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Understanding Dynamic Collaboration in Teleconsultation

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ABSTRACT

Information and communication technology (ICT) has been widely deployed in the provision of health care for decades. Teleconsultation, one of these new telemedicine solutions, has been prevalently implemented in numerous countries with its tremendous potential to improve healthcare. However, the clinical utility has remained at a disappointing level. Unlike prior research that focuses on the pre-adoption or implementation stages, our research explores not only the understanding the antecedences of actual usage in post-adoption of teleconsultation service, but also the reasons for low actual usage in clinical practice. We identify specific theoretical attributes that are relevant to our research question, and extend TOE into an integrative theoretical framework. Initial propositions are generated based on theoretical perspectives in each dimension of the framework. Finally, we design a comparative case study as our research methodology, and conduct deductive analysis to test our propositions using data from multiple sources. Theoretical and practical implications, as well as future research, are outlined.

Keywords

Teleconsultation, telemedicine, post adoption, TOE framework, media synchronicity theory.

INTRODUCTION

Worldwide, there is an unbalanced situation in terms of increasing health needs and the required resources to provide more efficient, effective, and reasonably priced healthcare service. These are imperative problems that call for effective remedies, engaging healthcare practitioners. Particularly in developing countries such as China, there is the challenge of medical resources being extremely unevenly distributed. Most specialists work in well-resourced hospitals located in big cities, such as Beijing and Shanghai, whereas large parts of the population in rural areas have scarce resources (Zhang, Wand and Xi 2010).

By definition, telemedicine is "the use of electronic information and communication technologies to provide and support healthcare when distance separates the participants" (Ekeland, Bowes and Flottorp 1996). Teleconsultation is "a particular type of telemedicine typically involving one healthcare provider—usually a primary care provider seeking advice from another—usually a specialist or sub-specialist—who has specialized expertise regarding the health problem at hand" (Paul 2010).

Information and communication technologies, which provide a wider boundary for collaboration, are expected to substantially improve work performance. It is possible for teleconsultation to solve this unbalanced distribution of medical resources in a cost-effective fashion. In reality, technology is widely installed in prosperous and rural hospitals, but the actual utility still remains at a disappointingly low level. A growing call for effective and efficient teleconsultation comes from both the academic and practical domains. Our research thus aims to provide a comprehensive understanding of dynamic collaboration between specialized hospitals and non-specialized hospitals in teleconsultation.

LITERATURE REVIEW

Teleconsultation

The general situation for telemedicine reported by an extensive survey of telemedicine is that “There have been great expectations for telemedicine, but implementation of such applications has proven to be difficult, and not widely used”(Obstfelder, Engeseth and Rolf 2007). One stream of research focuses on the assessment of teleconsultation endeavors. Most studies conduct case studies that present various findings related to barriers in clinical usage, such as time-intensiveness, expertise asymmetry, poor image resolution, etc. (Braa, Hanseth, Heywood, Mohammed and Shaw August 2007; Ekeland, Bowes and Flottorp 2010; Lehoux, Sicotte, Denis, Berg and Lacroix 2002; Sicotte and Lehoux 2003). Another stream provides overviews found from theoretical and methodological perspective and critical success criteria, etc. (Obstfelder et al. 2007; Whitten, Johannessen, Sørensen, Gammon and Mackert 2007). In summary, there are studies that target either technological issues or the social context (Chaoa, Jenb, Hungc, Lid and Chie 2007; Han, Lee and Park 2010; Nicolini May–June 2011); however, collective agreement on success criteria has been reached on the interplay between the technical and social factors (Gammon, Johannessen, Sørensen, Wynn and Whitten 2008; Obstfelder et al. 2007), where theories adopted are in the cluster of social and technology studies, including Actor Network Theory (Latour 1999), Giddens’ Structuration Theory (Giddens 1984), Institutional theory, (Scott 1995), etc.

