

E-Health in China, Our Practice and Exploration

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Abstract—China started to pay more attention to regional and national health information network construction after the SARS epidemic outbreak in 2003. The Chinese government marks the public health system construction as the most urgent part of national medical reform, with information and computer technology(ICT) being considered as the key of deploying regional collaborative medical service(RCMS), which is also known as e-Health. In this paper, we firstly analyze the difficulties of carrying out e-health projects in China and then present the active attempts, finally a case representing current progress is presented and studied.

Index Terms—E-health, Regional collaborative medical service, RCMS.

I. INTRODUCTION

To achieve the goal of "every person can access the basic medical and health services" for the 1.33 billion citizens in the world's biggest developing country, Chinese government has been conducting medical reform for many years [13]. After having improved medical facilities in big hospitals, it is found that it could't address the problem of public health and didn't meet people's health care requirement, the government has turned more attention to raise the level of primary health care services. On April 6th 2009, the government released the latest medical reform plan, which planned RMB 850 billion (\$124 billion) to revamp the current medical system. Different from previous medical reform plans, the medical informatization is first placed at one of the most important positions of the whole plan. As regional medical information platform construction is getting considered as the key solution of medical reform, e-Health and regional collaborative medical service (RCMS) are now playing more important roles in leading this reformation. In 2004, e-Health was first attempted at several community health care centers, and then in 2005, China released a series of policies to support developing e-Health and RCMS [2]. Although the standardization in this area is still in progress and the relevant laws also remain to be developed, the government is now planing more projects to carry out e-Health and RCMS. In Beijing, Dalian, Xiamen, RMCS demonstration projects are being established with strong support from governments at different levels, hospitals, companies, universities and other health care institutions.

II. CHALLENGES

Based on information technologies platform, general data exchange standard, interface standard and relevant health information service standard, the goal of e-Health is to integrate regional health resources, share and deliver medical

information, establish collaborative health service, and support health information collection of relevant departments inside or outside the region [8]. China has particular difficulties to implement e-Health due to its broad space, large population, and the unbalance of health care conditions varying from big cities to remote mountainous areas. Fig 1. shows application goals of RCMS in China.

A. Uneven health care conditions

To achieve the goal of "integrate and share resource", frequent communication between hospitals is needed. However, the unbalance between hospitals inter- or intra- regions have resulted in communicating problems. Hospitals are officially classified to three levels in China, level III represents the top-level hospitals which are minority of the industry but account for majority of medical resources; level II represents middle scale hospitals, while level I represents small hospitals such as community hospitals at cities, and township hospitals in rural areas. The gap between hospitals at different levels is huge, and the top level hospital is commonly still absorbing more resource and getting bigger, while the low level hospitals remain poor condition. Although hospitals at same level are active in resource integration and inter-hospital cooperation, the hospitals at different levels are commonly lack of communications, patient transfer mechanism between community hospitals and big hospitals also remains to be established [3].

B. Different Hospital, Different System

Having implemented health informtization for more than twenty years [13], most big and middle hospitals in China have their own health information system(HIS). However, the HIS of different hospitals are usually differentiated due to that they are from different software and hardware providers. For instance, each hospital commonly has a electrical medical record(EMR) system, but the ID used to identify a patient commonly has different structures in different systems [12].

More than hospitals, relevant government departments at different levels have been encountering the similar communicating problems since they have established different health information system. These HIS system were initially designed by different organizations/businesses to carry out functions of corresponding departments. Although the original requirements are well met, the difficulty of integrating these information system scales as the database expands, and consequently blocks the progress of regional collaboration medical service [5].

C. Lack of Standards

Standardization of interfaces and protocols is essentially required to make communication between different HIS systems.

