



Evolution of the Emergency Patient Screening and Diversion System at E-Da Hospital in Response to the COVID-19 Pandemic

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The assault of severe acute respiratory syndrome (SARS) on Taiwan in 2003 has not only overhauled the healthcare system of the country to cope with potential outbreak of similar life-threatening infectious disease but also impacted on the infection control policy of individual medical institutes. We reviewed and summarized the essential changes in the strategy for screening and diverting patients with suspected coronavirus 2019 (COVID-19) at E-Da Hospital in the emergency care setting since January 2020. Following the alarm triggered by the first episode of nosocomial infection in another medical institute in northern Taiwan in February 2020, our initial screening strategy at the emergency department focused on a travel history to China and the presence of fever. Besides, chest x-ray and computed tomography played a key role in determining subsequent patient disposal. Later, in view of the global spread of the disease, our alert has been expanded to include all visitors to Taiwan and our updated screening protocol has placed a strong emphasis on the need for personnel protection on encountering patients with suspected COVID-19 as well as reporting patients who meet the reporting criteria according to their clinical presentation, laboratory diagnosis, epidemiological criteria to the Taiwan Centers for Disease Control (TCDC). In conclusion, through timely identification and treatment of patients with potential COVID-19, the emergency department remains the first line of defense against the pandemic. An effective and flexible strategy is crucial for successful patient screening and diversion in the emergency care setting

Key words: coronavirus disease 2019, severe acute respiratory syndrome coronavirus 2, infection control, emergency department

Introduction

Following the traumatizing experience in the year 2003 when severe acute respiratory syndrome (SARS) assaulted several Asian countries,¹ Taiwan has overhauled its emergency healthcare response system to

prepare for the next possible attack of wide-spread infectious diseases. Accordingly, even before the isolation of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on January 7, 2020,² the Taiwan Centers for Disease Control (TCDC) organized an emergency response team as early as January 2, 2020. The E-Da Healthcare Group also acti-

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vated the emergency response on January 6, 2020 with the implementation of precaution measures including attention being paid to a travel history to China during history-taking and the mandatory requirement for clinicians to wear personal protective equipment (PPE) during tracheal intubation at the emergency department (ED) as well as reporting all patients with suspected infection to the TCDC.

On January 20, 2020, the Ministry of Health and Welfare of Taiwan established the Central Epidemic Command Center (CECC) for integrating administrative, educational, and healthcare resources as well as coordinating the efforts of infection control from both governmental and private healthcare institutes. There are 22 medical institutes responsible for coping with patients with suspected or confirmed coronavirus 2019 (COVID-19) infection. Isolation wards are available in 116 hospitals throughout Taiwan. The E-Da Healthcare Group provides 15 negative-pressure wards and 24 isolation wards for patients with potential SARS-CoV-2 infection. Not unexpectedly, the first case of COVID-19 was confirmed in Taiwan on January 21, 2020.

However, an alarm was triggered among all healthcare institutes in Taiwan on February 29, 2020 when the first nosocomial infection was reported at a tertiary referral center in northern Taiwan. As the first line of defense, the ED of E-Da Hospital has started strict measures to identify visitors with possible COVID-19 infection and separate patients with potential infection from those without to avoid nosocomial spread. The current report summarized the evolution of the patient screening and diversion system at the Emergency Department of E-Da Hospital.

Methods

We reviewed and summarized the essential changes in our strategy for screening and diverting patients with suspected COVID-19

in the emergency care setting since January 2020 when the disease was first identified as a distinct human-to-human infectious threat.² With the incorporation of knowledge of the disease and the reporting criteria issued by the TCDC, we updated our patient allocation and management protocols.