Post-adoption

There is a plethora of research on IT adoption and usage, a research area which has become one of richest streams in the IS field. Based on the figure proposed by Jasperson, the adoption process goes through the organizational application adoption decision, to the individual application adoption decision, and then to the post-adoption area (Jasperson, Carter and Zmud 2005). Considerable research has contributed to the pre-adoption and implementation of IT, as seen from both the organizational and individual perspective; however, the influential factors are distinct in different pre-adoption and post-adoption contexts. For this reason, we need more specific understanding of post-adoption variance (Jasperson et al. 2005; Zhu and Kraemer 2005).

The Technology Organizational Framework (TOE) (Tornatzky and Fleischer 1990) has been proposed for understanding antecedents of innovative IT use in different business contexts (Lee and Shim December 2007; Zhu and Kraemer 2005). However, the TOE framework provides only an overall scope, and is therefore not a well-defined theory for particular research issues. Further, individual theories may lack the “breath of variables in TOE and its classification. Consistent with recent research that combines appropriate attributes to TOE, we aim to enrich the understanding in our specific context with solid theoretical attributes (Mishra, Konana and Barua 2007; Zhu, Wu and Peng 2003).

THEORETICAL FRAMEWORK

Proposing preliminary theories with propositions as “sufficient blueprint” is an essential step for positivist case study research (Yin 2008). Although there is a growing trend of studies with theories, there is no solid theory for teleconsultation. We thus first propose the framework that accommodates TOE, along with relevant theories could provide explicit guidance for practitioners to achieve efficient and effective teleconsultation. This provides a higher level framework for understanding not only the dynamic collaborative endeavors between two participant organizations but also for exploring potential ways of reaching mutual agreement by examining the internal and external influences of both sides of teleconsultation adoption (Gregor 2006). Consistent with the TOE framework (Tornatzky and Fleischer 1990), the theoretical framework comprises three dimensions: organizational, environmental, and technological. Under this general umbrella, we further identify relevant sub-dimensions in each of the three contexts to fit our research area into the conceptual framework.

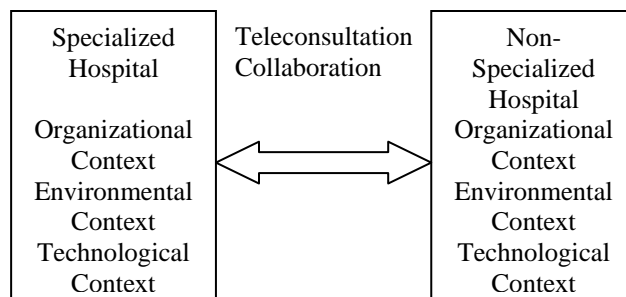


Figure 1. Multidimensional Conceptual Framework

Organizational Context

Generally, organizational context refers to resources and characteristics of the firm. The concept of resources originated in resource dependency theory (RDT) (Tornatzky and Fleischer 1990), in which a resource refers to “anything perceived as valuable by an actor (i.e., an organization), such as information, material, capital, or access to markets, and dependency is a state in which one actor relies on the actions of another to achieve particular outcomes” (Pfeffer and Salancik 1978; Ulrich and Barney 1984). We define the resource in teleconsultation as the hospital resource that includes medical specialists, technological infrastructure for telemedicine, and the related business capital, such as affordable expense on purchase and maintenance of teleconsultation systems, as well as expecting profit from teleconsultation. The interdependency issue in teleconsultation is reflected in collaboration between hospitals.

RDT points out that successful collaboration is built on the mutual assumption that the outcome of a relationship is greater than what can be achieved by the individual party. In other words, the motivation for collaboration depends on the exclusive mutual benefit of two parties. The ultimate goal is to achieve collaborative agreement: a linkage between companies to jointly pursue a common goal (Pfeffer and Salancik 1978; Tillquist, King and Woo 2002). Thus, the key issue is to identify sustained motivation determinants of collaboration, and then assess governance dependency through coordination of activities between two organizations (Huxham and Vangen 2000). Accordingly, we have included teleconsultation demands and the clinical situation, as well as management support into sub-dimensions of the conceptual framework; we have also designed our interview questionnaires to reflect related terms and conditions, after which we assess the coordination. This leads to our first proposition:

P1: When organizational resources of participants in teleconsultation service can be leveraged to form mutual agreement on collaboration, teleconsultation service is facilitated.

