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Development of information systems and clinical decision support systems for emergency departments: a long road ahead for Japan

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ABSTRACT

Emergency care services face common challenges worldwide, including the failure to identify emergency illnesses, deviations from standard treatments, deterioration in the quality of medical care, increased costs from unnecessary testing, and insufficient education and training of emergency personnel. These issues are currently being addressed by implementing emergency department information systems (EDIS) and clinical decision support systems (CDSS). Such systems have been shown to increase the efficiency and safety of emergency medical care. In Japan, however, their development is hindered by a shortage of emergency physicians and insufficient funding. In addition, language barriers make it difficult to introduce EDIS and CDSS in Japan that have been created for an English-speaking market. This perspective addresses the key events that motivated a campaign to prioritise these services in Japan and the need to customise EDIS and CDSS for its population.

INTRODUCTION

In recent years, the momentum of the technological revolution brought about by health information technology (HIT) has increased. Healthcare reforms, hospitals and regional healthcare alliances have increasingly taken advantage of HIT. Adoption and widespread use of electronic forms for record maintenance have led to increased convenience and easier access to medical records.

Digitisation of the information used in emergency departments has necessitated a consideration of the unique aspects of emergency department care and information handling. For example, general outpatient treatment and emergency care differ in terms of medical examinations and locations within the hospital. General outpatient treatment can vary in duration. In contrast, emergency care involves short-term treatment and efficient performance of complex tasks. Examinations must be completed quickly since many patients exist in highly critical situations. Interruption of examinations is common because of high patient volume. Therefore, the use of a common electronic health record system to meet these different needs could be problematic.[1–3] For this reason, hospitals in many countries use emergency department information systems (EDIS) designed specifically for use in emergency departments. In addition, clinical decision support systems (CDSS) that are designed to reduce medical errors are often used as part of the hospital electronic health record system, which also includes EDIS.

Electronic medical record systems in medical facilities in Japan are, however, mainly designed for use in general outpatient care wards. EDIS is not yet well known, and electronic health record systems designed specifically for use in emergency departments are not available. What follows is a discussion about the history of the development of EDIS and CDSS, their present use, an examination of the factors that impede the adoption of these systems in Japan and possible issues in the future based on the current situation in Japan.

DEFINING HIT, EMERGENCY DEPARTMENT INFORMATION SYSTEMS, AND CLINICAL DECISION SUPPORT SYSTEMS

HIT is mainly used in the following areas: the management of administrative and medical equipment; the maintenance of patient records, within and outside hospitals; the provision of information to patients; and the transfer of medical information. Countries throughout the world have adopted HIT to reduce medical costs and errors and to ensure safety.[4–6] HIT was developed primarily for use in general outpatient wards. However, emergency departments require customised systems that reflect the unique examinations and treatments required in emergency care,[3] which are EDIS.[1 3 7] EDIS is broadly defined as 'an electronic medical record system that increases the efficiency of emergency patient examinations and treatment'.[3] It is not simply a record of examinations but is also composed of several core functions to support clinical care, such as patient and order entry, triage, result reporting, document management, CDSS and risk management, patient and resource tracking, and discharge management.[3] Core administrative EDIS functions comprise hospital and departmental statistical metrics management; coding and billing, including interaction with insurance carriers and provision of information to third parties; integration with public health and other registries; disaster management; disease surveillance; and early detection and management during outbreaks of new infectious diseases or terrorist attacks. Thus, the responsibilities of EDIS include medical care, hospital administration and national policy making.[3 8]

CDSS improve medical safety by reducing errors in judgment, allowing information sharing that forms the clinical basis for decision making,[9–12] providing information about drug allergies, contraindications for drugs in combination, test results associated with drugs (eg, digoxin and low serum potassium levels), drug dosage adjustments (eg, opioids or insulin), medication characteristics, special considerations for elderly patients, imaging technique ordering for patients with pacemakers and proposal of a set of appropriate diagnoses.[13–15]

BARRIERS TO ADOPTION OF EDIS AND CDSS

Although the merits of EDIS and CDSS are widely acknowledged in the medical profession, the USA has been slow in adopting these new technologies. Landman et al first reported the prevalence of EDIS in emergency departments in the USA;[16] they found that 1.7% of hospitals had a comprehensive EDIS system, which included an ordering system, an information interoperability function and CDSS, while 12.3% of hospitals had a basic EDIS with only some of these functions. Barriers were reported by the authors, including the costs of integration and maintenance, staff members reacting adversely to changes in their existing work conditions, uncertainty about system reliability, difficulty with use, suspicions that the technology would soon become outdated and concerns about maintaining confidentiality; all of these deterred the adoption of EDIS.[17 18] In addition, some studies have reported that CDSS can be difficult to use, causes inefficiencies and may increase medical errors and death rates.[7]

PRESENT STATUS OF HIT, EDIS AND CDSS IN JAPAN

The number of medical facilities in Japan switching from paper to electronic medical records has increased in recent years. According to a survey conducted by the Japanese Ministry of Health, Labour and Welfare, 969 of 8838 hospitals (11%) and 9077 of 98 609 clinics (9%) had adopted electronic medical record systems by 2008. In May 2010, the Japanese government's Information Technology Strategic Headquarters announced its new Information and Communication Technology Strategy. This strategy is supposed to offer a powerful stimulus for cooperation among healthcare facilities; work has already begun on standardising forms and terminology codes and on forming healthcare information networks.

