



## Case Screening Criteria for Early Detection of COVID-19 Cases in the First Wave of the Pandemic, Thailand

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### Abstract

In response to the emerging threat of a global pandemic, on 4 Jan 2020, Thailand became one of the first countries to activate a national emergency operations center for what was later to be known as the COVID-19 response. On 8 Jan 2020, just four days later, the first COVID-19 case outside of China was detected at an international airport in Thailand. As prompt detection of cases is critical to mitigate transmission, identifying the optimum case screening criteria for RT-PCR testing for SARS-CoV-2 was a priority for the Thai government, but also a challenge given the non-specific symptoms associated with COVID-19. Eight case screening criteria (CSC) were applied over four months. This study describes Thailand's COVID-19 CSC, the validity of individual criteria, and provides acceptable sensitivity for future waves by analyzing retrospective surveillance and laboratory data reported through Thailand's national surveillance system. Between 4 Jan and 26 Apr 2020, 1,209 hospitals reported 53,068 individuals who were laboratory tested for COVID-19. Of these, 20,061 (37.8%) met at least one of the criteria and the number of confirmed cases was 2,922. Each criteria was sensitive to detect confirmed cases (overall sensitivity=83.3%). There were no significant differences between individual criteria ( $p>0.05$ ), and a low positive predictive value (12.1%) indicated that the criteria were broad. The criteria were regularly revised to improve COVID-19 detection and response. The acceptable sensitivity of these criteria should be monitored regularly and should be more than 80% for disease detection and subsequently trigger the immediate response.

**Keywords:** coronavirus disease, SARS-CoV-2, COVID-19, detection

### Introduction

Thailand was among the first countries that detected a coronavirus disease (COVID-19) case outside China after the report of an unusual outbreak of viral pneumonia in Wuhan, China, in December 2019. The Department of Disease Control (DDC), Ministry of Public Health (MOPH) activated the Emergency Operations Center (EOC) for COVID-19 on 4 Jan 2020. In response, the Thai government established an active surveillance system for COVID-19 at 1) ports of entry, including international airports, seaports, and border crossings, 2) government and private hospitals, and 3) in the community.<sup>1</sup> The government also implemented disease screening in government

quarantine facilities for Thai people returning from high-risk areas.<sup>1,2</sup>

The initial reports of COVID-19 cases in Thailand were mainly travelers returning from Wuhan, China. Subsequently, local transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) among Thai citizens became the most prominent form of transmission.<sup>1-3</sup> Thus, initially the early detection of imported COVID-19 cases was a priority for Thailand's surveillance and response strategies but later the detection of cases through rapid screening at hospitals and communities became more important to prevent and control widespread community outbreaks. Hence, the case screening criteria (CSC) used to define eligibility for suspect cases to be tested for SARS-CoV-

2 by reverse transcription polymerase chain reaction (RT-PCR) must be routinely reviewed and adjusted to fit the changing epidemiology and context. An optimal CSC can be used to identify COVID-19 cases earlier and more accurately to subsequently reduce the workload of medical staff and save costs, to ensure accuracy of epidemiologic classification, and to hasten control of the outbreak.

In Thailand, the eight criteria of suspect cases were applied during 4 Jan to 26 Apr 2020.<sup>4</sup> The objective of this study was to describe the COVID-19 case screening system, assess the validity of each criteria, and provide acceptable sensitivity in another wave of the pandemic eventuates.

## Methods

We retrospectively reviewed various documents, for example, the COVID-19 operation guideline for health personnel and public health officers, daily COVID-19 situation reports, and the Declaration of an Emergency Situation according to the Emergency Decree on Public Administration in Emergency Situation B.E. 2548 (2005), to review case screening procedures, changes in the criteria for suspect cases, and different contexts that affected surveillance for COVID-19. The case screening criteria are summarized in Table 1. We extracted de-identified data of all persons recruited for RT-PCR testing for all suspect and confirmed COVID-19 cases in the DDC COVID-19 National Surveillance Database during 4 Jan to 26 Apr 2020. A person was defined as a suspect COVID-19 case if they met any criteria during the epidemic periods. A confirmed COVID-19 case was defined as any person who tested positive for SARS-CoV-2 from his or her clinical specimen at a national reference laboratory.

