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ABSTRACT

Telemedicine has a strategic role in providing timely medical care and containing the spread of infectious diseases. Despite its importance, telemedicine is largely underdeveloped in developing countries. This paper attempts to explore the factors influencing telemedicine usage by conducting case studies in two Chinese hospitals. Based on a research model we proposed, factors are identified that are likely to affect the use of telemedicine.

Keywords

Telemedicine, China, Case study, Hospital, Health care.

INTRODUCTION

Severe Acute Respiratory Syndrome (SARS) has drawn considerable worldwide attention since it revealed how vulnerable the global public health could be. During the SARS outbreak, delayed diagnosis and treatment of SARS became a key factor that contributed to the rapid spread of the deadly disease. A more rapid and efficient medical care providing system is needed to respond to the challenge posed by such medical crises. In developing countries such as China, providing medical care services via the traditional face-to-face venue in emergency situations is problematic due to the wide geographic expansion and the scarcity of medical expertise in rural areas. In contrast to the traditional care delivery venue, telemedicine allows patients and healthcare providers to receive help from specialists located in remote sites, thus greatly extending the reach of geographically confined medical resources. Given its capability of virtually reallocating medical resources, telemedicine could be employed as a vigorous weapon to combat SARS. Indeed, several instances of successful telemedicine applications in China have been reported. Telemedicine is capable of sharing valuable medical information and expertise and seems to hold considerable promises in contributing to the global public health.

Telemedicine is defined by the Telemedicine Information Exchange (1997) (Welsh, 1999) as the "use of electronic signals to transfer medical data (photographs, x-ray images, audio, patient records, video conferences, etc.) from one site to another via the Internet, Intranet, PCs, satellites, or videoconferencing telephone equipment in order to improve access to health care." Telemedicine embodies the concept of "the use of advanced telecommunications technology to exchange health information and provide health care services across geographic, time, social, and cultural barriers" (Reid, 1996). It includes services such as distance case discussion, distance diagnosis, distance healthcare, tele-education, telemedicine statistics, and medical resource sharing, among others (Yang and Gao, 2001). The past decade has witnessed an explosion of interest in telemedicine, with numerous programs introduced in North America, Europe, and Japan (Zhao, 1998).

Given the strategic role of telemedicine in providing timely medical care and containing the spread of infectious diseases in developing countries, a sophisticated understanding of how telemedicine is used is necessary. Yet relatively little research effort has been made to look into the adoption and use of telemedicine in developing countries (Stanford, 1998). This paper attempts to explore the factors influencing telemedicine usage by conducting case studies in two Chinese hospitals. Based on a research model we proposed, eight factors are identified that are likely to affect the diffusion of telemedicine. This paper presents the research model and preliminary case study results.

THEORETICAL FRAMEWORK

In order to lend theoretical rigor to this paper, a research model was developed on the basis of the extant literature to serve as a guide of our case analysis. We reviewed the prior research regarding telemedicine usage in particular and IT usage in general so that the research model we proposed possesses sufficient generality and specificity simultaneously. Figure 1 shows the model. It posits that telemedicine usage is affected by two broad categories of factors. The national factors category consists of government policies, economics, technological infrastructure, and social norms and culture, while the organizational factors category encompasses top management champion, support, resources, and compatibility. Each of these eight factors is discussed as follows.