Unfortunately, the concept of EDIS is not well known in Japan; as a result, no Japanese companies manufacture electronic medical record systems designed specifically for use in emergency departments. In addition, EDIS, which was first developed in English-speaking markets, was difficult to introduce in Japan because of language barriers. However, the value of EDIS is apparent when reflecting on past events. For example, in 1995 the members of the Japanese 'Aum Shinrikyo' cult released sarin nerve gas in the Tokyo subways during morning rush hour, causing 12 deaths and over 5500 injuries.[19] This acetylcholinesterase inhibitor can be fatal within minutes to hours. However, no electronic communication between hospital staff, the police or the government existed. An EDIS would have allowed early detection, diagnosis and a proper initial response to the situation.

CDSS is not widely used in Japan. Although several CDSS initiatives are currently underway, many are stand-alone, non-standardised systems. For CDSS to be more widely employed, EDIS that use standardised medical terminologies or are able to switch to a standardised system are required as information bases. CDSS must be compatible with EDIS and standardised within hospital systems and across medical facilities. Such systems aid the accumulation of valuable information for evidence-based clinical medicine. For example, the Systematised Nomenclature of Medicine Clinical Terms is one of the largest standardised computer terminology databases in the world. However, language differences make the system extremely difficult to adopt in Japan. Thus, a system suited to the unique needs of Japan is needed and is already in progress.[20] Other barriers to the adoption of CDSS from an English-speaking market are differences in the types of drugs, dosages and diseases. For example, Kawasaki disease is relatively common in Japan but rare in Western countries. Thus, systems for appropriate diagnoses developed overseas could not be used in Japan without modification.

Recently, the strategy has also been a stimulus for cooperation between healthcare facilities in prehospitals, where work has begun on standardising forms and terminology codes and forming healthcare information networks. The Canadian Triage and Acuity Scale[21] and the newly developed Japan Triage Acuity Scale are being used increasingly in prehospitals in Japan.

DEVELOPMENT OF EMERGENCY MEDICAL CARE SYSTEM IN JAPAN

Delays in the treatment of critical patients became a problem in Japan during the 1970s. The number of traffic accidents increased rapidly because of the increased use of automobiles, leading to many hospitals turning away ambulances and refusing care to accident patients. To counter this situation, emergency medicine was created as a distinct specialty in Japan. Before the establishment of emergency medicine in Japan, there were no emergency physicians; emergency patients were treated by surgeons and internists without specific training in emergency medicine in a multispecialist model.[22]

To prevent the concentration of patients in just a few emergency hospitals, emergency medical facilities were designated as primary, secondary or tertiary care facilities.[23] Patients who could not be treated at a primary care facility would be transported to a secondary or tertiary care facility. Paramedics were able to choose between healthcare facilities depending on the patient's condition. Primary care facilities are clinics without beds; these accept patients on a walk-in basis who do not require inhospital care. Secondary care facilities examine and treat patients with moderately severe conditions and provide inhospital care; they accept walk-in patients and those transported by ambulance. Tertiary care facilities offer intensive treatment in all medical specialties to critical patients; most emergency surgery is performed in such facilities. In 2010, there were 605 primary care, 4169 secondary care and 220 tertiary care facilities in Japan.

Secondary or tertiary care facilities are not limited to trauma or burn patients, but also include non-trauma patients. In addition, walk-in patients can seek medical attention at any facility. Because there are too many secondary care facilities against the number of emergency physicians, many secondary care emergency hospitals might not be able to deliver appropriate emergency care for all types of medical/surgical emergencies. Accordingly, the selection of appropriate hospitals to which to transport emergency patients is a critical issue that requires skill in differential diagnosis in emergency medical technicians, which may be difficult to apply at the scene. Moreover, most secondary care emergency hospitals are staffed by non-emergency specialists, whose specialties may not be appropriate for any given patient, during the night or on holidays. This

may account for many refusals by emergency hospitals to accept some patients.[22]

