship.

At first it was surprising why this would be the case. Insignificance between shared language and DM could be one reason why there is lacking literature that stressed shared language and DM relationship. However, this reason is not enough to generalize this lack of published studies. Future research needs to further assess why there is insignificance between shared vision and DM. Ather study emphasized the importance of shared vision and DM (Mamykina *et al.*, 2002), yet this study was a literature review. As a result, it is not possible to perform a deeper analysis as to why these authors stated a positive relationship between shared vision and DM; except that this critique seemed logical considering that the relationship facilitates collaborative creativity. However, the empirical assessment of this study revealed no significance between shared vision and DM. Future qualitative case studies using interviews could assess why such empirical relationship is insignificant.

6.2.2 DISCUSSING THE EMPIRICAL RESULTS OF SOCIAL CAPITAL THEORY → KNOWLEDGE SHARING RELATIONSHIP

From the point of view of the relationship between SCT and knowledge sharing quality, in the overall structural model (Figure 6.1), the empirical evidence suggested that trust, shared language and shared vision are positively significant with regards to knowledge sharing quality. These empirical findings support the following studies: (1) (Chiu *et al.*, 2006; Parayitam, 2010; Roberts, 2006; Mascia & Cicchetti, 2011) for trust, (2) (Mamykina *et al.*, 2002) for shared language and (3) (Chiu *et al.*, 2006; Nicholson, 2006) for shared vision. The role between physicians' SC and knowledge sharing quality was also empirically tested in other studies, such as Chiu *et al.* (2006) and Chang & Chuang (2011). Chiu *et al.*, (2006) shared similar empirical evidence with this thesis, i.e. social interaction ties, norms of reciprocity and identification were insignificant in relation to knowledge sharing quality. Even though, Chiu *et al.*'s empirical findings showed social interaction ties, norms of reciprocity and identification positively significant with DM, the similarity in significance was in agreement to what the researcher was expecting since the Chiu *et al.*, (2006)'s conceptual framework assessed the relation between SCT and knowledge sharing quality along with social cognitive theory (SCoT) and knowledge sharing quality. In Chiu *et al.*'s study, SCT and SCoT were composed of independent variables and knowledge sharing quality and knowledge sharing quantity were the dependant variables. In addition, Chiu *et al.*'s conceptual framework was assessed quantitatively with an online survey in which 310 VC members participated. In comparison,

this thesis received 204 responses from VC physician members. Even though the settings of these two studies were similar, differing conceptual frameworks reflect similarity in the significances and insignificances in the relationships between SCT variables and knowledge sharing quality occurring. The research was expecting similar findings since SCoT was included in Chiu *et al.,* (2006)'s conceptual framework since SCoT describes participant's behaviour is influenced by the social network and their individual cognition. SCoT was utilized here to assess the outcome expectation of the participants. Hence, according to the researchers, similar empirical findings between this thesis and Chiu *et al.,* (2006)'s conceptual framework show that the influence SCoT has on knowledge sharing quality and knowledge sharing quantity is in no relation with the influence of SCT on knowledge sharing quality and knowledge sharing quantity. Hence, even though the conceptual framework of this thesis did not include SCoT, but SCT, it is not surprising why empirical findings of this theses and Chiu *et al.,* (2006)'s conceptual framework were similar.

Additional LISREL assessment between variables of SCT and knowledge sharing quality, during the absence of DM quality (Figure 6.1) proves that trust, shared language and shared vision are positively significant with knowledge sharing quality, while social interaction ties, norms of reciprocity and identification are insignificant with knowledge sharing quality. One possible explanation for reciprocity not being significant with knowledge sharing quality is that reciprocity cannot predict knowledge contribution within a VC (Chang & Chuang, 2011). This additional LISREL assessment (i.e. relationship between SCT and knowledge sharing quality while DM was controlled) expressed similar empirical results to the assessment of SCT and knowledge sharing quality in the presence of DM (conceptual framework in Figure 6.1) and to Chiu *et al.,* (2006)'s conceptual framework that assessed SCT, SCoT, knowledge sharing quality and knowledge sharing quality quantity.

The additional LISREL test showed that the similar empirical results between the conceptual framework of this thesis and the conceptual framework of Chiu *et al.,* (2006) did not occur by chance. During the additional LISREAL assessment, when DM quality was controlled, the relationship between SCT and knowledge sharing quality expressed: (1) a significant relationship between the dependant variable (knowledge sharing quality) and dependant variables (trust, shared language and shared vision) and (2) an insignificant relationship between the dependant variable (knowledge sharing quality) and dependant variables (social interaction ties, norms of reciprocity and identification). Just as how the researcher controlled DM quality during the additional a LISREL assessment and no change in the relationship between SCT and knowledge sharing quality, Chiu *et al.,* (2006)'s structural framework also expressed the relationship between SCT and knowledge sharing quality with various other earlier-mentioned

variables. Hence, even though other variables influenced SCT variables and knowledge sharing quality, they could not have negatively influenced SCT and knowledge sharing quality since both the researcher of this thesis and Chiu *et al.,* (2006) in their study performed CFA (where variables are assessed for factor loadings - as expressed in this thesis's previous chapter).

In the Chang and Chuang's structural framework (2011), the following variables were assessed: all variables of SCT except shared vision, knowledge sharing quality, knowledge sharing quantity and individual motivation. This study reported that social interaction ties, trust, norms of reciprocity, identification and shared language are positively significant with knowledge sharing quality. Upon comparing empirical findings of this Chiu *et al.,* (2006) with the structural model of Figure 6.1, only trust and shared language were positively significant with knowledge sharing quality in both studies. In this thesis, the relationship between social interaction ties, norms of reciprocity and identification were insignificant in relation with knowledge sharing quality during the presence of DM (as depicted in Figure 6.1). When DM was removed, as depicted in 6.1, social interaction ties, norms of reciprocity and identification also remained insignificant. Chang and Chuang quantitatively assessed the structural framework using an online survey using 282 VC member participants. Upon deeper analysis of Chang and Chuang's structural framework, the researcher has concluded that variances in empirical results.

The settings of both studies, i.e. Chang and Chuang, (2011)'s structural framework versus this thesis's structural model assessed SCT and knowledge sharing quality, Figure 6.1 – in the presence of DM and when DM was controlled. Both of these studies utilized an online survey targeting VC members. As per the researcher's observation there seems to be no reason why empirical results should vary, especially given that results in this thesis and in Chiu *et al.* (2006) were similar. Hence, a deeper observation was conducted over Chiu *et al.* and of Chang and Chuang data analysis procedure. After Chiu *et al.* performed data collection, data analysis began by assessing the measurement modeling using CFA followed by assessing their structural model with SEM, similarly to the procedure applied in this thesis. However, Chang and Chuang assessed the relational model via CFA followed by multiple regression analysis. This is one possible explanation why different results were obtained. One study (Chang & Chuang, 2011) that compared multiple regression with SEM stated that: (1) multiple regression is an inconvenient statistical procedure representing or assessing hypothesis and (2) SEM includes multiple statistics procedures such as multiple regression, ANOVA, etc. On the one hand, one explanation why empirical evidence in Chiu *et al.* (2006) and this thesis were similar lies in the data analysis technique. On the other hand, Chang and Chuang, (2011) followed a different data analysis technique, which is why their empirical evidence varied.

There were other studies that advocated a positively significant relationship between social interaction ties and knowledge sharing quality (Robertson, 2011; Tarn, Wen, & Shih, 2008; Mascia & Cicchetti, 2011); consequenlty, they were not support by the empirical evidence of this thesis. Robertson (2011) published a literary review paper, where he reported that VCs are utilized for knowledge transfer through interactions. Yet, Robertson's assessment was not supported by the empirically findings of this thesis where knowledge sharing quality and DM model, social interaction ties and knowledge sharing quality play an insignificant role. Another study (Tarn, Wen and Shih, 2008) theoretically supported a relationship between social interaction ties and knowledge sharing quality. The authors assessed man made system disasters to improve disaster control systems. They concluded that such a system can be implemented on a VC platform since social interaction ties support intelligence process for knowledge sharing quality.

Again, the empirical findings of this study were only able to prove whether this proposed solution was supported or not. Furthermore, Mascia & Cicchetti (2011) explored the role of physicians' professional networks to help physicians adapt EBM DM process. Data analysis from 207 physician survey participants empirically proved a relationship between SC and DM. However, this study suggested that physics' network ties facilitate evidence-based knowledge transfer. Empirical evidence of this thesis suggested an insignificant relationship between social interaction ties and knowledge sharing quality in the presence of DM and in the absence of DM, (Figure 6.1). Hence, this empirical finding adds empirical and practical value to the findings of Mascia & Cicchetti (2011). One explanation why empirical findings of this thesis suggested an insignificant role of social interaction ties on knowledge sharing quality was due to the presence of DM, i.e. when physician utilize a VC for DM, social interaction ties play a significant role on knowledge sharing quality, as depicted in Figure 6.1.

However, when an additional LISREL test was performed, the relationship between social interaction ties and knowledge sharing quality, in the absence of DM (Figure 6.1), the path coefficient between social interaction ties and knowledge sharing quality lowered from 0.08 to 0.06. Hence, these empirical findings suggest that physicians do not interact to share knowledge when making a decision in a group. However, they could be interested in creating new knowledge through their interactions (Magnier-Watanabe *et al*., 2010) when DM in a VC. Austin (2003) suggested a positive affiliation between identification and knowledge sharing quality. This empirical assessment of this thesis did not explore the relationship between identification and knowledge sharing quality but the relationship between experts' identification of skills when DM and the positive affiliation between identification and knowledge sharing quality was

based on reputation of experts' rated skills within a network. Austin's study was, however, helpful in showing that identification facilitates knowledge sharing quality. Nonetheless, the empirical finings in this thesis confirm that one expert can identify another expert and hence, identification facilitates DM but the fact that one expert identifies skills of another expert does not necessarily support knowledge sharing quality. One explanation is that by identifying who can help you to share knowledge does not necessarily help you in sharing knowledge.

6.2.3 DISCUSSING THE EMPIRICAL RESULTS OF KNOWLEDGE SHARING → MEDICAL DECISION MAKING RELATIONSHIP

Even though the positive significance between knowledge sharing quality and medical DM quality was similar to the empirical results shared by Lin & Chang (2008); the findings of this thesis are a new knowledge contribution. The rationale behind this statement is that since the conceptual framework of Lin & Chang (2008) assessed the role of factors influencing medical knowledge sharing → medical knowledge sharing (explicit and implicit knowledge) → medical DM quality. Hence, the conceptual model of Lin & Chang (2008) differs from the model of this thesis. These empirical findings are in agreement with: (1) the study of Rantapuska & Ihanainen (2008) that focused on the application of knowledge when making ICT investment decisions and (2) a study of Roberts (2006) and Lin (2008) that focused on the importance of knowledge sharing to facilitate DM. The empirical result confirms that knowledge-shared DM is closest to this research's scope; especially when the empirical evidence suggests that knowledge sharing quality significantly and positively facilitates medical DM quality. This statement was also previously mentioned in chapter Two. As a result, this empirical evidence suggesting that knowledge sharing quality facilitates medical DM quality encourages future research on clinical DM and diagnostic errors (Berner, 2009).

6.2.4 DISCUSSING THE EMPIRICAL RESULTS OF THE MEDIATING ROLE OF KNOWLEDGE SHARING BETWEEN SOCIAL CAPITAL THEORY → DECISION MAKING

The assessment of the mediating role of knowledge sharing between physicians' SC and medical DM quality sheds a new light on. To begin with, the simple regressions between independent variables of SCT and (1) medical DM and (2) knowledge sharing quality all indicated positive relations. However, the overall model (Figure 6.1) showed a few insignificant relationships. The difference in these results, between simple regression models and the overall model, is in line with Kline's findings (2005) that all

variables with a structural model are related with one another due to their covariance with each other. The assessment of relations between two variables, whether significant or insignificant, are based on the model in which they are empirically assessed, was correct. In addition, the mediating role of knowledge sharing showed positive relations between all independent variables and DM quality.

Such results prove a solid role of knowledge sharing quality and support other studies that advocated its importance as a mediator (Kline, 2005). DM is based on experiential knowledge (Rantapuska & Ihanainen, 2008) where information should be framed to facilitate DM (Levin, Snyder, & Chapman, 1988). The knowledge is mediated around human SC of DM so it can be utilized effectively for DM (Rantapuska & Ihanainen, 2008) within a VC, with SC as a prerequisite for knowledge sharing (Huysman & Wulf, 2006). The mediating role of knowledge sharing is also an evidence of physician-patient DM (Rantapuska & Ihanainen, 2008).

Further LISREL analyses added clarity to the mediating role of knowledge sharing quality between physicians' SC and their medical DM quality when knowledge sharing quality was controlled in the overall model of Figure 6.1. When knowledge sharing quality was controlled, the independent variables, which were insignificant with medical DM quality, were not the same as the insignificant variables in the overall model. In the overall model, the insignificant independent variables with regards to DM quality, were social interaction ties, norms of reciprocity shared language and shared vision. However, this pattern differed when knowledge sharing quality was controlled. The insignificant independent variables then were social interaction ties, norms of reciprocity and shared language. Such observed changes signify the presence of the mediating role of knowledge sharing quality between physicians' SC and medical DM quality.

6.3 MODIFIED CONCEPTUAL FRAMEWORK

Similarly to Schaufeli (2008), the outcome of performing SEM is a marginally revised (i.e. modified) version of the hypothesized model. This study also performed CFA followed by SEM, where the outcome of SEM was a revealed modified model composed of the SCT's independent variables (social interaction ties, trust, norm of reciprocity, identification, shared language and shared vision), mediating variable (knowledge sharing quality) and dependant variable (medical DM quality) best fit for the collected data of this thesis study. This overall structural model (Figure 6.1) is the modified framework after completing data analysis techniques, i.e. CFA followed by SEM, to systematically make amendments to propose a fit structural model. During the data analysis phase, further LISREL analyses were performed to re-assess

this overall model. At this stage social interaction ties and norms of reciprocity were eliminated, as these two variables were insignificant in relation to the mediating variable (knowledge sharing quality) and the dependant variable (medical DM quality). At this stage, when the model was re-assessed using SEM fitness indices, the RMSEA of this new experimental model was 0.08. As a result, this index of fitness was higher than the RMSEA of the overall model (Figure 6.1), i.e. 0.068. Such further LISREL analysis proved that removing insignificant variables made no improvements. As per the researcher's observations, removal of these insignificant variables made the overall model less fit. In conclusion, the overall model is the best form of an empirically evidenced modified conceptual framework.

6.4 ADDRESSING THE THESIS'S RESEARCH PROBLEM

This PhD study aimed at assessing how effective physician VCs are at facilitating medical DM and how effective is physicians' knowledge sharing quality within such VCs to facilitate medical DM quality. As described in the previous section, the relationships between physicians' SC and medical DM quality bear positively significant relationships due to identification and shared vision. In addition, identification and shared vision significantly support physicians' SC and, as a result, significantly and positively affect knowledge sharing through which SC significantly and positively improves medical DM quality in a VCoP environment. In this scenario empirical evidence suggested that identification expressed partial mediation, while shared vision expressed full mediation. Henceforth, this thesis was able to assess the effectiveness of VCs on medical DM quality. Its empirical evidence suggested VCs facilitate medical DM quality in the absence and presence of knowledge sharing in a VC. Hence, this thesis empirically suggested that VCs facilitate medical DM quality. Table 6.1 presents the critique that facilitated generating the research gap. In addition, there are:

1. ***Cited research challenges related to tacit knowledge sharing*** **-** There are challenges in tacit knowledge sharing mentioned by the literature (Bates & Robert, 2002). For instance, even though language facilitates knowledge sharing, this factor does not apply to tacit knowledge sharing (Antonio & Lemos, 2010).

    a. ***Solution presented by this thesis*** **-** This thesis empirical assessment of the relationship between physician's SC and knowledge sharing quality is depicted in Figure 6.1. Empirical findings facilitated the researcher attaining a deeper understanding of tacit knowledge sharing within a VC environment and, as a result, understanding what role language plays when sharing knowledge. Findings suggested that shared language plays a

significant role during knowledge sharing. One study (Widén-Wulff & Ginman, 2004) suggested a need to assess the relation between information behaviour and SC. This thesis's empirical analysis went one step ahead of Widén-Wulff & Ginman (2004) and assessed knowledge and KM.

i. ***New Opportunities 1a -*** Even though other studies had empirically assessed the relationship between SCT and knowledge sharing quality, the researcher found that only a few studies assess SCT and knowledge sharing in a VC environment for physicians only. The empirical assessment of SCT and knowledge sharing for physicians narrows a gap in research given limited literature on evaluating and implementing KM in the public sector (Bate & Robert, 2002). By empirically assessing physicians' SC and knowledge sharing, this thesis assessed SC knowledge sharing, which is one of the KM processes. However, the need for implementation of this relationship (SCT and knowledge in a HC environment) is yet required, considering that Willis *et al.* (2010) mentioned that little research exists in clinical domain concerning knowledge transfer.

