Knowledge Management System and Infertility Treatment Using Traditional Chinese Medicine

Research-in-Progress

Dr. Wendy Wang  
Trident University  
wendy_phoenix@hotmail.com

Ming Wang  
Fidelity Information and Technology LLC  
xy.wm@hotmail.com

Dr. Lijuan Jiang  
Yunnan College of Traditional Chinese Medicine  
jianglijuan825@163.com

ABSTRACT
Traditional Chinese medicine (TCM) has been practiced for over 5000 years. Different from western medicine which has its origin from anatomy, TCM is based on the ancient Chinese perception of humans as part of the environment and universe, subject to nature and its forces, therefore, health and diseases are direct result of the interaction of humans with the environment and the balance of distinct yet interconnected organs. The effectiveness of TCM has been recognized widely, yet due to its complexity and underlying conceptual foundations, it is very challenging to seek scientific evidence on how it works using lab experiments. This paper discusses an ongoing knowledge management project that is built on the logic of TCM treatment of infertility. The purpose of this project is to promote understanding of the TCM treatment, uncover its underlying theories, preserve TCM knowledge, and facilitate its continuing development.

Keywords
Knowledge management, traditional Chinese medicine, data warehouse, health care, infertility

INTRODUCTION

Traditional Chinese medicine and western medicine

Traditional Chinese medicine (TCM) is a science that studies the physiology, pathology, prevention, diagnosis, and treatment of disease. Mainly using medicinal herbs and acupuncture, TCM has been guarding the Chinese civilization for more than 5000 years. Although its effectiveness has been widely acknowledged, due to its complicated theoretical foundation, it is hard for researchers to provide scientific evidence on how and why TCM works using lab experiments. Hence, the status of TCM as a branch of science has been under constant question and examination.

TCM is very different from western medicine in its foundation, diagnosis methods, and treatment: 1) Western medicine originates from anatomy; TCM is based on the ancient Chinese belief that the human body is in tune and part of the bigger universe, it is under the influence of the bigger cosmos which consists of 5 basic elements: gold, wood, water, fire, and earth. The health and illness of the human body is the direct result of its interaction with the environment and the harmony or imbalance of its distinctive and interconnected organs. Western medicine makes progress mainly via lab experiments whereas TCM makes progress mainly via first hand clinical experience. 2) Built on labs, experiments, and anatomy, western medicine collects vital information using many medical devices, e.g., stethoscope, CT scan, or MRI. TCM uses four ways for diagnosis: Observing (O), Smell (S), Ask(A), and Check (C), observing the appearance of the patients, e.g. the tongue, countenance, shape of the body; smelling and noticing any unusual odor, asking questions and making inquiries, and checking the pulse of the patients; 3) TCM and western medicine also differ in method of treatment. Western medicine doctors tend to prescribe the same pills to patients who are diagnosed with the same illness, whereas TCM doctors will give customized prescription since the causes of the illness differ as well as the individual body types and the time of the year. Therefore, even
when patients get the same kinds of medicinal herbs, the weights of the herbs can be different from one prescription to another. The practice of surgery is one of the highly prized specialties of western medicine, whereas TCM considers body a living organism with all parts interconnected to each other, surgically removal of any organ is perceived to be the last resort. In spite of their differences, western medicine and TCM play complimentary roles in healing and treatment. Western medicine is much suited for treating illness that requires immediate attention, whereas TCM for chronic diseases.

Information technology and Traditional Chinese medicine

Great TCM doctors require constant learning and accumulation of knowledge coming from lifelong practice. They are the main force of treating difficult cases. However, passing on the knowledge of these doctors to the next generation have not been easy. The traditional and also the best way to learn is to follow a TCM master and gain firsthand knowledge; however, such opportunities are few. Learning from books and publications provides another option, yet publications cannot preserve the gist of the treatment systematically and comprehensively. With the aging of these TCM doctors, the world is at the risk of losing their knowledge and expertise.

The introduction of information technology to TCM in 1970s has offered more tools to preserve TCM and facilitate the continual development of this national treasure. Chinese government has issued a series of policies to encourage research on Informationization of TCM knowledge management (“Huge opportunities for the Informationization process of China’ health care,” April 15, 2011). The Informationization process of health care in China has enjoyed tremendous growth in recent years as the result of government support. However, most of the information systems center on hospital management. In 2008, a study conducted by the Health Ministry of China on 3765 hospitals indicates that 80% of the HIS systems are doctor’s appointment system, emergency care pharmacy management system, hospitalized patient cost system, and drug warehouse management system (“Chinese government calls for informationization to improve the quality of TCM,” June 15, 2012). Bi, Meng and Cheng (2012) developed a data warehouse for over 1000 Uygur medicine. Extracting from 5 years of medical records of a city TCM hospital, Hu, Zhou and Gu (2008) built a data warehouse to record the number of patients, days in hospital, costs, effectiveness of the TCM treatment. This information is important for better management of the hospital. To improve medical practice, there is a huge need to develop systems that are treatment oriented. This paper discusses an ongoing knowledge management project that treats infertility. It is a joint effort of renowned TCM doctors, IT professionals, TCM hospitals, and government. As far as we know, it is the first of its kind that built on the TCM masters’ logic and philosophy to treat infertility, the importance of its contribution to the field is hard to be overstated.