The validity and usefulness of the case screening criteria during each epidemic period was assessed by the sensitivity and the positive predictive value. The specificity and the negative predictive value could not be evaluated because there were limitations in the DDC COVID-19 National Surveillance Database.

In the analytic part, we used proportions to present the results of the quantitative study and the Chi-square test was used to assess differences in sensitivity by time.

## Results

The Department of Disease Control (DDC), Ministry of Public Health (MOPH) performed a COVID-19 risk assessment and found that Thailand was the top destination for travelers from Wuhan, China.<sup>5-7</sup> Therefore, the DDC activated the Emergency Operations Center (EOC) specifically for COVID-19 on 4 Jan 2020. The COVID-19 surveillance system involved screening 1) at ports of entry, airports, seaports and ground crossings, 2) at government and private hospitals, and 3) in the community.<sup>1</sup> Furthermore, screening was conducted in government quarantine facilities for Thai people returning from high-risk areas. Table 1 summarizes the eight screening criteria used during the study period.<sup>4</sup>

Of the 1,422 hospitals in Thailand, 1,209 (85.0%) reported that 53,068 individuals had been tested for SARS-CoV-2 infection by RT-PCR to the DDC COVID-19 national surveillance system. Of these, 20,061 individuals (37.8%) met criteria of the CSC. There were 2,922 confirmed COVID-19 cases during the study period (Figure 1), resulting in an overall positivity rate of 5.5%. Of the confirmed cases, 59.8% were detected in hospitals, 34.8% in the community (34.3% by contact tracing and 0.5% by active case finding), 4% in government quarantine centers, and 1.4% in international airports. The median age was 36 years (range: 1 month - 91 years) and the ratio of males to females was 1.2:1 (Figure 2). Most were Thai (86.3%), followed by Burmese (1.7%), Chinese (1.1%), French (0.8%), and British (0.8%) nationals. There were 51 deaths resulting in a case fatality rate of 1.7%. All died from respiratory failure, with other contributing causes reported as sepsis (7.8%) and acute renal failure (5.8%).

## Case screening criteria (CSC)

### CSC 1: 3 to 27 Jan 2020

Individuals suspected of having COVID-19 were recruited for SARS-CoV-2 testing if they met both of the following clinical and epidemiological risk criteria:

1. Clinical criteria: Fever (temperature >38°C), plus at least one acute respiratory tract infection (ARI) symptom such as cough, rhinorrhea, sore throat, or difficult breathing,

2. Epidemiological criteria: Travel from Wuhan within 14 days prior to onset of symptoms.

The COVID-19 screening process at all international airports in Thailand used these criteria for case detection. DDC officers performed the clinical and thermal screening process among all air passengers arriving directly from Wuhan.

The first imported COVID-19 case was detected at Suvarnabhumi international airport on 8 Jan 2020. The case was a 61-year-old Chinese female who lived in Wuhan and developed fever, cough, sore throat and a runny nose on 5 Jan 2020. The total number of cases

investigated during this period was 136, of which 8 were confirmed cases (positive rate = 5.9%). The sensitivity of the first case definition was 87.5% and the PPV was 6.5%.

### CSC 2 and 3: 28 Jan to 17 Feb 2020

These two screening criteria used the same clinical and epidemiological criteria, so were combined. The evidence of clinical manifestation from the first phase showed that some of the COVID-19 cases in Thailand had mild symptoms. Therefore, the significant changes of the criteria were as follows:

#### 1. Clinical criteria:

1.1 Fever (temperature >37.5°C), or a history of fever, plus at least one ARI symptom as mentioned in CSC 1 and,

1.2 Pneumonia: diagnosed with pneumonia which did not improve after treatment or had an unknown cause or was severe or caused death.

