

# Chapter 7

## Aspects of Information Communications Technology for Better Medical Control

**Isao Nakajima**

*Tokai University School of Medicine, Japan*

**Yasumitsu Tomioka**

*Tokai University School of Medicine, Japan & University of Hyogo, Japan*

### **ABSTRACT**

*The 3G mobile phone has propagation problems in urban areas and experiences severe congestion after major disasters in supporting mobile eHealth. We expect a Quasi-zenith satellite with nationwide coverage. In near future, the data transmission of image of pharyngoscopy, motion picture of light reflex, 12-leads ECG, automated ultrasonic echo and vital signs from ambulances shall be performed to assist medical control. For example, Thrombolytic agents are reportedly effective even when injected into a vein, if injected in the early stages of acute myocardial infarction, which will reduce medical costs, resulting in high-quality services available uniformly across the nation. This paper describes Japanese aspects of mobile eHealth to support ambulatory applications.*

### **1. OBJECTIVES**

Transmission of in-ambulance data without inconveniencing or undue effort on the part of the rescue crew—in other words, automation of in-ambulance activities (measurement/analysis, activity recording, message transmission)—is es-

sential in implementing uniform medical control standards across the nation. One of key elements for this automation is information communications technology (ICT). Its development is a must for emergency transportation for the near-future. Currently, no country has succeeded in supporting patients through ICT on board ambulances. As an

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ER doctor, I believe the need to do so will grow in the near future. This paper describes our basic concept of ICT to support ambulatory application, especially medical control.

## **2. TECHNICAL COMMUNICATION BACKGROUND**

### **2.1 What is ICT?**

In Japan, ECG monitor, peripheral saturation of blood oxygen, cardiac defibrillator, and other ME equipments have been already installed in 4800 ambulances. The purpose of in-ambulance ICT is to improve emergency rescue quality by transmitting patient data and ambulance GPS data to the triage center automatically, with no inconvenience to or undue effort by the crew. Ideally, ICT would connect the patient monitor online with TCP/IP and record crew activities automatically and electronically. In reality, time standards for the ambulance clock, cardiograph, and communication devices are not synchronized in Japan, and rescue crews must match these manually every morning. Synchronizing these devices would be a simple matter if the devices were linked via TCP/IP connections.

### **2.2 The Third Generation (3G) Mobile Phone**

Some believe communications with moving ambulances should be based on the 3G mobile phone network (Curry & Harrop, 1998; Istepanian, Jovanov, & Zhang, 2004; Lee, Kim, Hwang, & Kim, 2008; Pavlopoulos, Kyriacou, Berler, Dembeyiotis, & Koutsouris, 1998). Is this correct? Is the 3G mobile phone network good enough to ensure multi-path high-speed transmission from fast-moving ambulances? The answer is no, even in Japan, where a 3G network is established nationwide.

### **Multi-Path Communication**

This technology is not yet established. If the base station antenna is located very close to the mobile terminal and communication occurs in line-of-sight mode (Nakagami-Rice fading), communications will be reliable and stable and throughput close to nominal values. But in non-line-of-sight mode (Rayleigh fading), communication is not reliable under multi-path conditions, resulting in inadequate throughput. Maintaining a 384kbps connection rate (the FOMA uplink standard) during transmission from a moving car is quite difficult. None of the various studies involving transmissions from ambulances using the 3G network have led to introduction of a practical system.

**Service area problems:** The number of base stations for the NTT DoCoMo 3G FOMA Service is now at around 3,200 in the Kanto-Koshinetsu area and 10,700 across the nation, with service areas expanding. The population coverage is about 98% nationwide as of the end of December 2007. This coverage, however, counts all city/village citizens when their local administration office exists in a service area (Figure 1). Undoubtedly, this approach counts mountainous areas and remote islands that are actually located outside service areas. Since mobile phone carriers follow profit-oriented market dynamics with cream-skimming policies (shedding unprofitable areas), they will not invest money to construct base stations in these areas. Even with the advent of the 4G network, they will likely focus on urban areas while shortchanging rural populations.

### **2.3 Public Wireless LANs**

Are public wireless LANs useful? Wireless LANs are already in service at railway stations, airports, and main streets. If this system is deployed everywhere, broadband communications will be possible for public rescue vehicles such as patrol cars and ambulances. In an experiment,

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