Chapter 2

The Role of Emergency Medicine in Screening SARS Patients

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Introduction

The Health Care System in Hong Kong was completely unprepared for the outbreak of severe acute respiratory syndrome (SARS) which occurred in March 2003. It challenged the entire medical system resulting in the temporary closure of emergency departments (Figure 1) and hospitals 1-4. In the early stages the illness affected an unusually high proportion of health care workers. The health care system was faced with many difficult issues including how and where to screen the hospital workforce and local community, and who should take responsibility for this screening task?

Emergency Medicine is a systems-based, primary care specialty with skills and training to screen large populations of patients but its primary brief is to deal with acutely ill patients and not to provide a Public Health Service 5. However, in the acute crisis brought about by the SARS outbreak it was appropriate for the Emergency Department (ED) to take short term responsibility to coordinate screening as there were no other facilities immediately available.

Figure 1
An exceptional sign - a closed emergency department in a closed hospital.
This chapter reviews the challenges and responses involved in initiating and developing a SARS-screening clinic in an Emergency Department of a University Hospital in Hong Kong. Whilst clinical features aid the assessment of patients suspected of having SARS, radiography supplemented by high resolution computerized tomography is the cornerstone of SARS assessment.

**Key Points**

*Accuracy of clinical features and radiology to detect SARS in our experience*

- *Clinical features have a sensitivity of 90% for identifying SARS.*
- *Chest radiography supplemented with high resolution computerized tomography achieves a sensitivity of 99% for detecting SARS.*

**Historical Background**

As mentioned in the previous chapter the first known case of this form of atypical pneumonia was identified in Guangdong Province, South China in November 2002 and in February 2003 the first case, a physician from Guangzhou, was diagnosed in Hong Kong. Whilst staying at a local hotel he infected a number of other people, one of whom was subsequently admitted to the Prince of Wales Hospital, New Territories.

The index case in the Prince of Wales Hospital was a 26-year-old Chinese man who presented twice to the emergency department – on 28th February and 4th March – and after the second visit was admitted to a general medical ward. The diagnosis was pneumonia. At the time there were more than 20 other patients in the ward and 30 medical students. In addition to many of the patients and relatives on the ward, 15 medical, 15 nursing, five other ancillary staff and 17 of the medical students fell ill.

In response to this disastrous clustered outbreak of SARS in Prince of Wales Hospital, an emergency screening clinic was set up to evaluate all staff or immediate contacts. The objective of the clinic was to provide a safe environment in which to screen the staff and relatives of patients in the hospital who had recently been in contact with patients with SARS-pneumonia.
The clinic gave us the opportunity to study the clinical response to the virus in a high-contact environment. The global spread of this illness means that our experience is likely to be repeated in many healthcare settings around the world.

Key Points
Objectives of a SARS screening Clinic
- To provide a safe environment for staff to work
- To prevent secondary infections
- To accurately and appropriately screen, diagnose and manage suspect SARS cases

Questions without answers
In the early period, health care providers were faced with a severe, life-threatening, infectious disease of unknown aetiology, unknown epidemiology, unknown clinical presentation and clinical course, no vaccine, no evidence-based treatment, and an uncertain prognosis. There were numerous reports of healthcare workers who had contracted the illness some of whom were personally known to staff, some of whom had died. Apart from the challenge of dealing with patients and their illness, the staff had to deal with their own psychological needs including the fear that they might contract the illness, spread it to their family and the possibility that it could be terminal.

Clinical Assessment
The World Health Organisation (WHO), Centers for Disease Communication (CDC) published early guidelines for managing SARS but the evidence base had not been evaluated properly. The specific challenges that concerned us were:
(1) How reliable and sensitive were current WHO guidelines for screening SARS cases?
(2) Advanced cases of SARS usually develop an overt illness with fever, cough, shortness of breath, lymphopenia, pyrexia >38°C, and thrombocytopenia but were these the important features early in the illness at the time of screening?
(3) Should all suspect cases with any one or more symptoms/signs of a fever, cough, shortness of breath, lymphopenia, pyrexia >38°C or thrombocytopenia have the illness and be admitted to a hospital ward? If so, and they did not have the illness, would they contract it after admission?
(4) If subjects were discharged from clinic with plans for daily follow up, would they return home to infect their families and spread disease further? Therefore how we had to address SARS-pneumonia could best be diagnosed in an anxious, polysymptomatic group of patients who may present to a primary care facility for screening and diagnosis.

