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Brief Communication

Rapid responses in the emergency department of Linkou Chang Gung Memorial Hospital, Taiwan effectively prevent spread of COVID-19 among healthcare workers of emergency department during outbreak: Lessons learnt from SARS

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ABSTRACTS

Linkou Chang Gung Memorial Hospital, Taiwan has been on the forefront of efforts to manage and mitigate the Coronavirus Disease 2019 (COVID-19) pandemic since 20th January 2020. Despite having one of the largest and busiest emergency departments (EDs) in the world, we have managed to maintain a “zero-infection” rate among our ED healthcare workers through various systematic approaches. The measures implemented include establishing a clear flowchart with route planning, strict infection control policies and regulation of medical equipment, and team-based segregation in the workplace. These strategies, borne of our experience during the severe acute respiratory syndrome (SARS) outbreak, can complement a network of well-trained personnel to enable EDs around the world in successfully mounting an effective defense against new airborne illness while minimizing healthcare personnel casualties.

First detected in late 2019, the Coronavirus Disease 2019 (COVID-19) outbreak in Wuhan has rapidly morphed into a global pandemic within a few months. Its swift spread has crippled and continues to devastate healthcare systems around the world. Taiwan was among the first few affected countries, owing to its proximity to China and the high flight passenger volume between both countries. Despite being highly vulnerable, Taiwan has demonstrated extraordinary

infection control results compared to other Asian and Western countries [1]. Furthermore, the emergency department (ED) of Linkou Chang Gung Memorial Hospital (LCGMH) has maintained a “zero ED health care workers infection” rate while battling severe acute respiratory syndrome (SARS) in 2003 and during the present COVID-19 epidemic.

LCGMH, one of the largest hospitals in the world with a capacity of 3406 beds [2], is the nearest tertiary hospital to Taiwan

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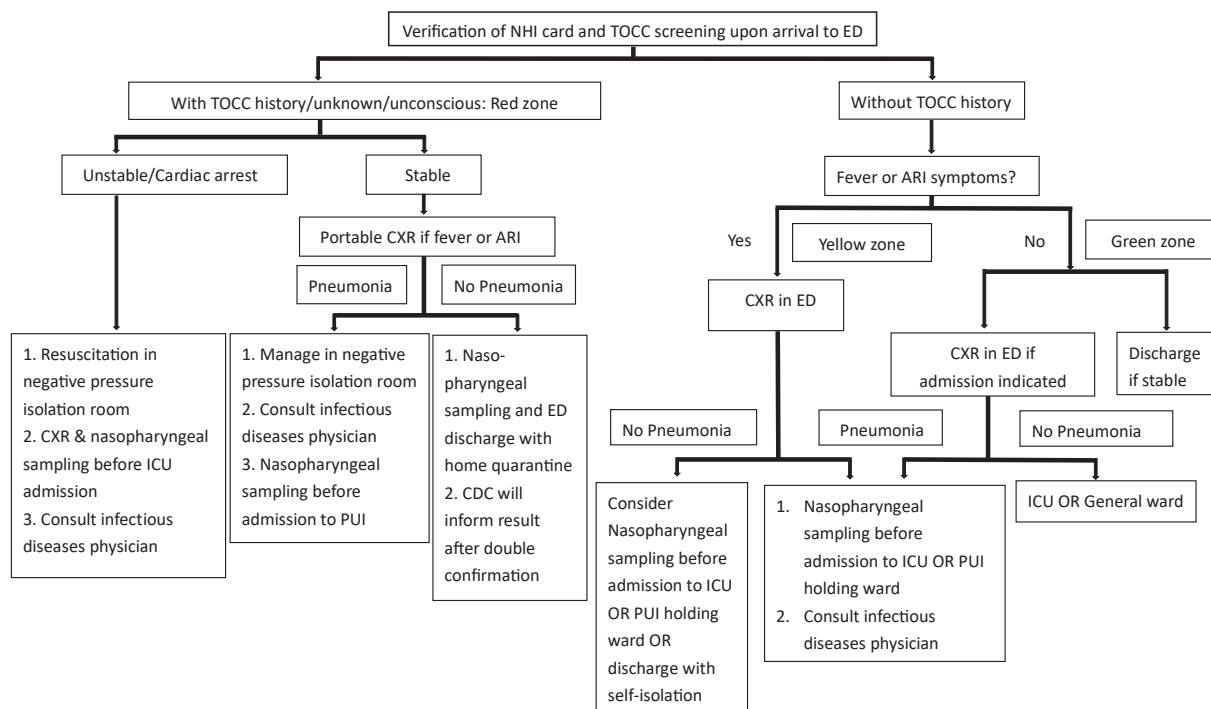


Fig. 1 Flowchart for triaging patients presenting to the ED of LCGMH.