#### 2. Epidemiological criteria:

2.1 Travel from mainland China within 14 days prior to onset of symptoms,

**Table 1. Thailand's eight case screening criteria for early detection of COVID-19 (from 4 Jan-26 Apr 2020)**

Case screening criteria	Completed the criterion when	1. Fever		2. ARI symptom (at least 1)	3. Pneumonia				4. Risk area	5. Closed contact		6. Occupations with high COVID-19 risk		7. Cluster of ARI that tested negative for flu		8. Physician suspected
		(1.1) Temp. (°C)	(1.2) History of fever		(3.1) Not improve after treatment	(3.2) Unknown cause	(3.3) Severe case	(3.4) Unknown cause with dead		(5.1) Suspect case	(5.2) Confirmed case	(6.1) HCW	(6.2) Others	(7.1) HCW setting	(7.2) Other setting	
1	1 and 2 and 4	≥38							Wuhan							
2	1 and (2 or 3) and (4 or 5 or 6)															
3	1 and (2 or 3) and (4 or 5 or 6) and 6 and 3.4								China							
4	1 and (2 or 3) and (4 or 5 or 6) and (5 or 6.1) and 3.2 or 3.4	≥37.5							Country with local transmission				contact with traveler who came from the risk area			
5	1 and (2 or 3) and (4 or 5 or 6) and (5 or 6.1) and 3.2 or 3.3 or 3.4 or 7															
6	1 and 2 and (4 or 5 or 6) and 3 and 6.1 and 3.1 or 3.2 or 3.3 or 3.4 or 7		Yes	Yes	Yes	Yes	Yes	Yes	Epidemic area	Yes	Yes					
7	1 and (2 or 3) and (4 or 5 or 6) and 5 with any symptom and 3.1 or 3.2 or 3.3 or 3.4 or 7	≥37.5 (≥37.3 for POE)							Epidemic area (all international flight)			Yes	contact with traveller / crowded area	≥ 3 cases in the same ward in a week	≥ 5 cases in the same area in a week	
8	1 and (2 or 3) and (4 or 5 or 6) and 6 and (5 or 8) and 3.1 or 3.2 or 3.3 or 3.4 or 7															Yes

Note: ARI: Acute respiratory infection, HCW: Health care worker, POE: Person of interest, Temp: Temperature

2.2 Close contact with a suspect/confirmed COVID-19 case within 14 days prior to onset of symptoms.

A total of 566 individuals were tested for COVID-19 using RT-PCR, 27 of whom were confirmed cases

(positive rate=4.8%). The sensitivity of the CSC during this period was 85.1% and the PPV was 4.1%.

#### CSC 4: 18 Feb to 1 Mar 2020

On 30 Jan 2020, the World Health Organization (WHO) declared the COVID-19 pandemic a public health emergency of international concern to accelerate preparedness and response in all countries.<sup>1,3</sup> At this stage, the disease was spreading in many countries in East and South-East Asia and caused the CDC to change their CSC. The high-risk areas during this period were those countries with evidence of local transmission such as China (including Hong Kong, Macao, and Taiwan), Japan, and Singapore. Healthcare workers were also classified as a high-risk population. The number of people who were tested with RT-PCR during this period was 2,380, of which seven were confirmed cases (positive rate=0.3%). The sensitivity was 85.7% and the PPV was 0.3%.

On 1 Mar 2020, the Thai government announced that COVID-19 was a dangerous communicable disease under the Communicable Diseases ACT 2015 (B.E. 2558).<sup>1,2</sup>

#### CSC 5: 2 to 19 Mar 2020

After local transmission was observed in Thailand,<sup>1,3</sup> the EOC modified the screening criteria by including in the list of people to be screened, those who were living or had lived in the same residential area with travelers from a high-risk area or in an area with a cluster of ARI (not influenza outbreak). During this period, territories outside Thailand were defined as Disease Infected Zones of COVID-19, dated 5 Mar 2020, and included North Korea, China (including Macau and Hong Kong), Italy, and Iran. The list also included countries in which there was evidence of local transmission. Consequently, 5,477 people were tested for COVID-19, of which 230 were confirmed cases (positive rate= 4.2%). The sensitivity of the fifth CSC was 83.9% and the PPV was 4.2%.