Implementation of the first emergency patient screening and diversion strategy

At the beginning of the COVID-19 pandemic in February 2020, the global number of cases was small and most patients were confined to Mainland China. Our knowledge about the symptoms and signs as well as the imaging presentations of the disease was limited. As the first step of screening, we reinforced history-taking by focusing on travel, occupation, contact, and possibility of cluster infection (Fig. 1). Before the global spread of the pandemic, whether an individual from abroad were at risk of exposure to SARS-CoV-2 depends on the risk level of that particular country from where the patient returns in accordance with the list officially issued by TCDC. Because the list was updated constantly, the protocol on patient screening needed to be modified accordingly. At first, only Mainland China was listed as the high-risk area with the Hubei Province classified as one of the highest risk and the other areas of China (including Hong Kong and Macau) classified as regions of relatively low risk (Fig. 1).

Besides travel history, fever and imaging studies were recommended as triage strategies for COVID-19.³ Although computed tomography (CT) was considered more sensitive than chest x-ray in identifying viral pneumonia,³ its use as a screening tool would compromise the opportunity of patients with a real need for a CT scan at the ED (e.g., those with a traumatic head injury or acute abdomen) as well as inpatients and outpatients with indications for CT (e.g., assessment before tumor surgeries).

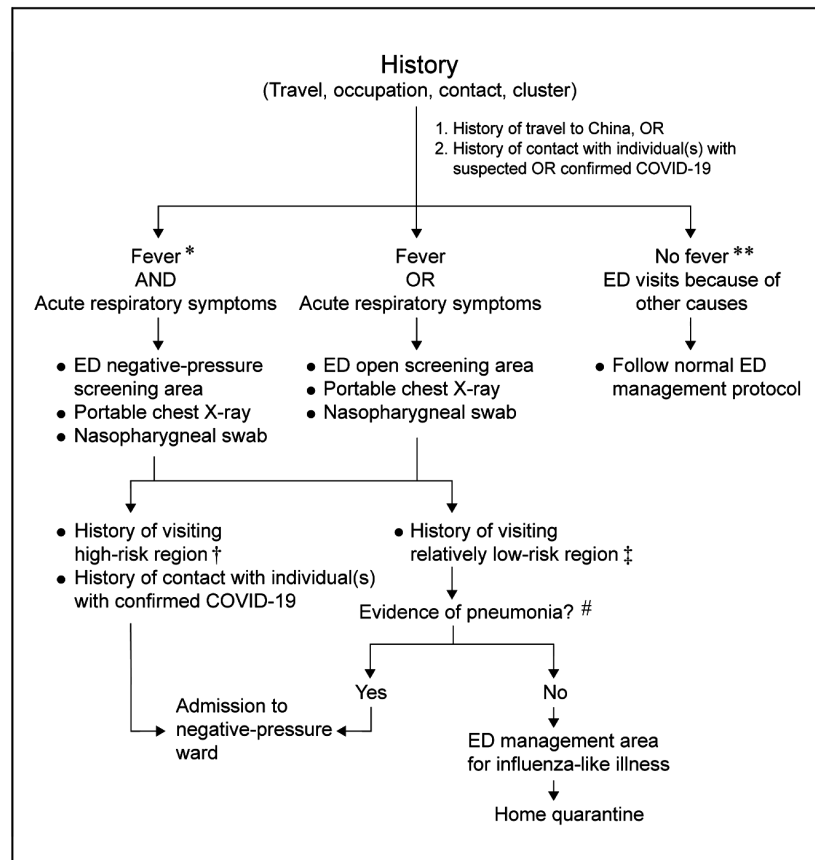


Fig. 1 Initial protocol on management of patient with suspected COVID-19 infection in the emergency setting.

*Defined as tympanic temperature ≥ 38 degree Celsius; **Defined as absence of fever in recent 14 days;

†Hubei Province of China; ‡Other regions of Mainland China including Hong Kong and Macau; #Diagnosis

based on chest radiograph interpretation by two emergency physicians. Disagreement between the two

emergency physicians required consultation with a respiratory physician and a radiologist. Chest computed

tomography (CT) examination if disagreement between the two specialists.

