Evolving global and national criteria for identifying a suspected case of COVID-19

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Abstract

Background: The outbreak of coronavirus disease 2019 (COVID-19) began in December 2019 and continues to spread worldwide. Rapid and accurate identification of suspected cases is critical in slowing spread of the virus that causes the disease. We aimed to highlight discrepancies in the various criteria used by international agencies and highly impacted individual countries around the world.

Methods: We reviewed the criteria for identifying a suspected case of COVID-19 used by two international public health agencies and 10 countries across Asia, Europe, and North America. The criteria included information on the clinical causes of illness and epidemiological risk factors. Non-English language guidelines were translated into English by a co-author who is fluent in that particular language.

Results: Although most criteria are modifications of World Health Organization recommendations, the specific clinical features and epidemiological risks for triggering evaluation of patients with suspected COVID-19 differed widely among countries. The rationale for these differences may be related to each country's resources, politics, experience with previous outbreaks or...
pandemics, health insurance system, COVID-19 outbreak severity, and other undetermined factors.

**Conclusion:** We found no consensus regarding the best diagnostic criteria for identifying a suspected case of COVID-19.

**Keywords**
Coronavirus disease 2019, suspected case, clinical characteristics, epidemiological risk, diagnostic criteria, severe acute respiratory syndrome coronavirus 2, study participants

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**Introduction**
The outbreak of coronavirus disease 2019 (COVID-19) was first identified in December 2019. On 11 February 2020, the virus that causes COVID-19 was officially named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). On 11 March 2020, the World Health Organization (WHO) declared that COVID-19 can be characterized as a pandemic. The clinical spectrum of COVID-19 is still evolving and is far from complete. Therefore, one of the most challenging tasks for health care providers is early recognition of COVID-19, to mitigate community spread and manage affected patients.

Respiratory droplets and direct contact are considered the primary routes of transmission for other respiratory viruses, including SARS-CoV, Middle East respiratory syndrome coronavirus (MERS-CoV), and influenza. Case reports from China have described that most non-residents of Wuhan who developed COVID-19 had visited Wuhan (the epicenter of this pandemic) prior to symptom onset, or had contact with Wuhan residents, or had close contact with confirmed cases. For this reason, the transmission of SARS-CoV-2 is very likely to follow the same pattern as other coronaviruses.

Fever and dry cough are the two most commonly reported symptoms of COVID-19. The WHO has recommended using these symptoms to identify a suspected case of COVID-19 since the very beginning of the outbreak (Table 1).

As the emergence and spread of COVID-19 in different countries have been evolving rapidly, the reporting of cases varies widely among countries. This has resulted in what appears to be large variation in the total number of cases in different countries. However, the number of confirmed cases reported by a specific country may not provide an accurate estimate of the actual number of infected patients because many factors, such as a limited supply of testing kits, government policies, and criteria for identifying a suspected case, can potentially distort the data. Our objective was to analyze the criteria used in different countries for identifying a suspected case of COVID-19. For comparative analysis, we translated these criteria into English when necessary (i.e., criteria from China, Germany, Iran, Italy, Japan, South Korea, and Thailand).

**Methods**
We reviewed publicly available information regarding COVID-19 from 1 January 2020 to 14 March 2020 issued by various public health organizations around the world, including international agencies (the WHO and European Centre for Disease...
Table 1. Criteria for identifying a suspected case of COVID-19 according to the WHO and ECDC.