LITERATURE REVIEW

Advances in information technology have made it possible to provide an integrated and coordinated health care system (Katic, Ozvacic, Blazekovic-Milakovici, Vrcic-Keglevic, Bergman-Markovic, Tiljak, Lazi, Nekic, Petricek, 2007; Rajan and Ramaswamy, 2010). During the 1990s, IT investment was relatively low priority for hospitals and health systems in US, many of them face fiscal constraints and pressing need to upgrade aging facilities (Wilson and Tulu, 2010). With IT increasingly viewed as a means of improving quality, safety, and productivity in health care, the proportion of hospital revenue invested in IT has doubled in recent years. Data analysis of 2000 U.S. hospitals indicates that over 60% have now made a sufficient investment in IT to generate a positive return to the organization (“The economics of IT hospital performance”, 2007).

Many health information systems (HIS) are built on patient centered approach, aiming to provide patients with better care and management level information for better decision making (Katic et.al., 2007; Miller and MacCaull, 2009; Ventegodt, Morad, Hyam and Merrick, 2004; Ventegodt, Kandel, Neikrug and Merrick, 2005). Related research has been focusing on information quality, security, interoperability of these kinds of systems (Lederman, 2005; Rajan and Ramaswamy, 2010; Teiken, Bruggemann and Appelrath, 2010). There are systems designed to assist doctors, most are on diagnosing particular diseases e.g. lung cancer (Avci, 2011), anemia (Birndorf, Pentecost, Coakley and Spackman, K.A., 1996), and skin tumor (Umbaugh, Moss and Stoecker, 1991), few go further to suggest treatment options.

In China, information technology research in TCM started in 1970s. The earliest TCM computer program was developed in 1978, it was built based on the knowledge and experience of one of the most famous TCM master specialized in liver disease. This program is a pioneer in IT application on TCM (Lu and Hu, 2011). Since then, IT has been applied to manage TCM pharmacy (Bi et. al., 2012), analyze TCM masters’ prescription and treatment (Hu et. al. 2008; Ma, Lu, Yu, Zhao, Xie and Bao, 2012), digitalize and mining ancient TCM literature (Li, 2012; Meng, Wan and Zhang, 2011), and conduct TCM online education (Meng, et. al., 2011). However, China’s TCM informationization is still at the preliminary stage, there are few established TCM standards (Meng, et. al., 2011), few systems evaluation have been documented, it is hard to assess how effective these systems are.
Knowledge management and infertility treatment

Infertility is a serious issue that has inflicted couples who desire to have children. The one year infertility rate ranges from 3.5% to 16.7% in more developed nations, and 3.5% to 9.3% in less developed nations (Boivin, Bunting, Collins, and Nygren, 2006). WHO believe that around 60-80 million couples in the world are infertile, even with thorough medical examination, the cause of the infertility remain unexplained in 5-10% couples. In China, there has been very few application of technology such as artificial intelligence, expert system, and knowledge management system on gynecology (Mao, 1998), even fewer on infertility treatment. There are many reasons contributed to this situation: limited communication between hospitals and universities, lack of communications between doctors and computer scientists, shortage of talents that understand TCM and technology, lack of satisfactory software developing language, and lack of objective evaluation method etc. Being the first of its kind, the knowledge management system discussed in this paper is a pioneer of IT application in infertility treatment.

The knowledge management system is designed based on two main sources: over 50 years of the treatment logic and philosophy of one of the most famed infertility TCM doctors in China and ancient Chinese medicinal literature. System like this one is time consuming and tedious to build, doctors, especially the famous ones are usually too busy to participate, luckily in this project, the doctor and her students are committed out of the urgency of preserving years of knowledge and experience for the younger generation. Different from majority of the systems currently operated in China, this system is built with health care professionals in mind, a system built for the doctors with the help of doctors.

