



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



ELSEVIER

INTERNATIONAL EMS SYSTEMS

RESUSCITATION



www.elsevier.com/locate/resuscitation

The emergency medical services in Singapore

F. Lateef*

Department of Emergency Medicine, Singapore General Hospital, Outram Road, Singapore 169608, Singapore

Received 14 December 2005; accepted 14 December 2005

KEYWORDS

Ambulances;
Emergency medical services;
Healthcare;
Singapore

Introduction

Singapore is a cosmopolitan city state at the crossroads of Asia. It is one of the smallest countries in the world with a land area of 697.1 km², 193 km of coastline and a population of 4.185 million.¹ It is very densely populated. Singapore has been independent from Malaya for 40 years. It is an urban, developed republic with a president and a parliament. The ethnic distribution is made up of Chinese (76.2%), Malay (13.8%), Indian (8.3%), Eurasian and other races (1.7%).^{2,3} It typifies a multicultural and multiracial society. In 2003, 7.7% of the population was aged at least 65 years. With developed standards of healthcare such as an average life expectancy of 78.4 years and infant mortality rate of 2 per 1000 births, at an affordable 3% of the gross domestic product for the last three decades, Singaporeans are getting good value healthcare for their money.^{1,3,4}

Healthcare: the Singapore model

Specialist and tertiary healthcare is provided by six public hospitals (providing 80% of inpatient beds) and 13 private hospitals (20% of inpatient beds). Primary healthcare is readily accessible through an extensive and convenient network of private family physicians (80%) and public outpatient polyclinics (20%). An estimated 12% of outpatients also use traditional Chinese Medicine practitioners in the private sector.⁴

Healthcare cost is a major concern with every government. Medical care is increasingly sophisticated, diseases are detected earlier and investigative procedures have multiplied and become more costly. The Singapore model of healthcare financing has attracted much interest with favourable comments. It exemplifies an evolving public-private partnership.⁵ In the 1980s, the Singapore government re-examined from first principles the role of the state in healthcare financing and provision and concluded that the British style National Health System (NHS) was not a viable option. The model

* Tel.: +65 63214972; fax: +65 62260294.
E-mail address: gaefal@sgh.com.sg.

in use is primarily based on the philosophy of individual responsibility, backed by government subsidies and the principle of co-payment.⁶ It comprises:

1. Tax funding: where government subsidy is substantial in areas such as preventive care, public health, outpatient and public hospital services;
2. The ‘‘3M’’ (i.e. Medisave, Medishield and Medifund).^{3,4,6}
 - (a) *Medisave*. This is a national medical savings scheme, introduced in 1984, which helps individuals put aside part of their income into an account to meet their future personal or immediate family’s hospitalisation, ambulatory surgery and certain outpatient expenses.
 - (b) *Medishield*. This was introduced in 1990. It is a low cost catastrophic illness insurance scheme, designed to assist with medical expenses resulting from major or prolonged illnesses, for which the Medisave account would not be sufficient. Medishield operates on a co-payment and deductibles system to avoid problems with pre-paid insurance. Premiums for Medishield can be paid with funds from the individual’s Medisave account.
 - (c) *Medifund*. This endowment fund, set up in 1993, assists financially needy Singaporeans with their medical expenses. It represents a safety net for those who are unable to afford the already heavily subsidised charges, despite Medisave and Medishield. This fund was established with an initial capital of SGD 200 million. Capital injections are made when budget surpluses are available.
3. *Other health insurance*. This can be personal or through the employer. It is very popular with professionals in certain companies, but does not represent the answer to national health funding.
4. *Fee for service*. This practice is mainly in the private sector, which is beyond the reach of many and thus cannot function on its own. As the economy improves, this group and sector expands with it.