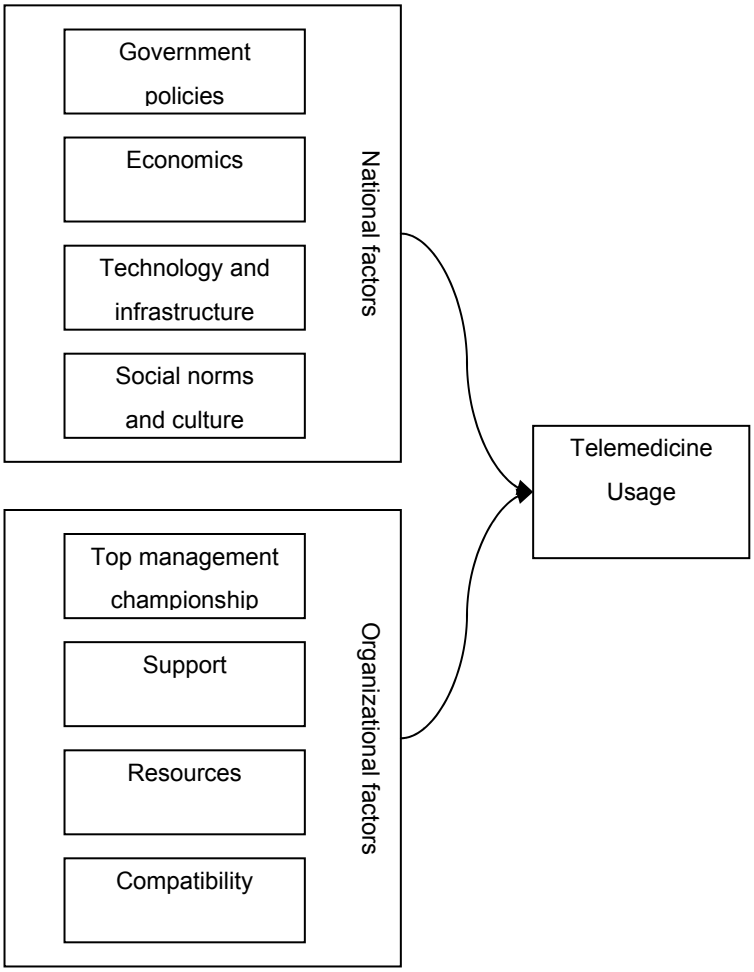

Figure 1. Research Model

National Factors

Governmental Policies

Government policies have been found to be highly instrumental in diffusion of computing in a society (Gurbaxani et al 1996). Governments influence the use of IT by either approving the technology and investing in the necessary infrastructure to cater for it, or disapproving the technology and enforcing restrictions on its importation and use (Mayuri, 1993). Health care is largely a localized business which focuses on serving people in adjacent communities. Hence, telemedicine initiatives can hardly go to the top of an executive's task list. Governmental policies advocating telemedicine development can legitimize health care organizations' initiatives to develop and use telemedicine which would otherwise be overshadowed by other organizational projects and never be rolled out. These policies send out a message to the executives suggesting that if their

behavior is congruent with the government's will their organizations are likely to obtain long-term intangible benefits from the government although their behavior might not bring them short-term tangible financial benefits.

Economics

It has been recognized that the economic status of a country will influence its IT policy (Sharma and Gupta, 2003). Economic factor proves to have an important role in IT success in developing countries (Walsham, 1989, Walsham, Symons and Waema, 1988). Given the high cost of telemedicine and low affordability of people in developing countries, economics is likely to heavily impact the development and usage of telemedicine.

Technological Infrastructure

Technological infrastructure includes telecommunications infrastructure, education and training. Telemedicine is health care delivery where physicians remotely examine patients using information technologies. To enable the use of telemedicine, a country needs a solid IT infrastructure (Adam 1996, Mbarika 2001). In the past, telecommunications infrastructure has usually been measured in terms of tele-density, the number of land telephone lines per capita (Marika, Byrd and Raymond 2002). With the increasing spread of wireless telecommunications, a broader perspective can to be taken in identifying IT infrastructure (Kibati and Krairit 1999, Peha 1999). Education and training are considered as a component of technological infrastructure because they are critical for the use of telemedicine. It is through education and training that health care professionals learn how to utilize telemedicine. Presumably, a country which has a poor technological infrastructure is unlikely to have a high level of telemedicine use.

Social Norms and Culture

Social norms and culture are complex notions usually assessed from multiple dimensions. There has been considerable research examining the cultural dimensions of IT development. The beliefs and values ingrained in people's mind by their cultural contexts significantly affect their thinking and perspective, and hence their approach to using technology (Baba 1995; Bertolotti 1984; Hakken 1991; Hill et al 1998; Hofstede 1980; Ingold 1996; Kransberg and Davenport 1972; McCoy 2002; Straub et al 2002). Telemedicine practice involves a number of sensitive issues such as security, privacy, confidentiality, and ethics; therefore, its usage will be largely complicated by the social context in which it exists.

Organizational Factors

Top Management Championship

A plethora of IS research has noted the importance of top management championship to the implementation, use, and success of IT in organizations. Top management championship reflects both top management beliefs and participation in IT projects (Chatterjee, Grewal and Sambamurthy, 2002), showing the level of commitment from senior management in utilizing IT to help an organization survive and prosper. Top management championship has been shown to improve the quality of IT (Ravichandran and Rai, 2000), to lead to the progressive use of IT (Feeny, Edwards and Simpson, 1992), to facilitate radical IT innovation (Chatterjee et al., 2002), and to relate to the assimilation of IT in firms (Armstrong and Sambamurthy, 1999). Telemedicine is ultimately applied in the context of health care organizations; hence, top management championship will have an impact on the level of its usage.