SYSTEM ARCHITECTURE

Treatment logic that the knowledge management system built on has included very detailed information on the process and procedures of infertility treatment, it is an end to end process from initial demographic information of the patients, potential causes of infertility, treatment available for each cause, rationale and rationale behind each treatment, and its final effectiveness (whether the treatments end with the successful pregnancy). For example, demographic information of the patient include not only routine information such as age, years of marriage, education, profession, but also information such as emotional state and mood changes since infertility, living environment (big, medium, or small city), urban or undeveloped rural areas, income level, eating habits (like spicy, mild, vegan etc), working mode (morning sift, day job, or night job), sleep pattern (early bird or nightingale), temperament, and personality etc.

There are mainly four components in this system (see figure 1): data acquisition; data cleaning, transformation, and loading; data integration; and information acquisition and analysis.

Data acquisition

Data acquisition consists of deriving information from 5 major sources: clinical cases with treatment logic, ancient Chinese TCM manuscripts, traditional Chinese herbs lexicons, Clinical cases, and other related information.

1) Data extracted from Clinical cases with treatment logic

Since this system is built on the general framework of end to end infertility treatment process including the treatment logic and rationale, before information is extracted from original patient record, designated TCM doctors will examine each patient record and add information such as rationales for using a particular medicinal herb or treatment, its sources in ancient Chinese medicinal literature etc. Only then, will the data be extracted and transferred to the system.

2) Ancient Chinese TCM literature

Many TCM treatments can trace its origin back to ancient Chinese medicinal literature such as Zhongjing Zhang’s Treatise on Cold Pathogenic and Miscellaneous Diseases written in the 3rd century and Shizhen Li’s Compendium of Materia Medica written in 16th century. Since modern TCM doctors customize the prescription based on the characteristics of each case, the treatment logic will not be complete without mentioning its source. Therefore knowledge system in this project will consolidate these books.

3) Traditional Chinese medicinal herbs lexicons

In addition to the routine lexicon of medicine e.g., disease coding lexicon, this system has also included lexicons that specialized in TCM such as TCM medicinal herbal lexicon and acupuncture lexicon.

4) Clinical cases

To preserve the originality and completeness of the clinical cases, this system will store the complete patient records it extracts data from. In addition, it also includes various general prescriptions for treating different infertility scenario. These general prescriptions are based on the experience of years of practice of TCM doctors.
Data cleaning, transformation, and loading

To ensure the data integrity, it is crucial to have built-in mechanism to ensure the quality of the data. Before the data is loaded into data warehouse, the incoming data will go through data integrity checking process to ensure its accuracy.

Data integration

After data is extracted, cleaned, and verified, they will be loaded and used to populate the data warehouse.

Information acquisition and analysis

With the completion of this system, users will be provided with tools to mine the wealth of information, generate routine reports, and explore patterns of treating various types of infertility cases.

SYSTEM EVALUATION

Few TCM system evaluations have been identified in the literature. However, there are a wealth of information on system evaluation in western medicine that can be used as reference. Keith et al. (1994-1996) evaluated performance of an Obstetrics and Gynecology system with 17 experts of the field (Keith R.D. and Creene K.R., 1994; Keith, R.D., Beckley, S., Garibaldi, J.M., Westgate, J.A., Iheachor, E.C., Greene, K.R., 1996), fifty out of 2400 high risk cases were randomly drawn and were diagnosed by the experts and the systems respectively twice with one month apart from each other. The results of the expert and system will be compared to see the similarity of these two. We consider this a good evaluation approach that can be used in our study. Since the main users of the system are TCM doctors and medical students, it is important to evaluate whether the system meets their needs. Doctors and medical students mainly use the system for two purposes: 1) information enquiry 2) assistance of diagnosing and treating a new case. Therefore the system will be assessed from these two perspectives. Participants of the evaluation will initially be recruited from TCM doctors and medical students from Yunan province, later from other provinces. After exploring the system for about 15 minutes, participants will fill up a survey to assess the information quality of the system. To evaluate how effective the system is in assisting diagnosis and prescription, both the system and the participants will be working on a brand new case independently. Based on the patient information,
participants and the system will provide diagnosis and prescription separately. Two TCM doctors that have not participated the evaluation will compare and assess the similarity of the result.

CONCLUSION

This paper describes an ongoing knowledge management system that is developed based on the logic of TCM infertility treatment. Compared to majority of the health information systems, this system is the first of its kind within our knowledge, a further step from current HIS’s patient centered, or health care management centered approach. This project is an effort representing the trend of the HIS system growing from the role of managing health care costs, reducing the paper work with insurance companies, establishing better patient records to preserving the best medical practice and supporting its sustainable improvement. This project will not only preserve the best practice of TCM infertility treatment, but also offer opportunities to study the process and treatment methods. Furthermore, it will provide valuable insight to facilitate the continual development of TCM medicine. Since this system is a pioneer in this area, experience gained would be very beneficial to the future effort.

REFERENCES


