WHAT'S NEW IN INTENSIVE CARE

Novel coronavirus infection during the 2019–2020 epidemic: preparing intensive care units—the experience in Sichuan Province, China

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Up to 31 January 2020, there have been 9811 officially reported confirmed cases of 2019-novel coronavirus (nCoV) infection in China since the epidemic began in December 2019 (updated data available at https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6).

With the rapid transmission, the epidemic has spread throughout the country, and 177 cases have been reported in Sichuan Province. As nCoV infection is a highly contagious disease with high mortality (3–15%) [1–3] and West China Hospital (WCH) is the largest hospital in the southwest of China and the referral medical center in Sichuan Province, it is our responsibility to prepare for admission of additional critically ill patients as a matter of emergency. We have held several expert meetings and have reviewed the related literature to develop a plan to respond to the epidemic [4, 5]. The purpose of the plan is to enable us to provide the maximum level of care to critically ill patients while ensuring the protection of medical staff.

Novel coronavirus infection special intensive care team

We set up a special emergency multi-disciplinary intensive care team to discuss the problems that we might encounter and countermeasures. Team members include intensive care unit (ICU) physician, infectious disease physician, nurse, respiratory therapist, nosocomial infection control expert, and administrative staff. We first evaluated the isolation conditions and the capacity of our department to admit a larger number of patients. Second, we specified the protection levels for different types of health care activities. Third, we assigned special work such as patient screening, consultation, and transfer to designated staff to minimize the number of health workers who had contact with patients with nCoV infection.

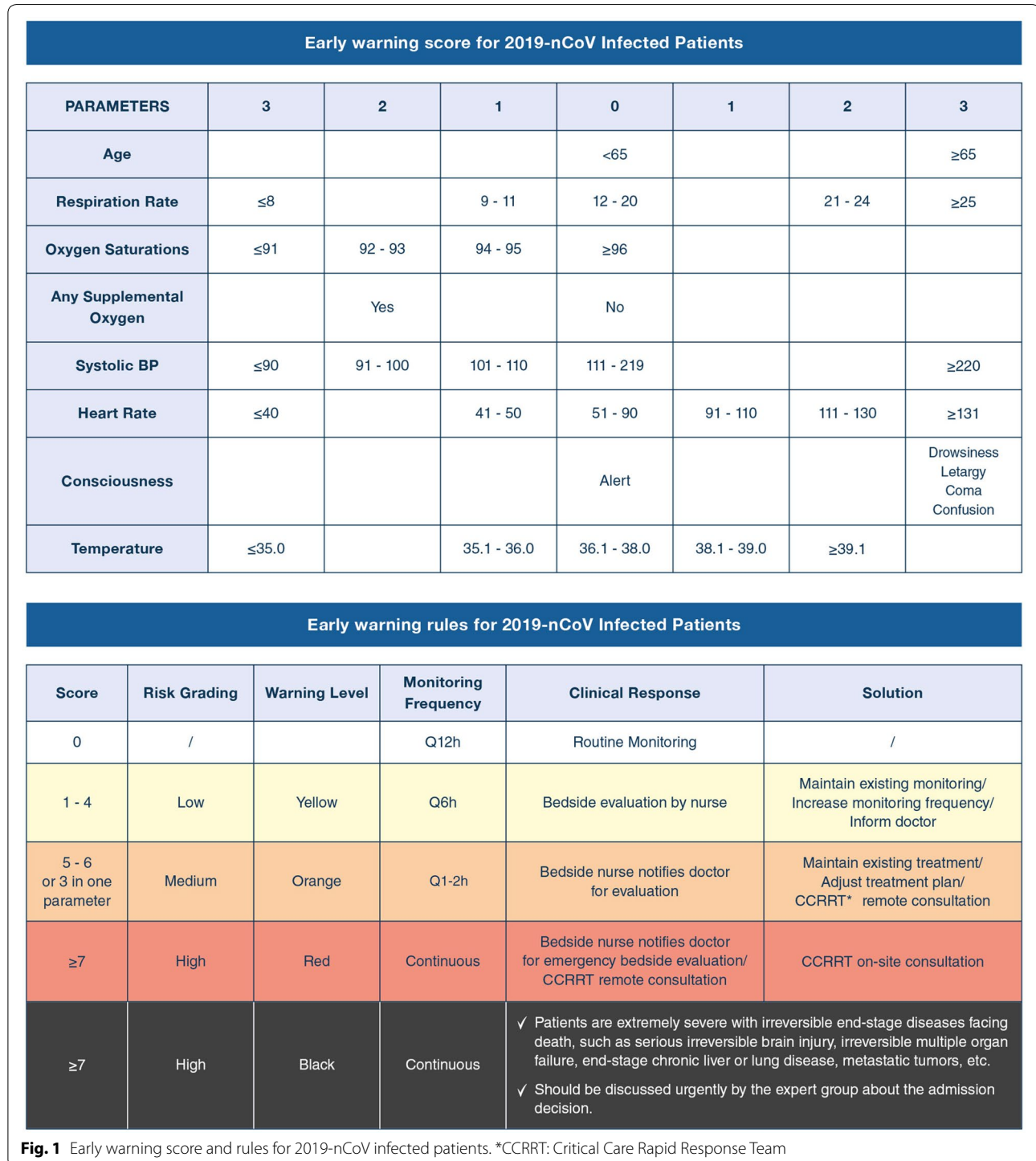### Bed and medical equipment preparation