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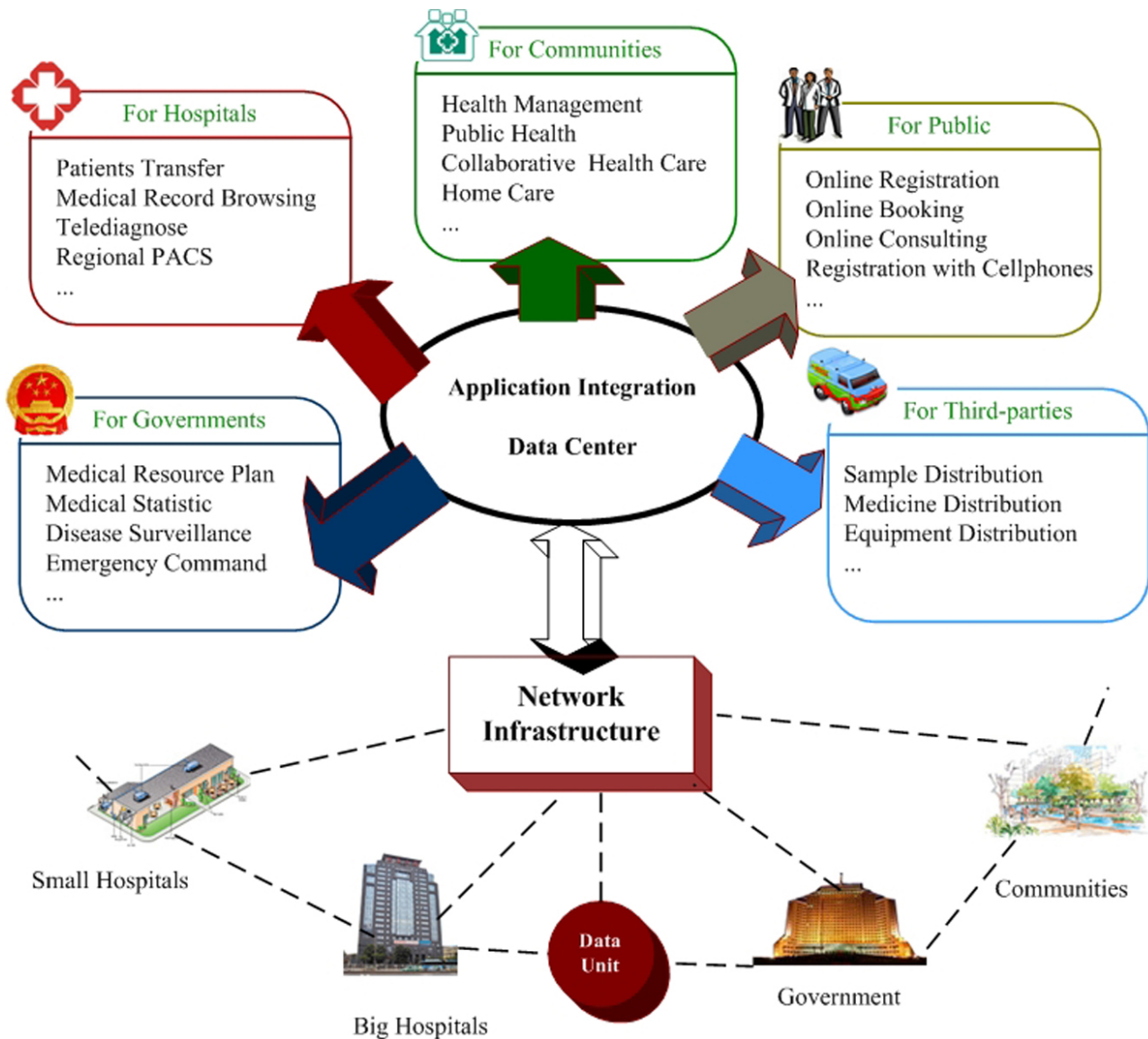


Fig. 1. Goals of RCMS in China. Applications are divided into five categories: for hospitals, for communities, for public, for governments and for third-parties.

China is in the pilot phase to establish reasonable information storage and exchange protocol for RCMS, and relevant laws also remain to be developed [3].

III. SYSTEM ARCHITECTURE OF ACTIVE ATTEMPTS

System architecture requires to be discussed and proved because it takes the biggest piece of hardware investment on a RCMS project, and will affect the final functionalities of the system [5]. In china, the finished and currently under construction systems can be divided into five categories described as follows. The first to fourth architecture can be only considered as a prototype of RCMS, as it doesn't realize the full functions of a RCMS.

A. Community Medical Information System (CMIS)

Shanghai and Beijing are regions where CMIS is rapidly growing [1]. The common mode of these CMIS system is to

build a data center for a community, and several community health service stations are linked to this data center for data exchange and information sharing. The basic functions of this CMIS system are building health recording system for each person in this region, sharing documents and other medical resources.