2. ***Cited Research Challenge related to knowledge sharing in affiliation with Decision Making –*** The researcher presented three categories during this part of the research.

a. ***Research Challenge related to knowledge sharing -*** There is a scarcity of means for practitioners' knowledge sharing behaviour for DM. Hence, it is necessary to develop means for decision-makers to communicate (Hancock & Durham, 2007) since DM requires good theoretical knowledge. Here, knowledge, experience, context, power, responsibility and the individual are all considered when making a decision (Hancock & Durham, 2007).

b. ***Cited Research Challenge related to KM and HC Topic -*** In addition, current research failed to analyse the effectiveness of KM tools on HC topics (Nicolini *et al.,* 2008) especially since diagnostics is proven failure and DM is an invisible process (Croskerry, & Nimmo, 2011).

c. Solution presented by this thesis - This thesis assessed knowledge sharing quality with DM quality, in the presence of physicians' SC. Empirical findings, as depicted in Figure

6.1, evidenced a positive and significant role between knowledge sharing and DM. The researcher agrees with Hancock and Durham (2007) since he also witnessed lacking published literature, which would show a direct correlation between knowledge sharing quality and DM. This study facilitated assessing empirically physicians SC on knowledge sharing to improve DM, so that physicians' SC, in a VC environment would empirically test a VC as a KM tool and DM as a HC topic.

i. ***New Opportunities 2a –*** The empirical findings, which related knowledge sharing and DM in the presence of physicians' SC, facilitate further opportunities to explore performance issues. Considering that there is HC information overload, this situation requires information rich VCs to transform to knowledge rich mechanisms VCs (Bate & Robert, 2002) to improve medical DM (Oinas-Kukkonen *et al.,* 2010; Mansingh *et al.,* 2009) and hence, reduce medical errors (Willis *et al.,* 2010).

ii. ***New Opportunities 2b -*** Considering that research fell short in assessing KM and DM process (Nicolas, 2004), the researcher believes that since this thesis is one of the few studies that empirically assessed knowledge sharing and DM, future research can consider Croskerry and Nimmo's (2011) comment that diagnostics is a failure and DM is an invisible process to why it is so and how DM can improve diagnostic. Since this thesis was able to empirically evidence that HC VCs are effective for medical DM, this constitutes a future research opportunity. In addition, future research can assess the relation between DM and performance since performance outcome tracing is a pre-requisite for building KM know-how (Perrott, 2008) and for building KM infrastructure to sustain tacit knowledge mobilization (Frid, 2000).

iii. ***New Opportunities 2c -*** Clinical DM is a choice-making process based on the alternatives within a given situation, where information is processed in a situational analysis using evidence and practice. In this case, action is rational and logical (Hancock & Durham, 2007). By empirically testing how effective physician's VCs are on their medical DM quality, this thesis has also opened doors for further analysis in the area of clinical DM. Ample DM takes place during a diagnostic process where poor decisions cascade to poor

recommendations (Ismael, 2009). Rationally making clinical decisions, based on scientific evidence and clinical experience (Puschner *et al.,* 2010), should be looked into in parallel with the under-researched decision theories, such as social judgment theory, information processing, etc, can be further looked into to examine what constitutes into a clinical decision quality (Demiris, 2006).

iv. ***New Opportunities 2d*** **-** Treatment DM can become shared DM where both, patient and doctor, decide while informed DM is where a patient decides on a treatment (Puschner *et al.,* 2010). Now that the researcher generalized the findings on SM's US physicians, future research can look beyond shared DM with both patients and physicians as participants.

3. ***Cited Research Challenge related to the mediating role of Knowledge Sharing between Physicians' Social Capital and Medical Decision Making*** **-** Knowledge sharing mediating role, between SC and DM, is an under researched area (Magnier-Watanabe *et al.,* 2010).

   a. ***Solution presented by this thesis*** **-** While this thesis assessed the role of SCT, knowledge sharing and DM, the mediating role of knowledge sharing was also assessed (Figure 5.3 – 5.8 and Table 5.8 to 5.13 in Chapter Five). Empirical findings narrowed the research gap that stated that there is a lack in research assessing the mediating role of knowledge sharing between SC and DM (Magnier-Watanabe *et al.,* 2010).

      i. ***New Opportunities 3a*** **–** Considering that new knowledge is only created during knowledge sharing for making decision (Mansingh *et al.,* 2009) and that there is minor published research/attention on VCoP's impact on intangible learning (Short *et al.,* 2010), there exists future opportunity to assess knowledge creation and intangible learning to support the views of Mansingh *et al.* (2009) and Short *et al.,* (2010).

6.4.1 CRITICAL EVALUATION OF THIS THESIS'S APPLIED RESEARCH APPROACH

The researcher critically evaluates the adopted methodology by evaluating the research approach, strategy and choice:

1. ***Evaluating the research approach*** - Initially when this research study began, the researcher sought to conduct HC and KM research. Consequently, the research to reviewed ample literature, identified a research gap, formulated a conceptual framework and identified four hypotheses. Such a top-down researching approach, i.e. reviewing literature to identify a research gap in order to formulate a conceptual framework (Creswell, 2002), suggests this thesis could only be conducted using a deductive research approach where theory development leads to hypotheses rather than the opposite i.e. inductive approach, where little literature exists since the research topic is new, hence requires data collection and analysis for theory development (Sanders, Lewis & Thornhill, 2009). In addition, Sanders, Lewis and Thornhill (2009) also recomended that if a research project lacks time, then a deductive approach is better since it is a low risk approach. This research was initiated in 2009 and ought to be completed within a four year time framework. On the other hand, inductive approach may be more risky and time consuming since there is no guarantee a theory will be formed as an outcome of the collected data.

2. ***Evaluating the research strategy*** - The choice for research strategy is guided by the research question (Sanders, Lewis & Thornhill, 2009). In accordance with this statement, this study expressed two "what" type questions, therefore applied an adapted survey. This study could have been alternatively based on a case study, making it an empirical investigation of a live phenomenon. A case study is better suited than a survey in exploring a context more in-depth, hence it may contribute to challenging the existing theory and furbish new research questions (Sanders, Lewis & Thornhill, 2009).. In addition, case study is able to generate answers to "what", "how" and "why" type research questions. In the future, a case study can add value to the empirical findings of this thesis considering that this thesis contributed its empirical findings, some of which supported while other did not support various associated theories mentioned in the Chapter 2 and 3 and discussed in this Chapter.

3. ***Evaluating the choice*** - This study utilized a mono method, since it applied a single data collection technique, i.e. a questionnaire instrument for collecting data and statistical analysis. Alternatively this study could have applied a qualitative method, i.e. interviewing for data

collection and performed data analysis techniques, for example data categorization for non-numerical data. This study could have also applied a mixed method. A mixed method unites qualitative and quantitative technique for collecting data in parallel or one after another (Sanders, Lewis & Thornhill, 2009). This study could have followed its empirical findings with a qualitative technique, simply to facilitate greater confidence in this study's conclusions (Sanders, Lewis & Thornhill, 2009).

6.5 SUMMARY

The aim of this chapter was to weigh the empirical evidence of the data analysis, using various supported and non-supported theories critiqued in Chapter Two and Chapter Three. To analyse why certain theories were supported or non-supported, further in-depth literature review was systematically conducted by comparing literature reviews, research methodologies, data analysis techniques and findings with this thesis, in order to provide possible explanations of the theories were supported or not by this thesis's empirical findings.

Next, this thesis justified why the researcher believes that the research gap was narrowed. Consequently, the researcher pinpointed three new venues for future research. Finally, further LISREL analysis confirmed that the overall structural model, depicted in Figure 6.1, was the final modified structural model. This conclusion was based on the findings of the comparison made between fitness indicators (RMSEA) of Figure 6.1's overall structural model and that of an alternative structural model, in which empirically evidenced insignificant relationships were removed.

CHAPTER 7: CONCLUSION

7.1 INTRODUCTOIN

Chapter Six pinpointed the studies that were supported and those that were not supported by the empirical findings in Chapter Five. The determined findings systematically described in Chapter Five were critiqued in Chapter Six to explain why they differed from or were in accordance with the empirical findings and hence, with the main hypotheses and sub-hypotheses of this thesis. This chapter concludes this study. In section 7.2 the researcher presented a research overview to highlight what led him to this study followed by a summary of the purpose and outcomes of each of the seven chapters of this thesis. Section 7.3 explains how this study met its research aims and objectives. Section 7.4 lists and describes the eight findings of this study and its contributions to research.

7.2 RESEARCH OVERVIEW

This thesis began by establishing and describing the research problem in Chapter One. The research problem, which was driven from the narrative of the published literature, stated that rising rates in patients' mortality have led to rising patient dissatisfaction, hindering healthcare (HC) quality. The cause of such a phenomenon is diagnostic errors, which lead to incorrect medical decisions. Hence, physicians' poor medical DM hampers HC service quality. Previous initiatives promising better HC outcomes, such as electronic health records (EHR), fell short. At this stage, this research began to explore the field of knowledge management (KM) in order to assess how its infrastructure and architecture could facilitate the improvement of HC quality. Past literature has indicated the need for assessing the effectiveness of knowledge management (KM) tool on a HC research topic; considering that research lacks empirical assessment in this area. This study considered KM tools as physicians' virtual community of practice (VCoP) and a HC research topic as medical decision making (DM) quality. From this point onwards, this study began a thorough review of literature, with first priority given to reviewing journal articles.

In order to meet the aims of research objectives, Chapter Two described a critiqued literature review to systematically analyse the literature indicating the following:

1. Diagnostic errors have negatively affected HC quality. Consequently, the researcher scrutinized the role of physicians' medical DM quality; hence medical decision making (DM) quality, which became one of a research topic of this study. This study described: (1) various DM theories, (2) the level of medical DM quality and (2) various DM types portrayed in the reviewed literature such as clinical DM, treatment DM, informed DM, etc.

2. The KM research area, i.e. KM processes, for example, knowledge sharing, knowledge creation, etc. and KM tools, for example, EHR, VCoP, etc. At this stage knowledge sharing quality became another research topic under investigation in this study.

3. The assessment of social computing and VCoP using social science theories like Social Capital Theory (SCT), Honeycomb framework, 21 Structuring Characteristics framework, were the main research factors under investigation.

4. Literature driven and systematically critiqued research gap: i.e. assessing the effectiveness of KM tool (physician's VCoP) on a HC research topic (medical DM quality) was pinpointed.

Chapter Three met another goal and objective of this study: the development of a conceptual framework. This goal was achieved by performing a deeper critique of theory, and allowed the researcher to pinpoint the research problem. The conceptual framework was based on 4 hypotheses (described in Section 3.2.1, 3.2.2. and 3.3) that were supported by 6 sub-hypotheses for each of the hypotheses, hypothesis 1 (Section 3.4) and hypothesis 2 (Section 3.5), i.e. a total of 12 sub-hypotheses. The conceptual framework describes the relation between physicians' SCT, knowledge sharing quality and medical DM quality. In addition, it is important to note that not only HC-related theory drove the literature review in Chapter Two and Chapter Three but various other theories pertaining to other industrial/business sectors were used, for example, marketing, banking, etc.

Chapter Four met another research goal and objective. This chapter specified the research methodology by outlining the research approach, methodology and design. The stance of this research is positivist and the research employed a quantitative method. The adopted research strategy was a non-experimental online survey conducted in SurveyMonkey (SM) online US

physicians' VCoP. Table 4.1 of Chapter Four depicts the types of research approaches preferred by justifying the choices made by the researcher. The research methodology was justified based on the similarities of research method patterns observed in four core studies from which this study's survey instrument was adapted. This chapter laid out the research context, i.e. empirical testing of the impact of physicians' VC on their medical DM quality; in addition to assessing the mediating role of physicians' knowledge sharing quality between physicians' SC and their medical DM quality. In order for this study to assess the impact of VCs on medical DM quality, the researcher needed to determine what framework would facilitate the description and the evaluation of social media platform, i.e. professional VCs. Henceforth, the Honeycomb framework was established as a benchmarking tool for evaluating VCs, similarly to Kietzmann *et al.* (2011) who applied the Honeycomb framework to examine Facebook and LinkedIn. In addition, 21 Structuring Characteristics framework was utilized to assess VCs. These two frameworks were, in case of the Honeycomb framework, directly applied and, in case of the 21 Structuring Characteristics framework, customized to fit the needs and context of this study before it was implemented. When these frameworks were implemented the rationale behind their utilizations was as follows:

1. Honeycomb framework would assist the researcher to pinpoint appropriate social media platforms.
2. Based upon the Honeycomb framework, the 21 Structuring Characteristics framework would assist the researcher to pinpoint an appropriate physicians' VC

An appropriate VC was selected to establish an organizational setting, i.e. SM. At this stage sample size was calculated as advised by published literature so that the analysed data could be generalised over the SM VC physicians' population. At this stage, this study, described: (1) the adapted survey instruments and (2) pilot study process, i.e. preliminary pilot testing (n = 10 non-physician academic Ph.D. holder participants), and pilot testing (n=31 physicians who were members of "*plastic_surgery yahoo group*" VC) for assessing the clarity, reliability and validity of this study's survey instrument. After presenting pilot study results, online data collection process was presented. The research methodology of Chapter Four was subsequently applied in Chapter Five, which described the process and the results of the data analysis. Initially, Chapter Five described how missing data was treated followed by the analysis and the application of two data analysis techniques to assess survey instrument's reliability and validity.

Various studies were critiqued during the data analysis process during which the researcher implemented CFA and then SEM. Final CFA model was depicted in Figure 5.1 and the overall fit structural model was depicted in Figure 5.9. Second part of this chapter highlighted the four hypotheses test results. Empirical findings confirmed reliability and validity of the survey instrument and also confirmed that physicians' VCs are effective towards medical DM quality and that knowledge sharing quality plays a positively significant role between physicians' SC and medical DM quality. In Chapter Six, causes and consequences of this study's empirical findings were discussed in light of the empirical findings presented in Chapter Five. In addition, Chapter Six highlighted future research that can build upon the empirical findings of this study. This chapter, too, fulfilled one of the research aims and objectives.

7.3 MEETING THE AIM AND OBJECTIVES OF THIS THESIS

The goals and objectives were defined in Chapter One in order to establish a road map to answer this thesis's research questions and hence, complete this doctorial study. These six objectives are summarized in Table 7.1, which pinpoints in addition what chapters facilitated achieving a specific objective.

- ***Research Aim***: to investigate (1) the effect of physicians' SC, aiding VC participation, on their DM quality and (2) the mediating role of physicians' knowledge sharing quality between their SC and DM quality.
- ***Research Questions 1***: to answer the question - What is the extent of the effect of physicians' SC on their DM quality in a VCoP environment and through what ways?
- ***Research Question 2***: to answer the question - What is the extent of the effect of physicians' knowledge sharing quality within the relationship between physicians' SC and their DM quality, within a VCoP environment?

The first objective (presented in Chapter Two) was to critically review the existing VCoP, KM and DM literature in order to understand associated social science theories with a particular focus on the HC sector, and subsequently to identify the existing knowledge and to pinpoint a gap in research. The second objective (in Chapter Three) was to investigate and critically evaluate influencing factors of the SCT, associated with VCoP, in relation to the mediating role of knowledge sharing quality between SCT and medical DM quality and to develop and propose a conceptual framework to assess the effectiveness of a VCoP on medical DM quality mediated by

knowledge sharing quality. The objective three (in Chapter Four and Five) was to test and evaluate the conceptual framework by first defining an appropriate research approach followed by implementing the research methodology by collecting and analysing data and then discussing the empirical findings. The objective four (in Chapter Six) was to refine and finalize the Conceptual Framework to provide a novel contribution to the domain of HC VCoP, knowledge sharing and medical DM.

7.4 MAIN FINDINGS AND CONTRIBUTIONS OF THIS THESIS

The overall findings of this thesis led to various contributions based on the contextual information presented in Chapter One, Two and Three, the research methodology described in Chapter Four, data analysis procedure and empirical findings in Chapter Five and the discussions in Chapter Six, which are as follows.

