Emergency Medical Service Systems in Japan; past, present, and future

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Abstract

Emergency medical services are provided by the fire defense headquarter of the local government in Japan. We have a one-tiered EMS system. The ambulance is staffed by three crews trained in rescue, stabilization, transportation, and advanced care of traumatic and medical emergencies. There are three levels of care provided by ambulance personnel including a basic-level ambulance crew (First Aid Class one, FAC-1), a second level (Standard First Aid Class, SFAC), and the highest level (Emergency Life Saving Technician, ELST). ELSTs are trained in all aspects of BLS and part of ALS procedures relevant to prehospital emergency care. Further development of an effective medical control system is imperative as the activities of ambulance crews become more sophisticated. A marked increase in the recent volume of emergency calls is another issue of concern. Currently, private services for transportation of non-acute or minor injury/illness have been introduced in some areas, and dispatch protocols to triage 199 calls are in development.

1. History and development of the Japanese EMS system

Japanese pre-hospital emergency transportation services were originally developed in Yokohama, in 1933, under the auspices of the local firefighting service. In the years before World War II, other major cities, such as Aichi and Tokyo, followed suit, developing similar services. In 1947, the enactment of the Constitution of Japan established the Local Autonomy law, which enabled local governments to provide pre-hospital transportation services; it was followed by the Firefighting Organization Acts of 1948. However, legal jurisdiction over these services remained legally undefined, and their implementation remained dependent on the discretion of individual cities, towns and villages. The latter half of the 1960's saw a rise in the incidence of traffic accidents and occupational injuries, and pre-hospital emergency care became an important component of public services throughout Japan. In 1963, the Firefighting Organization Acts were revised in order to reflect necessary changes in funding, and subsequently underwent three more revisions over the next two decades.

At the time of the first legislation, only 214 municipal bodies provided pre-hospital transportation services, but by 1991, that figure was 3066, or 99.3% of the nation.

As Japanese society aged and the EMS system evolved, the scope of pre-hospital emergency care underwent several major changes. In 1966, 42% of those transported by ambulance were trauma patients, but by 2003, only 26.4% were trauma patients, while 58.4% suffered from acute illness. In 1986, when the third revision of the Firefighting Organization Acts was made, emergency care for people with acute illness was specifically delineated as a major purpose of the EMS.

Training programs for pre-hospital care providers have evolved accordingly. In 1978, a basic training course for ambulance crews (First Aid Class One, or FAC-1) was introduced to provide basic life support. However, as the proportion of patients with acute illnesses increased, the roles of ambulance crews correspondingly expanded, until in 1991 the Emergency Life-Saving Technician (ELST) law was enacted, to provide an advanced level of emergency care [1]. An intermediate level of ambulance crew (Standard First Aid Class, SFAC) was simultaneously introduced. With on-line physician-control, ELSTs were allowed to use invasive alternative airways, place intravenous lines, and defibrillate cardiac arrest patients, with AED. Although the upgrade in education of ambulance personnel advanced patient care, a marked delay in defibrillation by ELSTs was eventually noted, attributable to the delay caused by the legal mandate that the ELST transmit the patient ECG to base hospitals to obtain physician permission to defibrillate [2]. The establishment of quick, on-line medical control was another problem. The medical direction by physicians at base hospitals was not always immediately available in many areas in those days. According to the national government report in 1999, only 47.5% of the prefecture governments, excluding large cities such as Tokyo and Osaka, had EMS systems capable of establishing on-line medical control within 1 minute when activated [3]. Based on these reports, in late 1999, the national government adopted a new policy that did not mandate ECG transmission prior to obtaining a physician's permission. In 2002, the Health and Welfare ministry allowed the use of AED by flight attendants in circumstances where physicians were not available. Promoted by these advances, and in concert with the development of the medical control system, the ELST law was

amended in 2003 so that ELSTs were authorized to use AED without on-line medical control.

In the same year, tracheal intubation was included as a sanctioned method of invasive airway management by ELSTs who had completed 262 hours of the Additional National Standard Training Course, including at least 30 cases of surgical tracheal intubation.

In the interest of further improving the outcomes of out-of-hospital cardiac arrest patients, epinephrine administration by ELSTs will be made legal in 2006. This is the first time in the history of Japanese pre-hospital care that non-physician personnel will administer a resuscitation drug. In order to be authorized to use epinephrine, the ELST is required to complete 220 hours of the Additional National Standard Training course.

2. Current status of EMS systems

The Nihon Telecommunication Network (NTT) has designated 1-1-9 as the universal emergency number, which is directly connected to the dispatch center located in the regional fire defense headquarter. On receipt of an emergency call, the fire defense headquarter sends the nearest available ambulance to the operational site. The ambulance also provides intra-hospital transportation services when more advanced care for the patient is required. All expenses are covered by local governments via tax revenue and there is no charge to the patient for care and/or transportation.