History and development of EMS

Prehospital emergency care services began as a hospital-based service. From 1960 to 1976, there were two ambulance services in operation. The first was the Central Ambulance Service, coordinated by the Emergency Department (ED) at Singapore General Hospital. Anyone with an emergency medical

problem could call on this service and an ambulance with a registered nurse, health attendant and driver would be dispatched. This service provided 24 h first aid and transport for over 10 000 calls per year, with an average response time of 25 min.⁷ The Singapore Fire Brigade operated the second service, which responded only to accidents and fire casualties. There was an average response time of 15 min.⁸

This dual system was confusing and as a result, in 1977 the services were integrated into the Emergency Ambulance Services (EAS) under the coordination of the Singapore Fire Brigade. It was a single tier system with nurses and midwives staffing the service. There was no formal medical control and ED doctors provided ad hoc advisory services.

In 1989, the EAS was absorbed into the Singapore Civil Defence Force (SCDF), under the Ministry of Home Affairs. Then began the single tiered EMS system with its fleet of 16 ambulances, each staffed by an ambulance officer (a registered nurse trained in first aid, Basic Life Support (BCLS) and midwifery), an attendant (a former fireman, trained in first aid and BLS) and a driver (trained in first aid). Later the same year, a pilot programme was initiated to train these ambulance officers in the use of automated external defibrillators (AED). By 1993, the number of ambulances had increased to 20 and AEDs were available on all of them. This was also the year when the National Heart Save Project was launched: the AED service being available on ambulances and the development of prehospital defibrillation protocols with regular audits by emergency physicians and cardiologists.

Today, 40 SCDF ambulances strategically located at 13 fire stations and fire posts handle between 80 000 and 90 000 emergency calls per annum. Ambulances from adjacent stations cross-cover during peak activity periods. All ambulances are equipped with basic airway, monitoring, intravenous and immobilisation devices, as well as AEDs. Access to the chain is by a universal emergency number, 995. All calls to the Central Dispatch Controls Room are categorised into either medical or fire emergencies. A 1992 study showed that the median ambulance response time was 11 min for 95% of the calls.⁹

As Singapore is highly urbanised, with high-rise buildings and congested streets, there are many difficulties in terms of system response, patient access and transport. Factors such as narrow landings, corridors and stairways, as well as the delays in getting the elevators immediately upon arrival, contribute to patient access delays. Consequently, the ‘on scene’ to ‘patient contact’ time interval, an often hidden component of EMS response time, has

been shown to be significantly longer for high-rise premises.¹⁰

In the Cardiac Arrest and Resuscitation Epidemiology (CARE) Project, Phase 1, carried out from 1 October 2001 to 30 April 2002, it was found that the mean EMS response time was 10.2 ± 4.3 min for out-of-hospital cardiac arrest.¹¹

Emergency medical dispatch is currently done by former firemen who have been put through dispatch training. They are trained in the latest in communication technology and use comprehensive dispatch protocols. The enhanced central access system will automatically provide information on the address of the location and contact number for every call received. Thus, the dispatchers only need to verify the information. These dispatchers also need to have the ability to use and understand the locally spoken languages and dialects besides English as Singapore is multiracial. Dispatch protocols, advice and policies are readily available for reference.

The national paramedic training scheme

Formal paramedic training began in 1995 as collaboration between SCDF, the School of Military Medicine and the Paramedic Academy of the Justice Institute of British Columbia of Canada. The programme consists of three modules, completed over 18 months. Candidates are trained in first aid, basic life support (BLS), use of AED, especially rhythm recognition, basic trauma life support (BTLS) and a whole series of anatomy, physiology and systemic lectures. There is also on-the-job clinical training. Successful programme completion leads to paramedic certification. The qualifications of the paramedics are comparable to the USA or Canadian EMT-D.