Support

Support is widespread sponsorship for a project across the organization and is important to the success of many kinds of IT implementations such as decision support systems and data warehousing (Guimares et al. 1992, Igbaria et al. 1997, Wixom and Watson 2001). It motivates people in the organization to support the innovation initiative and the organizational changes that inevitably accompany it (Curtis and Joshi 1998, Watson et al 1998). For instance, management support can overcome political resistance and encourage participation throughout the organization (Markus 1983). Support leads to facilitating conditions that make an act easy to do (Triandis, 1980). It refers to the degree to which necessary resources are provided to users upon request. Prior research showed support is a significant determinant of WWW usage (Cheung, Chang and Lai, 2000). Support is also a significant determinant of the ease of use of a new system for both new users and experienced users (Liang, Xue and Byrd, 2003, Venkatesh, 2000). In the context of telemedicine, organizational support includes availability of training and help from IT staff, which are organizational response to help users overcome barriers and hurdles to telemedicine use.

Resources

According to resource based theory, a firm is a bundle of resources and capabilities (Montealegre, 2002). Resources are firm-specific assets and competencies controlled and used by firms (Barney, 1997). Capabilities are a firm's abilities to integrate, build, and reconfigure internal and external assets and competencies so that they can perform distinctive activities (Teece,

Pisano and Shuen, 1997). Resources can be either tangible (e.g., financial assets, technology) or intangible (e.g., managerial skills, reputation). Bromiley (1986) concluded that the ability of the corporation to implement planned investments depends on the current implementation resources, management practices, the technology, and the kind of investment. Resources are important to telemedicine projects because telemedicine projects are expensive, time-consuming, resource-intensive initiatives. The presence of resources can lead to a better chance of overcoming organizational obstacles and communicate high levels of organizational commitment (Beath 1991, Tait and Vessey 1988).

Compatibility

Compatibility (Rogers, 1983) is one of the five major constructs that determine diffusion of innovations. It refers to the degree to which an IT is perceived being consistent with the existing values, needs, and past experiences of potential adopters. The linkage between compatibility and IT adoption has been consistently verified in empirical studies from perspectives of individuals (Brancheau and Wetherbe, 1990, Hoffer and Alexander, 1992, Slyke, Lou and Day, 2002, Taylor and Todd, 1995) and organizations (Copper and Zmud, 1990; Kwon and Zmud, 1997; Jones and Beatty, 1998; Kendall et al., 2001; Beatty et al., 2001). Moore and Benbasat (Moore and Benbasat, 1991) showed that there is a significant positive relationship between compatibility and perceived advantage. Studies on health care professionals indicate that Compatibility is a significant determinant of perceived usefulness (Chau and Hu, 2001, Liang et al., 2003). Chau and Hu (2001) argue that health care professionals usually develop a particular practice style and get entrenched to it over time. They are not likely to adopt an IT which affects their practice style. Therefore, we anticipate that doctors who think using telemedicine would not affect their current working style, or require the least amount of changes are more likely to use telemedicine.

THE CASES AND PRELIMINARY RESULTS

China has a vast territory, and its health care development in different areas is highly unbalanced. Limited medical resources and their imbalanced distribution become a serious problem in China's undeveloped areas. China's government discerned that information technology could be employed to improve healthcare quality and increase healthcare access by optimizing health resource allocation. Telemedicine is one of the national initiatives advocated by the government. Using the research model described in the preceding section, we conducted a case research in two selected hospitals in China with an attempt to examine what factors influence the use of telemedicine in China. Two case studies were conducted. The authors studied a level-3 hospital in Beijing, the telemedicine provider, and a level-2 hospital in Jiangsu, the telemedicine receiver. Employing the triangulation method which corroborates the same fact or phenomenon through gathering information from multiple sources (Yin, 1994), we interviewed the hospital president, managerial personnel of telemedicine services, IT manager, and doctors who used telemedicine in each hospital. Preliminary findings are presented in Table 1 and will be discussed in detail at the conference.

Categories	Factors	Findings
National Factors	Governmental policies	(+) Government advocacy (–) Lack of regulations
	Economics	(–) Patients have low affordability
	Technological Infrastructure	(–) Insufficient telecommunications infrastructure (–) Lack of standardization
	Social norms and culture	(–) High uncertainty avoidance in Chinese culture
Organizational factors	Top management championship	(+) High top management championship (research and teaching focus) (–) Low top management championship (financial focus)
	Support	(–) Management confusion (–) Lack of technical support (–) Lack of motivation systems
	Resources	(–) Inadequate investment (–) Lack of capable personnel (–) Lack of EHR, HIS, PACS
	Compatibility	(–) Incompatible with current medical practice style

Table 1. Preliminary Findings

FUTURE DIRECTIONS

This research-in-progress proposed a model of telemedicine usage and presented preliminary results of case studies in two Chinese hospitals. An in-depth analysis of the cases by using the research model will be conducted. The model proposed in this paper might not capture all the significant factors that affect telemedicine usage. We plan to carry out more case studies in other countries such as South Africa and India to improve this model in the future.