- ***Findings 1, 2 and 3 - Literature review to identify the research gap and the initial conceptual framework.***

  Finding 1: The critique of the current literature led to the establishment of various research gaps. More research is required, among others, to empirically assess KM tools in a HC research topic. This research gap was significant since research has not quantitatively assessed VCs and HC performance where VCs KM tools and HC performance is medical DM. While understanding the DM research area, the DM model (Figure 2.2) allowed the researcher to pinpoint a fine relationship between information and knowledge. Since information is related to knowledge, the researcher was able to critique a relation between knowledge and DM when classifying knowledge-shared DM (portrayed in Table 2.2). Medical DM quality improvement helps reducing medical errors. This finding led the researcher to define the research aim – i.e. to assess the effect of physicians' SC on medical DM quality in a VC environment.

  Finding 2: A literature review focused on SCT, led to understanding the importance of knowledge sharing for VC's SC. The researcher identified an association between SCT and VC, since SCT describes a network of relations in a VC, A further literature review of SCT, knowledge sharing and DM, led the researcher to discover the importance of

knowledge sharing as a mediator between SCT and medical DM, since such mediating role; between SCT and DM, is an under researched area.

Finding 3: Additional literature review, on and relates SCT, DM and knowledge sharing quality, led the researcher to identify factors and measures reflecting SCT, knowledge sharing quality and medical DM quality.

- ***Contribution 1 from findings 1, 2 and 3:*** The researcher was able to formulate an integrated conceptual framework (presented in Chapter Three) whose four hypotheses (assessing the relationship between SCT and medical DM, SCT and knowledge sharing, knowledge sharing and DM and the mediating role of knowledge sharing between SCT and medical DM) were empirically tested with the empirical evidence supporting all these hypotheses (presented in Chapter Four). As per the researcher's knowledge, no other research has so far attempted to assess this research gap or empirically tested this study's conceptual framework. Based on the empirical findings, this study discovered various insignificant relationships; mentioned in Chapter Five's Figure 5.9, i.e.(→ is relational path):

  1. Social interaction ties (SIT) → DM quality, NoR → DM quality, SL → DM quality and SV → DM quality and
  2. SIT → KS quality, NoR → KS quality and ID → KS quality,

  Various theories, described in Chapter Two and Three, were either supported or not supported by the empirical findings. The researcher performed a comparative analysis between different theories, then data collection and data analysis procedure to explain why these theories were/were not supported by the empirical findings of this thesis.

  The integration of (1) the SCT and knowledge sharing quality with (2) medical DM quality, is also a contribution that can be viewed beyond the HC context and such a framework is viable for: (1) data analyses similar to the context of this thesis in other business sectors or (2) empirical testing of this thesis's conceptual

framework using qualitative semi-structured interviewing of HC professionals and other VC member stake holders in other business areas.

- ***Finding 4 - Identifying appropriate VC and its associated social media platform:*** To test the conceptual framework, the researcher critiqued various research methodology papers and published literature to classify and formulate a research methodology. To test the conceptual framework, the researcher needed to perform data collection in a VC. Through the literature review, the researcher identified two frameworks (Honeycomb framework and 21 Structuring Characteristics framework). Honeycomb Framework was applied by critiquing its supporting theory with this thesis's scope (i.e. physicians - closed groups) and context (i.e. HC VCs) to formulate a Honeycomb Framework for professional VCs.

    - ***Contribution 2 from findings 4:*** Based on the fourth finding Honeycomb framework, the researcher pinpointed four social media platforms for VCs (LinkedIn, Facebook, List Servs and physicians' professional VCs). 5 Structuring Characteristics adopted from the 21 Structuring Characteristics framework were applied to these four social media platforms. As a result, 51 VCs that best suit the scope and context of this thesis were pinpointed (29 physicians' VC from LinkedIn VCs, 9 physicians; VCs from Facebook VCs, 5 physicians' VCs from List Serv VCs and 8 physicians' VCs from professional VCs) – depicted in Table 2.5. Hence, there are multiple donations to contribution 2:
        - Honeycomb framework and 21 Structuring Characteristics framework were identified from a literature review followed by
        - their application and customization to pinpoint four social media platforms and
        - 51 VCs on the four social media platforms.

    This thesis offers an additional contribution even to the 21 Structuring Characteristics framework. The constraints of this study led the researcher to customize the 21 Structuring Characteristics framework to 5 Structuring Characteristics framework. Consequently, other scholars could apply the other structuring elements of the 21 Structuring Characteristics framework to pinpoint

other VCs in business sectors and this compares their empirical findings with the empirical findings of this study.

- ***Contribution 3 from findings 4:*** First, 51 VCs were pinpointed based on the Honeycomb framework and the 5 Structuring Characteristics framework. Second, out of the pinpointed 51 VCs (Table 2.5), this study's research approach was applied to SM's physicians VC. This two-step action was followed by the researcher collecting data within SM physicians' VC. These three steps are also a methodological contribution. This methodological contribution can also be re-assessed using various other research design strategies such as qualitative interviewing within a specific case study.

- ***Finding 5 – Empirical evidences from quantitative assessment of the conceptual framework.***

  Upon making the second contribution, i.e. pinpointing appropriate research approach for this thesis and identifying 51 VC based on the 2 customized frameworks mentioned before, the conceptual framework was quantitatively assessed using an online survey, which was distributed to physicians of SurveyMoonkey VC. SurveyMonkey is one of the identified VCs pinpointed using the customized 5 Structuring Characteristics framework. This empirical assessment confirmed that this thesis's four hypotheses were supported, however, not by all sub-hypotheses (details of empirical assessment and hypotheses and sub-hypotheses testing are described in Chapter Five).

  - ***Contribution 4 from finding 5:*** Based on the fifth finding, the researcher empirically assessed the conceptual framework, various theories, described in Chapter Two and Three. The theories that were not/supported by the empirical findings of this thesis were discussed in Chapter Six. Such an analysis could also be conducted further if this study's conceptual framework is empirically tested in other business sectors or even if the target population, within the HC sector, changes from physicians to HC professionals.

- ***Finding 6 – Findings from the addition LISREL tests performed on the conceptual framework.***

  Upon making the fourth contribution, the researcher performed additional LISREL testing on this thesis's conceptual framework. The aim was to propose a modified conceptual framework. Nonetheless, this validation led the researcher to confirm that this study's structurally fit framework, depicted in Figure 5.9, is the best fit model for this study; still these additional LISREL tests, depicted in Figure 6.1, led the researcher to assess more path model relationships: (1) SCT and knowledge sharing quality in the absence of DM quality, (2) Knowledge sharing quality and DM quality in the absence of SCT and (2) SCT and DM quality in the absence of knowledge sharing quality.

  Contribution 5 from findings 6: The additional LISREL models, depicted in Figure 6.1, led the researcher to identify additional empirical results, thus adding value to the discussions in Chapter Six. The researcher discussed, among others, why certain relations in the overall structural model did not support their associated theory or findings mentioned in Chapter Two and Three.

7.5 RESEARCH ACHIEVEMENTS

This study has so far presented individual research findings and contributions made by the researcher. However, from a holistic point of view, this study aimed at assessing the effectiveness of physicians' VCs on their medical DM quality through knowledge sharing quality. This study performed all empirical assessments advisable by various studies and applied all techniques for data analysis recommended by relevant studies to test its conceptual framework. Testing this thesis's four hypotheses allowed the researcher to fulfil the research aim – assessing the effect of physicians' SC on medical DM quality in a VC environment.

7.6 RESEARCH IMPLICATIONS

In addition to the theoretical implication presented in Section 5.6.2, there are also practical implications of the findigs. The KM processes, facilitating organizations to compete (Hsia, Lin, Wu, & Tsai, 2006; Antonio & Lemos, 2010) require IT support infrastructure, for example, database, network, etc. (Rajesh, Pugazhendhi, & Ganesh, 2011), i.e. a pre-requisite for a KMS

(Mohamed, Stankosky & Mohamed, 2009). For practically implementing this thesis's structural model, HC requires a KM infrastructure provided through an IT infrastructure to sustain tacit knowledge mobilization (Frid, 2000).

Even though KM is central to the processes of HC, this sector still faces challenges; that reveals a need for the future HC research to focus on e-Health adaption, HC prevention, better understanding of HC KM adaption and implementation process, etc. Also globally, HC is molded to every nation's own culture and relies for problem solving on case based reasoning (CBR), i.e. reasoning from past experience and from old cases, stored in libraries (Khorasanil, Darab, Yarmohammadian & Afshari, 2012). These arguments provide evidence that the empirical findings from this study's structural framework, depicted in Figure 5.9, are contributions towards the improvement of the HC sector.

There is a need for a mechanism to provide participation incentives for creating and supporting VC knowledge. Such mechanisms can be harnessed to promote participation such as rewarding for participation, hence praising a participant's effort and performance (Chang & Chuang, 2011). Such a technological mechanism helps spread awareness and motivation amongst VC members where one knowledge seeking VC member could offer specific amount of reward points depending on the level of quality of the resource that was provided by another VC member (Huysman & Wulf, 2006).

Also, there is a need for leadership motivation considering that the findings of this study evidenced that trust facilitates knowledge sharing and DM within a VC. This supports the observation of Blue, Serva, Baroudi and Benamati (2009) who revealed that trust like any psychological benefit can only be attained when individuals interact fact-to-face and not through a computer-facilitated communication. Thus, leadership should motivate VC participation, a recommendation put forward also by Chang and Chuang (2011).

Limitation 1: From Chapter One till Chapter Six, this study presented the research starting with a combination of theoretical discussions, critical analysis of literature, and description of empirical analysis processes to a justification of this study's empirical findings. This study naturally carries certain limitations. To begin with, the first limitation is that the empirical findings can be generalised only over the physicians' population of the SM VC. Even though this study empirically assessed its literature driven conceptual model on a SM VC physicians; it is unclear if

the empirical evidence can be applied to other professional VCs. As a result, there are future opportunities for empirically testing this study's conceptual framework in other industrial organizations in order to gain a cross-disciplinary understanding of this framework. Furthermore, future research is needed to verify these findings over other populations of physicians, nationally or internationally, for example US physicians, UK physicians or European physicians, etc.

Limitation 2: While this thesis empirically assessed the mediating role of knowledge sharing between physicians' SC and their medical DM quality, this thesis did not assess the moderating role of knowledge sharing since that was not a requirement to answer this doctorial study's research questions. It would be interesting for future research to assess the moderating role of knowledge sharing between physicians' SC and medical DM quality.

Limitation 3: This study could have been affected by self-selection bias since the sample size was calculated based on the number of VC members of active VC participants. . It may be possible that inactive participants, who were not taken into account, could have had different opinions on VC's SC, but their opinions could not have been gathered. This study's empirical evidence is thus based on the current SM VC member physicians. Additional research could assist in a deeper investigation, possibly qualitative, to assess the root cause of the generalisations of empirical findings (as per the researcher's view, this would be possible by asking the why question) made by this study, in other words, future research could use why-type questions, in addition to the what-type research questions used in this study.

Limitation 4: Data collection was performed in a specific period of time, which means that data collection was cross-sectional. This type of data collection did not permit the researcher to investigate the time consuming phenomenon that could enhance this study's empirical findings on assessing the effect of SCT's factors on medical DM quality. Hence, in the future, the researcher should continue this investigation and establish an empirical research design where its conceptual framework is assessed longitudinally over the initial and long term use of a HC VC.

Limitation 5: Another limitation of this study stems from the time allotted to complete this research. As a result, the researcher answered the research questions by performing solely a quantitative analysis. This method satisfies the aim and answers the research questions of this study. Nonetheless, even though the researcher tested the hypotheses and successfully assessed the reliability and validity of the research instrument, a follow-up qualitative empirical

measurement could have provided more insight into further validation of the survey instrument. Still, this limitation was overcome by the size of the collected data and the research contributions provided by this thesis.

7.7 RECOMMENDATIONS FOR FUTURE RESEARCH

As stated in the previous chapter, the empirical assessment of this study opened doors to various opportunities for future research. Some of these opportunities were listed in the previous chapter. At this stage, the researcher takes the liberty to further critique and review literature to formulate a path and strategy that can be implemented for future research opportunities, with the HC sector as the main preference. Following are areas, which future research may follow-up:

- ***Future research area 1 - KM infrastructure*:** Similarly to how this study assessed SCT → KS quality → medical DM quality and SCT → DM quality; future study could also assess organizational structure and organizational culture. The rationale behind this recommendation is that SCT falls under the category of technical support services of KM infrastructure. The KM proposed framework is held on four pillars that aim at improving organizational processes i.e. collaboration and DM, performance and learning: (1) knowledge components, (2) KM processes, (3) information technology (IT) and (4) organizational aspects. Knowledge component defines the systemic epistemological perspectives (Rajesh, Pugazhendhi, & Ganesh, 2011). KM infrastructure is aided by: (1) technical support, (2) organizational culture and (3) organizational structure (Jie & Zhengang, 2010). Culture enables knowledge sharing (Ardichvili, 2008). Knowledge sharing has mediating effect between KM performance and KM infrastructure (Jie & Zhengang, 2010) where knowledge sharing facilitates medical DM since both tacit and explicit knowledge are compulsory for DM (Abidi, Yu-N, & Curran, 2005; Baskaran, Bali, Arochana, Naguib, Dwivedi, & Nassar, 2005). Organizational culture, residing at the cognitive level of an organizational structure, is critical in a VC to converge thoughts, ideas and participants' social behaviours. Culture is of three forms: (1) tangible values integrated to (2) practice to (3) intangible cognitive basic assumptions. These patterns are controlled by a common language and define how people think. Shared values and beliefs convert shared assumptions after successful organizational culture is encouraged in social processes supported by communication. Culture, in return, supports

communication. This is how organizational culture positively facilitates a VC (Huq, 2006).

As per the scope of this study; the research interests lay in the concept of socialization where tacit knowledge is shared, for example, sharing experiences (Ciccarese, Caffi, Quaglini, & Stefanelli, 2005; Nemati, Steiger, Iyer, & Herschel, 2002). Technical support is a KM system (KMS). Five components serve as pre-requisites for building a successful KM know-how: (1) CoP, (2) content management, (3) knowledge transfer, (4) performance outcome tracking and (5) technology infrastructure (Perrott, 2008). HC KMS infrastructure needs to be incorporated in this model. KMS is more than just a technology. It is composed of processes, tools and techniques with KM activities that operate through a comprehensive KMS framework. HC KMS is a new semantic trend that facilitates e-health ecosystem, i.e. a solution to the current HC information overload crises. This is possible through KM technologies and applications. These applications have better ability to assimilate and represent the cognitive dimensions of tacit knowledge. Such applications improve access and transfer of e-Health knowledge to all HC professionals at all levels (Hsia, Lin, Wu, & Tsai, 2006).

The KMS architecture model is based on three useful services (infrastructure, knowledge and presentation) facilitated by KM technologies. The infrastructure services establish an elementary technology for KM implementation based on storage – knowledge repository, for example data warehouse and knowledge server and communication, i.e. between users, collaboration among users and workflow management. Knowledge as a service is reinforced by technology solutions to encourage knowledge flow, generate new knowledge and warrant ease-of-access to knowledge repositories. As a result, new knowledge is created or discovered; refined, validated or new tacit knowledge is articulated. In addition, knowledge is also shared/transferred among organization members using technologies/KM tools like social networking analyses, also referred to as collaboration tools like social computing (an emerging research area) (Chua, 2004).

- ***Future research area 2 - KM processes:*** KM facilitates the process of turning data into information to get knowledge. KM processes allow the organization to improve itself and compete (Hsia, Lin, Wu, & Tsai, 2006). KM has become a tool to sustain an organization's competitive advantage (Antonio & Lemos, 2010). The KM process

involves acquisition, creation, filtrations, storing, sharing and exploiting of the available knowledge (Rajesh, Pugazhendhi, & Ganesh, 2011) is a pre-requisite for KM success and sustenance of development (Mohamed, Stankosky & Mohamed, 2009). As in the case of this research, HC organizational structure is: (1) the structure, (2) shared corporate culture, and (3) human resource management (Rajesh, Pugazhendhi, & Ganesh, 2011). To facilitate medical DM, building KM infrastructure is indispensable for sustaining tacit knowledge mobilization (Frid, 2000). There is minor published research/attention on VCoP's impact on intangible learning (Short *et al.,* 2010). Research lacks in VC knowledge collaboration to assess how collaboration breaks down in time to allow participants to contribute ideas in a dynamic VC environment. This is to understand how contributions unfold in time to examine why a participant even contributes. Such a research gap has not been studied from the point of view of the influence of knowledge collaboration but did so only from the point of view of sustainability of resources and network exchange mechanisms. Hence, fluidity, i.e. fundamental for a VC to facilitate knowledge collaboration has been understudied (Faraj *et al.,* 2011). This thesis has considered literature on knowledge collaboration, as it is essential to this research. However, knowledge sharing was given the main concern in this study since Faraj, Jarvenpaa and Majchrzak (2011) mentioned that recommendation and integration is the positive end of social disembodiment of ideas towards knowledge collaboration, the negative side is that idea can be miss-applied as it could be misunderstood.