#### CSC 6: 20 Mar to 2 Apr 2020

In mid-March, two large clusters of COVID-19 were detected one at a boxing stadium, which contained 274 confirmed cases, and the other at a nightclub, which contained 224 confirmed cases. Those who were later identified as high-risk contacts had already traveled back to their hometown provinces, thus spreading the

virus throughout the country, and the number of confirmed cases rose rapidly. The Office of the Prime Minister announced the Decree on Public Administration in Emergency Situation B.E. 2548 (2005) on 25 Mar 2020.<sup>2</sup> There were 13,724 people who were investigated, of which 1,603 were confirmed cases (positive rate=11.7%). The sensitivity of this criteria was 87.5% and the PPV was 17.8%.

#### CSC 7 and 8: 3 to 26 Apr 2020

After the infection had begun spreading more rapidly, the government decided to impose a lock-down order on the entire country on 3 Apr 2020. Traveling was restricted to those whose entry into the kingdom was deemed necessary. The essential travel documents required for entering Thailand were 1) The Fit to Fly Health Certificate that had been certified or issued no more than 72 hours before traveling, and 2) a letter from the Royal Thai Embassy at the country of origin. The law allowed non-Thai nationals who met some specific conditions to enter the country, for example, persons on diplomatic or consular missions, those under international organizations or representatives of the government performing their duties in Thailand, other persons or international agencies, including their families, that the Ministry of Foreign Affairs deemed necessary, and people who had work permits or had been granted permission from government agencies to work in Thailand. Upon entry into the country, people were told to strictly comply with disease prevention and control measures prescribed by the government such as quarantine for 14 days at a government-designated place.<sup>1,2</sup>

Therefore, the new screening criteria during this period included all inbound travelers. The seventh case screening criteria was in effect for only a few days before the eighth criteria was added, and as the change was minor, we combined them. After the country had been locked down and the MOPH had activated the active case finding activity nationwide to prevent the COVID-19 spreading as much as possible, 30,785 people were screened, of which 1,047 were confirmed cases (positive rate=3.4%). The sensitivity of this criteria was 76.6% and the PPV was 15.2%.

Overall, the sensitivity and PPV of these eight case screening criteria was 83.3% and 12.1%, respectively.