Environmental Context

Institutional pressure has been established as an inevitable effect on IT innovation adoption, and thus we consider it as one of the environmental influences on teleconsultation (Agarwal, Gao, DesRoches and Jha 2010; Gosain 2004; Sorensen 2003). In the domestic health care market, about 90% are public hospitals, but it is still a “buyer side” market (IDC 2009), and thus we focus on coercive pressure by government to for hospitals to establish social obligation to enact teleconsultation service. There are generally three major income sources in public hospitals: charges for medical services, profit from medicine sales, and government funding. Prosperous hospitals with extensive specialist resources and the most advanced medical infrastructure have the advantage in the healthcare market. However, prospering hospitals are under great coercive pressure to embrace social obligation. They need to find a balance between profit based operation and public welfare when they encounter IT related innovation adoption and implementation such as teleconsultation (Tornatzky and Fleischer 1990). Unlike the surplus in demand in prosperous hospitals, rural and community hospitals face the challenge of attracting enough patients and thus gaining profit. In this circumstance, government support is considered as the external environmental influence. Financial funds and policy support would help lower level hospitals to investigate and maintain IT innovations, e.g., teleconsultation. Thus,

P2: When the government provides financial and political support, and hospitals form social obligations from institutional pressures, teleconsultation service is facilitated.

Technological context

Decisions to adopt innovative IT technology depend on what technologies are available in the market, and how well they fit with a firm’s current technology in a cost-effective way (Xue, Padman, Ramsey and Spirtes 2008). Features of technology, including existing and available ones, have been widely supported in previous literature, indicating that they have an important influence on the adoption and implementation of innovative technology in healthcare (Tornatzky and Fleischer 1990). In teleconsultation, the adopted technology should fit with the communication process between collaborative hospitals. Media synchronicity of the adopted technology should match the synchronicity that the communication process requires. Media synchronicity is defined as a “state in which individuals are working together at the same time with a common focus” in Media Synchronicity Theory (MST) (England, Stewart and Walker 2000; Poon, Blumenthal, Jaggi, Honour and Kausha 2004). Thus, we assess available IT technology in teleconsultation from the aspects of hardware equipment, transmission quality, and technical support. To fit the technology with communication in teleconsultation, synchronicity needs for different teleconsultation (in terms of the medical nature) have to be identified. Thus,

P3: When the media synchronicity of the adopted technology matches the synchronicity that the communication process requires, teleconsultation service is facilitated.

Dimension	Issues	Reference
Organizational	<ul style="list-style-type: none"> Affordable expense on purchase and maintenance of teleconsultation systems Management support of teleconsultation Specialist's resource Teleconsultation demands and clinical situation Expected profit on teleconsultation Geographical location 	Tornatzky and S 1990 Sorensen 2003 Agarwal et al. 2010 Feldman and Horan 2011 Tillquist et al. 2002 Sorensen 2003
Environmental	<ul style="list-style-type: none"> Government support Regulations on responsibility Regulations on security Intangible benefit/altruistic motivation Social obligation Institutional pressure 	Tornatzky and Fleischer 1990 Sorensen 2003 Agarwal et al. 2010 Feldman and Horan 2011 Xue et al. 2008 Sen 1977
Technological	<ul style="list-style-type: none"> Teleconsultation hardware equipment Transmission quality Technical support Synchronicity needs for different teleconsultations 	Tornatzky and Fleischer 1990 Sorensen 2003 Agarwal et al. 2010 Feldman and Horan 2011 Dennis et al. 2008

Table 1 Multidimensional Analytical Framework

RESEARCH DESIGN

We conduct case studies to empirically test the propositions in our proposed multi-dimensional conceptual framework to explore the underlying reasons in dynamic teleconsultation collaboration. As comparisons between sites help to demonstrate the impact in different contexts (Zhu et al. 2003), we further apply a comparative case study design.

