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A Prototype of Electronic Home Care Visit Platform: Nurse's e-Bag

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Abstract

In this study, an electronic home care visit platform: Nurse's e-Bag integrating popular distributed technologies, mobile hardware, and bio sensor was developed. This implementation is based on the service model of the home care center at National Taipei College of Nursing(NTCN) Hospital, which is one of the branch hospitals of National Taiwan University Hospital(NTUH) and serves as the disposition and case management for long term care. For enhancing the efficiency and quality care for home visiting nurses, e-Bag was introduced to integrate with a mobile electronic home care records system and become one application part of NTUH U-Care system and also an electronic home care visit platform. Light weighted Nurse's e-Bag not only reduces the loading comparing to the traditional home healthcare, but also provides the teleconsultation when home visiting nurse encounters problems at the patient's home.

Keywords:

home visiting nurse, home care, ubiquitous healthcare, electronic health records, nurse's bag

Introduction

E-Health (healthcare activities based on Information and Communication Technologies) is probably the most prominent of these e-business services that can have a major visible impact on the development of the society, as endorsed in the World Health Assembly in May 2005. Ubiquitous Healthcare (u-Health) focuses on e-Health applications that can provide healthcare to people anywhere at anytime using broadband and wireless mobile technologies.

National Taiwan University Hospital, one of the most renowned medical centers in Taiwan collaborates with its branch NTCN hospital and industry partners to develop a U-Care system, which is focusing on community healthcare and long term care. U-Care system utilizes the medical, IT and telecommunication environments. U-Care is an important research project of a Mobile Hospital (m-Hosp) research group in National Taiwan University [1]. Mobile Hospital is switched to Ubiquitous Hospital (u-Hosp) from 2006. m-Hosp/u-Hosp recruits many multidisciplinary faculties and researchers from different colleges and also from several hospitals and other universities.

Nurse's e-Bag,, which was designed to provide the ubiquitous healthcare service and enhance the efficiency and quality care for home visiting nurses, was introduced to integrate with a mobile electronic health records system and become one important application part of NTUH U-Care system.[2] It also plays as an electronic home care visit platform by utilizing the information, communication and biomedical sensor technologies. As an important subgroup of u-Hosp research team, home visiting nurses at home care center of NTCN Hospital have the experience of implementation of electronic health record system and high acceptance of information technologies and collaborated with medical engineering and medical informatics experts to develop this application platform[3].

Methods

The basis of the design in Nurse's e-Bag is the service model of home care center at NTCN Hospital. Usually home visiting nurses at the home care center would receive referral notification of patients who need long term care or follow-up visits after discharge from NTU Hospital. For each referral, they would go to the patient's home for 1st time evaluation of health status. Then they visit the patient twice per month, re-evaluate the health status per four months, and make insurance claims for reimbursement (also per four months) until this case is deceased or home care is terminated. The principle business processes were deliberated as the following:

Mobile electronic home care records

When receiving a new case, a home visiting nurse first vfisits the patient to build personal data, health status evaluation, care plan suggestions, and an insurance claim profile. The health status evaluation contains thirteen

forms, divided into two groups: called 'A forms' and 'B forms'.

The 'A forms' contain data of cardiopulmonary vital sign, nutrition, and others. A nurse fills new healthcare information and adds them into the home care record in every visit. The 'B forms' contain summary data of 'A forms', and some extra data. Such as care plan suggestions, and insurance claims are produced every re-evaluation per four months. A care plan suggestion consists of care problems, care process, and evaluations. Each care problem has its default care processes to adopt. Contents of a care plan suggestion may be updated when necessary.

A home visiting nurse regular visits a patient twice a month, and fills new 'A forms' of the patient and re-evaluates the patient status per four month until the patient is recovery, moved, or dead. When one of these events occurs, the homecare is terminated and a 'closed case record' is built. With the mobile electronic home care records system, the data can be stored onsite and transmit to a server online via accessible Internet connection or synchronize in batch operation after the nurse return to office everyday.

Bio-sensor monitoring

The Nurse's e-Bag can also provides measurement and monitoring of bio-signals such as temperature, blood pressure, glucose, oxygen, respiration, ECG, and other vital signs. A bio-sensor network to record daily health status has been being developed in the U-Care system, so home visiting nurse can connect to the sensor network in the home setting or use the selective portable bio-sensors to records vital signs, and executes the home care record system which access results from sensor database into evaluation forms for the home care management.