Therefore, chest radiography was adopted as a preliminary screening tool at our institute (Fig. 1). Diagnosis of viral pneumonia from chest x-ray was first made by two emergency physicians. Disagreement between the two emergency physicians required the consultation with a respiratory physician and a radiologist. CT examination was considered only when there was disagreement between the two specialists.

In addition to the demand for imaging studies, allocation of staff and a designated space for patient screening at the already crowded ED imposed another formidable challenge to the emergency medical care system. To eliminate the possibility of nosocomial infection from individuals with suspected COVID-19, separated accesses (e.g., elevators) to isolation or negative-pressure wards are needed

for the transportation of potentially infected patients. Therefore, patients with suspected COVID-19 were allocated to different areas for further management in accordance with their risks of contracting the disease based on travel history and symptoms; patients with a recent travel history to Mainland China who presented to the ED with a fever and acute respiratory symptoms were required to receive portable chest radiography and a nasopharyngeal swab sampling in the ED negative-pressure screening area, while those with a travel history to Mainland China with a manifestation of either fever or acute respiratory symptoms needed to receive a portable chest x-ray examination and a nasopharyngeal swab in an outdoor sampling station (Fig. 2). On the other hand, those with a positive travel history to China who visited the



Fig. 2 Outdoor nasopharyngeal sampling station

ED because of other symptoms or conditions followed the normal ED management protocol (Fig. 1).

As the next step of management, patients with a history of traveling to high-risk areas of China or contact with individual(s) with confirmed COVID-19 were admitted to negative-pressure wards for treatment and surveillance. Patients who visited relatively low-risk areas with imaging findings suggestive of pneumonia were required to be admitted to negative-pressure wards, while those without sign of pneumonia were discharged for a 14-day home quarantine (Fig. 1).

Updated management strategy for patients with possible COVID-19 in the emergency setting

With accumulating information about the symptoms and signs of COVID-19, the reporting criteria issued by the TCDC for patients with suspected or confirmed infection were modified in April 2020 (Table 1).⁴

Accordingly, our approach to screening and diverting patients with suspected infection was updated (Fig. 3). In view of accumulating evidence showing that chest radiography⁵ and computed tomography^{6,7} may not be appropriate tools for ruling out the diagnosis of COVID-19, the two imaging modalities are no longer determinants of patient allocation in the

updated protocol (Fig. 3). Instead, members of clinical staff (i.e., physicians and nurses) are required to put on appropriate personal protective equipment (PPE) when caring for patients presenting to the ED or outpatient department with acute respiratory symptoms. In the absence of community-acquired COVID-19 in Taiwan, a history of exposure to infected individual can still serve as a reference for allocating patients to the appropriate area (i.e., negative pressure or well-ventilated areas) for nasopharyngeal sampling. We also abide by the government policy to report to TCDC the detail of patients who meet the reporting criteria (Fig. 3, Table 1).

Discussion

The emergency department (ED) of a tertiary referral center is usually a busy place with patients seeking medical and surgical help of various causes. Although the outbreak of the COVID-19 pandemic was anticipated to impose a heavy burden on the crowding condition,^{8,9} the number of patients visiting the ED actually decreased worldwide.¹⁰⁻¹⁴ Nevertheless, ED remains the most important fortress to fend off the COVID-19 pandemic.

Although a travel history to heavily infected regions is not important for the diagnosis of COVID-19 in most countries where community outbreaks are common, it is still vital for identifying potentially infected individuals in Taiwan which is one of few places in the world without evidence of large-scale community-acquired infection. In terms of symptoms, despite the report of fever as the most common symptom from various cohorts of COVID-19 patients that occurs in up to 83% – 98% of the patient population,¹⁵ previous studies have shown a probability of asymptomatic infection in up to 30 to 40 percent of infected individuals.^{16, 17} Therefore, even though fever remains an easily discernible parameter for preliminary screening for those with potential SARS-CoV-