| Organization/Issue date | Main criteria | Epidemiological risk | Remarks |
|-------------------------|---------------|----------------------|---------|
| WHO\(^7\) 27 February 2020 | Acute respiratory illness (fever **AND** at least one sign/symptom of respiratory disease (e.g., cough, shortness of breath) **AND** no other etiology that fully explains the clinical presentation. Any acute respiratory illness. | **AND** | A history of travel to or residence in a country/area or territory reporting local transmission of COVID-19 during the 14 days prior to symptom onset. Having been in contact with a confirmed or probable COVID-19 case in the 14 days prior to onset of symptoms. |
| ECDC\(^3\) 2 March 2020 | Acute respiratory tract infection (sudden onset of at least one of the following: cough, fever, shortness of breath **AND** with no other etiology that fully explains the clinical presentation. Any acute respiratory illness. | **AND** | A history of travel to or residence in a country/area or territory reporting local transmission of COVID-19 during the 14 days prior to symptom onset. Having been in close contact with a confirmed or probable COVID-19 case in the 14 days prior to onset of symptoms. Once local or community transmission has been reported in the country or area, all patients presenting with symptoms of acute respiratory infection in primary care or the emergency department of a hospital (first contact with the health care system) will be considered suspected cases.

COVID-19, coronavirus disease 2019; WHO, World Health Organization; ECDC, European Centre for Disease Prevention and Control.
Prevention and Control (ECDC)) and public health organizations in 10 countries or regions, namely, China, Germany, Iran, Italy, Japan, South Korea, Taiwan, Thailand, the United Kingdom (UK), and United States of America (US). For non-English documents, one co-author who is fluent in the relevant language translated the information into English.

We focused on criteria for identifying a suspected case of COVID-19 and summarized the criteria in the form of clinical course of illness and epidemiological risk. This study is solely a qualitative analysis; no statistical analysis was undertaken.

Owing to the nature of the present study, the requirements for ethics approval and informed consent were not applicable.

Results

The criteria according to the two international public health agencies and 10 countries (listed in alphabetical order) are summarized below.

International agencies

A summary of criteria of the WHO and ECDC is listed in Table 1. We also searched the Africa Centers for Disease Control and Prevention (Africa CDC) website. The Africa CDC is currently using the WHO criteria and has not released any continent-specific criteria.

The criteria of the ECDC are nearly identical to the WHO criteria, except that epidemiological risk is waived once there is a local or community outbreak.

China

As part of the effort to slow the spread of SARS-CoV-2 and reduce mortality, the National Health Commission released the first version of its diagnosis and treatment protocol for novel coronavirus pneumonia on 16 January 2020. During the subsequent 2 weeks, this protocol was frequently updated owing to rapid nationwide spread of COVID-9 and emerging data. By the end of January, the fourth version of the protocol was released. The newest version of this protocol was published on 3 March 2020 (Table 2), with the recommendation to use clinical manifestations and epidemiological risks to define suspected cases of COVID-19. Clinical manifestations consist of symptoms, radiographic features, and complete blood count; epidemiological risks mainly focus on the hot zone (Hubei Province, especially Wuhan), exposure to patients with confirmed COVID-19, and evidence of community spread. Although the seventh version of this protocol is similar to prior versions, there are several key differences. The seventh version includes fever and/or respiratory symptoms in identifying a suspected case; respiratory symptoms were not included in the fourth version (Table 3). In the fourth version of the protocol, epidemiological risk factors were considered mandatory but this requirement was loosened in the seventh version, with individuals considered suspected cases without any epidemiological risks as long as all three clinical manifestations were met.

The Chinese protocol also emphasizes the utility of chest imaging and complete blood count when evaluating a suspected case. The imaging findings in COVID-19 vary from localized pure ground-glass opacities to consolidated lesions to lung whiteout. Based on chest imaging alone, COVID-19 is difficult to distinguish from other viral pneumonia. However, when the outbreak erupted in Hubei Province, the demand for testing kits dramatically exceeded the supply; as a result, National Health Commission revised its recommendations in the fifth version of the Chinese protocol and allowed the diagnosis of COVID-19 to be based on clinical manifestations and characteristic chest imaging.
| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|-------------------|---------------|----------------------|---------|
| **China**<sup>11</sup> Seventh version 3 March 2020 | Two of the following features are required: (1) Fever AND/OR respiratory symptoms (2) Radiographic features suggesting COVID-19<sup>a</sup> (3) In early phase, WBCs normal or mildly decreased OR lymphocyte count normal or decreased | One of the following risks are required<sup>b</sup> (1) Travel to/living in Wuhan or adjacent areas, or other areas with confirmed COVID-19 cases within 14 days of symptom onset (2) Close contact with a laboratory-confirmed COVID-19 case within 14 days of symptom onset (3) Close contact with an individual who has fever or respiratory symptoms, coming from Wuhan or adjacent areas, or from other areas with confirmed COVID-19 cases within 14 days of symptom onset (4) Cluster cases with fever AND/OR respiratory symptoms (occurring within a family, workplace, or school within a period of 2 weeks) | Well-founded suspicion. |
| **Germany**<sup>14</sup> 5 March 2020 | Non-specific general symptoms OR acute respiratory symptoms of any severity Acute respiratory symptoms of any severity with or without fever Acute respiratory symptoms of any severity with or without fever | Contact with confirmed cases within 14 days prior to the onset of disease. | Case under differential diagnostic clarification. |
Table 2. Continued.

