

ABSTRACT

The growth of emergency services in Singapore over years in terms of volume and complexity is relentless. In the pre-hospital environment, ambulance call volumes have more than doubled from 62,095 in 1997 to 142,549 cases in 2012. The use of emergency ambulances services should be commensurate with the timeframe of which the medical condition is deteriorating or the potential for sudden catastrophic outcomes. Activation of the EAS ambulance for STEMI and strokes help to reduce the D2B time and time to thrombolysis. Patients at risk of AMI or stroke often fail to recognise the symptoms and hence fail to activate the EMS system. Physicians do have a role to identify those at risk to educate them to achieve better outcomes. Good documentation of positive and significant negative findings and relevant tests provides a baseline to expedite patient assessment at the ED. An understanding of the available ED resources as well as the access to services, especially when sub-specialty consultation is needed, helps to improve the appropriateness of referrals.

Keywords: Emergency Medical Services, Emergency Department Overcrowding, Emergency Healthcare Operations

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INTRODUCTION: EMERGENCY MEDICAL SERVICES IN SINGAPORE

The growth of emergency services in Singapore over years in terms of volume and complexity is relentless. In the pre-hospital environment, ambulance call volumes have more than doubled from 62,095 in 1997 to 142,549 cases in 2012. Of note, non-emergency calls have drop from 23,900 in 1997 to 2,232 in that period of time. Over the period of 2007 to 2012, P1 caseload has grown by 89.5% while P2 and P3 caseloads have grown by 31.3% and 32.6% respectively.

Similarly, restructured hospitals emergency departments, face a rapidly rising volume from 552,233 attendances in 2003 to 934,485 in 2011. At this rate, 2014 will likely see over a million attendances at the emergency rooms across the country.

In light of such staggering numbers, there is an urgent need to improve the usage of emergency care resources to ensure that the care delivered is effective and coordinated for patients.

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EMERGENCY AMBULANCE SERVICES IN SINGAPORE

The Singapore Civil Defence Force manages the national emergency ambulance services (EAS), consisting of a fleet of 36 ambulances during the day and 30 ambulances during the night. It is supplemented by 10 private ambulances performing a long day shift (8am to 10pm) and is committed to respond to the incident site within 11 minutes 80% of the time as the key performance indicator.

The fleet is augmented by 41 fire bike deployment locations whereby fire and rescue specialists trained in CPR/AED can respond to potential cardiac arrest cases around the island during peak traffic hours. In addition, there are currently 8 fast response paramedics that provide a higher capability response for trauma cases and medical emergencies.