Staff and Patient Safety
We also had to consider:
(1) How should we provide a safe, secure screening environment for medical and nursing staff to assess these cases without secondary spread from suspect SARS cases to the staff and possibly their families or friends?
(2) What personal protective equipment is necessary and how much training and education is required? Should the assessment area be in the emergency department or hospital or remote from the hospital?
(3) How could we reassure an anxious workforce which was faced with the uncertainty of a potentially deadly illness, for which there was no known cause, no known treatment and no vaccine?
(4) What issues affect morale?

Not only did these questions require addressing but that in order to provide good answers, it was imperative to start researching the virus and its effects from every possible angle. The four main issues were clinical assessment, appropriate management, staff safety and research.

Definition
At the start of the staff screening clinic little was known about the illness except that it appeared that a virus was involved. Although, the case definition of SARS was clearly defined later during the course of the outbreak (discussed in the previous chapter) in the initial days the case definition itself was loose and vague. At the time, according to WHO, SARS was suspected in a person with a high fever (>38°C), AND one or more respiratory symptoms (e.g. cough, shortness of breath or difficulty breathing) AND close contact with a person previously diagnosed with SARS 18. A probable case of SARS was when an individual met the criteria of a suspected case but then developed pneumonic change on chest X-ray.
Initially in the absence of a reliable test for the virus, the diagnosis of confirmed SARS-pneumonia was made when a person had known contact, documented persistent pyrexia (>38°C), AND consistent clinical course of the illness, AND evidence of pneumonia. Pneumonia was diagnosed either on plain radiography or by computerized tomography. A diagnosis of non-SARS pneumonia was made if the patient responded well to antibiotics within 48 hours.

Later, when coronavirus was confirmed as the aetiological pathogen and a virological test became available, the final diagnosis was by a team of medical, respiratory and infectious diseases clinicians in conjunction with positive virological evidence of the presence of coronavirus.

**Clinical Features**

The clinical course of the disease is thought to follow an incubation period (≈ 2-16 days), with high fevers, chills, rigors and myalgia. Respiratory symptoms are not prominent prior to admission to hospital and may be poor discriminators between SARS and non-SARS cases in the early phase. Some patients presented with diarrhea, abdominal pain and loss of appetite.

Although there are reports that SARS patients commonly have basal crackles, these findings are present in admitted patients with advanced illness. In the early assessment phase, very few patients have chest signs. Sore throat, lymphadenopathy and skin rashes are also absent.

Basic observations are performed at every follow up including pulse rate, systolic and diastolic blood pressure, respiratory rate, temperature and oxygen saturation (if available) on room air. Although a pyrexia > 38°C is a characteristic feature of patients with probable SARS after admission to hospital and is a hallmark of WHO guidelines, many patients did not have documented pyrexia when screened in our clinic within a few days of the onset of symptoms. Many of these patients had a good contact history, symptoms of fever, malaise and/or chills and typical radiographic features of pneumonia but in the absence of pyrexia. Therefore the role of pyrexia in the early assessment of patients with SARS must be viewed with caution.
### Key Points

**Clinical discriminators for patients with SARS [9]**

Most discriminating features are:
- Fever,
- Malaise
- Chills
- Loss of appetite

Other less common features may be:
- Cough
- Shortness of breath
- Abdominal pain
- Diarrhoea
- Loss of appetite

*Pyrexia >38°C:*
- Is often absent in the first few days since symptom onset.

### Radiography

Our investigations have shown that clinical criteria and temperature alone yield a sensitivity of detecting SARS of only 80% but the addition of imaging (daily CXR, diagnostic HRCT in specific cases) may give a sensitivity of 100% and a positive predictive value of 60% (personal communication). Chest X-rays requested in the first 100 cases showed a variety of appearances at presentation including unifocal (Figure 2), multifocal (Figure 3) or diffuse (Figure 4) pneumonia. High resolution computerized tomography (HRCT) was requested in some patients and showed a typical area of ground-glass opacification (Figure 5). Our policy in the screening clinic was to request HRCT for patients who had normal chest radiographs (Figure 6a) but persistent pyrexia and symptoms. Some patients with normal radiographs have retrocardiac (Figure 6b) or retro-diaphragmatic (Figure 6c) lesions which are difficult to detect on a frontal CXR but clearly evident on CT.
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Figure 2
Frontal chest radiograph showing an area of air space opacification in the right lower zone (arrow).

Figure 3
Frontal chest radiograph showing confluent consolidation in right upper zone and subtle areas of air-space opacities in both lower zones (arrow).

Figure 4
Frontal chest radiograph showing diffuse areas of air space opacification in both lower zones.