Continuing education is an important component of paramedic training. Recertification courses in BLS, BTLS and AED are conducted regularly. They are also encouraged to attend courses, both local and foreign courses. Overseas attachment and visits have also been carried out for some of them to give them the exposure to other EMS systems. They regularly participate in national and regional emergency preparedness exercises to define their roles in mass casualty incidents and disasters. Many have had the experience of volunteering for overseas disasters such as the 1990 Phillipines earthquake, the 1995 collapse of a condominium in Malaysia, the 1999 Taiwan earthquake and also the recent Indian Ocean tsunami. They are also trained in handling chemical and biological hazards and have

been through the Hazardous Material Life Support Training.

The fast response paramedic scheme

In 1992, SCDF introduced a motorcycle-based fast response paramedic (FRP) scheme as a first tier response to calls for cardiac arrest/collapses and road traffic accidents. There are one or two such FRPs at each fire station. These FRPs have the same capabilities as the EAS paramedics (BLS, defibrillate with the AED, BTLS, manage the airway with the use of basic adjuncts and laryngeal mask airway) and they must have a motorcycle riding license, with training in defensive riding. Patients attended to by the FRPs will subsequently be transported to the hospital by the ambulance that arrives subsequently. The introduction of the scheme reduced the response time from 15 to 8 min.

The Medical Advisory Council (MAC)

Prior to 1997, the EAS functioned only with ad hoc medical advice being provided by emergency physicians from the receiving EDs. In 1997, the MAC was established and it was made up of three emergency physicians, two surgeons, a cardiologist, an anaesthetist and a paediatrician. The MAC, chaired by an emergency physician, governs and endorses protocols and procedures, and assures quality and standards within the EAS and among the FRPs. This council also oversees the training and operations of the emergency medical dispatchers (EMDs).

Ambulance to hospital communications

Communications, a vital component of any EMS system, is necessary for direct medical control. Conventional methods of verbal communication include high frequency radio and cellular telephones.¹² These do have limitations such as variable voice quality, the need for written records with verbal communications and the technical difficulty of capturing and transmitting a range of clinical information. To improve data collection and communications, the Ministry of Health, National Computer Board, SCDF and the Singapore General Hospital collaborated to develop a wireless information technology system to supplement existing voice links between the ambulance crew and the EDs. The result was the Hospital and Emergency Ambulance Link (HEAL),

which was piloted on three ambulances. HEAL uses a user-friendly client server application with features such as touch screen and 'canned' text to facilitate data entry. Mobile computers in the ambulances automatically capture vital signs and ECG tracings and forward these to the receiving hospital via a wireless communications network. This information together with biodata, clinical and patient management information, create a complete electronic prehospital record.¹³

HEAL's main objectives are to convey medical information to the receiving ED and facilitate preparation, it provides paramedics a fast and simple way of communicating with ED physicians for online patient management.¹⁴ It also improves documentation. It is expected that these steps will enhance quality control, data management and patient care. The four modules in HEAL include:¹⁴

1. Advanced patient details module: this captures demographic data, vital signs, graphic and other medical information and conveys it to the receiving ED;
2. Ambulance incident management module: this sorts and archives records received from the ambulances;
3. Drug request and authorisation module: helps the paramedics get physicians' approval to administer specific drugs;
4. Text communication module: facilitates the exchange of messages between the ambulance crew and ED staff.

A 3-month analysis of the pilot runs revealed the following: it was possible to capture a complete ambulance case record electronically with a mean time of 94s versus 7min 7s for the traditionally written record:

1. Sixty-eight percent of the data was transmissible to the receiving ED compared to only 25% in non-HEAL ambulances;
2. The time spent by paramedics in the ED after handing over the patient to the ED staff was reduced from 15 to 8min, if they were on an ambulance using HEAL;
3. The waiting time for critical care patients to be seen was also reduced from 35 to 17min if they were brought in by the HEAL ambulance;
4. HEAL was able to prompt paramedics to carry out critical aspects of treatment in 100% of cases.

HEAL demonstrated the feasibility of electronic data collection in the prehospital environment.