Bidirectional Audio-video interaction

Another business process is the audio-video interaction among doctor-nurse and doctor-patient in mobility or at patient's home. A home visiting nurse can initiate a conference call via a built-in videoconference module on the portable computer or using the videoconference module of patient's U-Care system at home setting. The consultant doctor can be in real- time diagnosing the abnormal sign or bio-monitoring results of the patient. The vital sign was transmitted through Asynchronous Digital Subscribe Line(ADSL), Third Generation (3G) or General Packet Radio Service (GPRS) network. Therefore, the home visiting nurse can get more support from physicians to enhance the service quality

Results

System architecture

Full view of the system architecture can be separated into client side on a mobile light weighted computer and central server side (figure 1.). The server side is a simple system provides database management functions and queries. The mobile computer side contains two independent application systems, one is the electronic home care record system and another is the bio-sensor monitoring system.

The home care record system works with a local database which stores patients' records assigned to individual nurse. The mobile computers can be shared among colleagues by taking anyone of them with the e-bag when a nurse is scheduled to do the home visit. A nurse can download patient's data before she go out for work, and synchronize with the server when network available.

The bio-sensor monitoring system connects to sensors with their drivers and save data into another database. We can use thermometer, sphygmomanometer, glucometer, and pulse oximeter, peak flow meter and ECG. . This system works with another local database which retrieves bio-signal data via corresponding sensor drivers. The home care record system further integrates the bio-signal data and stores to its database.

User interface

A nurse can login into home care record system to perform data manipulate, download, and upload functions. If there is a new case, she would call the patient or go for the 1st visit to verify referral sheet come from hospital and fill the basic data forms in the system (figure 2).

When a nurse visits a patient, she can use the bio-sensor system to retrieve history data of biosensor monitoring (figure 3). Data are store into a JET database that a sensor uses a table in it. Data will be read by home care record system when the nurse fills evolution forms.

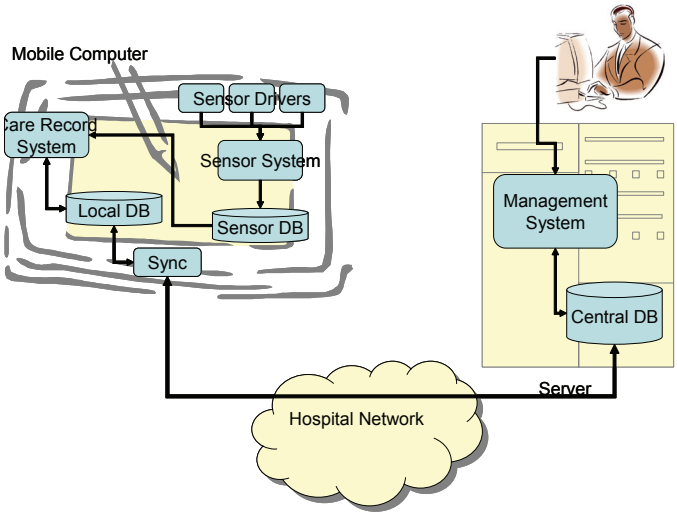

Figure 1 - The system architecture diagram

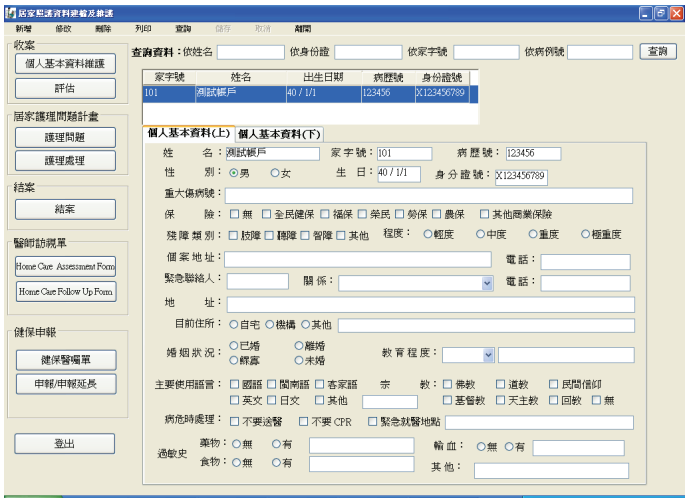

Figure 2 - Personal basic data form of home care records

Figure 3 - A history record of glucose level monitoring

Tele-consultation

If a home visiting nurse needs help from a doctor when she is visiting a patient who has unsolved problem, she may call the on-call doctor or patient's family doctor for consultation. In case it is a serious situation of a patient, the doctor might need to access the home care records in the server via his computer. At the same time he can also link to the patient's medical records from Hospital Information System if the patient is referred from same hospital. In this way, the quality of consultation is much improved comparing to traditional telephone consultation the nurse is the exclusive source of information.