- ***Future research area 3 – Leadership*:** Leadership plays a central role in KM processes (Bryant, 2003). Top management should administer the flow and restriction of information to employees of lower level to facilitate knowledge sharing whose enablers are ICT, culture and leadership. Trust is another enabler of knowledge sharing and is of two types: knowledge-based personal trust occurs by social interactions. Organizational trust is based organizational procedures and structure. Trust is best facilitated by both face-to-face and online interaction (Ardichvili, 2008). Leadership facilitates KM processes and KM infrastructure. Hence, it is a major prerequisite for this research for KM and medical DM quality improvement. Since communities have no reward systems to motivate knowledge sharing and motivation is important to sustain participation (Chang & Chuang, 2011), the role of leadership is necessary to investigate. Senior management contributes to a knowledge sharing environment during problem solving (Hick, Dattero & Galup, 2007). Leadership is of two types: (1) transactional and (2)

transformational (Bass, 1990). Leadership within an organization supports knowledge processes i.e. by rewarding employees who create new knowledge and share knowledge to improve organizational performance. This reward encourages an employee to progress effecting human capital benefits through such a KM process (Birasnav, Rangnekar, & Dalpati, 2009). Transactional leadership motivates knowledge application. Even though both types of leadership are required for effective KM; every individual tends to exhibit one form of leadership more than the other (Bryant, 2003). Within an organization's hierarchy, starting with the senior level, a culture climate is required within the work practice to holistically integrate a VC in daily work processes in an organization. Management can instigate trust towards a VC environment.

- ***Future research area 5 – Diagnostic Errors*:** More study is needed on clinical DM and diagnostic errors (Berner, 2009). Even though medical errors are common, research related to them is scarce (Wachter, 2010). Hence more research is needed on medical errors especially to assess if there are computerized tools to facilitate diagnostic errors (Wachter, 2010). This is due to the fact that medical errors: (1) are a poorly understood research area even though diagnostic errors are the main cause of medical errors (Singh, Naik, Rao, & Ann, 2007) and (2) cause patent deaths (Berner, 2009), (3) as a research area lack any empirical research to assess the impact of diagnostic medical errors on various factors and (4) as a research area have not established any mechanism to measure and promote physicians diagnostic skills. More than 17% of medical errors are diagnostic errors (Wachter, 2010). To tackle poor HC quality, US alone spends $2 trillion annually (Chernichovsky & Leibowitz, 2010; Pezzo & Pezzo, 2006). Research focused on patient safety type surfaced in 1999 and has examined medical error since 2007. In order to improve HC quality, it is important to know the basic origin for preventing diagnostic errors (Singh, Naik, Rao, & Ann, 2007). Diagnostic errors are:

    - ***Cognitive:*** i.e. faulty information, miss-interpreted findings or failure to consider alternative diagnosis for a finding,
    - ***System errors:*** like system technical malfunction or organizational failure or
    - ***Premature closure:*** conflicting information or faulty identification of findings that causes errors.

> Such errors are due to heuristics of memory based on similar case choices or attempting short cuts in reasoning. Future research should assess other variables (i.e. Increasing workload) on radiologist's performance and radiologists' diagnostic error count (Taylor, Voss, Melvin, & Graham, 2011). Besides delayed, missed or wrong diagnoses, communication breakdown is the main reason for medical errors. IT solutions help prevent communication breakdown between HC providers and patients. A main cause for diagnostic errors is clinical reasoning but yet research lacks in theory on cognitive DM processes to reach a diagnostic hypothesis (Singh, Naik, Rao, & Ann, 2007).

First, as stated in Chapter Two, research lacks in the area of DM, for example clinical DM, informed DM, shared DM, etc. In addition, future research can empirically assess various relations as depicted in Figure 7.1. In addition, future research should try identifying organizational processes that motivate successful development of VCs (Ranmuthugala *et al.*, 2011). This can be possible by using additional characteristics of the 21 Structural Characteristics framework.

REFERENCES:

Abidi, S. (2005). *Medical Knowledge Morphing: Towards Case-Specific Integration of Heterogeneous Medical Knowledge Resources. The 18th IEEE International Symposium on Computer-Based Medical Systems*. Dublin: In IEEE Press (Ed).

Abidi, S. S. R. (2008). Healthcare Knowledge Management: The Art of the Possible, Berlin Heidelberg, LNA12924: *Knowledge Management for Healthcare Procedures*, Doi: 10.1007/978-3-540-78624-5-_1, 1-21.

Abidi, S. S. R., Finleyb, A., Miliosa, E., Shepherda, M., & Zitnerb, D. (2004). Knowledge Management in Pediatric Pain: Mapping On-Line Expert Discussions to Medical Literature. Medinfo, 3(7), 3-7.

Abidi, S. S. R., Yu-N, C., & Curran, J. (2005). A Knowledge Creation Info-Structure to Acquire and Crystallize the Tacit Knowledge of Health-Care Experts. *IEEE Transactions on Information Technology in Biomedicine, Special Issue on Knowledge Management in Healthcare*, 9(2), pp. 193-204.

Abimbola, S. M. (2010). MDSNe - Medical Doctors Social *Networking*. Retrieved May 12, 2012, from MDSNe - Medical Doctors Social Networking: http://www.linkedin.com/groups?gid=3457609&trk=group-name

ACEP Membership. (2008). *American College of Emergency Physicians (ACEP).* Retrieved May 12, 2012, from American College of Emergency Physicians (ACEP): http://www.linkedin.com/groups?gid=51765&trk=group-name

Administrators in Medicine. (2012). Administrators in Medicine. Retrieved May 12, 2012, from Administrators in Medicine National Organization for State Medical And Osteooathic Board Executives: http://www.docboard.org/aim/

Ali Azali, R., Quaddus, M., & Xu, J. (2009). PUB-CBS-GSB-DRJ-53127 E1 verified, Influencing factors and the role of ICT on corporate sustainability in Bahrain's service industry: A field study approach. *Proceedings of the 10th international conference on social implications of computers in developing countries*, 55-68 October 2008, Dubai School of Government 2009, Dubai, UAE.

Almedom, A. M. (2005). Social capital and mental health: An interdisciplinary review of primary evidence. *Social Science & Medicine*, 61(5), 943–964.

Al Nawakda, E., Fathi, A. H., Ribie`re, V., & Mohammed, M. (2008). Knowledge management initiative at the Ministry of Health in the Kingdom of Bahrain: a case study. *VINE: The journal of information and knowledge management systems*, *28*(4), 535-553.

Alge, B. J., Wiethoff, C., & Kleinc, H. J. (2003). When does the medium matter? Knowledge-building experiences and opportunities in decision-making team. *Organizational Behavior and Human Decision Processes*, 91(1), 26–37.

Allison, P. D. (2012). *Handling Missing Data by Maximum Likelihood*. Retrieved Oct 24, 2013, from SAS Global Forum 2012: http://www.statisticalhorizons.com/wp-content/uploads/MissingDataByML.pdf

Alwis, R. S. and Hartmann, E. 2008. ' The use of tacit knowledge within innovative companies: knowledge management in innovative enterprises'. *Journal of Knowledge Management*, 12(1), 133-147.

Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the built environment: application of "mixed" research approach. *Work Study*, 51(1), 17-31.

American Spine Center. (2012). *Middle East Spine Doctors*. Retrieved Sept 14, 2012, from Middle East Spine Doctors: http://www.linkedin.com/groups/Middle-East-Spine-Doctors-4370608/about?trk=anet_ug_grppro

Anderson, O. W., & Shields, M. C. (1982). Quality measurement and control in physician decision making: state of the ar. Health Services Research, 17(2), 125-155.

Antonio, L & Lemos, B. (2010). Relevant factors for tacit knowledge transfer w ithin organisations. *Journal of Knowledge Management,* 14(3), 410-427.

Anya, O., Tawfik, H., Nagar, A., & Amin, S. (2010). Cotext-Aware Decision Support in Knowledge-Intensive Collaborative E-Work. Procedia Computer Science, 1(1), 2281-2290.

Arnold, K. A., Turner, N., & Barling, J. (2007). Transformational Leadership and Psychological Well-Being: The Mediating Role of Meaningful Work. Journal of Occupational Health Psychology, 12(3), 193-203.

Ardichvili, A. (2008). Learning and Knowledge Sharing in Virtual Communities of Practice: Motiivators, Barriers, and Enablers. *Advances in Developing Human Resources*, 10(4), 541-554.

ASAE (The Center for Association Leadership), 2010. *The future of Healthcare Knowledge Sharing*. Seoul, Chicago, IL, USA 19 November 2010. IL: ASAE.

Austin, J. R. (2003). Transactive Memory in Organizational Groups: The Effects of Content, Consensus, Specialization, and Accuracy on Group Performance. *Journal of Applied Psychology*, 88(5), 866–878.

Avolio, B. J., Zhu, W., Koh, W., & Bhatia, P. (2004). Transformational Leadership and organizational commitment: mediating role of psychological empowerment and moderating role of structural distance. *Journal of Organizational Behavior*, 25(8), 951-968.

B, A. (2010). *American Doctors*. Retrieved May 12, 2012, from American Doctors: http://www.linkedin.com/groups?gid=2794764&trk=group-name

B, A. (2010). *Chinese Doctors*. Retrieved May 12, 2012, from Chinese Doctors: http://www.linkedin.com/groups?gid=2794776&trk=group-name

B, A. (2010). *Indian Doctors*. Retrieved May 12, 2012, from Indian Doctors: http://www.linkedin.com/groups?gid=2803128&trk=group-name

B, A. (2010). *Middle East Doctors*. Retrieved May 12, 2012, from Middle East Doctors: http://www.linkedin.com/groups?gid=2794771&trk=group-name

B, A. (2010). *UK Doctors*. Retrieved May 12, 2012, from UK Doctors: http://www.linkedin.com/groups?gid=2803122&trk=group-name

Bacon, D. R., Sauer, P. L., & Young, M. (1995). Composite Reliability in Structural Equations Modeling. *Educational and Psychological Measurement*, 55(3), 394-406.

Baker, M. J. (2001). Selecting a Research Methodology. *The Marketing Review, 1*, 373-397.

Bali, R. K., & Dwievedi, A. N. (Eds.). (2007), *Healthcare Knowledge Management Issues, Advances, and Successes*, New Jersey: Springer.

Baron, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.

Baskaran, V., Bali, R. K., Arochana, H., Naguib, R. N. G., Dwivedi, A. N., & Nassar, N. S. (2005). In IEEE Press (Ed.) Towards Total Knowledge Management for Healthcare: Clinical and Organizational Considerations. *26th Annual International Conference of the IEEE EMBS*, San Francisco, CA.

Bate, S., & Robert, G. (2002). Knowledge Management and Communities of Practice in the Private: Lessons for Modernizing the National Health Service England And Wales. *Public Adminis- tration*, 80(4), 643–663.

Blanchard, A. L. (2008). Testing a model of sense of virtual community. *Computers in Human Behavior*, 24(5), 2107–2123.

Baskaran, V., Bali, R. K., Arochana, H., Naguib, R. M., Dwivedi, A. N., & Nassar, N. S. (2005). Towards Total Knowledge Management for Healthcare: Clinical and Organizational Considerations. *26th Annual International Conference of the IEEE EMBS.* San Francisco, CA.: In IEEE Press.

Bass, B. M. (1990). From Transactional to Transformational Leadership: Learning to Share the Vision. *Organizational dynamics*, 18(3), 19-31.

Bate, S. P., & Robert, G. (2002). Knowledge Management and Communities of Practice in the Private: Lessons for Modernizing the National Health Service England And Wales. Public Administration, 80(4), 643-663.

Being. (2007). composite reliability- the reliability of each composite. Retrieved Oct 10, 2012, from The only thing unchanged is change: http://zencaroline.blogspot.ca/2007/06/composite-reliability.html

Belinger, G., Castro, D., & Mills, A. (2004). *Data, Information Knowledge & Wisdom* . Retrieved 12 9, 2011, from System Thinking "A journey in the realm of systems": http://www.systems-thinking.org/dikw/dikw.htm

Bentley, C., Browman, G., & Poole, B. (2010). Conceptual and practical challenges for implementing the communities of practice model on a national scale - a Canadian cancer control initiative. BMC Health Services Research, 10(3), 1-8.

Bernard, H. R. (2011). *Research Methods in Anthropology: Qualitative and Quantitative Approaches* (5 ed.). Lanham, MD, USA: Altamira Press.

Berner, E. (2009). Diagnostic error in medicine: introduction. *Advances in Health Sciences Education*, 14(suppl 1), 1-5.

Bhattacharya, C. B., & Sen, S. (2003). Consumer-Company Identification: A Framework for Understanding Consumers' Relationships with Companies. *Journal of Marketing*, 67(2), 76-88.

Birasnav, M., Rangnekar, S., & Dalpati, A. (2009). Enhancing Employee Human Capital Benefits through Knowledge Management: A Conceptual Model. *Global Journal of e-Business & Knowledge Management, 1*, 20-26.

Birasnav, M., Rangnekar, S., & Dalpati, A. (2011). Transformational leadership and human capital benefits: the role of knowledge management. *Leadership & Organization Development Journal*, 32(2), 106-126.

Blanchard, A. L. (2008). Testing a model of sense of virtual community. *Computers in Human Behavior*, 24(5), 2107–2123.

Blue, J., Serva, M., Baroudi, J., & Benamati, J. (2009). Human Versus Virtual Moments:A Proposed Theoretical Framework for Understanding Their Implications in the Workplace. *Proceedings of the*

special interest group on management information system's 47th annual conference on Computer personnel research (pp. 181-186). New York: ACM.

BMJ Publishing Group. (2011). *Welcome to doc2doc*. Retrieved May 12, 2012, from http://doc2doc.bmj.com/

Bodenheimer, T., & Fernandez, A. (2005). High and Rising Health Care Costs. Part 4: Can Costs Be Controlled While Preserving Quality? *Annals of Internal Medicine*, 143(1), 26-31.

Bonaccio, S., & Dalal, R. S. (2006). Advice taking and decision-making: An integrative literature review, and implications for the organizational sciences. *Organizational Behavior and Human Decision Processes*, 101(2), 127-151.

Bryant, S. E. (2003). The Role of Transformational and Transactional Leadership in Creating, Sharing and Exploiting Organizational Knowledge. *The Journal of Leadership and Organizational Studies, 9*(4), 32-44.

Burton, L. J., & Mazerolle, S. M. (2011). Survey Instrument Validity Part I: Principles of Survey Instrument Development and Validation in Athletic Training Education Research. *Athletic Training Education Journal*, 6(1), 27-35.

Bogdan, R., & Taylor, S. J. (1975). *Introduction to qualitative research methods.* New York: Wiley.

Bose, R. (2003). Knowledge management-enabled health care management systems: capabilities, infrastructure, and decision support. *Expert System with Applications*, 24(1), 59-71.

Bot, S. D., Terwee, C. B., van der Windt,, D. A., Feleus, A., Bierma-Zeinstra, S. M., & Knol, D. L. (2004). Internal consistency and validity of a new physical workload. *Occup Environ Med*, 61(12), 980–986.

Canadian Anthropology Society. (2011). CASCA: A Brief History. Retrieved Aug 5, 2012, from CANADIAN ANTHROPOLOGY SOCIETY: http://www.cas-sca.ca/news-and-announcements/listserv

Canadian Institute of Health Research (CIHR). (2011). Colorectal Cancer Surgery and Pathology List Serv. Retrieved Aug 10, 2012, from KT tools: http://ktclearinghouse.ca/tools/uncategorized/cclistserv

Chahal, K. G. (2009). Information Systems evaluation in the public sector. Retrieved from Brunel University Research Archive (BURA). (AAT http://bura.brunel.ac.uk/handle/2438/4711).

Chang, H. H., & Chuang, S.-S. (2011). Social capital and individual motivations on knowledge sharing: Participant involvement as a moderator. *Information & Management*, 48(1), 9-18.