Multiple data source is used to enhance reliability, and thus we followed the instructions of Yin (Yin 2008) to explicitly document our case study protocol to include interview instruments, interview conditions and descriptions, and general guidance for interviews. To access the organizational level of analysis, we selected hospital administrative managers associated with IT healthcare as our interviewees. The interviews were semi-structured with open ended questions in order for participants to fully express their opinions. Each set of interviews lasted around one hour, the content of which was documented in text format. All in-person interviews were completed by one author for consistency of the interview strategy. The documented interviews were then analyzed independently by two authors. All interviews were undertaken in Beijing, Shanghai and Taiyuan from April 2011 to July 2011.

In Case 1, the No. 2 Hospital of Taiyuan City (the capital city of Shanxi province) is a second level (medium sized) hospital with roots in the middle layer of the three-layer structure. It connects up to the PLA General Hospital, a first level hospital in Beijing, which links down to thirty district hospitals in counties around Taiyuan City. The PLA General Hospital was founded in 1953 with more than 150 clinical, medical, and technology departments. This specialized hospital housing many famous specialists is reputed to be one of the best general hospitals in China, and is ranked in the Top 3 by the Health Department of General Logistics Department in China. The general medical level in Taiyuan City is not as high as that of the PLA General Hospital in Beijing. The teleconsultation between PLA General Hospital and No. 2 Hospital of Taiyuan City is through real-time video conference between specialists and non-specialists for diagnosing complicated cases. The teleconsultation between community hospitals and No. 2 Hospital of Taiyuan City is non-real-time remote Electrocardiograph (ECG).

In Case 2, the three layer structure selected is comparable to that of Case 1. The highest level of hospital is Beijing Tiantan Hospital, the middle level is Fenyang People hospital located in Fenyang city in Shanxi province, and the lowest level is Shanxi Sunji hospital. The third IT service provider is Neusoft Company and the consultation management center is located in Beijing Tiantan hospital. All hospitals in Case 2 are subscribers of Neusoft Company for its teleconsultation service. The Neusoft provides real-time interactive clinical consultation and non-real-time remote video consultation (remote diagnosis with medical experts reports based on patients' image materials acquired from CT, MR, CR and DR amongst others).

	Institution	Mode Structure	Interviewee
Case 1	PLA General Hospital	<pre> graph TD A[First Level Hospital] --> B[Second Level Hospital] B --> C[Community Hospitals] </pre>	CEO Director of IT department Director of Cardiology department Doctors and nurses
	No.2 Hospital of Taiyuan City		Doctors and nurses
	Community Hospitals		CEO Doctors and nurses
Case 2	Beijing Tiantan hospital	<pre> graph TD A[First Level Hospital] --> B[Second Level Hospital] B --> C[Rural Hospital] </pre>	Doctors and nurses
	Fenyang People hospital		CEO Director of IT department Doctors and nurses
	Neusoft company		Regional manager Sales manager IT department manager Project manager
	Shanxi Sunji hospital		CEO Doctors and nurses
Table 2 Case Study Design			

CASE ANALYSES

P1: When organizational resources of participants in teleconsultation service can be leveraged to form mutual agreement on collaboration, teleconsultation service is facilitated.

Case 1

The request party, the No. 2 Hospital of Taiyuan City, has patient demands for teleconsultation and a propaganda strategy. The hospital expects more revenue to be generated by teleconsultation. The supply party, the PLA General Hospital in Beijing, is motivated, but participation benefits its “social image” rather than making a profit. It sees teleconsultation as a way of alleviating the over-crowded outpatient and inpatient area. In sum, both hospitals are motivated to use the teleconsultation service, as the two hospitals indicate:

The CEO of No.2 Hospital of Taiyuan City: *“I hope we can get help on some difficult disease through teleconsultation from the PLA General Hospital. We have basic hardware equipment for doing distant video conference, so the expense is not a big deal for us. Also, we have complicated cases from time to time and our own doctors are not uncertain on diagnosing, so that we want to seek help from expertise in Beijing. The patient can be treated in our hospital instead transferred, and bring revenue for us. We also want to attract local patients to our hospital by their famous reputation.”*