Historical development

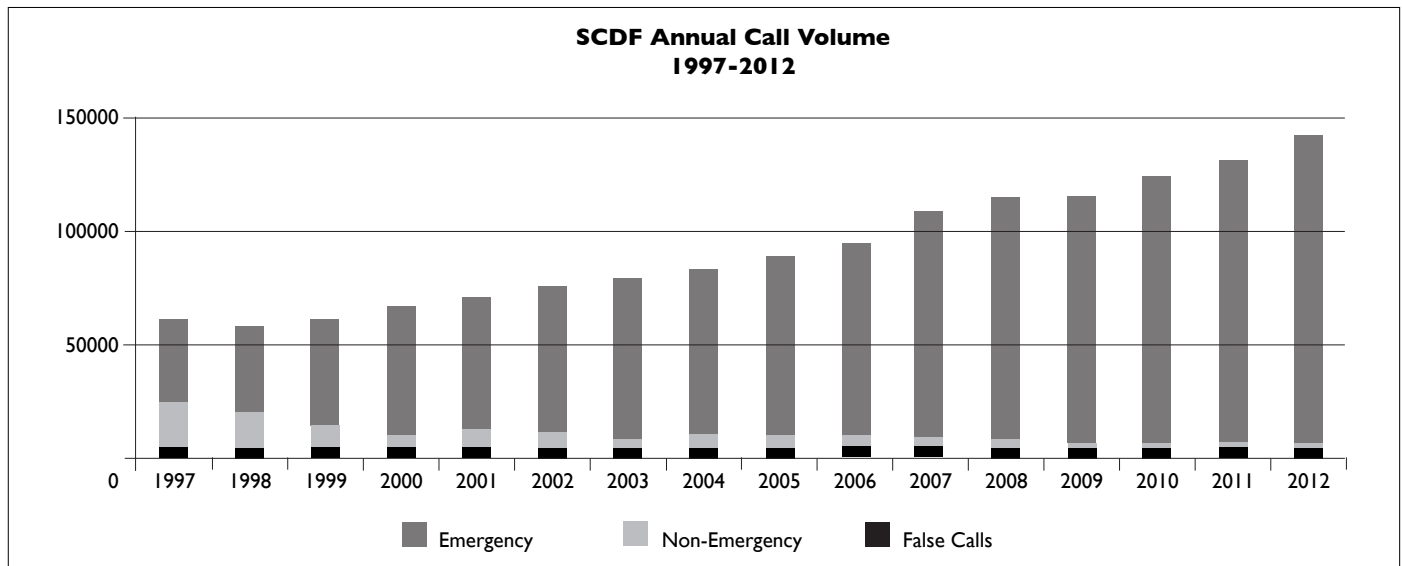
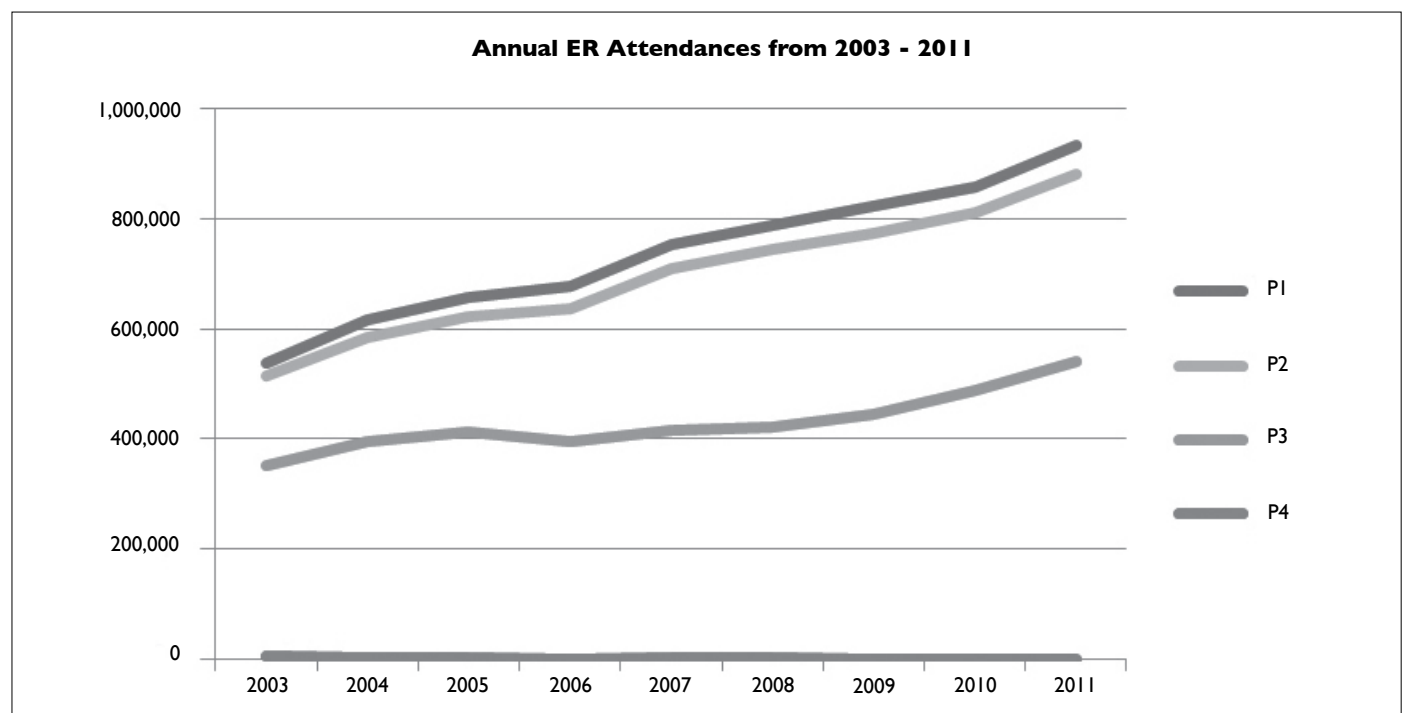
Between 1960 to 1976, there were two emergency ambulances services¹. The Singapore General Hospital managed the Central Ambulance Services, which provided 24/7 first aid and transport services from SGH using a nurse, an attendant and a driver for medical emergencies. They responded to over 10,000 calls annually with a mean response time of 25 minutes. The Singapore Fire Brigade operated the second service solely for responding to accidents and fire casualties. This was integrated into a single service in 1977 called the Emergency Ambulance Services (EAS) under the Singapore Fire Brigade¹.