The broadband and wireless telecommunication network such as home ADSL, Fiber to the home (FTTH), and 3G communication network have enabled videoconference function that the doctor can visually evaluate the situation of patient, and interpret the vital signs in real time. Nurse and doctor can use built-in video camera on mobile computers and free software to call videoconference easily.

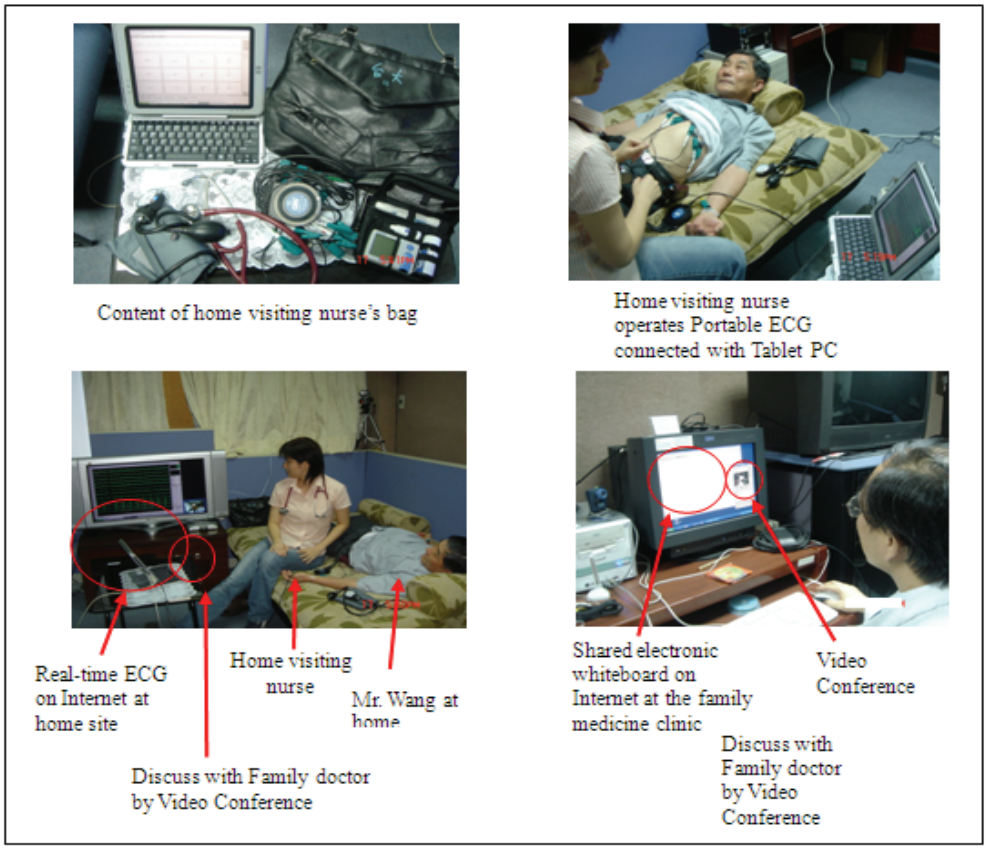

Figure 4 - Tele-consultation at patient's home

Discussion

Studies suggest that home visits can lead to improved medical care through the discovery of unmet health care needs. [4-6] Therefore, home visits will play an important role in long term care, and the electronic home care visit platform can significantly improve efficiency and quality of home healthcare comparing to the traditional nurse home visit. It makes the home care service be linked to a hospital-based health information system more easily. Moreover, the home visiting nurse and the patient's family doctor can easily collaborate to trace the history and clinical condition of patients. It is also convenient for survey or to evaluate the whole patient community through the electronic health records system, so the system can enhance the quality of medical service.