Emergency medical services are provided by the local governmental fire defense headquarters, as based on the Local Autonomy law and Firefighting Acts. Regions of

population fewer than 150,000 are allocated one ambulance for every 50,000 people; regions with population greater than 150,000 are allotted three ambulances, with another ambulance for each additional 70,000 people.

The Japanese EMS system is one-tiered, except for limited areas, where mobile ICU ambulances are available. The ambulance is staffed by three crew members trained in rescue, stabilization, transportation and advanced care of traumatic and medical emergencies. In some areas, in cases of cardiac arrest, fire brigades arrive at the site to assist the ambulance. Firefighting and rescue helicopters are used to provide air transport services if the ambulance crew determines that: a) the time delay in transporting a patient by ground to an appropriate facility poses a threat to the patient's survival and recovery, b) weather, road or traffic conditions would seriously delay the patient's access to advanced life support, or c) critical care physicians and equipment are needed to adequately care for the patient during transport.

There are three levels of pre-hospital emergency care personnel: a basic-level ambulance crew (FAC-1), an intermediate level of expertise (SFAC) and an advanced level (ELST) (Table 1). All of the ambulance crews are required to be trained in firefighting techniques and ambulance vehicle operations (emergency driving responses, tactics, techniques and maintenance).

The FAC-1 rank, based on 135 hours of the basic standard training course, qualifies the crew member to perform basic life support, administer oxygen and establish an oral airway.

The SFAC crew member has completed 250 hours of the National Standard training course, including FAC-1 training, as well as training in the use of AED,

laryngoscopy to remove upper airway foreign bodies, PASG for shock patients, automatic resuscitator and basic vital sign monitoring devices.

The ELST is an ambulance crew member who has completed the National Standard Training course for ELST, or its equivalent, and passed the national certifying examination. ELSTs are trained in all aspects of BLS and part of ALS procedures relevant to pre-hospital emergency care. In addition to the procedures performed by SFACs, ELSTs are allowed to use invasive alternative airways, such as laryngeal mask airway and the Combitube, to treat cardiac arrest patients. For those who have completed the Additional National Standard Training course, tracheal intubation is the preferred option in the management for cardiac arrest patients. In April 2006, authorized ELSTs will be able to administer epinephrine.

Although there is no re-certification system for ambulance crews, ELSTs are required to undergo 128 hours of in-hospital training every two years. In addition, they are strongly encouraged by the Medical Control Advisory Board to participate in continuing education opportunities, such as conferences, seminars, lectures and skill laboratories.

As of April 2005, 57,966 ambulance crews, including 15,317 ELSTs and 4757 ambulances, were deployed throughout Japan.

In limited areas, such as Funabashi and Senri, mobile ICU ambulances staffed with physicians are available. Moreover, air medical services, by a helicopter nicknamed “Doctor Heli,” are available in Hokkaido, Nagano, Chiba, Kanagawa, Shizuoka, Aichi, Wakayama, Okayama and Fukuoka. This service is modeled on the German air

ambulance system and the staffing includes a pilot and specially trained emergency physicians and nurses.

3. Medical control of EMS

Medical control is a critical component of EMS. In 1991, when the ELST law was enacted, the medical control system was not yet established and its subsequent development markedly delayed. As the services provided by ambulance personnel became more advanced, it was widely recognized that the establishment of a consistent medical control system was imminent. Accordingly, in 2001, a proposal to develop a medical control system in Japan was drafted by the Committee on Upgrading Activities of Ambulance Personnel (Table 2). In 2003, a Medical Control Advisory Board was established in each Japanese prefecture.

There are two types of medical control: on-line and off-line. On-line medical control is that provided via telephone by a physician at a base hospital or a dispatch center. Administrative off-line medical control is provided by an advisory board or medical director responsible for the quality of care delivered by the EMS system. Off-line medical control is further divided into two types: advance and ex-post-facto. Advance off-line medical control includes the development of educational programs and protocols for ambulance personnel, while ex-post-facto off-line medical control includes evaluation and analysis of personnel performance for purposes of quality control.

4. Categorization of hospital resource capabilities (Fig. 1)

The categorization of hospital resources identifies hospitals capable of handling emergency patients and enables EMS personnel to rapidly transport patients to appropriate medical facilities. Emergency facilities in Japan are classified into three levels based on resources, administrations, staff and education. Primary emergency facilities provide care for walk-in patients, secondary emergency facilities provide in-hospital care for acute illnesses and trauma, and tertiary emergency facilities, called "Life-saving Emergency Centers," provide total care for critically ill and severely traumatized patients. Life-saving Emergency Centers are also responsible for the education of medical personnel, including ambulance crews. Moreover, an advanced version of the tertiary emergency facility, called "Advanced Life-saving Emergency Center," provides care for severe burns, acute intoxication and reconstruction surgery for amputated extremities, in addition to the standard functions of the Life-saving Emergency Center.