The Singapore Fire Service eventually merged with the Civil Defence Force along with the EAS in 1989, which exists today. Before 1997, ambulances were crewed by a driver, a nurse and an ambulance attendant. However it was recognised that pre-hospital emergency care competencies and skills are not always matched by nursing skills that are taught. In 1997, SAF and SCDF collaborated to have paramedics locally trained at the SAF School of Military Medicine (SMM), which was accredited by the Justice Institute of British Columbia, a paramedic training institute with 35 years of experience.

Types of emergency medical service systems and skills levels

There are two common types of pre-hospital care systems, known as the Franco-German Model and the North American model of pre-hospital care. The Franco-German model is physician led and is based on advanced care and stabilisation in the field ("stay and play") while the North American model is based on the use of emergency medical technicians ("scoop and go") with definitive care provided at the hospital.

Due to the differences in infrastructure, resource availability, social and medical culture amongst countries, two types of

FIGURE 1. ANNUAL SCDF AMBULANCE ATTENDANCES**FIGURE 2. ANNUAL ED ATTENDANCES**

EMS systems have scopes of practice and benchmarks that are very different. Conducting research in emergency systems also pose ethical, resource, time and even space constraints on the ambulances. Hence, no two EMS are exactly comparable.

Broadly speaking, emergency medical technician training and certification are classified broadly into 3-4 levels (not including CPR/AED). The current operational skill level of the SCDF and SAF paramedic is level 3, which is approximately equivalent to the Canadian Primary Care Paramedic or the North American Advanced EMT level.

The scope of practice includes the ability to use supraglottic

airways, perform wireless ECGs transmission, semi-automated defibrillation, resuscitators, haemorrhage control, splinting, spinal management, intravenous fluid administration and the administration of drugs, including intravenous adrenaline (for cardiac arrest), intramuscular oxytocin (for delivery), sublingual nitroglycerin, oxygen, Entonox, oral aspirin and nebulised salbutamol and intravenous 10% dextrose.

The range of training hours and types of competencies varies broadly between systems even within the USA alone, as different cities, states and countries adapt standards appropriate to their healthcare standards.

FIGURE 3. SKILL LEVELS IN VARIOUS PRE-HOSPITAL SYSTEMS²

Skill Levels examples	Hours	North American	Canadian	Singapore
Endotracheal intubation, manual defibrillation, ECG analysis	1000-2000hrs	EMT – Paramedic	Advanced Care Paramedic	Lvl 4 (Instructors)
Supraglottic airways, semi-automated AED use, intravenous lines and limited medication	300-800hrs	EMT – Advanced	Primary Care Paramedic	Lvl 3 (Operational staff)
BVM, splints, spinal immobilisation, airway adjuncts,	150-400hrs	EMT – Basic	Emergency Medical Responder	EMT (lvl 2)
First Aid + BCLS	16-60hrs	First Responder	First Responder	First Responder
CPR/AED	3-4hrs			

Medical oversight

When medicine is practiced in the pre-hospital setting, there is a need to provide medical oversight (or supervision) of paramedic practice.

In Singapore, SCDF paramedics follow clearly defined medical protocols spelt out by a Medical Advisory Committee appointed by the Ministry of Home Affairs. This authorises them to carry out a range of emergency medical skills independently. They are required to strictly follow these protocols and not exceed these parameters. This is known as *offline medical control*. Offline medical control is often applied to larger paramedic systems whereby the workload makes it impractical to consult on most cases. These systems are complemented by auditing to ensure compliance.

The alternative to this is *online medical control*, whereby drugs or invasive procedures, even intravenous drips, have to be directly authorised by an on-call physician. An example of this is King County EMS in Seattle, Washington. This is often seen in much smaller EMS systems and is resource intensive.