Chernichovsky, D., & Leibowitz, A. A. (2010). Integrating Public Health and Personal Care in a Reformed US Health Care System. *American Journal of Public Health*, 100(2), 205-211.

Chiu, C., Hsu, M., & Wang, E. T. G. (2006). Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories. *Decision Support Systems*, 42(3), 1872-1888.

Chou, Y.-J., Teng, C.-I., & Lo, S.-K. (2009). Mutual self-disclosure online in the B2C context. *Internet Research*, 19(5), 466-478.

Chow, W. S., & Chan, L. S. (2008). Social network, social trust and shared goals in organizational knowledge sharing. *Information & Management*, 45(7), 458-465.

Chua, A. (2004). Knowledge management system architecture: a bridge between KM consultants and technologists. *International Journal of Information Management, 24*, 87–98.

Churchill, G. A. (1979). A Paradigm for Developing Better Measures of Marketing Constructs. *Journal of Marketing Research*, 16(1), 64-73.

Ciccarese, P., Caffi, E., Quaglini, S., & Stefanelli, M. (2005). Architectures and tools for innovative Health Information Systems: The Guide Project. International Journal of Medical Informatics. *International Journal of Medical Informatics*, 74(7-8), 553 - 562.

Cido´n, E. U., Martı´n, C. F., Villaiza´n, M. H., & Lara, F. L. (2012). A pilot study of satisfaction in oncology nursing care: an indirect predictor of quality of care. *International Journal of Health Care Quality Assurance*, 25(2), 106-117.

Collins-Camargo, C., & Hall, J. (2010). How Creating a Shared Vision Can Improve More Than Outcomes. *Policy & Practice*, 68(3), 10.

Connelly, L. M. (2008). Pilot Studies. *MEDSURG Nursing*, 17(6), 411-412.

Cook, D. A. (2010). Medical Decision Making: What Do We Trust? *J Gen Intern Med*, *25*(4), 282-283.

Creswell, J. W. (2002). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* Lnodon, UK: Sage Publications Ltd.

Croskerry,, P., & Nimmo, G. (2011). Better clinical decision making and reducing diagnostic error. *J R Coll Physicians Edinb*, 41(2), 155-162.

Chua, A. (2004). Knowledge management system architecture:a bridge between KM consultants and technologists. *International Journal of Information Management*, 24(1), 87–98.

D'Amour, D., Goulet, L., Labadie, J.-F., San Martín-Rodriguez, L., & Pineault, R. (2008). A model and typology of collaboration between professionals in healthcare organizations. *BMC Health Services Research*, 8(1), 188-202.

Dancey, C. P., & Reidy, J. (2011). Statistics Without Maths for Psychology fifth edition. England: Prentice Hall.

Dannecker, A., & Lechner, U. (2007). Knowledge Creation in Virtual Communities of Patients: The Role of Quality Assurance. Americas Conference on Information Systems (AMCIS). Colorado, 9-12 August: AMCIS 2007 Proceedings.

Dantoni, S. (2009). MCMS *Physician Members*. Retrieved from MCMS Physician Members: http://www.linkedin.com/groups?gid=2209280&trk=group-name

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319-340.

Davison, R. M. (1998). An Action Research Perspective of Group Support Systems: How to Improve Meetings in Hong Kong, Unpublished doctorial dissertation, City University of Hong Kong, Maryland, Kowloon, Hong Kong.

Demiris, G. (2006). The diffusion of virtual communities in health care: Concepts and challenges. *Patient Education and Counseling*, 62(2), 178-188.

Deng, W.-J. (2011). Development of the Hospitality Quality Management Culture Scale: A Pilot Study. **The** *Business Review, Cambridge,* 18(1), 205-211.

Detmar, S., Gefen, D., & Boudreau, M.-C. (2004). *Quantitative, Positivist Research Methods in Information Systems*. (D. Galletta, Editor) Retrieved Mar 17, 2012, from The ISWorld Quantitative, Positivist Research Methods Website: http://dstraub.cis.gsu.edu:88/quant/3genresearch.asp

Diamantopoulos, A., & Siguaw, J. A. (2000). Introducing LISREL. London: Sage Publications Ltd.

Dovey, K., & White, R. (2005). Learning about learning in knowledge-intense organizations. *The Learning Organization*, 22(3), 246-260.

Dubé, L., Bourhis, A., & Jacob, R. (2006). Towards a Typology of Virtual Communities of Practice. *Interdisciplinary Journal of Information, Knowledge, and Management*, 1, 69-93.

Dura´n-Narucki, V. (2008). School building condition, school attendance, and academic achievement in New York City public schools: A mediation model. *Journal of Environmental Psychology*, 28, 278–286.

Dovey, K., & White, R. (2005). Learning about learning in knowledge-intense organizations. *The Learning Organization, 22*(3), 246-260.

Edelenbos, J., & Klij, E.-H. (2007). Trust in Complex Decision-Making Network. Administration & Society, 39(1), 25-50.

Efimova, L., & Hendrick, S. (2005). In search for a virtual settlement: An exploration of weblog community boundaries. Retrieved Dec 13, 2012`, from https://doc.novay.nl/dsweb/Get/Document-46041/weblog-community-boundaries.pdf

Eleswed, M. (2008). Job Satisfaction of Subordinates as a function of Organizational Leadership Ethical Conduct: An Empirical Investigation in the State of Kuwait, Unpublished doctorial dissertation, University of Maryland Eastern Shore, Maryland, USA.

Ellis, B. (2008). *Medical Doctor (MD) Network*. Retrieved May 12, 2012, from Medical Doctor (MD) Network: http://www.linkedin.com/groupsDirectory?itemaction=mclk&anetid=1170587&impid=1170587-150787&pgkey=anet_about&actpref=anet_about-gbm&trk=anet_about-gbm-group&goback=%2Eanb_150787_*2_*1_*1_*1_*1_*1

Elwyn, G., Edwards, A., & Kinnersley, P. (1999). Shared decision-making in primary care: the neglected second half of the consultation. *British Journal of General Practice*, 49(443), 477-482.

Elwyn, G., Edwards, A., Kinnersley, P., & Grol, R. (2000). Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices. *British Journal of General Practice*, 50(460), 892-897.

Epocrates, Inc. (2012). *Epocrates.* Retrieved May 12, 2012, from Epocrates: http://www.epocrates.com/

Eysenbach, G., Powell, J., Englesakis, M., & Rizo, C. (2004). Health related virtual communities and electronic support groups: systematic review of the effects of online peer to peer interactions. (BMJ Helping doctors make better decisions) Retrieved July 26, 2011, from http://bmj.com/cgi/pmidlookup?view=long&pmid=15142921. [PMC free article] [PubMed]

Facebook. (2012). *American Board Certified Doctors for Egypt (ABCDE) - Associates*. Retrieved July 16, 2012, from American Board Certified Doctors for Egypt (ABCDE) - Associates: http://www.facebook.com/groups/ABCDE.Associates/

Facebook. (2012). *APPNA Yuong Physicians*. Retrieved May 12, 2012, from APPNA Yuong Physicians: http://www.facebook.com/groups/308140919099/

Facebook. (2012). *Columbia College of Physicians and Surgeons Class of 2015*. Retrieved May 5, 2012, from Columbia College of Physicians and Surgeons Class of 2015: http://www.facebook.com/groups/206743702674113/

Facebook. (2012). *Egyptian Women Physicians and Scientists*. Retrieved May 12, 2012, from Egyptian Women Physicians and Scientists: http://www.facebook.com/groups/186275698090831

Facebook. (2012). *Naturopathic Physicians*. Retrieved May 12, 2012, from Naturopathic Physicians: http://www.facebook.com/groups/160969783925161/

Facebook. (2012). *Physicians + Facebook Marketing - How to do it correctly!* Retrieved May 12, 2012, from Physicians + Facebook Marketing - How to do it correctly!: http://www.facebook.com/groups/142993412412626/

Facebook. (2012). *PIT Physician Support Group*. doi:Source in Integrated Framework table 4.4 in ch 4

Facebook. (2012). *Residency Ready Physicians*. Retrieved May 12, 2012, from Residency Ready Physicians: http://www.facebook.com/groups/ResidencyReadyPhysicians/

Facebook. (2012). *Thai American Physicians Foundation*. Retrieved May 12, 2012, from Thai American Physicians Foundation: http://www.facebook.com/groups/104301007309/

Facebook. (2012). *Thai Physicians (Mor Thai)*. Retrieved May 12, 2012, from Thai Physicians (Mor Thai): http://www.facebook.com/groups/morthai/

Faraj, S., Jarvenpaa, S. L., & Majchrzak, A. (2011). Knowledge Collaboration in Online Communities. *Organization Science*, 1-16.

Feng, C., & Gao, F. (2009). A Decision Model of Knowledge-Sharing for Supply Chain Enterprises Based on Game Theory. *2009 Second International Symposium on Knowledge Acquisition and Modeling* (pp. 114-117). China: Huazhong Normal University.

Ferketich, S. (1991). Focus on psychometrics: Aspects of item analysis. *Research in Nursing & Health*, 14, 165–168.

Fernandes, R. (2008). *AAPI Health Network-For Doctors Physicians Nurses Hospitals*. Retrieved May 12, 2012, from AAPI Health Network-For Doctors Physicians Nurses Hospitals...: http://www.linkedin.com/groups?home=&gid=136547&trk=anet_ug_hm

Field, A. (2003). Designing a Questionnaire. Retrieved July 18, 2012, from http://www.statisticshell.com/docs/designing_questionnaires.pdf

Field, A. (2005). Factor Analysis Using SPSS. Retrieved Feb 29, 2013, from http://www.statisticshell.com/docs/factor.pdf

Field, A. (2009). Discovering Statistics using SPSS Third Edition. London: SAGE Publications Ltd.

Fiol, C. M., & O'Connor, E. J. (2005). Identification in Face-to-Face, Hybrid, and Pure Virtual Teams: Untangling the Contradictions. Organization Science, 16(1), 19-32.

Foong, D. P., & McGrouther, D. A. (2010). An Internet-based discussion forum as a useful resource for the discussion of clinical cases and an educational tool. *Indian Journal of Plastic Surgery*, 43(2), 195–197.

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39-50.

Frappaolo, C. (2008). Implicit knowledge. *Knowledge Management Research & Practice*, 6(1), 23-25.

Frid, R. J. (2000). *Infrastructure for Knowledge Management.* San Jose, CA, USA: Writers Club Press.

Fubiani, C. (2011). *Doctors Overseas*. Retrieved May 12, 2012, from Doctors Overseas: http://www.linkedin.com/groups/Doctors-Overseas-4039463/about?trk=anet_ug_grppro

Galliers, R. D. (2011). In celebration of diversity in information systems research. *Journal of Information Technology*, 26(4), 299–301.

Girard, J. P., & Lambert, S. (2007). The Story of Knowledge: Writing Stories that Guide Organisations into the Future. *Electronic Journal of Knowledge Management*, 5(2), 161-172.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Scales. 2003 *Midwest Research to Practice Conference in Adult, Continuing, and Community Education*, (pp. 82–88).

Gossett, L. M. (2002). Kept at Arm's Length: Questioning the Organizational Desirability of Member Identification. *Communication Monographs*, 69(4), 385-404.

Grant, K. A. (2007). Tacit Knowledge Revisited – We Can Still Learn from Polanyi. *The Electronic Journal of Knowledge Management*, 5(2), 173-180.

Grounds, A., Gelsthorpe, L., Howes, M., Melzer, D., Tom, B. D., Brugha, T., et al. (2004). Access to medium secure psychiatric care in England and Wales. 2: A qualitative study of admission decision-making. *The Journal of Forensic Psychiatry & Psychology*, 15(1), 32–49.

Gupta, S., & Kim, H.-W. (2007). Developing the Commitment to Virtual Community: the Balanced Effects of Cognition and Affects. *Information Resources Management Journal*, 20(1), 28-45.

Guptill, J. (2008). Healthcare Knowledge Management: The Art of the Possible. *J Health Care Finance*, 31(3), 10-14.

Hahn, K. H., & Kim, J. (2009). The effect of offline brand trust and perceived internet confidence on online shopping intention in the integrated multi-channel context. *International Journal of Retail & Distribution Management*, 37(2), 126-141.

Hancock, H. C., & Durham, L. (2007). Critical care outreach: The need for effective decision-making in clinical practice (Part 1). *Intensive and Critical Care Nursing*, 23(1), 15-22.

Hara, N. & Hew, K. F. (2007). Knowledge-sharing in an online community of health-care professionals. *Information Technology & People*, 20(3), 235-261.

Hara, N., Solomon, P., Kim, S.-L., & Sonnenwald, D. H. (2003). An Emerging View of Scientific Collaboration: Scientists' Perspectives on Collaboration and Factors that Impact Collaboration. *Journal of the American Society for Information Science and Technology*, 54(10), 952–965.

Harsoor, S. (2010), Critical incident reporting and learning system: The black pearls. *Indian Journal of Anesthesia*, 54(3), 185-186.

Herndon, N. C., Fraedrich, J. P., & Yeh, Q. J. (2001), An investigation of moral values and the ethical content of the corporate culture: Taiwanese versus U.S. sales people. *Journal of Business Ethics*, 30(1), 73-85.

Health Information Directorate. (2012, Jan). *Healthcare Establishment Contacts*. Retrieved Feb 04, 2012, from Kingdom of Bahrain Ministry of Health: http://www.moh.gov.bh/EN/Contacts/HealthEstablishments.aspx

Helft, M. (2011). How Dave Goldberg turned Online Questtionnaires into a Hot Business. *Fortune*, 164(5), 68-68.

Henderson, A., Briggs, J., Schoonbeek, S., & Paterson, K. (2011). A framework to develop a clinical learning culture in health facilities: ideas from the literature. *International Nursing Review*, 58(2), 196-202.

Heritage, J., & Maynard, D. W. (2006). Programs and Prospects in the Study of Physician-Patient Interaction: 30 Years of Research. *Annual Review of Sociology*, 32, 351-374.

Hertzog, M. A. (2008). Considerations in Determining Sample Size for Pilot Studies. *Research in Nursing & Health*, 31, 180–191.

Hinds, J. (2012). *The Physician Network*. Retrieved May 12, 2012, from The Physician Network: http://www.linkedin.com/groupsDirectory?itemaction=mclk&anetid=3381909&impid=&pgkey=anet_search_results&actpref=anetsrch_name&trk=anetsrch_name&goback=%2Egdr_1328943639895_1%2Eanb_1759777_*2_*1_*1_*1_*1_*1%2Eanb_2601905_*2_*1_*1_*1_*1_*1%2Egdr_13289436399

Hlupic, V., Pouloudi, A., & Rzevski, G. (2002). Towards an Integrated Approach to Knowledge Management: 'Hard', 'Soft' and 'Abstract' Issues. *Knowledge and Process Management*, *9*(2), 90–102.

Hovenga, E. J. S. 2004. Globalisation of health and medical informatics education—what are the issues?. *International Journal of Medical Informatics*, 73(2), *101-109*.

Hovenga, E. Garde, S., & Heard, S. (2005), 'Nursing constraint models for electronic health records: A vision for domain knowledge governance', *Epub*, 74(11-12), *886-8989*.

Hsia, T. L., Lin, L.-M., Wu, J.-H., & Tsai, H. T. (2006). A Framework for Designing Nursing Knowledge Management Systems. *Interdisciplinary Journal of Information, Knowledge, and Management, 1*, 95-108.

Huq, A. (2006). Engaging Organisational Culture to Overcome Social Barriers in Virtual Communities. In Encyclopedia of virtual communities and technologies (pp. 193-197). Washington DC: George Washington University.

Huysman, M., & Wulf, V. (2006). IT to support knowledge sharing in communities, towards a social capital analysis. *Journal of Information Technology*, 21(1), 40-51.

Hoe, S. L. (2008). Issues and Procedures in Adapting Structural Equation Modeling Technique. *Journal of Applied Quantitative Methods*, 3(1), 76-83.

Howell, D. C. (2009). Treatment of Missing Data. Retrieved Aug 10, 2012, from Treatment of Missing Data: http://www.uvm.edu/~dhowell/StatPages/More_Stuff/Missing_Data/Missing.html

Hicks, R. C., Dattero, R. and Galup, S. D. (2007). A metaphor for knowledge management: explicit islands in a tacit sea. *Journal of Knowledge Management*, 11(1), 5-16.

how2stats. (2011, Oct). Replace Missing Values - Expectation-Maximization - SPSS (part 1). Retrieved Aug 10, 2012, from http://www.youtube.com/watch?v=4yhpYKzW98M

how2stats. (2011, Oct). Replace Missing Values - Expectation-Maximization - SPSS (part 2). Retrieved Aug 11, 2012, from http://www.youtube.com/watch?v=xEkJxl6mmQ0

Howell, D. C. (2008). The analysis of missing data. In W. Outhwaite, & S. Turner, OuthwaiteHandbook of Social Science Methodology. London: Sqage.