| Country/Issue date | Main criteria |
|--------------------|---------------|
|                    | Clinical course of illness | Epidemiological risk | Remarks |
| Iran 27 February 2020 | Clinical or radiological indications of viral pneumonia **without** alternative diagnosis AND Chills, dry cough, sore throat with or without fever **AND** shortness of breath or hypoxia (oxygen saturation <93%) (1) Fever with above symptoms without hypoxia **AND** (2) in a high-risk group with positive CT scan or chest x-ray | **AND** No measurable epidemiological risks. | (1) Any person who had close contact with a laboratory-confirmed COVID-19 case within 14 days of symptom onset (2) A history of travel in affected geographic areas within 14 days of symptom onset |
| Japan 4 March 2020 | Non-vulnerable person: Fever (**≥37.5°C** OR respiratory symptoms for more 4 days). Vulnerable person: Fever (**≥37.5°C** OR respiratory symptoms for more 2 days.) | **AND** Potential exposure to COVID-19 | Consider nucleic acid amplification (such as PCR), when criteria are met. A vulnerable person is defined as: (1) advanced age; (2) a person with diabetes, chronic heart failure, chronic obstructive pulmonary disease, or chronic kidney disease with dialysis; and (3) a person who is on immunosuppressants or receiving chemotherapy. |
| Italy 9 March 2020 (This version is the same as the EDC) | Acute respiratory tract infection (sudden onset of at least one of the following: cough, fever, shortness of breath) **AND** with no other etiology that fully explains the clinical presentation. | **AND** A history of travel to or residence in a country/area or territory reporting local transmission of COVID-19 during the 14 days prior to symptom onset. | Once local or community transmission has been reported in the country or area, all patients presenting with symptoms of acute respiratory infection to primary care or (continued) |
Table 2. Continued.

| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|--------------------|---------------|----------------------|---------|
| definition of 2 March 2020 | Any acute respiratory illness. AND Severe acute respiratory infection (fever and at least one sign/symptom of respiratory disease (e.g., cough, fever, shortness of breath) AND requiring hospitalization AND with no other etiology that fully explains the clinical presentation.) | Having been in close contact with a confirmed or probable COVID-19 case in the 14 days prior to onset of symptoms. | the emergency department of a hospital (first contact with the health care system) will be considered a suspected case. |
| South Korea (7-1 edition) | Fever OR respiratory symptoms AND A history of contact with a symptomatic laboratory-confirmed COVID-19 case who develops symptoms within 14 days from contact. | A history of travel to high-risk geographic areas within 14 days of symptom onset. | Contact or association with a domestic collective outbreak according to the epidemiological database and developing symptoms within 14 days of contact. |

(continued)
Table 2. Continued.