WHEN DOES EMERGENCY MEDICAL SERVICES MAKE THE BIGGEST DIFFERENCE?

Cardiac arrest, acute myocardial infarction, stroke, acute respiratory failure and trauma are commonly termed as the 'first hour quintet' which are recognised as time sensitive conditions which drive EMS demand and usage³. The use of EMS for such situations are fairly well accepted. While the use of EMS for cardiac arrest, acute respiratory distress and trauma are easily recognised, the use of EMS in acute myocardial infarction and stroke is sometimes less successful.

A study of 462 patients treated in SGH for ST elevation myocardial infarction (STEMI) showed that the use of the EMS system shortened the median door-to-balloon (D2B) time from 102 minutes to 86 minutes. 83.6% (n=386) patients did not activate the ambulance service immediately. 19.3% (n=89) of them saw a GP but only 5.4% (n=25) activated the EMS system⁷. 72% of those who saw a GP were not sent to the emergency department by an ambulance. This paper serves to highlight 3 issues:

1. Patients at higher risk of cardiac chest pain are often unaware of the significant cardiac symptoms, and when to activate

a 995 ambulance. There is an *opportunity* for GPs to better educate their patients. The AHA/ACC's 2004 guidelines recommend that healthcare providers should address with patients and their families the heart attack risk, symptom recognition, advisability of calling 995 if symptoms are not better or worsen 5 minutes after taking GTN (Class I)⁵.

2. GP do need to have a high index of suspicion for chest pain and have a means of risk stratifying the patients through history, examination and performing an ECG.
3. Patients and GPs may not be aware that activating 995 for STEMI can reduce the D2B time, reducing the ischemic damage. The wireless ECG performed onsite alerts the ED and helps to activate the cath lab concurrently (Class I)^{5,7}.

Similarly, more than half of the acute ischaemic stroke patients do not receive thrombolysis. The 2007 AHA/ASA (Class I) recommendations include increasing public awareness and educating patients at risk to recognise symptoms. The activation of 995 is also shown to help stroke patients meet the 4.5 hour thrombolysis therapeutic window. In this regard, GPs can play an important role in educating their patients⁶.

CONSIDERATIONS FOR USING THE AMBULANCE SERVICE

Unfortunately, there are still more cases whereby the judgement whether to activate the emergency ambulance may not be as clearly defined. Due to the wide range of potential emergencies, it is impossible to be prescriptive about patients who can be self-conveyed versus using the emergency ambulance services.

Nevertheless, there are some points that can be helpful in making these decisions to activate the ambulance:

1. *Acute, progressive symptoms*: New symptoms, especially those that are rapidly progressing are sinister and warrant further investigation. Cardiac symptoms are one of the most common causes of referrals and a detailed history of its **frequency, intensity, duration**; its response to **exertion, rest, GTN** and finally **similarity to prior ischemic** episodes are often helpful in determining the likelihood for concern. The chronicity of symptoms also help to determine if emergency ambulance transported is warranted.

2. *Sentinel events*: Signs or symptoms that describe a potentially catastrophic outcome. Examples include pregnancy with abdominal pain and syncope (ectopic), history of an abdominal aortic aneurysm with syncope and abdominal pain (leaking AAA), 'worst ever headache' (subarachnoid haemorrhage), fever, neck stiffness and photophobia (meningitis), first presentation of cardiac chest pain after balloon angioplasty (re-stenosis) and ischaemic heart disease and fainting (cardiac syncope). This is by no means exhaustive.
3. *Considering the symptoms in context*: Chest pain in a 20 year old without a medical history has clearly different implications from chest pain in a 50-year old with ischaemic heart disease. Similarly, if a 20-year old who presents with isolated left facial numbness that has not progressed for two days would not benefit from the activation of an ambulance (Bell's Palsy). However, if it doubt or if the patient is potentially at risk for a transient ischaemic attack or stroke, referring for further investigation would be a safe practice.
4. *Treating the patient and not just the results*: Patients recalled for abnormal test results done 1-2 days ago and are asymptomatic should probably not be sent by ambulance unless there is are compelling reasons to believe that the condition has drastically deteriorated in the last 1-2 days.