EMS and SARS

An outbreak such as severe acute respiratory syndrome (SARS) will certainly have an impact on the EAS and EMS.^{15–17} Policies and changes had to be implemented rapidly and information disseminated effectively to all personnel for full compliance. All paramedics were put on high alert. Universal precautions were re-emphasised and all EAS personnel had to go through mask fitting sessions, training in proper adornment and removal of personal protective equipment (PPE) (goggles/face shields, masks, impervious gowns and gloves), proper hand hygiene and disinfection of personal equipment such as stethoscopes. Temperature was used as a monitor for both patients and staff.^{15,16}

When taking the clinical history, emphasis was given to travel history, history of febrile illnesses and associated symptoms. Algorithms for the management of febrile patients were circulated and adhered to. When high risk patients were transported by the EAS, they had to use a mask and all the windows had to be kept open. The air-conditioning units were turned off. Nebulisation for patients were stopped and only metered dose inhaler with spacer were allowed. This aimed to reduce the chance of aerosolisation of droplets.¹⁵ Once such a patient had been sent to the ED, the ambulance crew had to thoroughly clean the ambulance. Contaminated but reusable patient care equipment was placed in biohazard bags for cleaning and disinfection. Contaminated non-reusable equipment was placed in biohazard bags and disposed of appropriately. The PPE worn during transport and whilst cleaning the ambulance was considered contaminated and disposed of accordingly.¹⁵

During the outbreak, for a period of three months, the Ministry of Health started a free SARS Ambulance Service. Anyone with travel history and the symptoms of febrile and respiratory illnesses were told to use this service instead of the usual EAS. This 'ring-fence' strategy was designed to reduce the likelihood of cross-infection.

Emergency departments and emergency medicine

There are six government hospitals providing 24-h ED service in the country, with an total annual patient load of about 600 000. One of these is a tertiary women and children's hospital. The largest and oldest is Singapore General Hospital (SGH),

a 1700-bed tertiary referral centre with 33 disciplines. The ED at SGH has an annual attendance of 120 000. All EDs in Singapore use a common national triage system known as the Patient Acuity Category (PAC) Scale. There are four priorities, P1–P4 in this system. Triage in all EDs are done entirely by trained nurses. Some of these EDs, including SGH, have 24-h consultant cover. The rest of the doctors working in the EDs are made up of emergency medicine trainees (or residents), surgical, medical and family medicine trainees, as well as general medical officers. Direct admission is possible to many disciplines, but for some consultation must be made with the on call specialist doctors. At three of these hospitals, there are neurosurgical and cardiothoracic specialists available round the clock. SGH also houses the Burns Intensive Care Unit and Burns Centre for the whole island. Paramedics can bypass other hospitals and send specific cases directly to the most appropriate hospital rather than the nearest hospital. As Singapore is small and transport distances are similar to most hospitals, issues relating to delays based on bypass decisions are uncommon.

Emergency medicine (EM) was recognised as a distinct medical speciality by the Ministry of Health in 1984. Five years later, structured academic post-graduate training programmes were introduced. In 1990, a specialist training committee for EM was appointed to oversee the development of advanced training locally. Several areas of subspecialisation were identified, i.e. Emergency Cardiac Care, Emergency Prehospital Care, Emergency Paediatrics, Emergency Toxicology, Emergency Trauma Care, Disaster Medicine and Observation Medicine. EM trainees had to do three years of Basic Training (similar to the USA Residency Programme), after which they are eligible to take the MRCS (Accident and Emergency Medicine and Surgery) from the Royal College of Surgeons, Edinburgh (RCSEd).¹⁸ Locally, there is also now the Masters in Medicine (EM) which is taken together with the MRCS examination, held in Singapore once a year, in collaboration with the RCSEd. Following these examinations the candidates have to go through another 2 years as Advanced Specialist Trainees. At the end of this there is a formal structured exit interview with the Academy of Medicine, Singapore. Once this exit interview is cleared trainees are eligible to get onto the Specialist Register in Singapore. Currently there are 50 registered emergency physicians in Singapore. There is also a Singapore Society of Emergency Medicine (SEMS). The speciality is gaining popularity and the achievements in EM in Singapore can help provide a model for the future development of EM in other similar environments.