| Country/ Issue date | Main criteria | Epidemiological risk | Remarks |
|---------------------|---------------|----------------------|---------|
| Taiwan 36 1 March 2020 | Fever \( \geq 38^\circ C \) OR acute upper airway symptoms OR Clinical, radiological or pathological diagnosis of pneumonia | A history of travel from affected geographic areas, or in contact with people from affected areas who have fever or acute airway symptoms, within 14 days of symptom onset. OR Having been in close contact with highly probable case \(^c\) or confirmed case, including providing care/living together without proper protective equipment OR direct contact with respiratory secretions/bodily fluids of such a person within 14 days of symptom onset. | Must report to Taiwan CDC within 24 hours if compatible with the criteria. |
|                     | Clinical, radiological or pathological diagnosis of pneumonia. Diagnosis of community-acquired pneumonia without travel history of affected geographic areas, clinicians have ruled out possible causes and highly clinical suspicion of novel pathogens. | Health care providers OR cluster cases within 14 days of symptom onset. | Highly probable case: not laboratory confirmed, but compatible with clinical criteria AND contact with a confirmed case within 14 days of symptom onset. |
| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|--------------------|---------------|----------------------|---------|
| **Thailand**<sup>37</sup> (Third version) 2 March 2020 | Fever **AND** any symptoms of respiratory illness (e.g., cough, runny nose, sore throat, respiratory distress, or dyspnea)  
1. Fever **AND** any symptoms of respiratory illness (e.g., cough, runny nose, sore throat, respiratory distress, or dyspnea)  
2. Pneumonia | **AND** Any of the following conditions in the 14 days prior to onset of symptoms:  
1. A history of travel in affected geographic areas  
2. Living in the same household as any person with a history of travel as in 1  
3. Working in close contact with international tourists  
4. Having been in contact with a confirmed or probable COVID-19 case  
5. Being a health care provider involved with or having contact with a suspected case | Criteria for airport health control. |
| | Pneumonia with one of the following conditions:  
1. Close contact with a confirmed or probable COVID-19 case in the 14 days prior to onset of symptoms  
2. A health care provider  
3. No improvement after treatment  
4. Unexplained etiology  
5. Severe case or death with unexplained etiology  
A cluster of patients with acute respiratory tract infection that have negative tests for influenza | **AND** No need to consider the epidemiologic risk. | Criteria for health care facility. |

(continued)
| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|-------------------|---------------|---------------------|---------|
| United Kingdom 13 March 2020 | Patient requiring hospital admission with: 1. Either clinical or radiological evidence of pneumonia OR 2. Acute respiratory distress OR 3. Influenza like illness 4. New continuous cough and/or high temperature | the same department (same health care facility for small health care facilities) within a week (2) For non-health care providers, having five people working in the same department within a week | Inpatient definition. |
| United States 4 March 2020 | Fever AND/OR symptoms of acute respiratory illness. | (1) Any person, including health care workers, having close contact with a laboratory-confirmed COVID-19 case within 14 days of symptom onset OR 2. A history of travel from affected geographic areas within 14 days of symptom onset | Patients who meet the following criteria and are well enough to remain in the community (stay at home). Fever is either measured temperature $\geq 100.0^\circ$F (37.78°C) or subjective fever. |
Table 3. Earlier versions of criteria for identifying a suspected case of COVID-19 in China, Japan, South Korea, and United States.

| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|--------------------|---------------|----------------------|---------|
| China | Two of the following features are required: (1) Fever (2) Radiographic features suggesting COVID-19 (3) In early phase, WBCs normal or mildly decreased OR decreased lymphocyte count | One of the following risks are required: (1) Travel to/living in Wuhan or other areas with community spread of COVID-19 within 14 days of symptom onset (2) Close contact with an individual who has fever or respiratory symptoms coming from Wuhan or other areas with community spread of COVID-19 within 14 days of symptom onset (3) Cluster cases or epidemiological link to a confirmed COVID-19 patient | Scattered small opacities and interstitial changes peripherally in the early phase; diffuse ground-glass opacities, infiltrates, or extensive consolidations in severe cases. Pleural effusions are uncommon. |
| China Fourth version 27 January 2020 | | | |
| Japan | Patient with fever or respiratory symptoms (mild to severe). | A history of close contact with a confirmed novel coronavirus case | |
| Japan 3 February 2020 | Patient with fever ($\geq 37.5^\circ\text{C}$) AND respiratory symptoms. | A history of travel to or residence near the outbreak area of novel coronavirus within 14 days before onset of symptoms. | |
| | Patient with fever ($\geq 37.5^\circ\text{C}$) AND acute respiratory symptoms. | A history of close contact with a person who traveled to or has residence near the outbreak area of novel coronavirus within 14 days before onset of symptoms. | (continued) |
| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|-------------------|---------------|----------------------|---------|
| **United Kingdom**<sup>41</sup> 10 March 2020 | Patient with severe fever **AND** respiratory symptoms that require ICU or ICU-like treatment, resulting in an unclear diagnosis. | In the 14 days before the onset of illness: (1) Travel to specified countries and areas. This includes transit, for any length of time, in these countries **OR** (2) Contact with a confirmed case of COVID-19. | Physicians should consider the patient a possible suspected case of coronavirus without laboratory confirmation. |
| **United States**<sup>42</sup> 28 February 2020 | Fever **OR** symptoms of lower respiratory illness (e.g., cough or shortness of breath). | Any person, including health care workers, having contact with a laboratory-confirmed COVID-19 case within 14 days of symptom onset. | Fever is either measured temperature $\geq 100.0^\circ F$ (37.78$^\circ C$) or subjective fever. |
| Country/Issue date | Main criteria | Epidemiological risk | Remarks |
|-------------------|---------------|----------------------|---------|
| United States<sup>16</sup> 17 January 2020 | Fever **AND** symptoms of lower respiratory illness (e.g., cough, shortness of breath) | **AND** | In the last 14 days before symptom onset: 1) History of travel from Wuhan City, China **OR** 2) Close contact with a person who is under investigation for 2019-nCOV while that person was ill |
|                      | Fever **OR** symptoms of lower respiratory illness (e.g., cough, shortness of breath) | **AND** | In the last 14 days before symptom onset, close contact with a laboratory-confirmed 2019-nCoV case while that person was ill. |

COVID-19, coronavirus disease 2019; ICU, intensive care unit; nCOV, novel coronavirus.
findings, without requiring serological or polymerase chain reaction (PCR) confirmatory tests. Whether this approach was cost-effective is debatable, but in that unique context, it facilitated the evaluation of suspected cases. Interestingly, the first published case series described clinical features of COVID-19 among hospitalized patients and highlighted that more than 50% of cases had normal white blood cell counts and lymphopenia. Subsequent Chinese protocols quickly adopted and integrated these new data, to help improve accuracy in assessing suspected cases.

**Germany**

The Robert Koch Institute (Ministry of Health) set four criteria for identifying suspected cases of COVID-19, as presented in Table 2. Every patient who fulfills criterion 1 or 2 is classified as a suspected case, which must be reported to the responsible public health department; the individual must also undergo laboratory diagnostic testing for COVID-19. Criteria 3 and 4 are cases under differential diagnostic clarification; these are tested for COVID-19 without reporting to the responsible public health department unless they have a positive test result. Criteria 3 and 4 show that the threshold of testing in Germany is set very low because there are only a few regions worldwide that have absolutely no COVID-19 cases, and every unclear case of pneumonia is tested in principle. To minimize the risk of spreading COVID-19 to other patients and health care providers, several hospitals have set up a separate specialized area in which patients are tested for COVID-19. Within the framework of influenza surveillance, samples from patients with acute respiratory diseases sent in by sentinel practices of the Working Group on Influenza have also been tested for SARS-CoV-2 at the Robert Koch Institute since 24 February 2020, to detect and monitor the circulation of SARS-CoV-2 at an early stage.

**Iran**

On 19 February 2020, two people were reported positive for COVID-19 in Qom, a province considered a holy site located south of Tehran. The disease spread dramatically thereafter. Within 3 days, COVID-19 was found in three other regions including Tehran, the capital, and the total number of confirmed cases and deaths increased dramatically. Iranian officials decided not to impose any quarantine, although the government did cancel cultural and sporting events, closed universities, schools, and offices, and placed restrictions on travel between cities. Officials asked everyone to stay at home, even those who were not symptomatic or were not in contact with any confirmed cases.