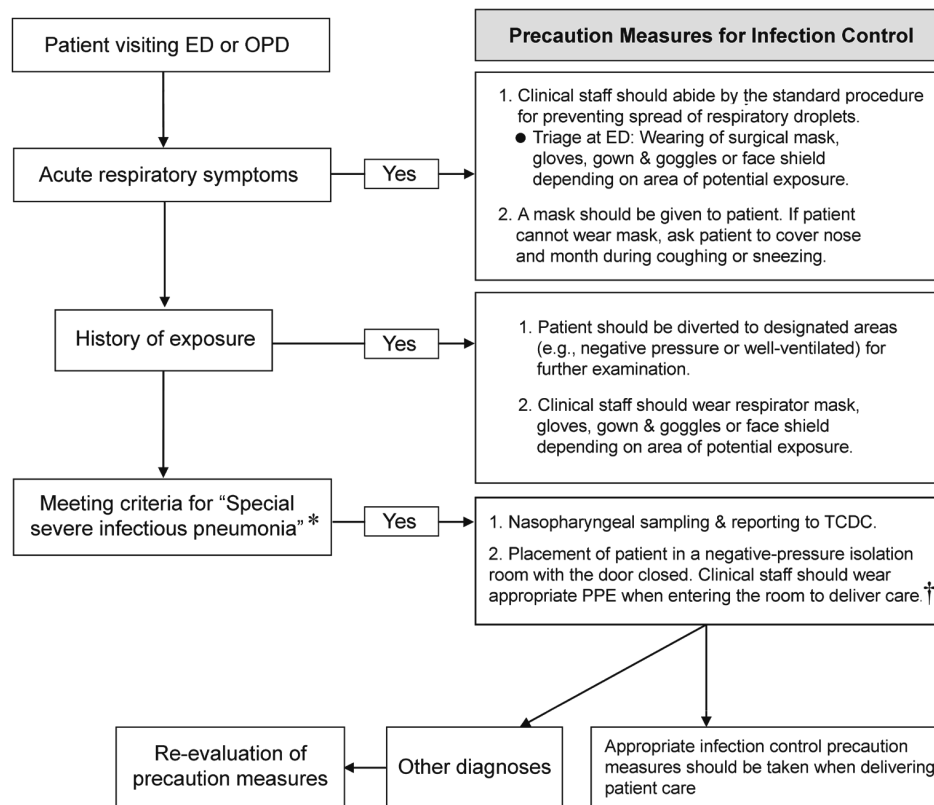


Fig. 3 Updated protocol on management of patient with suspected COVID-19 infection in the emergency and outpatient settings. *Reporting criteria detailed in Table 1; †Personal protective equipment (PPE) and procedure include maintaining hand hygiene, wearing gown, gloves, goggles, surgical mask or respirator mask (e.g., N95, FFP2). COVID-19: coronavirus 2019, ED: emergency department, OPD: outpatient department, TCDC: Taiwan centers for disease control.

2 viral infection, it may not be a sensitive tool for spotting early infection. Regarding the use of imaging modalities for early detection of COVID-19, a previous report revealed a sensitivity of chest x-ray for COVID-19 of only 55% within two days after symptom onset.⁵ Although the sensitivity increased substantially to 79% by the eleventh day,⁵ the findings did not support the use of chest radiography as an early screening tool. On the other hand, CT has a high sensitivity (67% – 100%) but a relatively low specificity (25% – 80%) for the diagnosis of viral pneumonia.⁶ Therefore, CT is not recommended as a sole diagnostic approach for COVID-19 infection.⁶ However, because the moderately low sensitivity of real-time reverse transcription polymerase chain reaction (RT-PCR) test for diagnosing COVID-19 (53% – 88%),^{6,7} the use of chest CT is still the imaging modality of choice for

the detection of COVID-19 in patients with typical symptoms in highly infected regions, particularly when the results of RT-PCR tests are negative.^{6,7} Taking into account the low sensitivity of CT and the relatively low disease prevalence in Taiwan, it is not included in the updated protocol for patient screening for patients visiting the ED or outpatient clinic (Fig. 3).