Figure 5
HRCT shows a small area of ground-glass opacification in the apico-posterior segment of the right lower lobe (arrow).
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Figure 6a
Normal frontal radiograph of a patient with clinical signs and symptoms highly suggestive of SARS.

Figure 6b
HRCT shows consolidation in the anterior basal segment of the left lower lobe (arrow). Note its retro-cardiac location which makes it difficult to identify it on a frontal CXR.

Figure 6c
HRCT shows consolidation in the posterior segment of the right lower lobe (arrow). Note its retro-diaphragmatic location which makes it difficult to identify it on a frontal CXR.

In our experience, the median time from symptom onset to identifying changes on imaging was 4 days for CXR - 7 days for HRCT (in patients where initial CXRs were normal).

In some rare instances the imaging was positive 21 days later and we believe some of these late presenters may have contacted SARS after being cohorted into a ward which already had other SARS patients.
Key Points

Early chest radiographic findings in SARS patients
- Unifocal and multifocal pneumonic patches
- Diffuse or Lobar pneumonia
- Median time from symptom onset to positive radiographs was 4 days

Early HR-CT findings in SARS patients with normal chest radiographs
- Retrocardiac ground glass pneumonia
- Retrodiaphragmatic ground glass pneumonia
- Median time from symptom onset to positive CT was 7 days

Laboratory Tests

Laboratory tests – complete blood and differential counts, renal and liver function tests, and coagulation profiles – were requested in our clinic although they offer little advantage over a good clinical assessment and radiography in the early screening phase. Lymphopenia is a common feature in SARS patients. However, many subjects in the screening clinic had profound but transitory lymphopenias that lasted no more than 24 to 48 hours. These patients have been found to be coronavirus negative on subsequent serology and so did not have a SARS-related episode. If they had been admitted to a common ward with SARS patients they may well have contracted the illness in hospital. Therefore lymphopenia in the absence of radiographic evidence of pneumonia should not be a criterion for admission to a common area with other possible SARS cases.

Specific diagnostic tests are now available but are unlikely to aid physicians working in a screening clinic. At present, these tests become positive late in the course of the disease after patients have developed pneumonia. An immunofluorescence assay for detecting anti-coronavirus IgG antibody is available and is believed to have a sensitivity between 50% and 100% at 7 to 21 days after the onset of fever. Polymerase chain reaction can also
be used to detect RNA from nasopharyngeal aspirates, urine and stool although the interval sensitivity is low [22,24,25].

**Key Points**

**Common tests**
- Leucopenia, lymphopenia and thrombocytopenia are common in SARS patients but are also common in coronavirus negative subjects.

**Specific tests**
- Coronavirus serology has 100% sensitivity at 21 days after fever
- Viral RNA may be detected in nasopharyngeal aspirates, urine and stool.

**SARS Screening Clinic**

In order to address the crisis facing the Prince of Wales hospital, a SARS clinic based in the emergency department of the Prince of Wales Hospital was opened on 12th March 2003. Initially the clinic was based in the emergency department and a SARS, or fever area, was separated away from the rest of the department (Figure 7). Staff had to change their personal protective equipment when entering and leaving the area. Later the clinic was moved outside the main hospital building. Screening potential patients with this disease is particularly difficult as the signs and symptoms are vague and consistent with virtually any viral illness. Therefore following up patients over a number of days is the only way of knowing whether they do in fact have SARS.

The question of whether to admit all suspicious cases is also an issue. If suspicious cases are admitted, they may actually contract the disease in hospital. If they are discharged they may infect their families and friends. In our experience of approximately 1000 screening cases, we had over 100 confirmed cases of SARS. We found that there were no cases of secondary spread amongst the suspicious cases followed at home with strict quarantine instructions.
All cases with confirmed SARS were admitted.

Guidelines for screening high-risk contact and low risk non-contact subjects have recently been published although there is currently little published evidence justifying them. We suggest modified guidelines based on our local experience. All of our subjects were likely to have some contact with a SARS case and so, unlike the general population where there may be no known contact, our cohort were at high risk of contracting the disease. In view of the fact that symptoms were often vague, that high temperature readings may be less common in the early stages, that clinical examination of the mouth, throat and chest usually revealed no abnormality even in patients with advanced stages of SARS-pneumonia, the importance of regular chest X-rays with or without CT cannot be over-emphasized.
Very few children attended our clinic, but SARS in children has been reported and is discussed in separate chapter.