WCH is a teaching hospital with 4300 total beds and 8 ICUs of total 206 ICU beds. Under normal conditions, the ICU bed usage is always above 90%. It was not appropriate to treat 2019-nCoV-infected patients in the central area because the large stream of people would have a negative impact on infection control measures to curb the spread of the infection. The hospital authorities decided to vacate 402 beds belonging to the Center of Infectious Disease and the adjacent Fifth Inpatient Building so that both are separated from the rest of the inpatient buildings in WCH (Supplementary Figure 1). Based on the initial data [1, 2] and taking into consideration the surge of critically ill patients, we plan to equip 50 ICU beds initially and adjust on the number of patients, as necessary. We made a list of requirements for other special medical equipment, such as ventilators, bronchoscopes, hemodialysis machines, ultrasound machines, standard personal protective equipment (PPE), and sterilizing equipment. During this epidemic period, a large amount of certified PPE, including medical masks, goggles, face shields, and waterproof isolation gowns, is required. Manufactures of the items on the requirement list were contracted and we

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drew up an advertisement to the society calling for donations to ensure sufficient supplies.

Education and training of staff

It is very important to make all staff aware of the public health significance of the epidemic, and of potential challenges in achieving disease control. Strict isolation and protection measures are a top priority. Training content

Early warning score for 2019-nCoV Infected Patients							
PARAMETERS	**3**	**2**	**1**	**0**	**1**	**2**	**3**
Age				<65			≥65
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220
Heart Rate	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Consciousness				Alert			Drowsiness Letargy Coma Confusion
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	

Early warning rules for 2019-nCoV Infected Patients					
Score	**Risk Grading**	**Warning Level**	**Monitoring Frequency**	**Clinical Response**	**Solution**
0	/		Q12h	Routine Monitoring	/
1 - 4	Low	Yellow	Q6h	Bedside evaluation by nurse	Maintain existing monitoring/ Increase monitoring frequency/ Inform doctor
5 - 6 or 3 in one parameter	Medium	Orange	Q1-2h	Bedside nurse notifies doctor for evaluation	Maintain existing treatment/ Adjust treatment plan/ CCRRT* remote consultation
≥7	High	Red	Continuous	Bedside nurse notifies doctor for emergency bedside evaluation/ CCRRT remote consultation	CCRRT on-site consultation
≥7	High	Black	Continuous	✓ Patients are extremely severe with irreversible end-stage diseases facing death, such as serious irreversible brain injury, irreversible multiple organ failure, end-stage chronic liver or lung disease, metastatic tumors, etc. ✓ Should be discussed urgently by the expert group about the admission decision.	

Fig. 1 Early warning score and rules for 2019-nCoV infected patients. *CCRRT: Critical Care Rapid Response Team

includes hand and respiratory hygiene, use of PPE, safe waste management, environmental cleaning, and sterilization of patient-care equipment [6]. We educate and train staff by means of presentations, short videos, WeChat, and supervision to ensure that staff are following the correct procedures.

Protection of medical staff

A special access to patients was set up and a boundary between the ward in which the nCoV patients are being treated and the office and living area of medical staff was established. The aim was to minimize the number of medical staff that have contact with a patient at any time, including during daily care, treatment, and transfer; minimize the use of high transmission-risk procedures such as bronchoscopy, manual ventilation, non-invasive ventilation, and tracheotomy. We use airborne precautions if these operations are necessary. Diagnostic imaging procedures such as X-ray and ultrasound at the bedside are prioritized, restricting computed tomography (CT) scans, because they cannot be performed at the bedside.

Early case recognition and classification of disease severity

A physiological parameter-based warning score is used to facilitate early recognition of patients with severe infection and admission decisions according to the severity classification. The score is a modified version of the National Early Warning Score (NEWS) with age ≥ 65 years added as an independent risk factor based on recent reports [7, 8] (Fig. 1).

Patients are divided into four risk categories based on the score: low, median, high, and exceptional. A specially assigned physician or the special critical care team decides which patients need to be treated in the ICU, taking into consideration the disease severity, opportunity to benefit, and sources of support (Fig. 1).

Strict restriction of patient contact

All staff are required to report any history of exposure, respiratory symptoms, and temperature before entering the building in which the nCoV patients are treated. Everyone must wear masks, isolation suits, and wash hands if need to be in the building. Family members and non-essential medical staff are strictly forbidden from entering the nCoV ward.

Research

As nCoV infection is a novel disease, knowledge about it is limited [9, 10], especially regarding the management of critically ill patients. We designed a case report form to collect clinical data, proceed with the ethics committee approval of research protocols, and contact with the laboratory that is qualified to conduct research on highly infectious organisms.

In conclusion, the 2019-nCoV epidemic is a threat, not only to China, but also to global health. As ICU physicians, our focus is on the management of the most severe patients. We are unable to predict how many critically ill patients we will receive but are doing the best that we can to be prepared and to work together to overcome the epidemic.

Compliance with ethical standards

Conflicts of interest
On behalf of all authors, the corresponding author states that there is no conflict of interest.

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