There is approximately one regional primary and secondary emergency facility for every 50,000 residents, and at least one Life-saving Emergency Center for each population of more than one million. As of December 2005, seventeen Advanced Life-saving Emergency Centers are designated in Japan.

5. The Emergency Medical Information Service system

For the purpose of proper management of the local EMS system, an Emergency Medical Information Service is available in each prefecture. This service is operated by the prefecture government and provides information regarding regional medical

facilities via the Internet. This information is available to citizens, as well as to healthcare personnel, although some kinds of information, specific to hospital resources, are restricted to healthcare personnel. In the event of a major disaster, this system becomes linked to the National Disaster Information System operated by the national government, and is used as an important tool to provide and exchange information such as magnitude of disaster impact, damages and available hospital resources.

6. Citizen involvement and the public's role in EMS

Public education is fundamental to the development of an effective EMS system. Training courses for citizens are provided by the fire defense headquarter, the Japanese Red Cross and volunteer groups. Licensed drivers are required to undergo CPR training courses at driver's schools.

One of the most significant advances over the last several years was the increasing public involvement in the defibrillation program. In 2004, the law was amended so that laypersons are allowed to use AED. In 2005, at the World Expo in Aichi, five cardiac arrests by ventricular fibrillation occurred, and four of those patients were resuscitated, with good neurological function, by bystander-operated AED [4].

7. Current issues and future directions

Our EMS system is modeled on that of the United States; however, the medical control system in this country is still in a developing stage. As the procedures

performed by ambulance crews become more sophisticated, the role of medical control will become more imperative.

A marked increase in the recent volume of emergency calls is an issue of concern. The number of ambulance dispatches in Japan was 5.03 million in 2004, and is even greater today [5]. The number of persons transported daily by ambulance is 13,741, on average. This means that ambulance teams are dispatched once every 6.3 seconds. The number of persons transported by ambulance was about 4.74 million, meaning that 1 in 27 individuals was transported to a hospital by ambulance. The period of time for an ambulance to arrive at the site from the initial call is approximately 6.4 minutes. Arrival times are expected to increase because of the marked increase in the volume of emergency calls. However, currently, the majority of emergency calls are for minor injuries or illness, which compromises arrival times to sites of severe illness or injury. Private services for transportation of non-acute or minor injury and illness have been introduced in some areas, and dispatch protocols to triage 199 calls are in development.

An effective EMS system requires the combined effort of multiple organizations, agencies and specially trained individuals. Appropriate medical control, the skills of pre-hospital and in-hospital medical personnel, and cooperation and collaboration among associated personnel and agencies enable the Japanese EMS system to successfully deliver emergency medical service.

References

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[4] Nakagawa T, Inoue Y, Noguchi H et al. The strategy of mass gathering medicine in Expo 2005 Aichi Japan. Japanese Journal of Disaster Medicine 2006; 10(2): 187

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Table 1 Classification of ambulance crews in Japan

	FAC I	SFAC	ELST	
Educational facilities	Schools run by local governments	Schools run by local governments	Schools run by local governments or subsidized by the national government	Private schools
Eligibility for training course	Higher than high school education	Higher than high school education	Ambulance personnel who have 5 years or 2000 hours of experiences as SFACs	Higher than high school education
Total hours of education (skill laboratory and in-hospital training)	135 hours (17 hours)	250 hours (35 hours)	750–1095 hours (405 hours)	1785–2445 hours (1125 hours)
Authorization	Local government	Local government	National government	
types of procedure	BLS Suction of oral cavity Administration of Oxygen Use of oral airway	→ ECG, SpO2, BP monitor Auscultation Use of nasal airway Use of laryngoscope to remove foreign body Use of PASG Use of autonomic Care for patients with special needs*	→ Life saving procedures for cardiac arrest patients 1. Use of invasive airway devices 2. Placement of IV line and administration of fluid 3. Administration of epinephrine	

FACI: First Aid Class I
SFAC: Standard First Aid Class
ELST: Emergency Life Saving Technician
BLS: Basic Life Support

ECG: Electrocardiogram
SpO2: Pulse-oxymetry
BP: Blood Pressure
PASG: Pneumatic Anti-Shock Garment

* obstetric patients
patients with mental illness
pediatric patients
patients requiring oxygen at home