**Key Points**

**Objectives of a SARS screening Clinic**
- To provide a safe environment for staff to work
- To prevent secondary infections
- To accurately and appropriately screen, diagnose and manage suspect SARS cases

**Guidelines for screening contact subjects**
For any subject who has been in contact with a person with SARS pneumonia in the past 10 days and where SARS-pneumonia is a concern. ALL patients have basic observations, history and examination.

<table>
<thead>
<tr>
<th>Does the patient have any ONE of temperature &gt; 37.5°C, chills, rigors, myalgia or loss of appetite?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
<tr>
<td><strong>No</strong></td>
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**Mx 1.** Discharge with hygiene advice and advice to return if symptoms of chills, rigors, myalgia or loss of appetite return OR pyrexia >37.5C

**Request CXR**

| No signs of consolidation |
| Signs of consolidation |

**Mx 2.** Admit to SARS screening ward

**Mx 3.** Daily follow up monitoring for chills, rigors, myalgia or loss of appetite return, pyrexia >37.5C and CXR

| If symptomatic or pyrexial for 48 hours |
| If asymptomatic and no pyrexia for 48 hours |

**Mx 4.** Request CT

| If CT shows no consolidation, Make Mx3 |
| If CT shows consolidation, Make Mx2 |
Staff Safety

It was clear that hospitals and healthcare workers are particularly at risk, accounting for 50% of all cases in some early reports. The healthcare sector has to be particularly prepared as this is most likely where an outbreak may start and restart. Revision of infection control with meticulous attention to detail is important. Staff working in, and patients attending, the clinic were issued guidelines regarding personal hygiene. All staff wore personal protective equipment (Figure 8) and were issued with guidelines regarding dressing and removal of the equipment. There is little evidence base for these procedures and other hospitals which have not been affected with the high number of affected staff and patients have adopted less rigid procedures. However, all institutions emphasise that changing gloves and hand washing after each new patient encounter is vital. Surface cleansing was undertaken with dilute hypochlorite solution four times per day. Staff were also encouraged to take showers after going off duty and in some hospitals they were encouraged to shower after each ‘potential SARS’ case.

Some healthcare epidemiologists may have the view that SARS is no more serious than the usual winter influenza outbreaks, as many more patients will die from influenza than SARS each year. However in the last few decades of medicine, we have not seen a healthcare system paralysed for months by one infectious agent. We therefore re-emphasize that staff safety and strict infection control measures are essential in combating SARS, should the outbreak recur.
**Key Points**

**Staff safety**

**Essential issues are:**
- Staff must wash hands and change gloves after every patient.
- Staff must shower if they come into contact with vomit, urine of fæces or if a patient directly cough on them.
- Staff must wear masks when interviewing patients.

**Optional issues are:**
- Hats, gowns and N95 masks.
- Antiseptic scrubs.

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**Personal hygiene guidelines for staff working in the screening clinic**

All staff were advised:

- to wash hands with liquid soap before and after patient contact, and after removing gloves
- to change gloves between patients and to wash hands.
- to wear a mask in clinic at all times
- to wear a mask out of hospital if they were in contact with anyone with respiratory symptoms or fever.
- to wear gloves for all direct patient contact
- to wear a gown in clinic at all times
- to wear eye protection (e.g. goggles)
- to avoid aerosols and use of nebulisers
- to clean surfaces regularly with disinfectant
- to seek medical protection promptly if they had symptoms compatible with SARS (e.g. fever, chills, myalgia, shortness of breath and difficulty breathing
- to build up good body immunity with proper diet, regular exercise, rest, reduced stress and to avoid smoking
- to maintain good ventilation
- to avoid crowded places with poor ventilation
- to know how to respond when splashed by respiratory secretions (should ask for immediate relief and go washing)
- that, after hand washing, to use paper towel (not elbow) to turn off the tap
- to know their “Shift Infection Control Officer” who would conduct random audits.
Personal hygiene guidelines for patients attending the screening clinic

- to wear a mask in clinic at all times
- to wear a mask out of hospital if they had respiratory symptoms or fever or were in contact with anyone with respiratory symptoms or fever.
- to wash hands with liquid soap before and after patient contact, and after removing gloves
- to clean surfaces regularly with disinfectant
- to seek medical protection promptly if they had symptoms compatible with SARS (e.g. fever, chills, myalgia, shortness of breath and difficulty breathing)
- to build up good body immunity with proper diet, regular exercise, rest, reduced stress and to avoid smoking
- to maintain good ventilation
- to avoid crowded places with poor ventilation
- to pay attention to a hygiene information sheet.