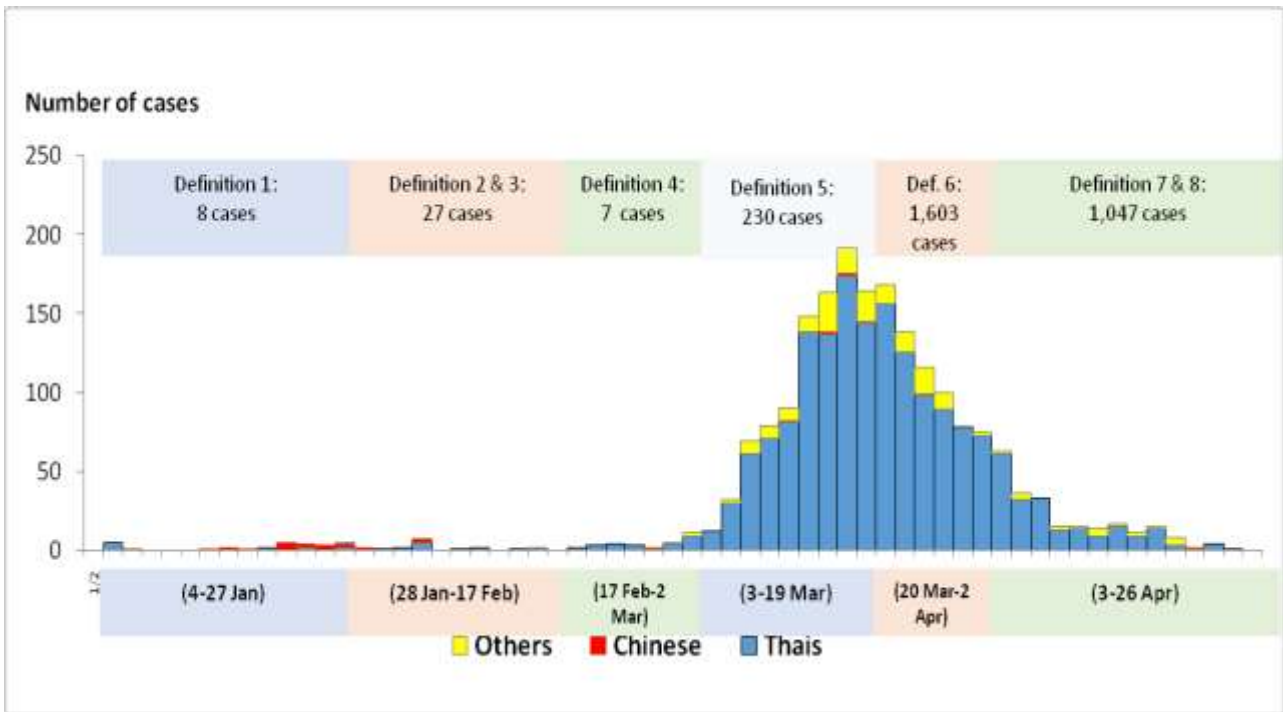
There were no significant differences between sensitivities and PPV of individual criteria ( $p>0.05$ ).

**Discussion**

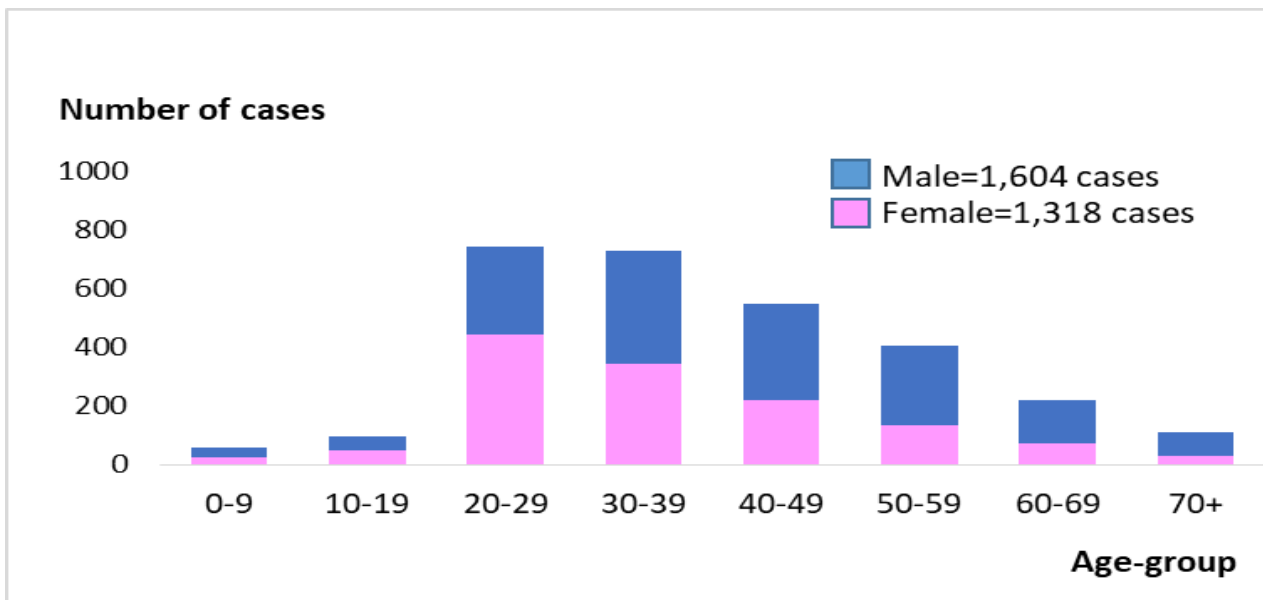
Eight case screening criteria which had been used in each epidemic phase were relatively sensitive to detect COVID-19 cases at a good level. Although, the CSC were expanded in order to detect more cases but the sensitivity over time period was not increasing. This point was important to be aware that there might be a large number of asymptomatic COVID-19 cases in the