Hox, J. J., & Bechger, T. M. (1998). An Introduction to Structural Equation Modeling. *Family Science Review*, 11, 354-373.

Hoyle, R. H., & Smith, G. T. (1994). Formulating Clinical Research Hypotheses as Structural Equation Models: A Conceptual Overview. *Journal of Consulting and Clinical Psychology*, 62(3), 429-440.

Hsia, T.-L., Lin, L.-M., Wu, J.-H., & Tsai, H.-T. (2006). A Framework for Designing Nursing Knowledge Management Systems. *Interdisciplinary Journal of Information, Knowledge, and Management*, 1, 95-108.

Huysman, M., & Wulf, V. (2006). IT to support knowledge sharing in communities, towards a social capital analysis. *Journal of Information Technology*, 21(1), 40-51.

Iacobucci, D. (2010). Structural equations modeling: Fit Indices, sample size, and advanced topics. *Journal of Consumer Psychology*, 20(1), 90–98.

iHealth Beat Reporting Technology's Impact on Health Care. (2009, Jan 29). *How Well Are Online Physician Communities Being Received?* Retrieved Feb 19, 2012, from iHealth Beat Reporting Technology's Impact on Health Care: http://www.ihealthbeat.org/Data-Points/2009/How-Well-Are-Online-Physician-Communities-Being-Received.aspx

Ismael, K. (2009). *Mekerene University Reserch Repository Item 123456789/628.* Retrieved July 24, 2011, from Uganda Scholarly Digital Library: http://hdl.handle.net/123456789/628

Jabareen, Y. (2009). Building aConceptual Framework: Philosophy, Definitions, and Procedure. *International Journal of Qualitative Methods*, 8(4), 49-62.

Jaber, A. J., Sidi, F., & Selamat, M. H. (2010), 'Tacit Knowledge Codification', *Journal of Computer Science*, 6(10), 1141-1147.

Jackson, S. L. (2008). Research Methods and Statistics A Critical Thinking Approach Third Edition. Belmont, CA, USA: Wadsworth Publishing.

Jansen, R. J., Curseu, P. L., Vermeulen, P. A., Geurts, J. L., & Gibcus, P. (2011). Social capital as a decision aid in strategic decision-making in service organizations. *Management Decision*, 49(5), 734-747.

Jeon, S., Kim, Y.-G., & Koh, J. (2011). An integrative model for knowledge sharing in communities-of-practice. *Journal of Knowledge Management*, 5(2), 251-269.

Jie, X. (2010). Research on the Relationship between Knowledge Management Infrastructure, Knowledge Sharing and Knowledge Management Performance. *Management and Service Sciences (MASS), 2010 International Conference, School of Public Administration, Guangzhou*.

Jie, X., & Zhengang, Z. (2010). Research on the Relationship between Knowledge Management Infrastructure, Knowledge Sharing and Knowledge Management Performance. *Management and Service Science (MASS), 2010 International Conference on*, (pp. 1-4). Muhan.

Johnson, R., & Christensen, L. (2011). Educational Research: Quantitative, Qualitative, and Mixed Approaches (Vol. 4). Los Angeles: Sage.

Johanson, G. A., & Brooks, G. P. (2010). Initial Scale Development: Sample Size for Pilot Studies. *Educational and Psychological*, 70 (3), 394-400.

Jones, Q. (1997). Virtual-Communities, Virtual Settlements & Cyber-Archaeology: A Theoretical Outline. *Journal of Computer-Mediated Communication*, 3 (3). Retrieved Feb 20, 2013, from http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1083-6101

Jones, R. I. (2009). *Astute Physician*. Retrieved May 12, 2012, from Astute Physician: http://www.linkedin.com/groups?gid=1894343&trk=group-name

Joreskog, K. G. (1999). How large can a Standardized Coefficient be? Retrieved Feb 12, 2013, from http://www.ssicentral.com/lisrel/techdocs/HowLargeCanaStandardizedCoefficientbe.pdf

Jøsang, A. (1999). Trust-based decision making for electronic transactions,. The 4th Nordic Workshop on Secure IT Systems (NORDSEC'99). Stockholm, Sweden: Stockholm University Report 99-005.

Judge, T. A., Bono, J. E., & Locke, E. A. (2000). Personality and Job Satisfaction: The Mediating Role of Job Characteristics. *Journal of Applied Psychology*, 85(2), 237-249.

Kalkan, V. D. (2008). An overall view of knowledge management challenges for global business, *Business Process Management Journal*, 14(3), 390-400.

Kamal, M. M. (2008). Investigating Enterprise Application Integration (EAI) Adaption in the Local Government Authorities (LGAs), Unpublished doctorial dissertation, Brunel University, West London, UK.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons*, 53(1), 59-68.

Kelloway, E. K., Barling, J., & Helleur, J. (2000). Enhancing transformational leadership: the role of training and feedback. *Leadership & Organization Development Journal*, 21(3), 145-149.

Kenny, D. A. (2012). Mediation. Retrieved Feb 12, 2013, from Mediation (David A. Kenny: http://davidakenny.net/cm/mediate.htm

Khalifa, G. R. (2011). *Information Systems evaluation in the public sector*. Retrieved from Brunel University Research Archive (BURA). (AAT http://bura.brunel.ac.uk/handle/2438/5193).

Kherallah, M. (2012). *Middle East Critical Care Assembly*. Retrieved May 12, 2012, from Middle East Critical Care Assembly: http://www.linkedin.com/groups/Middle-East-Critical-Care-Assembly-3702918/about?trk=anet_ug_grppro

Khorasani1, E., Darab, M. G., Yarmohammadian, M., & Afshar, S. (2012). Knowledge-Based Health System in the age of Knowledge. *International Conference on Information Management and Evaluation* (pp. 165-IX). Ankara: Academic Conferences International Limited.

Kietzmann, J. H., Hermkens, K., McCarthy, I. P., & Silvestre, B. S. (2011). Social media? Get serious! Understanding the functional building blocks of social media. *Business Horizons*, 54(3), 241—251.

Kline, R. B. (2005). Principles and Practice of Structural Equation Modeling Second Edition. New York, USA: The Guilford Press.

Kim, S., Kang, H. S., & Kim, J.-H. (2011). A sexual health care attitude scale for nurses: Development and psychometric evaluation. International Journal of Nursing Studies, 48(12), 1522–1532.

Kogut, B., & Zander, U. (1992). Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science*, 3(3), 383-397.

Koh, J., & Kim, Y. G. (2004). Knowledge sharing in virtual communities: an e-business perspective. Expert Systems with Applications, 26(2), 155–166.

Komito, L. (2011). Social Media and Migration: virtual community 2.0. *Journal of the American Society for Information Science and Technology*, 62(6), 1075-1086.

Kopáčková,, H., & Škrobáčková, M. (2009). *Decision Support Systems or Business Intelligence: What can help in Decision Making?* Retrieved Dec 2, 2011, from http://dspace.upce.cz/bitstream/10195/32436/1/CL585.pdf

Kozer, E., Macpherson, A., & Shi, K. (2002). Variables Associated With Medication Errors in Pediatric Emergency Medicine. PEDIATRICS, 110(4), 737-742.

Kumar, A. (2008). *Physicians*. Retrieved May 12, 2012, from Physicians: http://www.linkedin.com/groups?gid=150787&trk=group-name

Kumar, J. (2009). *Indian doctors in UK*. Retrieved May 12, 2012, from Indian doctors in UK: http://www.linkedin.com/groups?gid=2516098&trk=group-name

Lai, H. F. (28-30 June 2010). Applying Fuzzy AHP to Evaluate the Sustainability of Knowledge-based Virtual Communities in Healthcare Industry. Service Systems and Service Management (ICSSSM), 2010 7th International Conference on Service Systems and Service Management (pp. 1-6). Tokyo, Japan: IEEE Xplore Digital Library.

Lai, H. F. (28-30 June 2010). Applying Fuzzy AHP to Evaluate the Sustainability of Knowledge-based Virtual Communities in Healthcare Industry. Service Systems and Service Management (ICSSSM), 2010 *7th International Conference on Service Systems and Service Management* (pp. 1-6). Tokyo, Japan: IEEE Xplore Digital Library, 18-19 Oct.

Lancaster, G. A., Dodd, S., & Williamson, P. R. (2002). Design and analysis of pilot studies: recommendations for good practice. *Journal of Evaluation in Clinical Practice*, 10(2), 307–312.

Landro, L. (2006). 'Social networking comes to Health care'. Viewed 2 Dec 2010, http://www.post-gazette.com/pg/06363/749317-96.stm

Lauring, J., & Selmer, J. (2011). Multicultural organizations: common language, knowledge sharing and performance. *Personnel Review*, 40(3), 324-343.

Law, j. (2011). Online Physician Communities: Know Your Network. Retrieved June 12, 2012, from PharmExecBlog: http://blog.pharmexec.com/2011/01/12/online-physician-communities-know-your-network/

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Lee, J. W., Jones, P. S., Mineyama, Y., & Zang, X. E. (2002). Cultural Differences in Responses to a Likert Scale. *Research in Nursing & Health*, 25, 295-306.

Leggat, S. G. (2007). Effective healthcare teams require effective team members: defining teamwork competencies. *BMC Health Serv Res*, 17(7), 7-17.

Levin, I. P., Snyder, M. A., & Chapman, D. P. (1988). The Interaction of Experiential and Situational Factors and Gender in a Simulated Risky Decision-Making Task. *The Journal of Psychology*, 122 (2), 173-181.

Li, G. X., & Li, Y. J. (2010). Knowledge Sharing Behavior in Learning Online Communities: A Social Capital Perspective. *Management of Innovation and Technology (ICMIT), 2010 IEEE International Conference* (pp. 910-915). IEEE Xplore.

Li, L. (2009). *National Association of Physician Advisors*. Retrieved May 12, 2012, from National Association of Physician Advisors: http://www.linkedin.com/groupsDirectory?itemaction=mclk&anetid=1860691&impid=&pgkey=anet_search_results&actpref=anetsrch_name&trk=anetsrch_name&goback=%2Egdr_1328943639895_1%2Eanb_1759777_*2_*1_*1_*1_*1_*1%2Eanb_2601905_*2_*1_*1_*1_*1_*1%2Egdr_13289436399

Lin, C., & Chang, S. (2008). A relational model of medical knowledge sharing and medical decision-making quality. *Int. J. Technology Management*, 43(4), 320-348.

Lin, C. P. (2011). Assessing the mediating role of online social capital between social support. *Electronic Commerce Research and Applications*, 10(1), 105–114.

Lin, C., & Chang, S. (2008). A relational model of medical knowledge sharing and medical decision-making quality. *Int. J. Technology Management*, 43(4), 320-348.

Lin, S. C., & Huang, Y. M. (2005). The role of social capital in the relationship between human capital and career mobility. *Journal of Intellectual Capital*, 6(2), 191-205.

Lin, W. (2008). The effect of knowledge sharing model. *Expert Systems with Applications,* 34*(2)*, 1508-1521.

Lindkvist, L. (2005). Knowledge Communities and Knowledge Collectivities: A Typology of Knowledge Work in Groups. *Journal of Management Studies*, 42(6), 1189-1210.

Liu, C., Jiang, Z., Zhen, L., & Su, H. (2008), A bilateral integrative health-care knowledge service mechanism based on 'MedGrid', *Medline*, 38(4), 446-460.

Lloria, M. B. (2008). A review of the main approaches to knowledge management. *Knowledge Management Research & Practice*, 6(1), 77-89.

Lucchiari, C., Masiero, M., Pravettoni, G., Vago, G., & Wears, R. L. (2010). End-of-life decision-making: a descriptive study on the decisional attitudes of Italian physicians. Life Span and Disability XIII, 1, 71-86.

Magnier-Watanabe, R., Yoshida, M., & Watanabe, T. (2010). Social network productivity in the use of SNS. *Journal of Knowledge Management*, 14(6), 910-927.

Maizes, V., Rakel, D., & Niemiec, C. (2009). Integrative Medicine and Patient-Centered Care. *EXPLORE: The Journal of Science and Healing*, *5*(5), 277-289.

Majewski, S. (2008). *American College of Physicians*. Retrieved May 12, 2012, from American College of Physicians: http://www.linkedin.com/groups?gid=867307&trk=group-name

Mamykina, L., Candy, L., & Edmonds, E. (2002). Collaborative Creativity. *Communications of the ACM*, 45(10), 96-99.

Mancilla-Amaya, L., Sanin, C., & Szerbicki, E. (2010). Smart Knowledge-Sharing Plat-form for E-Decisional Community. *Cybernetics and Systems, 41*(1), 17-30.

Mansingh, G., Osei-Bryson, K.-M., & Reichgelt, H. (2009). Issues in knowledge access, retrieval and sharing – Case studies in a Caribbean health sector. *Expert Systems with Applications*, 36(2), 2853–2863.

Maryland, B. (2003). Pharmacy–Nursing Shared Vision for Safe Medication Use in Hospitals: Executive Session Summary. *American Journal of Health-System Pharmacy*, 60(16), 13-19.

Marzano, J. (2009). *American Board of Physician Specialties* (ABPS). Retrieved May 12, 2012, from American Board of Physician Specialties (ABPS): http://www.linkedin.com/groups?gid=1882809&trk=group-name

Mascia, D., & Cicchetti, A. (2011). Physician social capital and the reported adoption of evidence-based medicine: Exploring the role of structural holes. *Social Science & Medicine*, 72(5), 798-805.

McLane, W. (2010). *New England Physician Network*. Retrieved May 12, 2012, from New England Physician Network: http://www.linkedin.com/groups?gid=2893071&trk=group-name

McLellan, H. (1998). The Internet as A Virtual Learning Community. *Journal of Computing in Higher Education*, 9(2), 92-112.

MD Search.com. (2011). Physicians and Online Communities. Retrieved June 12, 2012, from MD Search.com: http://www.mdsearch.com/physician-social-networks

Mew, L. (2006). Online Social Networking for New Research Opportunities. In Encyclopedia of virtual communities and technologies (pp. 359-362). Washington DC: George Washington University.

Modahl, M., Tompsett, L., & Moorhead, T. (2011). Doctors, Patients & Social Media. Retrieved Feb 26, 2012, from http://www.quantiamd.com/q-qcp/doctorspatientsocialmedia.pdf

Mohamed, M. S., O'Sullivan, K. J., & Murray, A. (2006). Knowledge management and information technology: can they play in perfect harmony. *Journal of Knowledge Management*, 10(3), 103-116.

Mohamed, M., Stankosky, M., & Murray, A. (2006). Knowledge management and information technology: can they work in perfect harmony? *Journal of knowledge management*, 10(3), 103-116.

Mohamed, M., Stankosky, M. and Mohamed, M. 2009. An empirical assessment of knowledge management critically for sustainable development. *Journal of Knowledge Management*, 13(5), 271-286.

Ministry of Health - Kingdom of Bahrain. (2009). *1 – Summary Statistics*. Retrieved Oct 15, 2011, from Ministry of Health - Kingdom of Bahrain: http://www.moh.gov.bh/PDF/Publications/Statistics/HS2009/PDF/CH01-summary_2009.pdf

Ministry of Health - Kingdom of Bahrain. (2009). *Health Statistics 2009*. (M. o.-H. 2010, Producer) Retrieved Oct 20, 2011, from Ministry of Health - Kingdom of Bahrain: http://www.moh.gov.bh/PDF/Publications/Statistics/HS2009/PDF/CH05%20human%20resources_2009.pdf

Modahl, M., Tompsett, L., & Moorhead, T. (2011). Doctors, Patients & Social Media. Retrieved Feb 26, 2012, from http://www.quantiamd.com/q-qcp/doctorspatientsocialmedia.pdf

MomMD, LLC. (2012). Medical Careers. Retrieved May 12, 2012, from mommd connecting women in medicine: http://www.mommd.com/

Morrison, K. 2009. 'Health care meets social networking'. Viewed 2 Dec 2010,

http://www.bizjournals.com/jacksonville/stories/2009/01/19/daily9.html

Murray, E., Pollack, L., White, M., & Lo, B. (2007). Clinical decision-making: physicians' preferences and experiences. *BMC Family Practice*, 8(10), 1-10.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. Academy of Management. *The Academy of Management Review*, 23(2), 242-266.