Guidelines on use of personal protective equipment

When putting on Personal Protective Equipment (PPE)

1. Wash hands
2. Put on cap/face-shield
3. Put on visor/mask
4. Put on gown
5. Put on gloves

Removing PPE (dirty gown to dispose)

1. Remove cap/face-shield
2. Remove gown
3. Remove glove
4. Wash hands
5. Remove visor/mask
6. Wash hands

Removing PPE (clean gown to keep for re-use)

1. Remove cap/face-shield
2. Remove glove
3. Remove gown – fold inside-out and keep in plastic bag
4. Wash hands
5. Remove visor/mask
6. Wash hands
Managing Patients with Suspected SARS

One of the first principles of medical practice is ‘Do no harm’. It was quickly apparent that hospitals with communal, congested wards were a hazard to any patient or staff member who entered the ward and who did not have the illness. Patients with suspected SARS will not necessarily have the illness and therefore should not be admitted to high-risk communal areas. These patients should be isolated from relatives, other members of the community and from patients with SARS. The question is where this can best be achieved? If hospitals can offer protected, single-occupant areas then suspected cases may be admitted to such areas. But if hospitals can not offer these areas to each individual then they are high-risk areas as patients are at a risk of contracting the disease in the hospital. Our strategy was to follow up all suspect cases in our screening clinic on a daily basis until either they became probable cases in which case they were admitted or there was a 48 hour period of no symptoms, normal laboratory results and normal chest x-ray.

This process may become easier with the development of a more reliable rapid laboratory test. However, sensitivity of a single test is unlikely to be high early in the illness and the principles of managing suspected SARS patients still apply.

Hospital admission criteria
At our institution the initial primary criteria for admission to a hospital clearing ward was EITHER a history of close contact with a SARS patient in the previous 10 days, fever and chills/rigors, and documented pyrexia >38°C, OR a history of fever, chills and rigors and any one of four abnormalities: an oxygen saturation of <95%; abnormal chest radiograph; unstable hemodynamics; or abnormal blood results.

No patients had unstable hemodynamics during the assessment phase and only one had an oxygen saturation <95%. It also quickly became evident that many patients had brief transient episodes of lymphopenia or thrombocytopenia. These patients did not develop SARS pneumonia and appeared to have a typical viral episode that quickly resolved. Therefore these cases of suspect SARS were not admitted to hospital but were advised to isolate themselves from their families. Many of these staff moved into hospital accommodation or hotels. Only probable cases of SARS were admitted to a hospital ward.

Follow up criteria
Patients were followed up daily after first attendance if there was a contact history, one or
more symptoms (as described in the data collection section below), documented pyrexia >38°C on at least one occasion, a normal or indeterminate chest radiograph, or abnormal investigations (e.g. leucopenia, lymphopenia, monocytes or thrombocytosis). Patients were given hygiene advice and a follow up appointment for the next day.

**Discharge criteria**
Patients were discharged after first attendance if they had vague or no symptoms, no pyrexia, a normal radiograph and normal laboratory investigations. They were given hygiene advice and advised to return if they experienced a fever. Patients who were followed up daily were discharged after 48 hours of remaining asymptomatic, with no documented pyrexia and normal chest radiographs and laboratory tests.

### Key Points

**Managing patients with suspected SARS**
- Many patients suspected of SARS do **NOT** have SARS
- Suspected patients should **NOT** be isolated in communal areas.
- Suspected SARS patients should be isolated in single room areas.

**Admission criteria**
- Patients with pneumonia require close observation and isolation.

**Discharge criteria**
Patients the following may be discharged:
- No symptoms for 48 hours.
- No pyrexia for 48 hours
- Normal chest X-ray.
- Normal whole blood count.

**Conclusion**

With the global spread of disease, it is likely that other health care settings will also be faced with the dilemma screening symptomatic staff and patients who have close contact with SARS-pneumonia patients after a SARS outbreak.
This chapter describes process of care in a screening clinic which provided a safe environment for staff, patients and their contacts with no secondary infections. We have learnt that hospitals are dangerous places to be in if you do not have SARS. Unless facilities for mass isolation rooms are available, it may be better to have home quarantine to avoid suspected cases who do not actually have SARS going on to contract the disease after admission to a communal SARS or infectious triage ward. The early phase of the illness is characterized by non-specific symptoms such as fever, myalgia and chills. Documented fever is often not possible despite the presence of pneumonic change on x-ray.

In the future, it will be important to have a heightened awareness of the condition, to produce a vaccine, and to immunize the majority of the population. Until this is possible SARS remains a threat.
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References


