Solutions and Plan of Smart Healthcare in Wuxi

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Abstract. Smart Wuxi needs smart healthcare. However, currently Wuxi faces some challenges in healthcare. To address the issues, the solutions for smart healthcare in Wuxi by using the advantage of information and communication technology (ICT) are provided in this report. These solutions will make medical services in Wuxi be smarter and higher-quality. At last, some future proposals are provided to further complete smart healthcare for smart Wuxi city.

1 Introduction and Challenges

Smart healthcare is an important research area for Internet of Things (IoT) in Wuxi, which employs sensors and other information identifying technologies, wireless and wired networks to realize large-scale, multi-layer interaction between patients and medical equipments, medical staff and healthcare institutions. At the same time, it is also an important foundation for the healthcare development of Wuxi and essential to Wuxi’s health reform which is vital to the welfare and livelihood for city residents. As a result, smart Wuxi city needs smart healthcare as a support, and smart healthcare is also burnishing Wuxi’s reputation as a high-tech center.

At present, smart healthcare has played an important role in smart Wuxi city. With the increasing applications of IoT, smart healthcare has achieved impressive results and brought better healthcare experiences not only for patients, but also for other healthy citizens, in contrast with traditional healthcare. Despite this, smart Wuxi still faces some challenges in the healthcare system, for instance, as follows:

- **Smarter hospital.** Smarter hospital is an important improvement of smart healthcare system. A natural problem is how to build a smarter hospital for greatly improving medical services and patient experience.
- **Data integration/realtimeness.** How to combine heterogeneous health data sources in a unified and meaningful way enables the discovery and monitoring of health data from different sources. It is also important for smart healthcare to ensure the data realtimeness.
- **Medical resource shortness.** There are not enough medical resources for the population. For example, there are fewer doctors and high-level healthcare institutions but more patients.
- **“Low” usage of community health service centers.** In contrast with community health service centers, people prefer the high-level healthcare institutions. This results in the low usage of community service centers.
- **Bad health habits.** The citizens have some bad health habits that contribute to poor health, for instance, smoking and no sport.
- **Lack of information sharing.** Hospitals are not sharing enough information. This leads to the following two problems at least. First, the health information records of patients can not be queried. Second, there is lack of medical cooperation between hospitals.

2 Solutions
Advances in Information and Communication Technology (ICT) can make medical services smarter, higher-quality, and improving lives every day for Wuxi.

These advances for solutions include:

(1) Radio Frequency IDentification (RFID) technology

RFID technology is a good tool for building a smarter hospital, which is now mature to provide the part of the IoT physical layer in smart environments through low-cost, energy-autonomous, and disposable sensors. An RFID system generally consists of three main components as shown in Fig. 1.

![Components of an RFID system](image)

- **RFID tag, or transponder.** An RFID tag is a small object, such as an adhesive sticker, that can be attached to or incorporated into a product just like barcode tag.
- **RFID reader, or transceiver.** It can read data from a transponder and at the same time, write data to a transponder.
- **Data processing system.** This utilizes the data obtained from the transceiver in some useful manner.

Smarter hospitals using passive/active RFID solutions should be built according to the following three main points:

- Managing assets such as hospital equipments, blood samples, and drugs;
- Tracking and identifying patients, e.g., using GPS outdoor for location, using card-like devices for identifying;
- Providing data for electronic medical records systems.

Using RFID can not only monitor the whole hospital continuously and reliably, but also improve patient safety and reduce the potentially preventable, in-hospital medical errors.

(2) Big Data Analysis and Fusion technology

Various health data from heterogeneous sources (including the internet, smart-phones, embedded sensors in large numbers deployed for a variety of applications and so on) usually have different health views as well as very large scale. Such data can be dealt with and analyzed by big data analysis and fusion solution, such as big data mining and machine learning methods. Big data analysis for smart health should mainly consider the following:

- Big data models and architectures for smart healthcare;
- Data integration and information fusion for smart healthcare;
- Security, trust and privacy in smart healthcare;
- Predictive modeling for improving healthcare;
- Real-time protocols for smart healthcare.