B. Big Hospital-Centered Systems

Unlike CMIS, common mode of these systems is to build a data center in one big hospital for a region, health service stations within the scope of the big hospital's radiation are also connected to this data center. Comparing to CMIS, systems in this type allow the participants to use the resources of this big hospital, such as telediagnosis and patients transfer.

C. Regional Picture Archiving and Communication System, Regional PACS

Systems in this type is to build a medical image center for a specified region, members in this system are responsible for image collection and are allowed to download and view images collected by other members.

D. Regional Health Data Center

In these systems, a data center is built for each administrative district, medical information collection is then handled by medical institutes at front points. The data is only used for the medical operating status analysis and statics.

E. Real Regional Collaborative Medical System

Sharing documents in a broad area is the primary goal of these systems. Doctors can know the patient's diagnose history by searching the records of corresponding patient at any time and any place [9]. The electrical medical record (EMR) of each patient is linked to the PACS system, in which the pictures are stored and can be downloaded if needed.

As the key problem of RCMS system, data sharing has three solutions for current implementations [10]. 1),server/client model, data is entirely stored in data center, and the terminals upload/download via a server/client connection; 2),distributed model, data is still stored in different health care institutes, a protocol is used for exchanging patients' data; 3), hybrid model, medical records are still stored in different health care institutes, but the frequently used data for statics is stored in a shared data center. Fig 2. shows the hybrid data storing architecture of current implementation of RCMS in China.

IV. CASE STUDY: XIAMEN MODE

The Demonstration Project of Regional Collaborative Medical Service is supported by the 11th National Five-Years Plan. The PLA General Hospital plays the leading role in this project, and the vice group chief is the Information Center of Ministry of Health. Four different styles of demonstration areas are constructed in Beijing, Xiamen and Dalian. The area of east Beijing is featured by "community healthcare service in modern city", the area of west Beijing is featured by the mode of "Regional Collaborative Medical Service", joined by Haidian, Changping and Shijingshan districts. Dalian is a transplanted model of project results. Xiamen is the first demonstration area being constructed successfully and put to use formally, called "Health Information System of Xiamen Citizen", of which the key points are as follows:

A. Basic frame

1) Uniform digitalized central integrated platform, the goal is to integrate all the information systems of hospitals and community clinics of different levels, make sure there's no regional medical information "island". Now there are more than 80% integrated medical resources in the city.

2) Uniform medical network, connecting all the medical institutions and community clinics in the city.

3) Uniform data center, to solve the problems of data storage and management of the entire city.

4) Uniform inhabitant health archives. Now the whole life electronic archives of more than one million inhabitants, from the beginning to the end of one's life, have been built up.

5) Uniform inhabitant health card (social security card), serving as the only identity, could be used throughout the hospitals and community clinics in the city, for the purpose of sharing information.

Thus, essentially, the five "Uniform" is an application system, taking the advantages of advanced information sharing technologies, running digitally and intelligently, including medical resources, information, services, and management. It's an architecture of common medical health care service, which is also a whole medical and digital city.

B. Function setup

1) Service platform aimed at public. By form of a website, all the citizens can use the services of reservation registration, checking results and self health management through the access of "Health Information System of Xiamen Citizen".

2) Regional collaborative medical platform aimed at medical institution, serving for mutual diagnosis, read case history, alternate analysis and examination, remote consultation and electrocardiograph, sharing various information, etc.

3) Service platform aimed at community, supply all the citizens with health service and management of their entire lives, and the "Six in One" service - medical, prevention, recover, health management, health education, and family planning.

4) Service platform aimed at healthcare for women and children, connecting 36 women and children healthcare institutions, centered by the women and children healthcare hospital, serving for the entire healthcare service of all the pregnant and the entire planning immunity monitoring for all the children.

5) Service platform aimed at the third party, supplying the medical institutions and patients with the services of medical material distribution, delivering, and network purchase.

6) Service platform aimed at government, supplying government with the services of routine monitoring, disease prevention, and decision supporting. These six "aimed at" cover every aspect of health issues in a city.

Fig 3. gives a demonstration of Xiamen's citizen health information system.