There have been anecdotal cases from colleagues at SGH A&E whereby a ruptured ectopic pregnancy (with documented ultrasound finding of free fluid!) or documented acute coronary syndrome with STEMI arriving via private transportation. In such cases, the use of EAS ambulance is clearly warranted, as in all cases with potentially *unstable vital signs, changes in mental status*, potentially malignant *arrhythmias* or history of a *sentinel event*.

INTERFACING WITH THE 995 OPS CENTRE AND SCDF PARAMEDICS

995 call-takers are trained to verify contact numbers, locations, detect cardiac arrest before addressing the chief complaint. It

helps to allow the call-taker to ascertain the essential information for the dispatch of the ambulance and any appropriate additional resources such as the fire bikes or fast response paramedic.

Paramedics are trained explicitly to assess every patient, even if a doctor has seen them, and execute the most appropriate protocol(s) relevant to the patient's condition. While you may have already arrived at a conclusion or a clinical diagnosis, the paramedic is still obliged to perform a standard patient assessment with history taking, physical exam and the measurement of vital signs and relevant tests, such as repeating the ECG before instituting treatment and evacuation to hospital.

SCDF has encountered situations whereby GPs, in their haste to see the patient evacuated to hospital, refused to allow the paramedic to assess on site because they did not see the need for paramedics to follow these protocols, or 'waste time' performing another ECG. The wireless ECG is clearly shown internationally as well as locally to improve D2B time for better patient outcomes^{5,7}.

The rapid assessment by the paramedic is not meant to check on the work of the doctor; its role is to ensure that due diligence is performed for each patient, regardless of the knowledge or skill of the referring person.

REFERRING TO THE EMERGENCY DEPARTMENT

In 2012, public emergency departments handled 934,485 cases and the growth of P3 cases has outstripped all other types of cases in the last 3 years in terms of percentage as well as absolute numbers. In 2012 the total volume was 985,289 and it is likely that 2013 or 2014 will see over a million cases being attended to at emergency rooms in Singapore!

The modern emergency department today has a forward triage area to sieve out febrile patients for isolation followed by triage according to priority to ambulatory care (P3), critical care (P2) and resuscitation (P1) areas.

Additionally, observation medicine is a recent development in emergency departments to help reduce the number of patients who are admitted for common conditions such as chest pain, gastroenteritis, abdominal discomfort, minor head injury, back pain etc. In the past, these patients are often admitted and discharged within 24 hours.

FIGURE 4. THE 'GOLDEN HOUR QUINTET'

	Time sensitivity	Remarks
Out of Hospital Cardiac Arrest (OHCA)	Minutes	7-10% decrease in survival every minute after OHCA without CPR or AED ⁴ .
ST elevation Myocardial Infarction	90 minutes Door to Balloon Time	The AHA/ACC 2004 practice guideline on STEMI recommends the use of EMS for patients with STEMI symptoms and education to improve symptom recognition (Class I) ⁵ .
Stroke	4.5 hour window from onset to thrombolysis	AHA/ASA recommends that the use of EMS is strongly associated with a decreased time to stroke assessment ⁶ .
Acute respiratory distress	Minutes	Due to the broad nature of conditions causing respiratory distress, there are no uniform guidelines.
Trauma	"Golden Hour"	A concept that is figuratively correct, but the actual 60 minutes period is not scientifically validated as a determinant of survival.

Using standardised care protocols, patients are risk stratified, reviewed every as often as 3-8 hourly and managed for up to 23 hours at the ED. This helps to risk stratify patients for admission and discharge low risk patients much faster than it would be possible in ward-based care. Many cases that previously required admission are now managed and discharged faster at much lower cost, freeing up vital hospital beds.

GPs can play a crucial role by helping to taking on a proportion of this ½ million P3 ambulatory cases and referring judiciously to help those more acutely ill patients navigate through the increasingly crowded and busy ED through a better understanding of the services available.

FIGURE 5. YEAR-TO-YEAR INCREASE IN ED ATTENDANCES BY PRIORITY STATUS

	2009	2010	2011
P1	47,854	48,982	52,348
YTY(%)	10.8%	2.4%	6.9%
P2	328,879	320,317	341,547
YTY(%)	1.9%	-2.6%	6.6%
P3	443,603	488,651	539,859
YTY(%)	5.4%	10.2%	10.5%
Total	821,304	858,781	934,485

MAKING BETTER EMERGENCY DEPARTMENT REFERRALS

Referring a patient to the ED is useful when there is a need to rapidly exclude potentially life-threatening conditions, when admission is likely or a work up is needed within hours or days. Condition that have been stable for days or weeks can probably be referred directly to specialist outpatient clinics. Examples include conditions such as chronic cough, rashes, stable aches and pains or simple finger or toe fractures that can be buddy-splinted or treated conservatively without special equipment. Other than reassurance and a non-urgent specialist referral, there is a limit to what an ED can offer in such situations.