Future challenges

The EMS has gradually developed and continues to evolve in Singapore. EMS personnel are expanding their roles in the areas of administration, research and further education. Emergency physicians specializing in EMS and Prehospital Care Medicine are increasing in numbers and they are taking the lead by undertaking roles in system development. The number of research abstracts and publications have increased and there is particular interest in the areas of out-of-hospital cardiac arrest management, comparison of high versus low energy biphasic defibrillation and EMS response times and delays specific to the urban environment.

Singapore EMS experts are forging relationships with developing countries in the region to help and advise on the set-up and development of functional EMS systems, taking into consideration the social demographics and physical geography.

The future challenges, similar to other EMS systems around the world, include addressing ambulance and personnel shortages, improving and enhancing response times, upgrading the skills of our paramedics and enhancing automated, cost-effective technology into day-to-day practice. The Singapore EMS continues to improve its capacity to find solutions to new challenges.

References

1. Health facts 2004. Singapore 2004. Singapore: Health Information Management Branch, Ministry of Health; 2004.
2. Balachandra SB. A review of Singapore. Singapore: Ministry of Information and the Arts; 1997.
3. Healthcare systems in Singapore. Singapore: Ministry of Health; 2004. Available at: <http://www.moh.gov.sg/corp/systems/our/background.do>.
4. Lim MK. Transforming Singapore's healthcare: public-private partnership. *Ann Acad Med Singapore* 2005;34:461–7.
5. Ham C. Improving the performance of health services: the role of clinical leadership. *Lancet* 2003;361(9373):1978–80.
6. Lim MK. Healthcare system in transition II. Singapore. Part 1. An overview of healthcare systems in Singapore. *J Public Health Med* 1998;20:16–22.
7. Fung WG. The organisation of the emergency unit at Outram Road General Hospital, 1964–1968. *Singapore Med J* 1971;12:37–44.
8. Foo KH. My experience in the Singapore fire brigade service, emergency ambulance section. *Nurs J Singapore* 1983;23:44–5.
9. Seow E, Lim E. Ambulance response times to emergency departments. *Singapore Med J* 1993;34:530–2.
10. Lateef F, Anantharaman V. Delays in the EMS response to and the evacuation of patients in high-rise buildings. *Prehospital Emerg Care* 2000;4(4):327–32.

11. Ong EHM, Chan YH, Low ST, Seldrup J, et al. Cardiac arrest and resuscitation epidemiology in Singapore (CARE 1 study). *Prehospital Emerg Care* 2003;7(4):427–33.
12. Stewart C. Communications with EMS providers. *Emerg Med Clin N Am* 1990;8:103–17.
13. Meislin HW, Spaite DW, Conroy C, Detwiler M, Valenzuela TD. Development of an electronic EMS care record. *Prehospital Emerg Care* 1999;3:54–9.
14. Anantharaman V, Lim SH. Hospital and emergency ambulance link: using IT to enhance emergency prehospital care. *Int J Med Inform* 2001;61(2–3):147–61.
15. Lateef F, Lim SH, Tan EH. New paradigm for protection: the emergency ambulance services in the time of SARS. *Prehosp Emerg Care* 2004;8(3):304–47.
16. Huang CC, Yen DH, Huang HH, et al. Impact of SARS outbreaks on the use of emergency department medical resources. *J Chin Med Assoc* 2005;68(6):254–9.
17. Man CY, Yeung RS, Chung JY, et al. Impact of SARS on an emergency department in Hong Kong 2003;15(5–6):418–22.
18. Lim SH, Anantharaman V. Emergency medicine in Singapore: past, present and future. *Ann Emerg Med* 1999;33(3):338–43.