The implementation is fully based on the service model of the home care center at NCTN Hospital. A home visiting nurse visits 5 cases one day. The client of prototype platform using a light weighted notebook less than 1kg with long battery life is good for one day's work without charging. In general, the weight of paper healthcare records of five patients is equivalent to the notebook, and pc-based portable sensor devices are also less weighted than traditional physiological measurement equipment. Moreover, in U-Care system more and more biosensors will become standard remote monitoring devices installed at patient's home. Home visiting nurse will no longer need to carrier these devices. Therefore, home visiting nurse not only reduces the loading of her bag but also get the benefit of efficient case management by using this e-platform[7-8].

However, security and privacy issues are still the major concerns of an e-platform. There are many technologies along with ordinary user id and password which are applied on a mobile computer to ensure security, such as the finger print and Centralized Authentication (CA). Security problems might happen when download and synchronization of patients' data via network were performed. Since the wireless environment is not completely deployed in everywhere, the homecare record system is designed workable as off-line. There is a client program at mobile PC with a local database to store home care records. It raises the security issue that patient's data maybe unauthorized accessed. To reduce the risk of damage, only data of

patients assigned to the on duty nurse can be stored to the computer. If a patient should be reassigned to another nurse, or home care of a patient is terminated, his data in the computer of the original nurse will be clean when synchronizing. On the other hand, the data retrieval of biosignal could probably be another security hole. It is not a good idea to open our database to bio-sensor providers. So we propose a two tiers solution that ask sensor providers to export data of standard format from their sensor and save them into a JET database which is the default function of Windows OS and can be checked easily using Microsoft Access.

To representation of a full function e-platform home care visit rely heavily on high speed wireless and broadband network. At present, the bandwidth is still not enough to show full motion live video to the doctor, but in the near future, Taiwan will build high speed wireless network environment, such 3.5G High-Speed Downlink Packet Access(HSDPA) with 3.6 Mbps, WiMAX (Worldwide Interoperability for Microwave Access),

Conclusion

The prototype e-platform for home care visit materialized as a nurse e-bag which integrated with a mobile electronic home care records system, a biosensor measuring and retrieval system, and a videoconferencing and consultation system. The key element is a light weighted mobile computer with long battery life enhances the efficiency and reduces the total weight of bag content. The platform is flexible upon the working flow of the service model of the home care visit and serves as the disposition and case management tools for long term care. It involves popular mobile technologies and existing sensors that cost not too much. It also shows a good example for interoperability cross domain knowledge; include nursing, information technology, sensor technologies, and the outsourcing vendors. In the future, we expect more application and service models in long term care can be implemented with this e-platform.

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References

[1] Chen HS, Chang KH, Lai JS. Study of a mobile Electronic Medical Record System. 2002 Medical Informatics Symposium in Taiwan (MIST 2002)

[2] Chen HS, Su MJ, Shyu FM, Luh JJ, Hwang SL, Su S, Chen SJ, Lai JS, Mobile Hospital: Healthcare for Anybody at Anytime and Anywhere. The Journal on Information Technology in Healthcare 2006;4(2):111-12

[3] Yaw-Jen Lin, Chen-Chiang Ho, Chun-Ming Lin, and Heng-Shuen Chen, The Design and Implementation of a Mobile Patient Record for Home Care Network at NTCN Hospital. The 7th International Workshop on Enterprise Networking and Computing in Healthcare Industry, Busan, Korea (HEALTHCOM2005)

[4] Arcand M, Williamson J. An evaluation of home visiting of patients by physicians in geriatric medicine. Br Med J 1981;283:718-20.

[5] Fabacher D, Josephson K, Pietruszka F, Linderborn K, Morley JE, Rubenstein LZ. An in-home preventive assessment program for independent older adults: a randomized controlled trial. J Am Geriatr Soc 1994;42:630-8

[6] Ramsdell SW, Swart J, Jackson JE, Renvall M. The yield of a home visit in the assessment of geriatric patients. J Am Geriatr Soc 1989;37:17-24.

[7] M. V. M. Figueredo1, J. S. Dias2. Mobile Telemedicine System for Home Care and Patient Monitoring. Proceedings of the 26th Annual International Conference of the IEEE EMBS, September 1-5, 2004

[8] B. Spyropoulos, M. Botsivaly. Reducing Hospital length of stay through the formation of a Hi-Tec Home-care Environment. IEEE 2005.

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