Some of the administrative issues encountered with referral letters seen at the ED include (il)legibility of handwritten memos, insufficient documentation of significant positive AND negative findings. 'Please do the needful' is a term that is subject to many different interpretations.

The documentation of history and physical examination at the point of visit helps to chart the course of disease, as patients do not always repeat the same history, and significant history may be missed. Patients also often do not always go to the ED on the same day as instructed, so having the date of the referral on the memo is helpful to the receiving doctor.

Having baseline data regarding treatment attempted (such as a course of antibiotics), prior investigations, such as old blood results, ECGs to compare against provide a useful point of reference to expedite the working diagnosis at the ED, saving time and resources.

It is also useful to document the current medication or remind the patient to bring it along because this information is not readily available unless the data is captured electronically from

polyclinic. The bonus value of patients bringing their medication is also to understand the actual usage versus the prescribed usage. (I am no longer surprised by patients who split tablets to save cost or take daily medication ONLY when they feel unwell.)

Lastly, it is helpful to give the patient realistic expectations of what is likely to occur at ED; promising a particular outcome to a patient may create inappropriate demands. For example, some patients present with a letter from their GP asking the patient to undergo specific investigations, treatments or be admitted. Examples include 'please do CT/MRI', which may not always be available/required, causing confusion and frustration. Instead, the patient could be told to ED and attending doctor will do the necessary assessment and decide whether admission is needed or the condition can be treated without admission.

SAVING PATIENTS A TRIP TO THE EMERGENCY DEPARTMENT

There are some referral situations that occur in the primary care setting. In the first two, a trip to the ED may be avoided if the condition can be appropriately assessed and documented to be stable. In the third, referring to the right resource would help expedite care for the patient the avoid unnecessary secondary transfers:

1. Non-specific ECG changes – if a patient has had a previous ECG performed at the ED, comparing against the old ECG can help to confirm that no new changes have occurred, saving a time consuming trip down to the ED, especially for an asymptomatic patient.
2. Hypertension – while *hypertensive emergencies* are clearly defined by hypertension associated with end organ damage, there is no consensus on the blood pressure level⁸. These should all be referred to the ED. The less serious condition of a hypertensive urgency is less clearly defined, but a working definition of systolic BP >180mmHg or diastolic BP >120mmHg without symptoms can be used in the primary care setting. It would be reasonable to rest the asymptomatic patient for 15-30 minutes and retake the blood pressure. If the reading falls below these levels, adjusting the medication, appropriate advice to return if symptomatic and an early review can save the patient an ED visit.
3. Referring for subspecialty support – Knowing the availability of specialist support in various hospitals can help expedite patient care.
 - a. Pediatric referrals - Referring directly to NUH or KKWCH would be appropriate, especially if there is a likelihood of hospital admission.
 - b. Burns – complicated burns, such as over the face, hands, groin, large surface areas and/or deep partial thickness burn would benefit from being assessed by the SGH burns centre.
 - c. Obstetrics – obstetric emergencies should be referred to hospitals with an obstetrics department, namely KKWCH, NUH and SGH. Otherwise, secondary transfer for assessment will be required.

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LEARNING POINTS

- **The use of emergency ambulances services should be commensurate with the timeframe of which the medical condition is deteriorating or the potential for sudden catastrophic outcomes.**
- **Activation of the EAS ambulance for STEMI and strokes help to reduce the D2B time and time to thrombolysis.**
- **Patients at risk of AMI or stroke often fail to recognise the symptoms and activate the EMS system. Physician do have a role to identify those at risk to educate them to achieve better outcomes**
- **Good documentation of positive and significant negative findings and relevant tests provides a baseline to expedite patient assessment at the ED.**
- **An understanding of the available ED resources as well as the access to services, especially when sub-specialty consultation is needed, helps to improve the appropriateness of referrals.**