REFERENCES

1. Armstrong, C. P. and Sambamurthy, V. (1999) Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures, *Information Systems Research,* **10,** 304-327.
2. Barney, J. B. (1997) *Gaining and sustaining competitive advantage,* Addison-Wesley, Reading, MA.
3. Brancheau, J. C. and Wetherbe, J. C. (1990) The adoption of spreadsheet software: testing innovation diffustion theory in the context of end-user computing, *Information Systems Research,* **1,** 115-143.
4. Chatterjee, D., Grewal, R. and Sambamurthy, V. (2002) Shaping up for e-commerce: Institutional enablers of the organizational assimilation of web technologies, *MIS Quarterly,* **26,** 65-89.
5. Chau, P. Y. K. and Hu, P. J. (2001) Information technology acceptance by individual professionals: A model comparison approach, *Decision Sciences,* **32,** 699-719.
6. Cheung, W., Chang, M. K. and Lai, V. S. (2000) Prediction of Internet and World Wide Web usage at work: A test of an extended Triandis model, *Decision Support Systems,* **30,** 83-100.
7. Feeny, D. F., Edwards, B. R. and Simpson, K. M. (1992) Understanding the CEO/CIO relationship, *MIS Quarterly,* **16,** 435-448.
8. Hoffer, J. A. and Alexander, M. B. (1992) The diffusion of database machines, *Data Base,* **23,** 13-19.
9. Liang, H., Xue, Y. and Byrd, T. A. (2003) PDA usage in healthcare professionals: testing an extended technology acceptance model, *International Journal of Mobile Communications,* **1,** 372-3389.
10. Montealegre, R. (2002) A process model of capability development: Lessons from the eletronic commerce strategy at Bolsa de Valores de Guayaquil, *Organization Science,* **13,** 514.
11. Moore, G. C. and Benbasat, I. (1991) Development of an instrument to measure the perceptions of adopting an information technology innovation, *Information Systems Research,* **2,** 192-239.
12. Ravichandran, T. and Rai, A. (2000) Quality Management in Systems Development: An Organizational System Perspective, *MIS Quarterly,* **24,** 381-415.
13. Reid, J. (1996) *A telemedicine primer: Understanding the issues,* Billings, Montana: Artcraft Printers.
14. Rogers, E. M. (1983) *Diffusion of Innovations,* The Free Press, New York.
15. Sharma, S. and Gupta, J. (2003) Socio-economic influences of e-commerce adoption, *Journal of Global Information Technology Management,* **6,** 3-21.
16. Slyke, C. V., Lou, H. and Day, J. (2002) The impact of perceived innovation characteristics on intention to use groupware, *Information Resources Management Journal,* **15,** 5-12.
17. Stanford (1998) *Telemedicine in China,* Stanford University. http://telemed.stanford.edu/telemed-history.html
18. Taylor, S. and Todd, P. A. (1995) Understanding Information Technology Usage: A Test of Competing Models, *Information Systems Research,* **6,** 144-177.
19. Teece, D. J., Pisano, G. and Shuen, A. (1997) Dynamic capabilities and strategic management, *Strategic Management Journal,* **18,** 509-533.
20. Triandis, H. C. (1980) In *Beliefs, Attitudes, and Values*(Ed, Page, M.) University of Nebraska Press, Lincoln, NE.
21. Venkatesh, V. (2000) Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model, *Information Systems Research,* **11,** 342-365.
22. Walsham, G. (1989) The application of IT in organizations: some trends and issues, *Information Technology for Development,* **4,** 627-644.
23. Walsham, G., Symons, V. and Waema, T. (1988) Information systems as social systems: implications for developing countries, *Information Technology for Development,* **3,** 198-204.
24. Welsh, T. S. (1999) *Telemedicine,* web.utk.edu. http://web.utk.edu/~twelsh/teleweb/telemed.htm
25. Yang, J. and Gao, Y. (2001) In *Satellite Communication Applications*United Nation.
26. Yin, R. K. (1994) *Case Study Research: Design and Methods,* SAGE Publications.
27. Zhao, Y. (1998) Telemedicine makes gains in Chinese healthcare, *Diagnostic Imaging Asia Pacific,* **January 1998**.