The first official guideline for the diagnosis and treatment of COVID-19 was published on 27 February (Table 2). Based on this guideline, a suspected case is defined as someone who has a dry cough, chills, sore throat, with or without fever, or alternatively, upper/lower respiratory symptoms with positive imaging findings. A possible case is defined as an individual who meets the criteria of a suspected case and has had close contact with someone with confirmed COVID-19 infection in the past 14 days and who has recently traveled to a COVID-19 epidemic area in the past 14 days.

The Iranian guideline recommends anyone with sore throat and chills, with or without fever, to be evaluated for respiratory distress or hypoxia. If these are present, the patient should be referred to a designated medical center for further evaluation and testing. Febrile patients who are in a high-risk group (as defined in Table 2) without respiratory distress should undergo imaging tests; the recommended imaging modality is either chest radiograph or
computed tomography (CT) scan. If imaging findings are positive, the patient should be referred to a designated medical center. Febrile high-risk patients with normal imaging findings should be quarantined at home, may receive antibiotics, and should be followed daily by public health representatives. Febrile patients who are not in a high-risk group and have no respiratory distress should be quarantined at home. Febrile patients who are in a high-risk group but have a normal chest radiograph or CT scan should be quarantined at home and treated with hydroxychloroquine and oseltamivir.

According to the guideline, outpatients do not need to be tested for COVID-19. Patients with compatible clinical symptoms and radiologic findings are considered to have COVID-19, and treatment can be started in isolation at the designed medical centers. Confirmatory tests should be done only for patients with a positive initial test who require intubation; not all patients need confirmatory testing.

**Italy**

The first travel-related case of COVID-19 was confirmed in Rome on 30 January 2020. On the same day, a Ministry of Health decree suspended flights from and to China for 90 days. On 31 January, the Italian government declared a state of emergency. However, the first case of secondary transmission was identified in the Lombardy region (northern Italy) on 18 February. After that, the number of confirmed COVID-19 cases increased dramatically in northern Italy. Five days later, on 23 February, the Council of Ministers closed regions with outbreaks (Lombardy and 14 nearby provinces). On 9 March, a Prime Ministerial decree limited the movement of all citizens throughout the entire country and suspended all sporting events and closed schools and universities through 3 April 2020. On the same day, the definition of a suspected case of COVID-19 was revised and the latest definition of the ECDC was fully adopted, as presented in Table 1 and Table 2 (Italy).

**Japan**

On 16 January 2020, the first confirmed case of a novel coronavirus was reported. The basic policy for countermeasures related to the novel coronavirus was adopted at a ministerial meeting on 21 January. These countermeasures include: (1) border quarantine measures, (2) identification of suspected patients in Japan, (3) establishing operations centers for clinical laboratory testing, (4) ensuring the safety of all Japanese citizens outside of Japan, and (5) providing prompt and accurate information.

Simultaneously, prophylactic countermeasures for viral infection, including safe coughing techniques and handwashing, were widely promoted. Initially, the main testing targets were patients who had stayed in or traveled to Hubei Province, China within the past 14 days. However, human-to-human transmission within Japan was soon detected and as a result, screening targets were expanded to include four criteria (Table 3). However, the complexity of these criteria led to many other people requesting testing. Simpler screening criteria were published on 17 February, as shown in Table 2.

Around this time, the focus of countermeasures changed to attempting to suppress direct transmission via a national social distancing strategy, announced by Prime Minister Shinzo Abe on 29 February 2020. Schools were requested to close temporarily. In addition, mass gatherings and events were recommended to be canceled, postponed, or reduced in size. On 6 March, the restriction on medical insurance was lifted, which enabled health care facilities to use private laboratories for
COVID-19 testing directly, without going through public health centers. Consequently, many more tests could be performed. Additionally, a 14 day quarantine was mandated for all visitors from China and South Korea.

