International Journal of Computer & Software Engineering

Short Communication   **Open Access**

The Importance of the Information and Communication Infrastructure of Hospital Buildings

Eisuke Hanada

Department of Information Sciences, Faculty of Science and Engineering, Saga University, Saga, Japan

Abstract

Combining hospital information systems (HIS) and wireless LANs has enabled the immediate and accurate sharing of patient information among the hospital staff. I believe that the use of ICT will continue to be further enhanced in the future and that the construction of a reliable infrastructure is essential for the stable operation of systems built to meet the demands of modern medicine. Herein, I will point out problems with the hospital infrastructure and give my personal opinions on countermeasures that can be taken, based on my experience working in the system management departments of university hospitals. I hope that this paper will help to improve the efficiency of ICT utilization in the medical field and make it more effective.

ICT Introduction and Future Demand in the Medical Field

The introduction of ICT in the medical field is rapidly progressing [1]. Combining hospital information systems (HIS) and wireless LANs has enabled the immediate and accurate sharing of patient information among the hospital staff. I believe that the use of ICT will continue to be further enhanced in the future, including the automatic acquisition of vital data through integration with IoT and the use of AI to support clinical treatment.

There is no doubt that the construction of a reliable infrastructure is essential for the stable operation of systems built to meet the demands required of modern medicine. Based on my experience working in the system management departments of university hospitals, I will point out problems with the hospital electronic infrastructure and give my personal opinion on countermeasures that can be taken.

ICT Infrastructure in the Clinical Field

Especially in Japanese large-scale hospitals, the HIS is constructed as an aggregate of many subsystems. Terminals are located in disparate locations, and their relation to the server is often through a server-client or virtual terminal system. One university hospital with 600 beds where the author worked had about 45 servers and over 1,500 terminals. Some of the servers were integrated with private cloud servers, thus the number of servers as hardware was less than 45. The servers were connected to each other and to the terminals using an IP network.

In addition to HIS terminals, monitoring systems, various medical devices, and a variety of sensors are currently being connected using networks: not always IP networks. Especially in large scale hospitals, each system or device will be considered for implementation by the department that will manage it, thus, in many cases, a hospital wide network as a central part of the common infrastructure is not designed in the planning stage.

IP networks themselves are beginning to face a situation in which recent improvements in the transfer rate of wireless LAN exceed the capacity of the existing metal LAN cables. The maximum transfer rate of IEEE802.11be (Wi-Fi7) wireless communication, which is expected to appear in 2024, is 30 Gbps, while that of Category 6A metal cables, which are widely used at present, is only 10 Gbps.

Information and Communication Infrastructure in Hospital Construction

When building a hospital, the construction company and architects tend to hear opinions primarily from physicians, with nurses and administrative staff often participating in the discussion. Other departments, such as the pharmacy, laboratory, radiology, kitchen, and surgery support, may participate in the discussions in as much as they pertain to their own departments. Most of the common infrastructure for the hospital is designed by the facility management department, however, they often do not carefully consider information and communication facilities other than the power supply and telephones.

In almost all Japanese hospitals, the IP networks and networks used for monitoring systems are treated as being attached to the computer systems or to medical devices. In other words, they are "equipment", not a part of the "facility". Planning equipment installation often starts only after construction is almost completed, which can be a major obstacle to network construction, as shown in the following examples [2-4].

- Cable routes restricted due to the presence of light courts, etc. Cable routes may exceed cable length restrictions: Factors include limited locations where floor routers can be installed.

- Structural walls and beams obstruct cable installation: There are places where a cable cannot be placed without penetrating them, and there may be patients or terminals in unreachable locations

- Narrow ceiling space: Hospitals often install cables in ceilings, but the wiring and piping in the ceiling may already have been completed before cable installation is considered, thus the communication cables may not be installed properly.

*Corresponding Author: Prof. Eisuke Hanada, Department of Information Sciences, Faculty of Science and Engineering, Saga University, Saga, Japan, E-mail: hanada@cc.saga-u.ac.jp

- No information on the materials of walls and doors is shared: This is not only an obstacle when designing wireless communication, but also a cause of communication failure when walls, doors or floors are made of materials containing metal.

- Devices sometimes generate electromagnetic fields in the same frequency band as that used by a communication system: In wireless communication, these electromagnetic fields (electromagnetic noise) can interfere with communication. This is often due to the fact that wireless communication was not considered when the equipment was installed.

Countermeasures: Proper Intallation of ICT

As shown in the above examples, it is notable that large hospitals in particular do not pay sufficient attention to their information and communication infrastructure and do not consider it an integral part of the infrastructure at the time of building design, which hinders stable operation. The following are things that should be done to prevent these problems.

First, the director of the hospital must recognize that the information and telecommunications system is integral to the infrastructure and treat it as such. It is also important at the time of design to calculate where the communication systems to be installed will be used and to carefully consider the wishes of the departments that manage each communication system. The collected requests should be incorporated into the design in such a way that the necessary cable routes are ensured and wireless communication antennas (access points to wireless LAN) can be positioned appropriately. Also, it is critical that information be shared. In particular, it is extremely important to share information between the building construction department and the department that manages the telecommunication facilities. This will have a positive impact on the design for the location of cables and on signal coverage.

Furthermore, it is important to establish rules and educational programs related to the operation of the systems. In particular, systems using IP networks should consolidate information at the time of purchase and connection to prevent duplicate IP addresses and to prevent the creation of security holes. Unfortunately, clinical staff often do not receive network literacy education during training, which may both prevent them from taking correct actions (e.g., contacting administrators) in the event of communication failures and cause network failures (e.g., incorrect use).

After installation is completed, establishing a management system for the network is also important, especially for wireless communication. This is not only for the management of each device, but also for the management of electromagnetic noise, which is essential for every wireless communication system. Addressing problems quickly and taking measures to insure that they do not recur will be effective to improve the communication systems and their environment. Managers of each communication system and user representatives should participate in the management system. It is important to keep system safe through the sharing of information.

Conclusion

In the above, I have described the importance of the information and communication infrastructure of hospitals, current problems, and countermeasures against them. No system will function properly unless it is based on a well-considered infrastructure. In addition, the infrastructure must be properly constructed and maintained for it to function as desired. I hope that this paper will help to improve the efficiency of ICT utilization in the medical field, which will make it more useful and effective.

Competing Interests

The author declare that he has no competing interests.

References

1. Electromagnetic Compatibility Conference Japan, Committee for Promotion of Radio Use in Medical Institutions, Results of Survey on Promotion of Appropriate Radio Use in Medical Institutions in FY2021 (Hospitals) 2022.

2. Electromagnetic Compatibility Conference Japan, Guidance for safe and secure use of radio waves in medical institutions (revised version) 2021. (in Japanese).

3. Endo T, Kano T, Hanada E (2022) Guidelines for Medical Telemetry System. IFHE Digest 2022, pp.31-33.

4. Hanada E, Kudou T, Tsumoto S (2013) Installation of Secure, Always Available Wireless LAN Systems as a Component of the Hospital Communication Infrastructure. Journal of Medical Systems 37: 9939.