Table 2 Medical control of the EMS system in Japan

Direct medical control (on-line medical control) · Directions for invasive airway management and IV placement · Medical advice for an event that can not be handled by the protocols · Medical judgment for specific cares that can not be handled by the protocols · Advice and directions when the condition of the patient deteriorate abruptly · Medical judgment when the dispatch center operator can not handle the call · Advice and instructions from medical directors at the dispatch center
In-direct medical control (off-line medical control) a In-advence medical control · Physician's involvement in developing an EMS system that meets the needs in the region · Planning, supervision and evaluation of educational programs for ambulance personnel · Planning, supervision and evaluation of educational programs for ELSTs · Development of protocols for activities on the sciene and during transportation · Development of criteria for triage and selecting appropriate hospitals · Education of personnel at the dispatch center of the fire department · Development of protocols at the dispatch center including the priority based on communications · Development of protocols at the dispatch center to provide medical instructions such as CPR by phone b Ex-post-facto medical control · Evaluation of operational records of ambulance personnel (including life-saving procedures by ELSTs) · Evaluation of judgments and cares made by ambulance personnel on the basis of Quality Improvement · Re-evaluation of protocols from a medical point of view · Strategies for Quality Improvement including contiuing education, crisis management programs · Feedback of evaluation to education for ambulance personnel

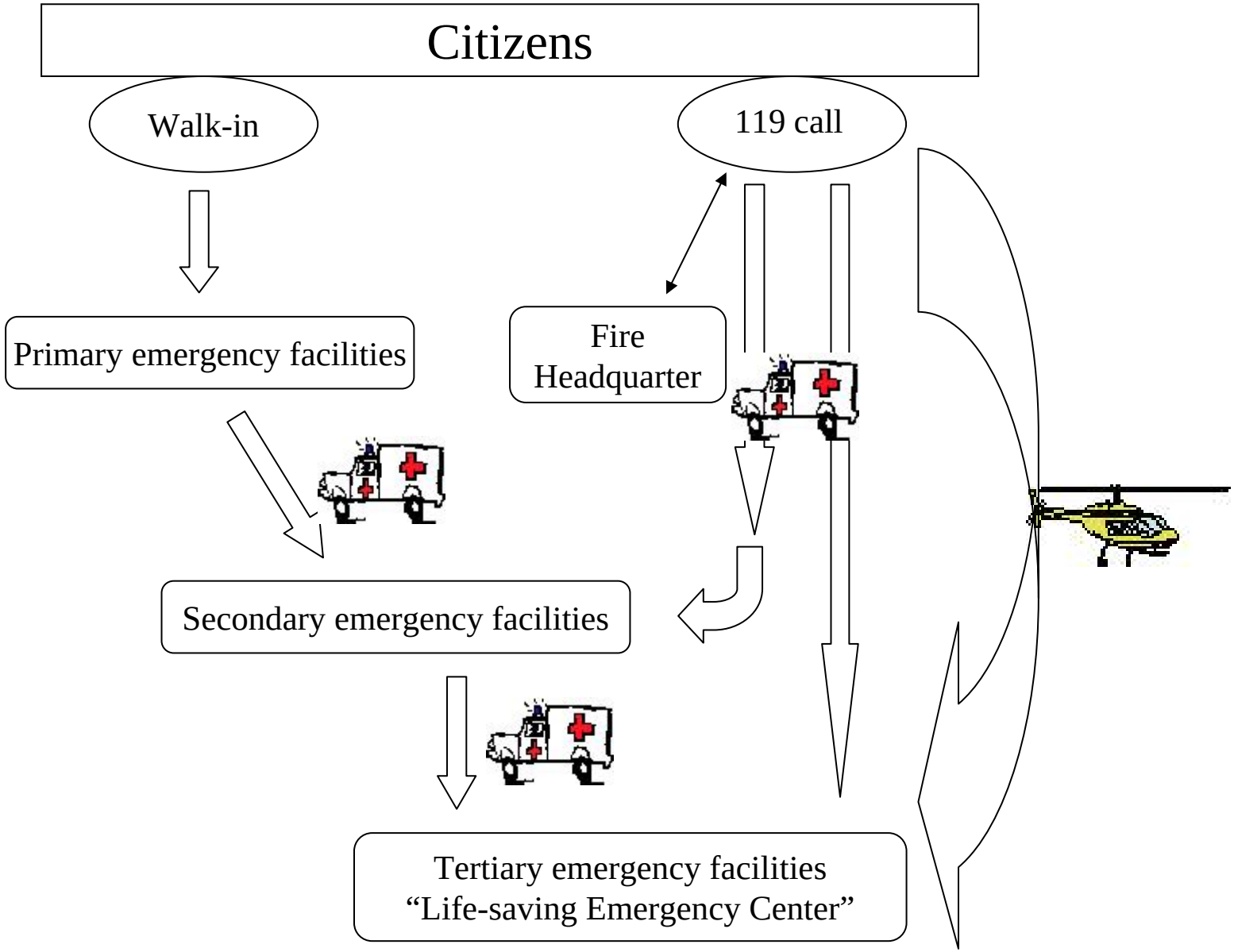

Fig. 1 The EMS system and categorization of emergency facilities in Japan