Most tertiary care facilities have 10 to 30 beds in their Intentive Care Units (ICUs), and staff size ranges from several doctors to more than 30 doctors per centre. The principal mission of the physicians in the emergency departments in these centres is to provide trauma or non-trauma/critical care service to emergency patients (ICU-type model). Indications for admission to emergency medical service centres are deteriorating vital signs, as judged by emergency medical technicians. Thus, only the most critical patients are admitted and the admission rate is close to 100%. When non-critical patients visit an emergency medical centre attached to a hospital, they are guided to a separate emergency room (ER) where doctors belonging to other specialties provide care.[22]

In 2003, ER and Western-style models were introduced into Japanese emergency medicine. Thus, three styles of emergency medical care coexist: the multispecialist model, the ICU model and the ER model. In 2007, a national survey was conducted of Japanese Association for Acute Medicine emergency physician-designated facilities. Two hundred and forty-eight of 420 facilities returned valid questionnaires (88% response rate); 82 facilities (33%) reported that their emergency departments were functional 24 h a day and 68 (27%) reported that their emergency department operated only during certain times of the day. Of the 4230 emergency medical facilities throughout Japan, most operate on either the multispecialist or ICU model; only teaching hospitals in major cities use the ER model.[22]

Thereafter, the number of trauma patients decreased as a result of developments in automobile technology, mandatory use of seatbelts and increased penalties for driving under the influence of alcohol. At the same time, the number of patients with non-traumatic injuries admitted to emergency departments began to increase. In 2010, approximately half of these patients were older adults. All expenses were and continue to be covered by local governments via tax revenues, entailing no charge to patients for care and/or transportation. This has led to an increase in the volume of patients visiting hospitals by ambulances and has lengthened the time to reach hospitals and the waiting times once there.

Presently, there is a need to coordinate care for patients in the emergency departments in Japan. Care coordination has been defined as '... the deliberate organisation of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of healthcare services'.[24] *When a patient is brought to the hospital with disturbances of consciousness, the emergency physician is responsible for contacting potential primary care physicians and, after treatment, searching for suitable hospitals to transfer the patient to if there is no social worker available to do so. These administrative duties distract emergency physicians from their main duty, which is to provide emergency care. Therefore, EDIS and CDSS would be useful tools for improving the quality and efficiency of emergency care.*

JAPANESE EXPECTATIONS FOR EDIS AND CDSS

The implementation of EDIS and CDSS in Japan must address issues specific to Japanese society with respect to the education of physicians. In emergency departments, rare diseases and medical complications must be considered. If not, serious consequences may result, even if the patient is seemingly well (eg, walk-in patients with subarachnoid haemorrhage or asymptomatic acute myocardial infarction on arrival at the hospital). The best approach emphasises ruling out serious and/or emergency presentations rather than using the traditional approach of reaching a diagnosis based on clinical observations, which is the main approach used in medical education in Japan. Emergency medical education, which emphasises ruling out critical diseases and those requiring emergency medical attention, has yet to have a serious impact as a method of education. In addition, according to the Japanese Ministry of Health, Labour and Welfare, only 1945 physicians (0.7%) of a total of 271 897 were practising emergency care in Japan in 2008. Therefore, in many hospitals, physicians from other medical departments who may not be adequately trained in emergency procedures are engaged in emergency practise.[22]

If CDSS were used in the future to guide examinations, provide updated treatment guidelines and standardise treatments, the quality of medical care would be improved. Residents could acquire the latest information and be educated in the field of emergency medicine, and emergency physicians could use CDSS to identify important points during a systematised examination to help residents distinguish easily confused diseases.

*This would be complemented by implementing EDIS, which would improve the effectiveness and efficiency of the emergency department through prioritising and coordinating its activities as well as matching the ever-changing therapeutic needs with available resources for patient care. Since this decision, in its knowledge and practise, is part of the intellectual core of emergency medicine, CDSS and EDIS are thus expected to help embody the raison d'*être of emergency medicine as a speciality. Furthermore, this knowledge and skill, when formulated and applied well, would help advance efficient use of medical resources in medical facilities, their networks, the wider context of medical service provision beyond an emergency department, and certainly in emergency situations, such as large-scale incidents and disasters.

After the 2011 earthquake and tsunami,[25] Japan realised that unnecessary tests and excessive medical treatments should be reduced when usable resources are scarce, especially in times of disaster. In such situations, all medical personnel are needed. The use of EDIS and CDSS may lead to increased awareness of the importance of physical findings and simple tests. If testing protocols based on the accumulated data of the Japanese population can be created and included in EDIS and CDSS systems, then unnecessary tests and unfortunate consequences would be reduced, which would allow medical personnel to use available resources more efficiently.

In conclusion, EDIS and CDSS are significant improvements for practising evidence-based medicine, which continuously gathers and revises scientific knowledge. They are useful tools that could improve the efficiency and quality of emergency treatment. Hopefully, both systems would be adopted more frequently at healthcare facilities, leading to an accumulation of knowledge and an advancement of epidemiological research in Japan.

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