Taoyuan International Airport, Taiwan's largest and busiest airport. Its ED is equipped with 190 beds and 2 negative pressure isolation rooms, and receives approximately 15,000 visits monthly [3]. It is staffed by 63 specialists, 28 residents, 25 post-graduate year physicians, 29 medical assistants, 215 nurses, 8 pharmacists, 14 radiographers, and 8 respiratory therapists.

Upon news reports of the spread of COVID-19 [4], LCGMH joined in immediately without hesitation as a frontline hospital to screen and to treat suspected cases. Drawing from lessons learnt during our experience with managing the SARS pandemic in 2003, LCGMH ED has worked expeditiously to implement the following infection control measures: establishment of a clear and feasible management flow chart with route planning, strict regulation in manpower and medical supplies, and minimization of infection risks during the course of treatment. These measures have been successful in ensuring zero infection rates of our ED healthcare workers thus far. This report aims to share our systemic approach to triaging and managing patients in the ED, which is proving effective thus far in safekeeping our ED healthcare workers from contracting the disease themselves and controlling the outbreak.

Modified flowchart for managing patient flow in our emergency department

Proper implementation of clear and robust standard operating procedures is essential for effective infection control in the ED, especially when patient volumes are high. Our new ED setup has been modified and divided into three areas, based on risk for COVID-19, to quickly triage all patients presenting to the ED during this period. The red zone is for patients with positive travel, occupation, contact, or cluster (TOCC) history

regardless of their presenting complaint – this is to sieve out asymptomatic carriers of COVID-19. The yellow zone is for patients with fever or acute respiratory infection (ARI) symptoms but negative TOCC history. The remainder of patients are deemed to have low risk for COVID-19 and thus are sent to the green zone [Fig. 1].

Upon arrival to LCGMH, all patients are triaged by nurses in a screening checkpoint with good ventilation of air situated next to our ED. Assessment of travel history is done objectively via verification of the patients' national health insurance (NHI) card, which electronically records all overseas travel conducted. Patients are also screened according to a standardized questionnaire to evaluate their TOCC history (Table 1). After the patients have their temperatures checked using infrared thermometers and are screened for presence of ARI symptoms, they are subsequently stratified accordingly into the 3 aforementioned zones.

Our red zone comprises 2 negative pressure isolation rooms and an environment with separate cubicles to protect patient privacy during examination and procedures. Each cubicle is equipped with a pair of telephones to enable consultation at a safe distance, as well as an acrylic shield to protect our physicians while they obtain nasopharyngeal sampling. The red zone is also equipped with a dedicated portable X-ray machine. Unstable patients with positive or undetermined TOCC history are immediately whisked to the negative pressure isolation room for resuscitation, while the stable patients are processed in the cubicles with good ventilation of air. All patients with fever (38 °C) or ARI symptoms in the red zone are required to undergo chest X-ray (CXR) and nasopharyngeal sampling. Nasopharyngeal samples are analyzed by both LCGMH and Taiwan Centers for Disease Control (CDC) for double confirmation prior to informing

Table 1 TOCC screening questionnaire.

Category	Travel History	Occupation	Contact History	Cluster
Questions	Have you traveled within 14 days?	What is your occupation?	What is your recent contact history?	What is your recent one-month cluster history?
Evaluations	<input type="checkbox"/> Personal (country:) <input type="checkbox"/> Family (country:) <input type="checkbox"/> Friends (country:)	<input type="checkbox"/> Healthcare industry (e.g. medical relevant/irrelevant staff, interns, volunteers) <input type="checkbox"/> Transportation sector (e.g. taxi driver) <input type="checkbox"/> Tourism (e.g. tour guide, hotel staff) <input type="checkbox"/> Airline industry <input type="checkbox"/> Others	<input type="checkbox"/> Hospital/clinic visit <input type="checkbox"/> Airport, tourist attractions <input type="checkbox"/> Large gatherings <input type="checkbox"/> Wildlife <input type="checkbox"/> Others	<input type="checkbox"/> Family under same roof <input type="checkbox"/> Self-quarantine <input type="checkbox"/> Self-screening <input type="checkbox"/> Self-regulation <input type="checkbox"/> Family with ARI symptoms or fever <input type="checkbox"/> Friends with ARI symptoms or fever <input type="checkbox"/> Colleague with ARI symptoms or fever <input type="checkbox"/> Others