C. Main Purposes

The Demonstration Project of Regional Collaborative Medical Service is a project carried through by the Ministry of Science and Technology and the Ministry of Public Health of China, whose goal is to realize the sharing of medical resources and information by integrating common and key technology of medical services, and to provide a medical service platform for hospitals, communities and government, and to maximize the use of the limit medical resources. By choosing and setting up different modes of demonstrations in the whole country, the third-party professional medical

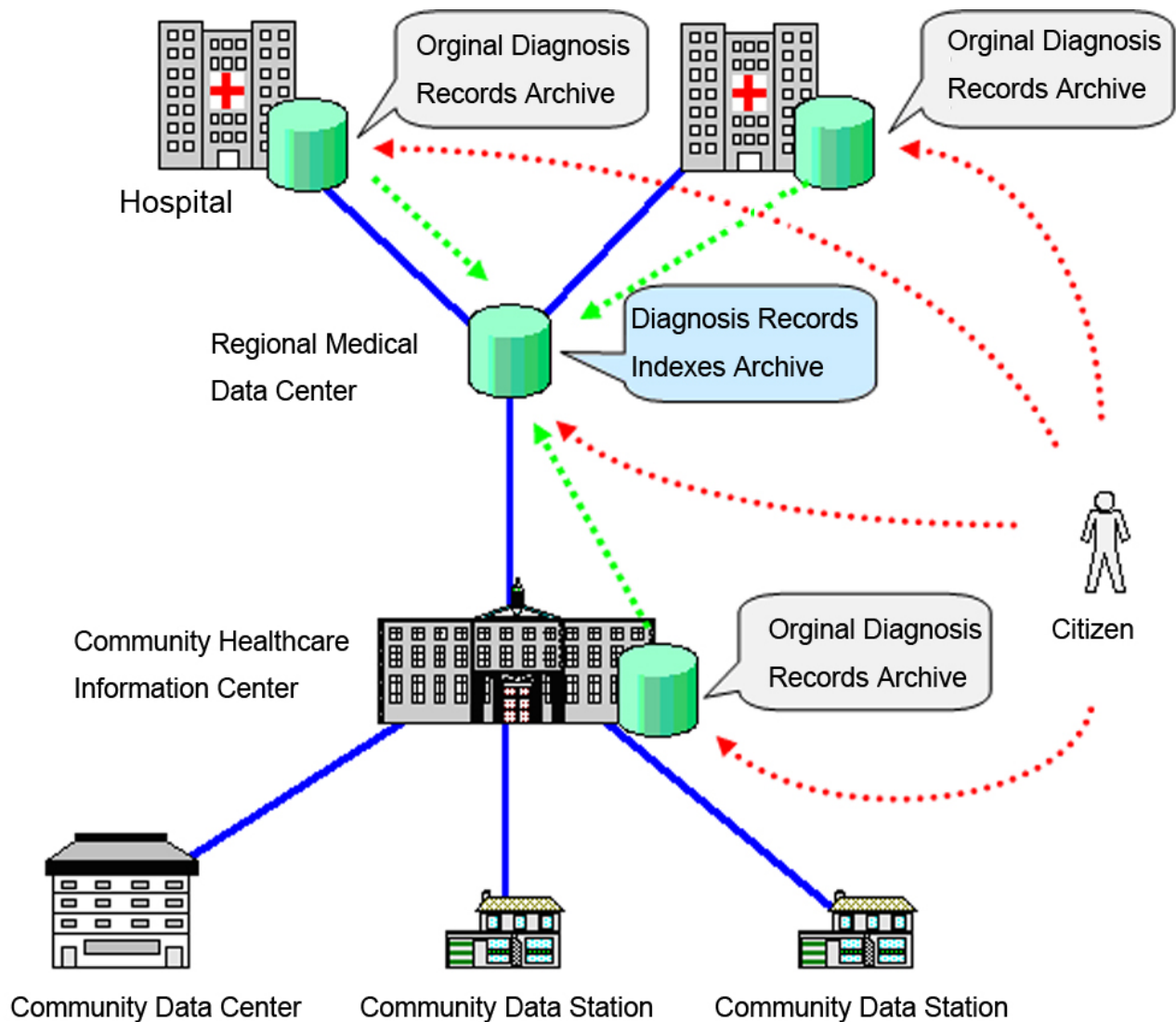


Fig. 2. Data storing architecture of current implementation of RCMS in China. The original (complete) diagnosis data is still stored in distributed hospitals, the regional data center keeps their common indexes, which is the basis for data exchange between hospitals or institutes.

delivering centers will be brought up, and more social and economic benefits will be achieved [17].