**South Korea**

The first confirmed case of COVID-19 was diagnosed in South Korea on 20 January 2020. Since then, the number of patients has increased exponentially. The surveillance guidelines from the Korea Centers for Disease Control and Prevention have been revised several times, the most recent being the seventh edition. The guideline is as stated in Table 2, but asymptomatic patients have also been tested at the discretion of a physician, facilitated by the low cost of testing and the abundance of testing kits.

Easy access to testing in South Korea followed the decision of a Seoul-based company to develop test kits back in early January 2020, even before the first patient in the country was diagnosed with COVID-19. Test kits were quickly developed, emergently approved, and massive production was initiated. This response system was forged after the 2015 outbreak of MERS. The country’s aggressive approach to diagnosis led to a high number of cases (more than 220,000 tests were performed as of 12 March), and innovative drive-through clinics allowed for efficient and safe high-volume testing while limiting patient–provider contact. In addition, the government pays for the cost of testing if the patient is symptomatic or is referred by a physician. For asymptomatic patients or those not referred by a physician, testing can be performed at a cost to the patient of 140 USD.

The general public also receive emergency text alerts when a positive COVID-19 result is confirmed, including information about the patient’s recent travel history. Although this has raised concerns about privacy, the technology has helped in surveillance of cases and has identified high-risk areas to avoid. It is likely that South Korea’s proactive approach in testing a large number of people (by far the highest number outside of China) has resulted in a death rate among confirmed cases that is among the lowest worldwide.

**Taiwan**

Taiwanese officials began to take action against the novel disease on 31 December 2019, when the WHO was notified about a new type of pneumonia with unknown etiology in Wuhan, China. On 15 January 2020, the government listed this disease, “Severe Pneumonia with Novel Pathogens,” as a Category 5 notifiable disease (the same level as MERS-CoV and Ebola virus infection) and mandated that cases be reported within 24 hours. The initial criteria were fever and acute upper airway symptoms with travel or a contact history with people from affected geographical areas (initially only Wuhan and the surrounding area). Indeed, travel history was more strongly emphasized than the clinical condition. However, after a few locally confirmed cases without a definite travel or contact history were identified, the criteria were modified. To prevent underestimating possible community transmission and nosocomial infections, pneumonia together with a high clinical suspicion of infection with a novel pathogen and occupation as a health care provider were added to the modified criteria on 28 February.

**Thailand**

On 13 January 2020, Thailand was the first country outside of China to report a case of COVID-19. At the end of January, Thailand still had the highest number of confirmed cases outside of China and
remained among the five most affected countries until 23 February. The total number of confirmed cases has increased more slowly in Thailand than in many other countries, and Thailand dropped out of the 10 most affected countries on 1 March. The third version of the criteria used for identifying a suspected case in Thailand was updated on 2 March and is summarized in Table 2. The criteria are very stringent relative to those of other countries, requiring patients to present with both symptoms (fever and any symptoms of respiratory illness) and an epidemiological risk factor to qualify for free testing. Physicians do not advise testing for symptoms alone owing to concerns about the cost of testing.

United Kingdom

Based on the WHO declaration of 30 January 2020 that the novel coronavirus outbreak was a public health emergency of international concern, chief medical officers in the UK promptly raised the risk level of COVID-19 from low to moderate in the country.27 One day later, the first two cases of COVID-19 were confirmed. Since then, the definition of a suspected case, along with other guidance in the UK, has been updated frequently. Earlier versions of the UK criteria, updated on 10 March (Table 3), seem to be a simplified version of the WHO guidelines as there are two main conditions: clinical cause of illness with epidemiological risk and clinical cause of illness without epidemiological risk. One thing that is explicitly specified as a risk factor is transit in an affected country for any length of time. The initial clinical threshold for patients with epidemiological risk factors was very low because it included patients with a fever but with no other conditions. Nevertheless, 3 days later (13 March), the definition was updated to focus only on the clinical course of illness and defined two types of suspected cases: those that qualified for hospital admission and those that should stay at home. This change in definition is likely to be the result of a rapid increase in the number of patients presenting to a hospital (Table 2).