*Acute respiratory infection (ARI) symptoms: cough, running nose, sore throat, myalgia, etc.

patients. Patients not requiring hospital admission will be issued 14-day home quarantine notices and instructed to take private transport home after discharge from the ED. If pneumonic changes are identified on CXR, the patient would then be brought to our negative pressure isolation rooms for further examination and management by both ED and infectious diseases specialists.

Patients with negative TOCC history but have fever or ARI symptoms are given surgical 3-ply masks to wear before being channeled to our yellow zone for CXR. If pneumonic changes were detected on CXR, these patients are required to undergo nasopharyngeal sampling before admission to dedicated holding wards for persons under investigation (PUIs). As for those yellow zone patients without pneumonic changes, nasopharyngeal sampling will be considered with subsequent admission to intensive care unit (ICU)/PUI holding ward or discharge with self-isolation. Lastly, patients in the green zone, are secondarily triaged according to the Taiwan Triage and Acuity Scale [5,6] and managed accordingly.

Tightening of infection control policies around the emergency department

LCGMH ED has imposed several policies for this duration to minimize risk of nosocomial infection at various points of patient contact. Realizing potential future outbreak after SARS in 2003, 2 negative pressure isolation rooms were installed in preparation for use in managing patients with suspected airborne/droplet diseases. The rooms are beneficial in isolating and preventing the transmission of the disease to other zone in the ED thereby protecting both patients and health care workers. The number of entrances and exits at the ED have also been reduced to facilitate monitoring of traffic flow after this COVID-19 pandemic. All patients are allowed only one accompanying family member, with all persons entering the ED required to undergo screening. Within the ED itself, all beds have been separated at least two meters apart, and HEPA filters were installed to further reduce risk of disease spread in the ED. Aerosol-producing procedures such as intubation are carried out by personnel wearing full personal protective equipment and N95 masks.

Manpower allocation and education

All healthcare personnel were banned from travelling overseas by the Taiwan Ministry of Health and Welfare since 24th Feb 2020 to ensure sufficient manpower in combating this COVID-19 pandemic. Our ED further implemented a manpower restricted movement order to limit employees from crossing over to another working area during their shifts. We also divided our personnel into various teams and segregated them by assigning different tea breaks and shifts, ensuring zero physical contact between teams at work. Shared areas, such as cafeterias, were actively disinfected before the arrival of the next team. These measures sought to reduce the risk of local transmission and keep a sustainable workforce in the ED should any team have to be quarantined. All personnel working in the ED including non-medical staff, were educated with infection control measures and must pass an examination before being allowed to work on the frontlines. Daily temperature monitoring was instituted, and those with fever and ARI symptoms were placed on mandatory home quarantine.

Sustainable medical supplies

Taiwanese hospitals were assured sufficient supplies of personal protective equipment by the Taiwanese government, which instituted stringent resource allocation policies in January 2020. To further encourage appropriate use and prevent wastage or even theft in our hospital, LCGMH mandated the signing out of each piece of equipment by the respective personnel.

Conclusion

LCGMH ED has had a clean track record thus far in preventing infections among our ED healthcare workers, from the previous SARS epidemic to the current COVID-19 pandemic. From January 20 to March 22, 2020, 738 suspected patients were managed in the red zone. Twenty new cases of COVID-19 infection were diagnosed. No ED healthcare workers was diagnosed with COVID-19 infection so far. We strongly believe

that the meticulous implementation of the measures described above, coupled with a network of well-trained ED staff, will help EDs around the world in deftly responding to the ongoing COVID-19 pandemic.

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Ethical approval

The Chang Gung Medical Foundation Institutional Review Board approved this study (IRB: 202000469B1), waiving the need for consent from study participants. All procedures performed in studies involving human participants were in accordance with the ethical standards of the Chang Gung Medical Foundation Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflicts of interest

The authors declare that they have no conflict of interest.

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