Big data analysis and mining is becoming increasingly important in healthcare information technology due to its excellent performance. There is thus a reason to believe that it is a very good
solution to the problems arising in big healthcare data.

(3) Smart Home solution

Smart home (or places) is a good choice to medical resource shortness. Smart homes enable patient self-treatment and monitoring by using simple devices (e.g., wireless devices and smart phones), which provide standardized outputs for specific physiological conditions, intelligent applications or software capable of analyzing and processing body signals, wearable sensors and other smart devices exclusively manufactured for the purpose of body signal monitoring or processing.

Note that, patients at smart homes should be monitored regularly by medical doctors; whereas, doctors themselves are usually busy. Therefore, interoperable services are required between Smart Home Healthcare System (SHHS) and Hospital Management Information System (HMIS). Fig. 2 shows the work model between SHHS and HMIS. Using these services, SHHS and HMIS can exchange information to provide guidelines to the patient.

![Fig. 2. Work model between SHHS and HMIS](image)

(4) Telemedicine technology

Telemedicine system can enhance the usage rate of community health service centers. Telemedicine is the use of telecommunication and information technologies in order to provide clinical health care at a distance, which has the following advantages when applied to community health service centers:

- Making community health centers and high-level hospitals closer, i.e., helping eliminate distance barriers;
- Sharing the same core medical resources (e.g., medical doctors) for patients in centers and in hospitals;
- Improving access to medical services and alleviating medical treatment-level differences between centers and hospitals;
- Accessing easily to the knowledge of high-level hospitals from community centers.

Thus, the community health service center should build the telemedicine system to improve the usage rate.

(5) Gamification Strategy solution

Gamification, a growing trend in health promotion, is showing that fun, social experiences can dramatically improve and change people’s behaviours or habits. In practice, gamification can be used to change bad health habits and encourage a new healthy behaviour such as regular
exercise and improved diet by applying game incentives such as prompts, competition, badges, and rewards to ordinary activities. Typically, gamification is web-based, usually with a mobile app or as a micro-site.

(6) Smart Cards plus Shared Common Platform solution

With the IoT as a basis, the solution uses smart cards and incorporates a shared common platform. The platform provides communication and information sharing between hospital and hospital information system, patients and hospital. Smart cards provide a convenient and secure medium for storing medical information. Patients can retrieve their medical information anywhere by IoT. Note that, medical information can be stored on smart cards or on dedicated servers. Hospitals can share patient’s records with others by shared common platform. This helps the cooperation between hospitals.

3 Future Proposals

Here, some aspects are suggested to further improve smart healthcare in Wuxi, as follows:

• *Integration with medical data.* Wuxi should build a *single* large medical database for data processing and analysis, because it is helpful to smart health applications. In addition, a single large database with realtime data is also necessary to realtime data analysis. Note that, the reliability of the data should be ensured.

• *Investment in healthcare.* The government should further increase investment in health care, because considerable investment is required to, for instance, treat common diseases (e.g., asthma and allergic rhinitis, COPD) and develop innovative health information technologies (e.g., gamification strategies for healthy habits) for smart healthcare. Note that, smart investment in healthcare is essential, for the benefit of both citizens and economy of Wuxi. A typical smart investment is the *innovative medicines initiative* (IMI), which can be used in Wuxi.

• *More advanced business models.* Innovative business models should be studied and designed for smart healthcare, which are expected to further improve health-related behaviors, patient-doctor communication, and so on. New projects must
  > focus on the development of technology that enables such novel business model;
  > and demonstrate the expected economic benefit of the novel business model.

• *Regulations and standards.* Policy makers need to further complete the regulations and standards of smart healthcare.

4 Conclusions

Smart healthcare is an important component of smart Wuxi city. At present, Wuxi faces some challenges (e.g., data integration, medical resource shortness, etc.) in health care. To solve these issues and build smart Wuxi, this report provides the smart health solutions using advances in information and communication technology. These solutions will make medical services of Wuxi smarter and higher-quality. Furthermore, some future proposals are also given to further complete smart healthcare in Wuxi city.