United States

On 17 January 2020, the Centers for Disease and Controls (CDC) issued the first guideline for identifying a suspected case of COVID-19.28 Four days later, the first travel-related case of COVID-19 in the US was reported. Before the end of January, the first case of human-to-human transmission in the US was confirmed. As in many other countries, the situation has been evolving rapidly. On 28 February, the CDC announced an updated version of the diagnostic criteria, with the following major changes, apart from expanding the list of affected geographic areas. First, testing should be considered for the scenario of severe unexplained clinical presentation without epidemiological risk; second, fever can be either subjective or confirmed. In fact, the first condition is aligned with the WHO guideline; the other conditions are proactive measures established by the CDC. On 29 February, the US Food and Drug Administration (FDA) issued a new policy that allowed certain laboratories to use diagnostic tests for COVID-19 before receiving FDA approval.29 On 4 March, CDC again updated the criteria to include a wider group of symptomatic patients. The new criteria dropped the specific condition of no epidemiologic risk but also emphasized that physicians should use their judgment to determine whether a suspected case requires further investigation.

Discussion

The COVID-19 situation varies from country to country. Effective responses or
countermeasures need the coordinated efforts of not only public health organizations but also governmental and private sectors, including health care systems and the insurance industry, and most importantly, citizens themselves. To better understand the risk of spreading SARS-CoV-2 globally, all countries should ideally have the same criteria for identifying suspected cases. However, in practice, there is no one-size-fits-all guideline in this pandemic and no best or practice criteria have yet been defined. Every country has set its own criteria based on the principle of ALARA (as low as reasonably achievable) given the available resources and the situation of the country, including budget, economic impact, insurance coverage, and so forth.

Based on all the criteria that we have reviewed, most criteria are similar to and appear to be adapted from the WHO criteria, focusing on specific symptoms and epidemiological risk assessment. However, depending on resource allocation, these criteria may fail to capture or may severely underrepresent certain populations including: (1) asymptomatic cases, (2) patients with a financial barrier to accessing laboratory tests (owing to a lack of insurance coverage and high testing costs) and (3) patients with a legal barrier to accessing the health care system (including undocumented immigrants and homeless individuals). The proportion of cases in the latter two groups is dictated to a large extent by the government policies of individual countries.

It is notable that although the WHO advises against people who are not sick wearing a mask in community settings owing to a lack of evidence, the global shortage of disposable surgical masks is a growing problem owing to massive mask use. Therefore, mask policies should be carefully implemented in conjunction with diagnostic criteria and other measures, to prevent a supply shortage and ensuing panic.

Our study has several limitations. First, at the time of writing, the COVID-19 pandemic is ongoing; therefore, the criteria are being updated frequently. However, we do not anticipate dramatic changes in the present criteria. Nevertheless, it is important to review these criteria in real-time at this point in the pandemic, so as to critically assess countermeasures. Second, non-English documents were translated by the co-authors, who are not certified medical translators. However, the authors’ medical knowledge and professional background should ensure a high degree of translation accuracy.

Conclusions

Some governments may initially have had political incentives to report a low number of cases of COVID-19 infection. As the virus spreads widely and death tolls rise, governments must appreciate the need for transparency and cooperation. Although the idea of universal testing is attractive, the cost, supply, and availability are currently limiting its widespread implementation in many areas. Adapting updated criteria and other countermeasures will contribute to flattening the curve of infection in this novel global pandemic. According to our findings, there is currently no consensus as to the best diagnostic criteria for identifying a suspected case of COVID-19.

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AA: Study design and planning; AA, AM, BH, FR, JK, JY, MM, MTC, SFM, and TK: data analyses, interpretation, writing.

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AA: Study design and planning; AA, AM, BH, FR, JK, JY, MM, MTC, SFM, and TK: data analyses, interpretation, writing.

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