Naik, A. D., & Singh, H. (2010). Electronic Health Records to Coordinate Decision Making for Complex Patients: What Can We Learn from Wiki? *Medical Decision Making*, 30, 722-731.

Nemati, H. R., Steiger, D. M., Iyer, L. S., & Herschel, R. T. (2002). Knowledge warehouse: an architecture of knowledge management, decision support, artificial intelligence and data warehousing. *Decision Support Systems*, 33(2), 143-161.

Ng, C. J., Lee, Y. K., Lee, P. Y., & Abdullah, K. L. (2013). Health innovations in patient decision support: Bridging the gaps and challenges. *Australasian Medical Journal [AMJ]*, 6(2), 95-99.

Nguyen, B. H. (2011). Adaptation Learning: An Ambidextrous Perspective. Retrieved Sept 1, 2012, from OSU dissertation archive Digital Collections @ OSU Library: http://dc.library.okstate.edu/cdm/singleitem/collection/Dissert/id/73722/rec/4

Nicolas, R. (2004). Knowledge management impacts on decision making process. *Journal of Knowledge Management, 8*(1), 20-31.

Nicolini, D., Powell, J., Conville, P., & Martinez-Solano, L. (2008). Managing knowledge in the healthcare sector. A review. *International Journal of Management Reviews*, 10(3), 245–263.

Nissen, H. E. (1985). Acquiring Knowledge of Information Systems-Research in Methodological Quagmire. In E. Mumfird, R. Hirschheim, G. Fitzgerald, & T. Wood-Harper, *Research Methods in Information Systems* (pp. 36-52). New York: North-Holland.

Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company*. New York: Oxford University Press.

O'Grady, L. & Jadad, A. 2010. *Shifting from Shared to Collaborative Decision Making: A Change in Thinking and Doing*, J Participat Med, 2(13), Viewed Jan 2, 2011, http://www.jopm.org/evidence/case-studies/2010/11/08/shifting-from-shared-to-collaborative-decision-making-a-change-in-thinking-and-doing-4/

Oh, C. K. (2011). *Northshore University Healthsystem Physician Group*. Retrieved May 12, 2012, from Northshore University Healthsystem Physician Group: http://www.linkedin.com/groups?gid=4121118&trk=group-name

Oinas-Kukkonen, H., Lyytinen, K., & Yoo, Y. (2010). Social Networks and Information Systems: Ongoing and Future Research Streams. *Journal of the Association for Information Systems*, 11(2), 61-68.

Omachonu, V. K., & Einspruch, N. G. (2010). Innovation in Healthcare Delivery Systems: A Conceptual Framework. *The Innovation Journal: The Public Sector Innovation Journal*, 15(1), 1-20.

Owusu-Frimpong, N., Nwankwo, S., & Dason, B. (2010). Measuring service quality and patient satisfaction with access to public and private healthcare delivery. *International Journal of Public Sector Management*, 23(3), 203-220.

Oxoby, R. J., & McLeish, K. N. (2004). Sequential decision and strategy vector methods in ultimatum. *Economics Letters*, 84(3), 399 – 405.

Ozmosis. (2012). Frequently Asked Questions. Retrieved May 12, 2012, from ozmosis: http://ozmosis.com/community/

Parayitam, S. (2010). The effect of competence-based trust between physicians and administrative executives in healthcare on decision outcomes. *Management Research Review*, 33(2), 174-191.

Parayitam, S., Phelps, L. D., & Olson, B. J. (2007). Strategic decision-making in the healthcare industry: the effects of physician executives on decision outcomes. *Management Research News*, 30(4), 283-301.

Paul, D. L. (2006). Collaborative Activities in Virtual Settings: A Knowledge Management Perspective of Telemedicine. *Journal of Management Information Systems*, 22(4), 143-176.

Peng, Z., Fang, Y., & Lim, K. H. (2011). Social Capital and User Acceptance of Enterprise System: Mediating Role of Local Management Commitment. Thirty Second International Conference on Information Systems (ICIS 2011) (p. Paper 24). Shanghai: ICIS 2011 Proceedings.

Perrott, B. E. (2008). Knowledge management from an industry perspective. *Journal of General Management*, 34(1), 33-70.

Pervan, S. J., Bove, L. L., & Johnson, L. W. (2009). Reciprocity as a key stabilizing norm of interpersonal marketing. *Industrial Marketing Management*, 38(1), 60–70.

Pezzo, M. V., & Pezzo, S. P. (2006). Physician Evaluation after Medical Errors: Does Having a Computer Decision Aid Help or Hurt in Hindsight? *Med Decis Making*, 26(1), 48-56.

Peskin, S. (2009). *Can a Medical 'Facebook' Help Your Plan Thrive?* Retrieved Feb 6, 2012, from Managed Care: http://www.managedcaremag.com/archives/0906/0906.socialnetworks.html

Petrides, L. A. (2004). Knowledge Management, Information Systems, and Organizations. EDUCAUSE *Center for Applied Research (ECAR)*, 2004 (20), 1-12.

Plan, S. L., & Leidner, D. E. (2003). Bridging communities of practice with information technology in pursuit of global knowledge sharing. *Journal of Strategic Information Systems*, 12(1), 71-88.

Plastic_surgeon. (2001). Yahoo! Group. Retrieved Sept 13, 2012, from Plastic_surgeon: http://groups.yahoo.com/group/plastic_surgery

PNG Medical Doctors. (2010). Yahoo! Groups. Retrieved Aug 10, 2012, from PNG Medical Doctors: http://health.groups.yahoo.com/group/pngdoctors-general/

Postmes, T., Spears, R., & Cihangir, S. (2001). Quality of Decision Making and Group Norms. *Journal of Personality and Social Psychology*, 80(6), 918-930.

ProNet, M. (2009). *Global Surgeons and Physician Professional Network*. Retrieved May 12, 2012, from Global Surgeons and Physician Professional Network: http://www.linkedin.com/groups?gid=2070023&trk=group-name

Puschner, B., Steffen, S., Slade, M., Kaliniecka, H., Maj, M., Fiorillo, A., Munk-Jørgensen, P., Larsen, J. I., Égerházi5, A., Nemes, Z., Rössler, W., Kawohl, W., & Becker, T. (2010). Clinical Decision Making and Outcome in Routine Care for People with Severe Mental Illness (CEDAR): Study protocol Viewing options: Abstract . *BMC Psychiatry*, 10(1), 90.

Radhakrishna, R. B. (2007). Tips for Developing and Testing Questionnaires/Instruments. Journal of Extension www.joe.org, 45 . Retrieved July 6, 2012, from Journal of Extension: http://www.joe.org/joe/2007february/tt2.php

Raghunathan, S. (1999). Impact of information quality and decision-maker quality on decision quality: a theoretical model and simulation analysis. *Decision Support Systems*, 26(4), 275–286.

Rahman, H. (2006). Social Impact of Virtual Networking. In S. Dasgupta, Social Impact of Virtual Networking (pp. 417-423). Washington DC: George Washington University.

Rajesh, R., Pugazhendhi, S., & Ganesh, K. (2011). Towards taxonomy architecture of knowledge management for third-party logistics service provider. *Benchmarking: An International Journal*, 18(1), 42-68.

Ramirez, M. (2008). *American Association of Physician Specialists*. Retrieved May 12, 2012, from American Association of Physician Specialists: http://www.linkedin.com/groups?gid=76197&trk=group-name

Ranmuthugala, G., Plumb, J. J., Cunningham, F. C., Georgiou, A., Westbrook, J. I., & Braithwaite, J. (2011). How and why are communities of practice established in the healthcare sector? A systematic review of the literature. BMC Health Services Research, 11(1), 273.

Rantapuska, T., & Ihanainen, O. (2008). Knowledge use in ICT investment decision making of SMEs. *Journal of Enterprise Information Management*, 21(6), 585-596.

Rao, K. V. (1998). India Network-the first case study of a virtual community. *Computer Communications*, 20(16), 1527- I533.

Raven, M. (2011). *Japan Medical Doctor Network*. Retrieved May 12, 2012, from Japan Medical Doctor Network: http://www.linkedin.com/groups?gid=3887254&trk=group-name

Razzaque, A. (2012, Dec 22). Survey Development Log. Retrieved Dec 22, 2012, from Survey Development Log: https://docs.google.com/spreadsheet/viewform?formkey=dGx4aHJ2clFySUE1RUh6M3pHdzhxM2c6MQ#gid=0

Razzaque, A., & Jalal-Karim, A. 2010. 'Conceptual Healthcare Knowledge Management Model For Adaption and Interoperability of EHR', European, Mediterranean & Middle Eastern Conference on Information Systems, 12-13 April 2019, USE.

Razzaque, A., & Jalal-Karim, A, (2010), 'The Influence of Knowledge Management on EHR to Improve the Quality of Healthcare Services', *European, Mediterranean & Middle Eastern Conference on Information Systems 2010* (*EMCIS2010*), 12-13 April 2010, E-Abu Dhabi, UAE.

Reckrey, J. M., McKee, M. D., Sanders, J., J., & Lipman, H. J., (2011). Resident Physician Interactions with Surrogate Decision-Makers: the resident experience. *The American Geriatrics Society*, 59(12), 2341-2346.

Regoniel, P. (2012, July 30). How to Make a Conceptual Framework. Retrieved Dec 13, 2012, from Knoji Coonsumer Knowledge: http://college-college-life.knoji.com/how-to-make-a-conceptual-framework/

Relax Doc. (2012). Retrieved May 12, 2012, from Relax Doc: http://www.mdsearch.com/physician-social-networks

Riaño, D. (2009). A Knowledge-Management Architecture to Integrated and to Share Medical and Clinical Data, Information, and Knowledge. Knowledge Representation for Health-Care: Data, Processes and Guidelines. 5943. IME 2009 Workshop KR4HC, 19 July, 2009.

Rico, R., Molleman, E., Sanchez-Manzanares, M., & Van der Vegt, G. S. (2007). The Effect of Diversity Faultlines and Team Task Autonomy on Decision Quality and Social Integration. *Journal of Management* , 33(1), 111-132.

Riege, A. (2005), Three-dozen knowledge-sharing barriers managers must consider, *Journal of Knowledge Management*, 9(3), 18-35.

Roberts, J. (2006). Limits to Communities of Practice. *Journal of Management Studies*, 43(3), *623-639.*

Robertson, B. (2011). A Theoretical Method of Measuring Virtual Community Health and the Health of their Operating Environment in a Business Setting. In B. K. Daniel, *Handbook of Research on Methods and Techniques for Studying Virtual Communities: Paradigms and Phenomena* (p. 11). Hershey, PA, USA: IGI Global.

Russ, T. L. (2011). Theory X/Y assumptions as predictors of managers' propensity for participative decision making. *Management Decision*, 49(5), 823-836.

Ryu, S., Ho, S. H., & Han, I. (2003). Knowledge sharing behavior of physicians in hospitals. *Expert Systems with Applications*, 25(1), 113-122.

Said, D. (2011). *Middle East Paediatric Group*. Retrieved May 12, 2012, from Middle East Paediatric Group: http://www.linkedin.com/groups/Middle-East-Paediatric-Group-3785267/about?trk=anet_ug_grppro

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students fifth edition.* England, UK: Prentice Hall.

Schaufeli, W. B. (2008). Workaholism, Burnout, and Work Engagement: Three of a Kind or Three Different Kinds of Employee Well-being? *Applied psychology*, 57(2), 173-203.

Schneckenberg, D. (2009). Web 2.0 and the shift in corporate governance from control to democracy. *Knowledge Management Research & Practice*, 7(3), 234-248.

Scientific Software International, Inc. (2013). LISREL. Retrieved Feb 12, 2013, from SSI Scientific Software International: http://www.ssicentral.com/lisrel/index.html

Scott-Ladd, B., & Chan, C. C. (2004). Emotional intelligence and participation in decision-making: strategies for promoting organizational learning and change. *Strat. Change* , 13(2), 95-105.

Seaman, M. (2008). BIRDS OF A FEATHER?: COMMUNITIES OF PRACTICE AND KNOWLEDGE COMMUNITIES. *Curriculum and Teaching Dialogue*, 10(1), 269–279. Curriculum and Teaching Dialogue. doi:269-279,306

Sermo. (2012). *The Largest Online Community, Exclusive to Physicians - Sermo*. Retrieved May 12, 2012, from Sermo: http://www.sermo.com/

Selby-Harrington, M. L., RN, D., Mehta, S. M., Jutsum, V., Riportella-Muller, R., & Quade, D. (1994). Reporting of Instrument Validity and Reliability in Selected Clinical Nursing Journals, 1989. *Journal of Professional Nursing*, 10(1), 47-56.

Sharma, R. S., Samual, E. M., & Ng, E. W. J. (2009). Beyond the digital divide: policy analysis for knowledge societies. *Journal of Knowledge Management*, 13(5), 373-386.

Sheridan, B. 2008. 'Open Wide…'. Viewed 2 Dec 2010, http://www.newsweek.com/2008/10/15/open-wide.html

Short, A., Jackson, W., & Nugus, P. (2010). Expanding clinical research capacity through a community of practice (CoPER). Nurse Education in Practice, 10(1), 52-56.

Siegrist, J. (2005). Social reciprocity and health: New scientific evidence and policy implications. *Psychoneuroendocrinology*, 30(10), 1033–1038.

Sifer-Rivière, L., Girre, V., Gisselbrecht, M., & Saint-Jean, O. (2010). Physicians' perceptions of cancer care for elderly patients: A qualitative sociological study based on a pilot geriatric oncology program. *Critical Reviews in Oncology/Hematology*, 75(1), 58–69.

Singh, H., Naik, A. D., Rao, R., & Ann, L. (2007). Reducing Diagnostic Errors though Effective Communication: Harnessing the Power of Information Technology. *J Gen Intern Med*, 23(4), 489-494.

Slavoljub, M. (2006). Knowledge sharing between users and information specialists: Role of trust. Facta universitatis - series: *Economics and Organization*, 3(1), 51-58.

Snap Survey Software. (2012). 5 Examples of Survey Demographic Questions. Retrieved May 12, 2012, from snap surveys: http://www.snapsurveys.com/blog/5-survey-demographic-question-examples/

Sogunro, O. A. (2002). Selecting a Quantitative or Qualitative Research Methodology: An Experience. *Educational Research Quarterly*, *26*(1), 3-8.

Soni, J., Ansari, U., Sharma, D., & Soni, S. (2011). Predictive Data Mining for Medical Diagnosis: An Overview of Heart Disease Prediction. *International Journal of Computer Application*, 17(8), 43-48.

Stafford, M. (2000). To Err Is Human: Building a Safer Health System. *ProQuest Central*, 97(7), 5-9.

Stewart, S. A., & Abid, S. S. (2011). An Infobutton for Web 2.0 Clinical Discussions: The Knowledge Linkage Framework. IEEE Trans IEEE Transaction on Information Technology in Biomedicine Technol Biomed.

Stolberg, H. O., Norman, G., & Trop, I. (2004). Randomized Controlled Trials. *The Practice of Radiology Fundamentals of Clinical Research for Radiologists*, 183(6), 1539-1544.

Straub, Detmar, Gefen, D., & Boudreau, M.-C. (2004). *Quantitative, Positivist Research Methods in Information Systems*. (D. Galletta, Editor) Retrieved Jan 19, 2012, from The ISWorld Quantitative, Positivist Research Methods Website: http://dstraub.cis.gsu.edu:88/quant/2philo.asp

Suhr, D. D. (2006). Exploratory or Confirmatory Factor Analysis? Proceedings from the 31st Annual SAS® Users Group International Conference, March 26-29. San Francisco, California.

SurveyMonkey. (2012). 1. Answer What is SurveyMonekey Audience? Retrieved Aug 15, 2012, from Answers & FAQs: Answer What is SurveyMonekey Audience?: http://help.surveymonkey.com/app/answers/detail/a_id/231

SurveyMonkey. (2012). About Us. Retrieved Aug 15, 2012, from Everything You Wanted to Know, But Were Aftraid to Ask: http://www.surveymonkey.net/mp/aboutus/

SurveyMonkey. (2012). Answers & FAQs. Retrieved Aug 15, 2012, from Answer What if I have really specific targeting needs for my survey?: http://help.surveymonkey.com/app/answers/detail/a_id/5730

SurveyMonkey. (2012). My Surveys. Retrieved Nov 10, 2012, from SurveyMonkey: http://www.surveymonkey.net/MySurveys.aspx

SurveyMonkey. (2012). Welcome to SurveyMonkey! Retrieved Aug 10, 2012, from SurveyMonkey: http://www.surveymonkey.net/home/

Suurmond, J., & Seeleman, C. (2006). Shared decision-making in an intercultural context Barriers in the Interaction between physicians and immigrant patients. *Patient Education and Counseling*, 60(2), 253–259.