community. The positive predictive value of these eight CSC was small indicated that the criteria for disease investigation were broad and might reflect the low incidence of COVID-19. Moreover, many people had been tested for SAR-CoV-2, even they did not meet the CSC. Therefore, we are quite confident that the overall incidence of COVID-19 from January to April 2020 was relatively low in Thailand. However, in order to know the incidence close to reality as possible, the seroprevalence survey or special surveillance may be conducted, e.g. sentinel surveillance among high risk population.

**Figure 1. Epidemic curve of confirmed cases during the COVID-19 pandemic in Thailand (4 Jan to 26 Apr 2020)**



**Figure 2. Number of confirmed cases by age-group and gender (4 Jan to 26 Apr 2020)**



Overall, the surveillance system was able to detect COVID-19 cases, the CSC in each context of the situation was suitable for COVID-19 that required a highly sensitive tool for early detection.<sup>8,9</sup> because the disease can spread even the infected individuals had mild symptoms.<sup>10,11</sup> The data from the COVID-19 national surveillance system was brought back to improve the surveillance system all the time and was used to plan and formulate strategies for disease prevention and control as well as resource management, e.g. personal protective equipment procurement and distribution.

It was clear that the first phase of the pandemic of Thailand, most COVID-19 patients were imported from China. After the central government of China imposed a lockdown in Wuhan and other cities in Hubei, the number of cases in Thailand was declined.<sup>1,12,13</sup> In the later phase, most of the cases were Thais. The first wave of the COVID-19 pandemic peaked in March 2020. The number of cases was rising rapidly due to boxing stadium and nightclub outbreak which were mass gathering places, similar to many events that mass gathering activities were highly visible events with the potential for infectious disease spreading.<sup>14</sup> After the government expropriated a lockdown order on the entire country, the number of COVID-19 cases was declined rapidly. The intervention was designed by the guidance of surveillance information that detected a rise of COVID-19 cases rapidly and timely, by context specific CSC, and the information from surveillance system that helped to identify problems and risk factors. As a result, the government was able to launch effective prevention and control measures suitable to the situation that contribute to a successful control of epidemic. From this study the acceptable sensitivity of CSC should be more than 80%.

### Limitations

There were some biases when validity of each case screening criteria was compared due to dynamic of epidemic and lock-down measure. Thus, this study assumed that all population recruited between 4 Jan to 26 Apr 2020 were from the same setting. This study would like to compare both sensitivity and specificity

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to demonstrate the acceptable case screening criteria in which Thailand can afford using available resources for laboratory testing. However, the DDC COVID-19 National Surveillance Database did not collect data of people who did not meet the CSC so the specificity and negative predictive value could not be evaluated. In early period of pandemic, some data were not collected therefore these missing data might lead to analysis bias. For example, data on loss of smell was not collected thus we might lose some COVID-19 case.

### Conclusion

Each case screening criteria (CSC) was sensitive and broad to detect confirmed cases. Overall sensitivity was 83.3% and overall PPV was 12.1%, and no significant difference between individual criteria. The CSC were regularly revised to improve the performance of surveillance system. Although the epidemic in each period was controlled without direct correlation to the sensitivity of CSC. But the sensitivity level of CSC may be used for the surveillance's performance monitoring and to trigger the immediate response in the next wave of COVID-19 epidemic that may occur if prevention measures especially country locks down was removed as it occurred in other countries.<sup>1,3,15</sup> From this study the acceptable sensitivity of CSC should be more than 80%.

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### Suggested Citation

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