In addition to screening for patients visiting the ED with suspected infection, E-Da Hospital has taken important precautions to ward off any opportunity of nosocomial COVID-19 infection from hospital visitors including (1) visitors to ordinary wards are prohibited to avoid exposure of patients, families, and hospital staff to unnecessary infection risk; (2) visitors entering the hospital through the front door need to pass through a checkpoint where body temperature is measured and travel

Table 1. Reporting criteria and case definitions for coronavirus disease 2019 (COVID-19).⁴

1. Clinical presentation criteria

One or more of the following:

- (1) Fever (≥ 38 degree Celsius) or symptoms of acute respiratory tract infection.
- (2) Abnormal sense of smell (anosmia), abnormal sense of taste (dysgeusia), or diarrhea of unknown etiology.
- (3) Community-acquired pneumonia (CAP) highly suspected to be COVID-19 by physicians.

2. Laboratory diagnosis criteria

One or more of the following:

- (1) Pathogen (SARS-CoV-2) isolated and identified from a clinical specimen (nasopharyngeal swab, throat swab, expectorated sputum, or lower respiratory tract aspirates).
- (2) Positive molecular biological testing for viral (SARS-CoV-2) RNA from a clinical specimen (nasopharyngeal swab, throat swab, expectorated sputum, or lower respiratory tract aspirates).

3. Epidemiological criteria

One or more of the following within 14 days prior to symptom onset:

- (1) History of traveling or living abroad, or contact with symptomatic (fever or other respiratory tract infection symptoms) individuals returning from abroad.
- (2) History of close contact with symptomatic suspected or confirmed case(s), including caring for or interacting with these individuals, or direct contact with body fluid or respiratory secretions without adequate personal protective equipment (PPE).
- (3) History of cluster related to confirmed cases.

4. Reporting requirements for COVID-19

Any cases with one or more of the following conditions should be reported to the Taiwan Centers for Disease Control (Taiwan CDC):

- (1) Meet clinical presentation criteria (1) AND one or more epidemiological criteria.
- (2) Meet clinical presentation criteria (2) AND any of epidemiological criteria (1) or (2).
- (3) Meet clinical presentation criteria (3).
- (4) Meet laboratory diagnosis criteria.

5. Case definitions

1. Suspected case: meet clinical presentation criteria but not laboratory proven, plus history of close contact with symptomatic confirmed case(s) within 14 days prior to symptom onset.
2. Confirmed case: meet laboratory diagnosis criteria, regardless of clinical signs and symptoms.

histories are scrutinized by accessing their electronic information through their national health insurance cards; and (3) patients coming to the hospital for chronic medications can renew their prescription, which enables them to acquire their medications from local pharmacies without entering the hospital.

Nevertheless, the definite diagnosis of COVID-19 remains to be a positive RT-PCR test,¹⁸ which is a nucleic acid detection technique that cannot be used for routine screening to give immediate results in an emergency setting. Therefore, however strict the criteria we adopt for patient screening at the ED, the process is not infallible because of the possibility of asymptomatic and presymptomatic patients.^{16,17} The key role in fending off the pandemic is being played by the TCDC to which a tribute is paid for maintaining a strict quarantine policy for visitors arriving in Taiwan to enable timely identification of imported cases, thereby minimizing the risk of community-acquired infection and the possibility of infected patients visiting the ED.

Conclusion

As the frontline of defense, the emergency department plays a vital role in identifying and treating patients infected with COVID-19. Through constantly modifying our patient assessment and diversion strategy according to the updated knowledge of the disease and the latest policy of the government, we aim at achieving timely detection, early treatment, and immediate reporting of patients afflicted with COVID-19 as well as preventing nosocomial spread of the infection.

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