(As reported) The PLA General Hospital: *“We have plenty of patients in our outpatient service, so that we don’t see teleconsultation mainly for profit, but for building our ‘social image’ more widely. In addition, by doing teleconsultation, lots of patients don’t need to travel long way to Beijing and our over-loaded inpatient situation can be alleviated. “*

Although both hospitals had initiatives to use teleconsultation services, the actual utility was disappointingly low. We then assessed their managerial support on teleconsultation separately in order to find the obstacles to success. In No. 2 Hospital of Taiyuan City, there is no designated department or person responsible for teleconsultation. In essence, running a teleconsultation service requires considerable preparation work (namely, setting up applications, searching and reaching suitable expertise, negotiating available times) and quality assurance, etc.

Case 2

The specialists' resource allocation, the demands and expectations on teleconsultation, as well as the affordability of teleconsultation of Case 2 are similar between the Shanxi Sunji hospital and Beijing Tiantan Hospital. However, in Case 2, there is a clinical consultation management center for teleconsultation service provided by Neusoft company. The management center establishes standard procedures, enacting the detailed cooperating scheme and system maintenance, as well as the training - all of which ensures that resources for participants in teleconsultation service will be leveraged to support mutual agreement on collaboration. The evidence of usage of teleconsultation shows a considerable number of success cases.

(As reported) Director of department of neurology in Beijing Tiantan hospital: "Before the video conference for teleconsultation, the panel doctor of Sunji hospital has to upload patients' CT scans and description of medical history record to the system as required. At the beginning, he also briefly summarizes them to me. Then I give him my consulting advice and explained to him as....Although the patient has missed the best recover period, I also suggested him to start the rehabilitation program for patient as early as possible and told him to pay attention to ..."

An 'in charge' doctor in Shan Sunji hospital: *"Thanks to teleconsultation and the advice from Dr. Ma (from Beijing Tiantan hospital), we clarify and confirm the patient's problem. The whole consultation proceeded thirty minutes, and the consulting report released later."*

To conclude, the key to the failure in Case 1 and the success in Case 2 is attributed to the lack of, and successful, management, respectively, of the organizational resources through which both sides achieved mutual collaborative agreement on teleconsultation.

P2: When the government provides financial and political support, and hospitals form social obligations from institutional pressures, teleconsultation service is facilitated.

All hospitals of our cases agree that financial and political government support is critical to IT adoption in healthcare, including teleconsultation. Hospitals, especially rural ones, face a lot of operational pressure. Therefore, financial support from the government facilitates the teleconsultation implementation and adoption process.

Director of information technology department in Fenyang hospital: *"Ever year, big amount of money need to spend on IT systems and service in our hospital. The local ministry of health department will fund some money for it; however, it only can cover a small portion of our expense. If we can get more funding, we may consider hire some people or form a team to do teleconsultation. I think the results would be better."*

Director of Cardiology department in No.2 hospital in Taiyuan City: *"... as the early stage of launching the dynamic electronic cardiology program, we were facing lots of difficulties. For instance, most community hospitals do not have the "box" for capture patient's dynamic electrocardiograph and we need to equip each box per hospital. The total expense on equipment for thirty community hospitals is really a big amount and luckily we get the Taiyuan government support on this purchase. Otherwise, we may not launch this program in a short time at this scale."*

The lack of specific laws for teleconsultation is a big concern for hospitals, and thus the enacting of detailed laws and standard protocol would facilitate teleconsultation service. Suitable government pressure and regulations would facilitate teleconsultation service.

Director of information technology department in Fenyang hospital: *"...Yes, we heard of "Facilitating Regulations on Telemedicine Regulation1991", but it is the regulation, not the law. We were once involved in a dispute. We gave consulting advice through teleconsultation, but the local doctor didn't interpret correctly and made wrong treatment for patients. However, we still had responsibility for that..."*

P3: When the media synchronicity of the adopted technology match the synchronicity that the communication process requires, teleconsultation service is facilitated.