Building up the Regional Collaborative Medical Service is very significant for e-Health development.

(1) The hospitals in a region can communicate with each other more efficiently by collaboration. Through the computer network, doctors can communicate with each other more conveniently, which will make doctors more experienced and skilled.

(2) More efficient communication will be set up between urban and rural areas. The collaboration exists not only in the cities, but also in urban and rural areas, almost everywhere in the country. In the coming future, doctors in rural area could invite experts in some polyclinic to make a remote imaging consultation for patients through network. The patients who cannot be cured because of low medical care conditions would be treated better under the collaboration circumstance.

(3) More efficient communication will be set up between

doctors and common people. We could have a health consultation via computer at home instead of going out to hospital. Doctors in the community could provide services at patient's home. And doctors could get patient's status anytime after clinic activities. Now some orthopaedics doctors can observe the patients who have left hospital after operation through Internet.

(4) The government can monitor and manage the hospitals and other medical care institutions more efficiently. The information of medical resources will be gathered in regional collaborative medical care system. Meanwhile, the business data will be exposed on the network, so the government can monitor the medical practices directly from the network. And the government can learn and deal with issues raised by any one who is not satisfied with the medical care. As a result, the medical care quality will be improved.

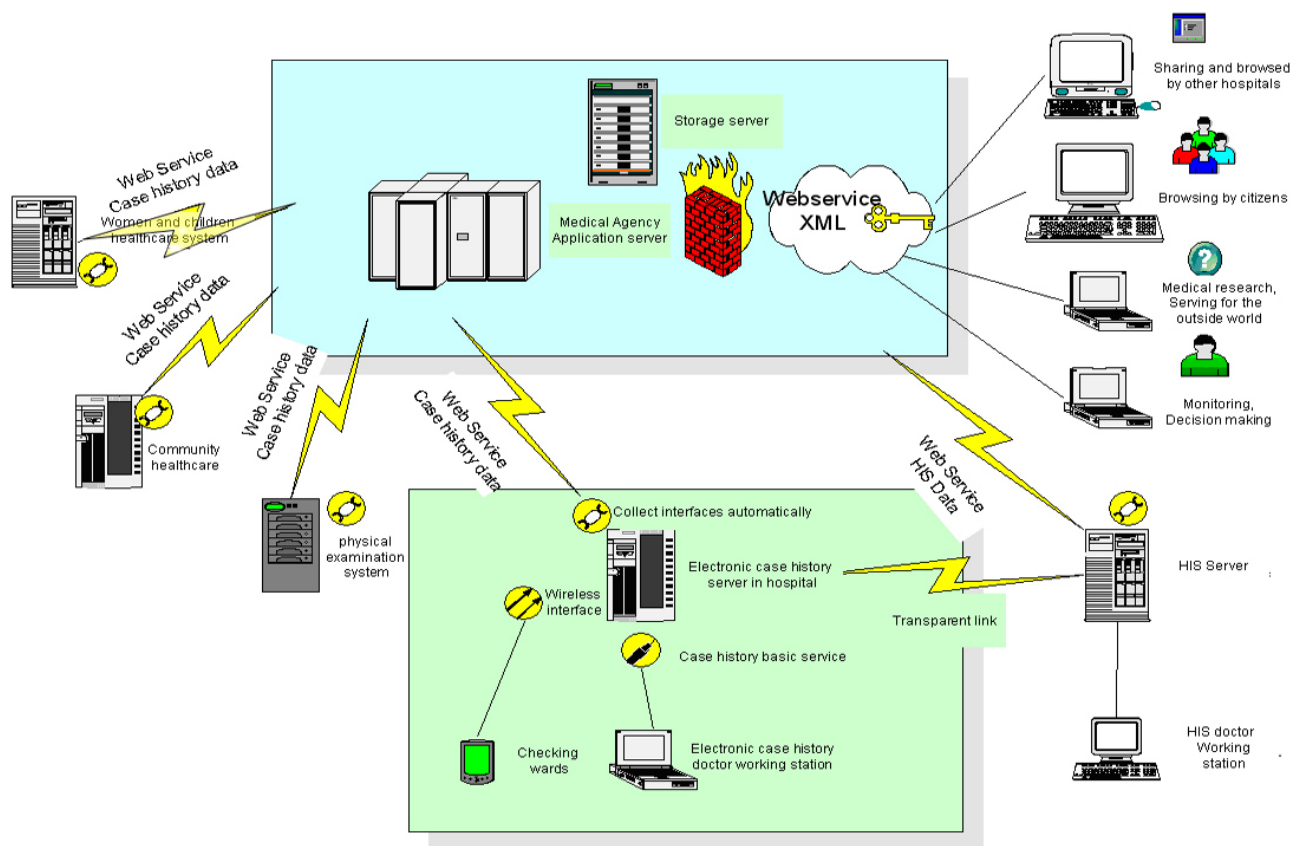


Fig. 3. System architecture of Xiamen's citizen health information system.

D. Results

There are significant changes in patients' hospitalization, hospital service mode, and governmental monitoring mode because of the all-directional digital, networking, and intelligent service for the patients, citizens, and the government, through which health system works more efficiently, medical cost reduces obviously, consultation gets more conveniently, health care is getting perfected, and medical order is also getting better gradually. The phenomenon of "difficult and expensive to see a doctor in China" is getting improved significantly. According to the analysis of 2008, 21 million yuan has been saved owing to the reduction of repeat examinations. Patient can make a reservation anywhere using their telephone, cell phone, message service, and Internet. Uniform electronic health archive is built up, for the first time the government can really manage the health system of the entire citizens, which is the goal that developed countries worldwide are fighting for. The applied system in Xiamen is very important to improve the whole people's health level.

E. Discussion

1). Construction Mode. "Xiamen Mode" is carried through by the Ministry of Science and Technology and the Ministry of Public Health of China, lead by the Xiamen government, technically and instructively led by the PLA General Hospital, combing together with many specialized companies, hospitals,

