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Safe and Efficient Use of Wireless Communication in a Large Hospital

Eisuke Hanada[a], Hideaki Nakakuni[b], Takato Kudou[c], Corbet Vernon Sullivan[d], Emiko Hata[e], Hideko Yakuni[e], Michiko Yoshioka[e], Shusaku Tsumoto[b]

[a] *Division of Medical Informatics, Shimane University Hospital, Japan*
[b] *Department of Medical Informatics, Shimane University School of Medicine, Japan*
[c] *Faculty of Engineering, Oita University, Japan*
[d] *Language Education and Research Center, Kyushu Sangyo University*
[e] *Nursing Department, Shimane University Hospital, Japan*

Abstract

Computer systems, often called hospital information systems (HIS), have been installed in most large Japanese hospitals. In almost all cases, HIS have a server/client type structure connected by a LAN. For voice communication among the hospital staff, a landline telephone is often used. The potential demand for the introduction of wireless communication devices for data/voice communication into hospitals is high. However, because of guidelines made to reduce problems that might be caused by electromagnetic interference (EMI) with medical electric devices, the introduction of these systems has, until recently, been shelved in almost all cases. Because it has become possible to protect against the possible occurrence of EMI, the number of hospitals introducing such wireless communication is growing. We report a case of a university hospital in which data and voice wireless communication have been safely and efficiently introduced.

Keywords:

wireless communication, cellular phone, wireless LAN, PHS, information security

Introduction

Computer systems are rapidly being installed into most large Japanese hospitals. Usually called a hospital information system (HIS), most have a server and client type structure using TCP/IP LAN. However, voice communication among hospital staff members is often still done with fixed, landline telephones. The potential demand for the introduction of wireless data/voice communication into hospitals is high because of the promise of savings these technologies bring through improvements in patient service and labor efficiency [1]. However, because of "electromagnetic interference" (EMI) with medical devices and of guidelines enacted in many countries to protect against such interference, the introduction of such systems has been shelved in almost all hospitals. In recent years, it has become possible to protect against the possible occurrence of EMI, the number of hospitals introducing wireless communications has grown. This paper describes a university hospital in which wireless communication has been safely and efficiently introduced. (hereafter termed the target hospital).

Materials and methods

Background of the target hospital

The target hospital is located in western Japan, has 616 beds, about 300 doctors, and 350 nurses. It has 12 wards, an ICU, and an NICU. Each ward has 8-10 daytime and 2-3 night nurses. The HIS of the target hospital has 44 servers and 524 client terminals.

HIS wireless data communication

Before introducing a wireless LAN, we examined the safety limits against EMI of some commonly used medical pumps [2]. The results showed that no EMI would be expected to occur unless an apparatus with extremely strong output power were used.

Seventy-two client terminals are connected with servers using an IEEE 802.11a wireless LAN at each ward. These terminals are used only by the medical staff for browsing information, reviewing the medical charts of the patients with barcode scanning, and to immediately record medications and transfusions given at bedside. Reasons for choosing IEEE802.11a were its high rate data transfer and freedom from 2.45GHz band electromagnetic noise. To keep personal information security high, the SSID value is different on each floor and connection attempts using the SSID as "Any" are refused. Also, authentication with an ID and a password has been added and all communications are logged. The AP-5100 (ICOM Inc.), which has an OCB AES (128 bits) cipher system and a Media Access Control (MAC) address filtering function, were adopted as the access points.

Mobile voice communication for staff members [3]

In the target hospital, both landline telephones and the Personal Handy-phone System (PHS) are used for voice communication between staff members. PHS is a totally digital mobile communication system that was developed in Japan. The output of a PHS terminal is a maximum of

80mW. Almost no EMI with medical devices caused by the signals emitted by PHS terminals was found [4]. In many Japanese hospitals, PHS is used instead of the traditional nurse call system terminal. PHS is well-known for increasing efficiency, improving patient service, and raising the level of medical safety among Japanese nurses.

Doctors and some nurses working in the target hospital have had access to a public PHS terminal since November 2004. A red strap is connected to the PHS terminal to serve notice that the terminal has been registered for use in the hospital. Installing a public PHS service means no in-house telephone exchanger is needed. This results a great reduction of cost. The initial cost of this system was only about 4,500 U.S. dollars for the use of 280 PHS. If an in-house exchanger were to be installed, more than 100,000 U.S. dollars would be required. To determine the effectiveness of the public PHS system, the number of calls received on a fixed-line telephone in a ward was compared 7 days before and after the introduction. Total number of calls received was reduced from 1,908 to 997 (47.7% reduced). The number of calls received at surgical rooms increased, possibly because carrying mobile phones, including PHS, into surgical rooms is forbidden. Two years later, PHS handsets were given to every chief nurse. Also, a PHS handset that can make calls with PHS freely is provided to every ward to make it easier to contact doctors. Totally, 440 PHS handsets were in use in the target hospital at the end of November, 2006.

Mobile communication as a service for patients/visitors

In Japan, the use of cellular phones in business has been widely promoted as they are now recognized as being indispensable for doing business. The free use of phones by inpatients can decrease stress and the sense of isolation caused by hospitalization, thus raising the Quality of Life (QOL) [5].

The target hospital has permitted the use of cellular phones in unrestricted zones since January, 2004, with the following rules; “Cellular phones can be used only in visitor lobbies, single bed sickrooms, and in dining areas”, “The medical staff can use cellular phones at nurse stations and in conference rooms”, “Cellular phone use is not allowed within 50cm of medical devices”, “Patients connected to medical devices are prohibited from using cellular phones”, “After a set time for turning out sickroom lights, the use of cellular phones is prohibited”, and “Staff members are not allowed to use a cellular phone during rounds, while walking, or during explanations to patients or their family”. These rules are widely displayed and are given to inpatients. The co-operation of patients and staff members has been requested, and no EMI has been observed since these rules were put into effect.

Discussion and conclusion

In Japan, other than the target hospital, there are no hospitals with more than 600 beds using wireless communications for both data and voice communication at the end of December 2006. The main reason is the fear of EMI. However, by keeping cellular phones away from medical devices and by using mobile phones or wireless LAN apparatus with weak electromagnetic wave output, it is possible to stop or minimize EMI with medical devices. Limiting the areas in which phones are allowed is important for the purpose of preventing EMI, controlling noise, and preventing medical accidents due to the inattentiveness of the caller [6].

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Address for correspondence

Eisuke Hanada
Division of Medical Informatics, Shimane University Hospital
Enya-cho 89-1, Izumo, 693-8501 Japan
E-mail: e-hanada@med.shimane-u.ac.jp