Asynchronized case: in Case 1, although the teleconsultation between the No. 2 Hospital of Taiyuan City and the PLA General Hospital was not well used, the particular consultation service in cardiology between the No. 2 Hospital of Taiyuan City and three community hospitals in Taiyuan was used extensively. Launched in 2009, the program already generated profit for both levels of hospitals. In addition, it brought social benefits for local patients and thus received government funds for extension.

Director of cardiology department in No. 2 Hospital of Taiyuan City: *"Before launching the program, we formed a particular team to do the market research, from which we would like to know what situation in those community hospitals."*

The results showed that all community hospitals had equipped with the electrocardiogram machine and local doctors had capability to operate the machine and did the electrocardiogram for patients. However, many local doctors could not provide correct diagnosis and local patients were not trust with the community hospitals in turn...Since electrocardiogram is already a digital format and it is easy to be transmitted as long as they have computers connected to the internet..."

This case shows that teleconsultation communication in cardiology can be done asynchronously when local hospitals have existing technology that can support this process. Consistent with previous medical literature (Puentes, Bail, Wickramasinghe and Naguib 2007), as well as findings from the pilot cases and main cases, departments (such as cardiology, pathology, and medical image) that require a high diagnostic level but a relatively low level of lab operation are suitable for asynchronous teleconsultation. Other cases, such as the dermatology, ophthalmology, etc., which need more direct interaction between physicians and patients, have difficulty giving complete consultations at different geographical locations. Teleconsultation could be considered as a supplementary assistance or could serve as follow-up consultation service.

Synchronized case: one of the critical factors in synchronous teleconsultation is the prerequisite of existing mutual knowledge for both participants. More specifically, non-specialists should prepare sufficient patient medical documents, such as symptom descriptions, test reports, medical histories, etc., and send them to specialists before the teleconsultation. Additionally, non-specialists should have enough medical knowledge to digest the consultation given by specialists. In our investigation, many synchronous teleconsultations were hindered due to the lack of prerequisite understanding and the unmatched communication process with medical diagnosing requests. On the other hand, more efficient cases with better diagnosing results occurred if sufficient managerial and operational procedures as well as regulations were applied to both participants in teleconsultation. This is indicative of the comparative examples in the two cases:

Case 1 Director of information technology department in No.2 Hospital of Taiyuan City: "The time is very limited in teleconsultation, but quite amount of it is wasted by asking and exchanging medical reports. Sometimes, we provide consultations based on potential symptoms that patients may encounter to, such as if..., then...; else if..., then...unfortunately the doctors in the village hospital seems do not understand the instructions and cannot treat local patients correctly."

Case 2 Neusoft regional manager: "We have formal procedures for interactive teleconsultation. For instance, the junior doctor (requesting party) needs to prepare complete test results and ancillary reports which approved by the specialist (supplying party) before the video conference. We also have strict time arrangement schedule and step-by-step procedures from start to end. To ensure the service quality, we also set up strict deadline to hand in diagnosing report with signatures to our system..."

CONCLUSION AND IMPLICATIONS

This paper presents a multi-dimensional conceptual framework not only to understand dynamic teleconsultation among distant participants, more specifically to understand the antecedences of actual usage in post-adoption of teleconsultation service, but also provides reasons for low actual usage in clinical practice. Theoretically, this study extends the TOE theory together with RDT, institutional pressure and MST to understanding collaboration dynamics in teleconsultation. This could serve as a basis for developing theory on how technology and organizational factors affect healthcare outcomes in a virtual process. Practically, our propositions provide suggestions for better collaboration among hospitals. For example, appropriate technology (in terms of media synchronicity) should be provided to facilitate teleconsultation communication processes.

There are, of course, limitations in the current study given its explorative nature. Generalizability could be a concern, given that we investigated relatively few hospitals. We plan to collect data from other collaborative hospitals. Further research could examine how to accommodate resources and policy (identified in our propositions) to encourage continued long-term teleconsultation collaboration.

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