and communities in Xiamen. Xiamen government investigates 26.5 million yuan, it has listed this project as a citizen project for the last two years. The medical agency established sub project groups led by the director of the agency, inviting the upper group to join in the command platform of medical agency, organizing all the stuffs together to take a research on the project. Therefore, this project is not just a simple project, but more importantly, it is a project concerning government, people's livelihood, and the whole society.

2). Top Design. Xiamen demonstration area is built up upon the five "Uniform" and six "aimed at", which leads to the information sharing of the whole city's medical resources, medical informatics, health informatics, and management information, and also to the digital, networking, and intelligent service. This design mode is very scientific and reasonable, which is key to the successful "Xiamen Mode", from which we think that we have initially formed some ideas of medical informatization in small and medium-sized cities.

3). Technical Innovation. Because that the project is time limited and difficult, so the essential common technologies demanded are developed by collaborative specialized companies, introduced scientifically and integrated systematically by advanced networking information technology both at home and abroad, which makes it new technical norms and standards. So, technically, the key element to the success is the innovative application of advanced networking information technology in medical industry, which is proved that it is

advanced and feasible indeed. It could be generalized as a propagable national norms and standards.

4). Mode Innovation. The original intention and the carrying-out point of "Xiamen demonstration area" is the innovating of medical healthcare service mode. By means of building up creatively a platform supported by networking information technology, all the medical resources, patient's information, citizens' health information, and government management information are connected together in order to share them across the entire city, serve for all the citizens, medical institutions, and government at all levels in a personified and intelligent way. Most of the citizens are satisfied with this mode. It is praised that we have made a great exploration in innovating our country's medical healthcare service mode, it is an outstanding outcome in the domain of medical informatics, a successful practice of self innovation propelled by the collaboration of military and civilian, a good example of the extension of science to people's livelihood.

V. CONCLUSION

By recognizing the importance of information and computer technologies to medical systems, China has planned new medical reform within the direction to e-health. The Chinese government has realized that necessity and the lack of sound law systems, social insurance systems to develop RCMS systems. Experimental projects at Xiamen, Beijing and Dalian have been conducted to construct regional collaborative medical systems, and to resolve the problem of people's "difficult and expensive to see a doctor". Accompanying unavoidable challenges, opportunities are also introduced by new Chinese medical reform for companies with high quality medical IT solutions.

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