Symonds, E. (2011). A practical application of SurveyMonkey as a remote usability-testing tool. *Library Hi Tech*, 29(3), 436-445.

Tamir, J. (2011). *Physician Alignment, integration and Operations*. Retrieved May 12, 2012, from Physician Alignment, integration and Operations: http://www.linkedin.com/groups?gid=3848200&trk=group-name

Tarn, M. J., Wen, J. H., & Shih, S. C. (2008). A theoretical perspective of man-made system disasters Social-technical analysis and design. *Disaster Prevention and Management*, 17(2), 256-280.

Taylor, G. A., Voss, S. D., Melvin, P. R., & Graham, D. A. (2011). Diagnostic errors in pediatric radiology. *Pediatric Radiology*, 41(3), 327-334.

Thakkar, D., Hassan, A. E., Hamann, G., & Flora, P. (June 2008). A Framework for Measurement Based Performance Modeling. Proceedings of the 7th international workshop on software and performanc (pp. 55-66). Honolulu , HI, USA: ACM.

The 2012 Statistical Abstract The National Data Bank. (2011, Sept 17). *Table 164. Physicians by Sex and Speciality: 1988 to 2009.* Retrieved Mar 17, 2012, from U.S. Census Bureau: http://www.census.gov/compendia/statab/2012/tables/12s0164.pdf

The Association for Educational Communications and Technology. (2001). 41.1 What Is Descriptive Research? Retrieved Mar 17, 2012, from The Handbook of Research for Educational Communications and Technology: http://www.aect.org/edtech/ed1/41/41-01.html

The Center for Association Leadership. (2010). *The future of Healthcare Knowledge Sharing.* Seoul, Chicago, IL, USA 19 November 2010. IL: ASAE.

The Society of Rural Physicians of Canada. (2009). About SRPC. Retrieved Aug 10, 2012, from Society of Rural Physicians of Canada\: http://www.srpc.ca/srpc_services.html

Tornos, I. (2008). *Global Physician Network*. Retrieved May 12, 2012, from Global Physician Network: tp://www.linkedin.com/groupsDirectory?itemaction=mclk&anetid=145957&impid=&pgkey=anet_search_results&actpref=anetsrch_name&trk=anetsrch_name&goback=%2Egdr_1328943639895_1%2Eanb_1759777_*2_*1_*1_*1_*1_*1%2Eanb_2601905_*2_*1_*1_*1_*1_*1%2Egdr_1328943639901_

Tuutti, L. M. (2010). Online community as a source of social capital - A qualitative case study of "The Other IBM. Retrieved Sept 19, 2013, from https://aaltodoc.aalto.fi/handle/123456789/414

Venkatesh, V., & Davis, F. D. (1996). A Model of the Antecedents of Preceived Ease of Use: Development and Test. *Decision Sciences*, 27(3), 451-481.

Van der Meijden, M. & Jansen, S. (2010). In IEEE Press (Ed) Performance measuring in communities of practice: A method and case study. Research Challenges in Information Science (RCIS) *Fourth International Conference*.

Wachter, R. M. (2010). Why Diagnostic Errors Don't Get Any Respect—And What Can Be Done About

Them. *HEALTH AFFAIRS*, 29(9), 1605–1610.

Walker, J. T., & Maddan, S. (2009). Statistics in Criminology and Criminal Justice: Analysis and Interpretation, Third Edition. Ormindale, Canada: Jones and Bartlett Publishers.

Wallace, D. P., Fleet, C. V., & Downs, L. J. (2010). The Use of Research Methodologies in the Knowledge Management Literature. *ASIST 2010, October 22–27, 2010.* Pittsburgh.

Wang, C.-C., & Lai, C.-Y. (2006). Knowledge Contribution in the Online Virtual. *In Capability and Motivation Book Series* (pp. 442-453). Berlin: Springer.

Wang, W.-T., & Wei, Z.-H. (2011). Knowledge Sharing in wiki communities: an empirical study. *Online Information Review*, 35(5), 799-820.

Wang, Y., Yu, Q., & Fesenmaier, D. R. (2002). Defining the virtual tourist community: implications for tourism marketing. *Tourism Management*, 23.

Weston, R., & Gore, P. A., (2006). A Brief Guide to Structural Equation Modeling. *The Counseling Psychologist*, 34(5), 719-751.

White, M. P., Cohrs, J. C., & Go¨ritz, A. S. (2011). Dynamics of Trust in Medical Decision Making: An Experimental Investigation into Underlying Processes. *Medical Decision Making*, 710-720.

Wickramasinghe, N., Bali, R. K., Lehaney, B, Schaffer, J. L., & Gibbons M. C. (Eds). (2009). *Healthcare Knowledge Management Primer*. New York & Lomdon: Routledge Taylor & Francis Group.

Wickramasingha, N, Gupta, J. N. D & Sharma, S. K (Eds.). (2005), Creating Knowledge-Based Healthcare Organizations, *Idea Group Publishing*, Hershey.

Widén-Wulff, G., & Ginman, M. (2004). Explaining knowledge sharing in organizations through the dimensions of social capital. *Journal of Information Science*, 30(5), 448-458.

Willis, S., Sarnikar, S., El-Gayar, O. F. and Deokar, A. V. 2010. Information Systems and Healthcare XXXIV: Clinical Knowledge Management Systems—Literature Review and Research Issues for Information Systems. *Communications of the Association for Information Systems*, 26, 79.

Wilner, M. (2012, Aug 10). Doctors on the SurveyMonkey panel. (A. Razzaque, Interviewer)

Wilson, T. (2008). *The Medical Informatics Physician*. Retrieved May 12, 2012, from The Medical Informatics Physician: http://www.linkedin.com/groupsDirectory?itemaction=mclk&anetid=150121&impid=&pgkey=anet_search_results&actpref=anetsrch_name&trk=anetsrch_name&goback=%2Egdr_1328943639895_1%2Eanb_1759777_*2_*1_*1_*1_*1_*1%2Eanb_2601905_*2_*1_*1_*1_*1_*1%2Egdr_132894363990

Wright, A., & Sittig, D. F. (2008). A Four-Phase Model of the Evolution of Clinical Decision Support Architectures. *Int J Med Inform*, 77(10), 641-655.

Wu, Y., Senoo, D., & Magnier-Watanabe, R. (2010). Diagnosis for organizational knowledge creation: an ontological shift SECI model. *Journal of Knowledge Management*, 14(6), 791-810.

Wuantia Communications, Inc. (2012). *QuantiaMD.* Retrieved May 12, 2012, from QuantiaMD Home: https://secure.quantiamd.com/

Yaich, R., Boissier, O., Jaillon, P., & Picard, G. (2011). Social-Compliance in Trust Management within Virtual Communities. *IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology* (pp. 322-325). Lyon, France: IEEE Computer Society.

Yan, W., Chen, C.-H., & Khoo, L. P. (2002). An integrated approach to the elicitation of customer requirements for engineering design using picture sorts and fuzzy evaluation. *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, 16(2), 59-71.

Yang, B., Watkins, K. E., & Marsick, V. J. (2004). The Construct of the Learning. *Human Resource Development Quarterly*, 15(1), 31-55.

Yu, T.-K., Lu, L.-C., & Liu, T.-F. (2010). Exploring factors that influence knowledge sharing behavior via weblogs. *Computers in Human Behavior*, 26(1), 32–41.

Yusoff, M. S. (2011). A Confirmatory Factor Analysis Study on the Medical Student Stressor Questionnaire among Malaysian medical students. *Education in Medicine Journal*, 3(1), 44-53.

Zacks, R. (2007). *Sermo Strikes Back: A Physicians' Online Community Lashes Out Against Bloggers Who Publicize Security Gap*. Retrieved Jan 26, 2012, from XConomy: http://www.xconomy.com/boston/2007/09/26/sermo-strikes-back-a-physicians-online-community-lashes-out-against-bloggers-who-publicize-security-gap/

Zhang, L., Tan, C. P., Li, S., Fang, H., Rai, P., Chen, Y., et al. (2012). The Influence of Interaction Attributes on Trust in Virtual Commnuities. In L. Ardissono, & T. Kuflik, *UMAP 2011 Workshops* (pp. 268–279). Berlin Heidelberg: Springer.

Zhao, N. (2009, March 23). The Minimum Sample Size in Factor Analysis. Retrieved July 12, 2012, from Atlassian Confluence Community: http://www.encorewiki.org/display/~nzhao/The+Minimum+Sample+Size+in+Factor+Analysis

Zhu, W., Chew, I. K., & Spangler, W. D. (2005). CEO transformational leadership and organizational outcomes: The mediating role of human–capital-enhancing human resource management. *The Leadership Quarterly*, 16(1), 39–52.

APPENDIX A

Survey distributed to 600 SurveyMoney Virtual Community members

Brunel Business School
Research Ethics
Participant Information Sheet

Dear Sir/Madam,

I am a researcher at Brunel University, London, UK. Part of my research is a survey, currently being pilot tested. I would really appreciate your kind participation in this questionnaire

TITLE OF THE RESEARCH PROJECT:
"Study to Assess the Effectiveness of Physicians' Virtual Community of Practice on their Decision and Shared Knowledge"

WHAT IS A VIRTUAL COMMUNITY?
Where group of physicians share common interest, experience, answer each others' questions and/or provide emotional support online.

AIM OF MY RESEARCH:
My research aims at assessing the effectiveness of a virtual community of practice on a physician's medical decision making and knowledge sharing.

PURPOSE OF YOUR PARTICIPATION IN THIS SURVEY:

- Please answer all items of the survey
- Will take no longer than 15 minutes

TARGET DATE:
I would really appreciate it if you could submit this questionnaire by Aug 20, 2012.

BRUNEL UNIVERSITY RESEARCH ETHICS:
I received ethical approval from Brunel University to conduct this research project. Hence, all identities and provided information will be considered strictly confidential.

For further inquiries please contact me at Skype ID – 'anjum.razzaque' or anjum.razzaque@brunel.ac.uk Thank you for your input.

Sincerely,

Anjum Razzaque
PhD Student in Information Systems,
Brunel Business School Brunel University, London, UK.

GENERAL QUESTIONS Please Note – Check (X) for the answer closely characterizing you.				
1.	Gender:	☐ Male	☐ Female	
2.	Work experience (in years):	☐ Less than 5 ☐ 11 – 15 ☐ Above 20	☐ 5 – 10 ☐ 16 – 20	
3.	Specialty,(i.e. department)	☐ Internal Medicine ☐ General Surgery ☐ OBS/GYN ☐ Pediatrics ☐ Family Medicine ☐ Ophthalmology ☐ Dermatology	☐ ENT ☐ Radiology ☐ Anesthesiology ☐ Physiotherapy ☐ Urology ☐ Neurology ☐ Emergency	☐ Other _____
Definition of Virtual Community: Where group of physicians share common interest, experience, answer each other's' questions and/or provide emotional support online.				
4.	I am part of a Virtual Community because I am part of a/an: ☐ Professional email list ☐ Professional group in a social media platform e.g. Facebook, LinkedIn or Twitter ☐ Professional platform on the Internet, e.g. SERMO, QuantiaMD, Epocrates, etc ☐ Video conference for joint discussion or collaboration between two or more physicians			

IMPORTANT:

For each of the following statements, please indicate your degree of agreement or disagreement by clicking the appropriate number given against the statements. The Scales are:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
↓	↓	↓	↓	↓
1	2	3	4	5

SOCIAL INTERACTION TIES:						
Social Interaction Ties is the Interactions between members' network of relations						
5.	I maintain close social relationships with some members in a virtual community	1	2	3	4	5
6.	I spend a lot of time interacting with some members in the virtual community on a personal level	1	2	3	4	5
7.	I have frequent communication with some members in the virtual community.	1	2	3	4	5

Strongly disagree ↓ 1	Disagree ↓ 2	Neutral ↓ 3	Agree ↓ 4	Strongly agree ↓ 5

TRUST:						
Trust is beliefs or expectations to exchange resources in a virtual community						
8.	Members in the virtual community will not take advantage of others even when the opportunity arises.	1	2	3	4	5
9.	Members in the virtual community will always keep the promise they make to one another	1	2	3	4	5
10.	Members in the virtual community would not knowingly do anything to disrupt the conversation.	1	2	3	4	5
11.	Members in a virtual community behave in a consistent manner.	1	2	3	4	5
NORMS OF RECIPROCITY:						
Norms of Reciprocity is exchanging resources is considered fair and rewarding due to time spent and effort exerted by virtual community members						
12.	I know that other members in the virtual community will help me, so it's only fair to help other members.	1	2	3	4	5
13.	I believe that members in the virtual community would help me if I need it.	1	2	3	4	5
IDENTIFICATION:						
Identification is view of oneself as one with others, due to one's positive feeling and sense of belonging in a virtual community						
14.	I feel a sense of belonging towards the virtual community.	1	2	3	4	5
15.	I have the feeling of togetherness or closeness in the virtual community.	1	2	3	4	5
16.	I have a strong positive feeling towards the virtual community .	1	2	3	4	5
17.	I am proud to be a member of the virtual community	1	2	3	4	5
SHARED LANGUAGE:						
Shared Language is common acronyms or underlying assumption facilitate daily interactions for resource exchange in a virtual community						
18.	Members in the virtual community use common terms or jargons.	1	2	3	4	5
19.	Members in the virtual community use understandable communication pattern during the discussion	1	2	3	4	5
SHARED VISION:						
Shared Vision is members' collective interests and goals that facilitate them to share their resources with one another						
20.	Members in the virtual community share the same goal of learning from each other.	1	2	3	4	5
21.	Members in the virtual community share the same value that helping others is pleasant.	1	2	3	4	5

Strongly disagree ↓ 1	Disagree ↓ 2	Neutral ↓ 3	Agree ↓ 4	Strongly agree ↓ 5

KNOWLEDGE SHARING QUALITY:						
Knowledge sharing quality is virtual community's shared resource is its members' knowledge whose overall quality is assessed						
22.	The knowledge shared by members in virtual community is relevant to the topic.	1	2	3	4	5
23.	The knowledge shared by members in virtual community is easy to understand.	1	2	3	4	5
24.	The knowledge shared by members in virtual community is accurate.	1	2	3	4	5
25.	The knowledge shared by members in virtual community is complete.	1	2	3	4	5
26.	The knowledge shared by members in virtual community is reliable.	1	2	3	4	5
DECISION MAKING QUALITY:						
Medical Decision Making Quality is decisions are outcomes of shared knowledge between members whose overall quality is being assessed						
27.	I am more certain of the diagnoses after my interaction with members in the virtual community.	1	2	3	4	5
28.	I am more certain of the treatment after my interaction with members in the virtual community.	1	2	3	4	5
29.	I am more certain of the health benefits after my interaction with members in the virtual community.	1	2	3	4	5
30.	I am more certain of the side effects after my interaction with members in the virtual community.	1	2	3	4	5
31.	I am more certain of the risks after my interaction with members in the virtual community.	1	2	3	4	5
32.	I am more certain of the use of evidence-based knowledge after my interaction with members in the virtual community.	1	2	3	4	5

Thank you for your cooperation… !

APPENDIX B

Ethical Approval Letter.

Head of Brunel Business School
Professor Zahir Irani

Brunel University, Uxbridge,
Middlesex, UB8 3PH, UK
Telephone +44 (0)1895 274000
Web www.brunel.ac.uk

Thursday, 21 June 2012

To the Bahraini Ministry of Health

This is to confirm that Mr Anjum Razzaque has gained ethical approval by the Brunel Business School Research Ethics committee (BBS-SREC) for his research entitled "Assessing the Impact of Physician's Social Capital on Decision Making Quality mediated by Knowledge Sharing Behaviour within a Virtual Community of Practice: An Empirical Quantitative Analysis". We therefore would like to ask for your support to Mr Razzaque to conduct his research and in acquiring any further required approvals at your end.

If you have any questions please do not hesitate to contact me.

Kindest regards

Dr Ahmad Ghoneim
Head School Research Ethics Committee
Brunel Business School
Brunel University
Uxbridge, Middlesex UB8 3PH
United Kingdom
Tel: +44 (01895) 265 176
Fax: +44 (01895) 269 775