Clinical Spectrum, Geographical Variability of COVID-19, and its Implications

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**Abstract:** The coronavirus disease 2019 (COVID-19) pandemic has triggered a worldwide unprecedented public health crisis. Initially, COVID-19 was considered a disease of the respiratory system, as fever and at least one respiratory symptom was used to identify a suspected COVID-19 case. But there are now numerous reports of COVID-19 patients presenting with myriads of extrapulmonary symptoms, however, a substantial number of patients are asymptomatic. Additionally, there are significant clinical and epidemiological variations of severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) infection across different geographical locations. The updated research, thus, challenges the existing surveillance system that is mainly based on fever and respiratory symptoms. As countries are coming out of lockdown to save economic fallout, a revised surveillance strategy is required to effectively identify and isolate the infected patients. Besides, since developing countries are becoming the new epicenters of pandemic and there are limited resources for RT-PCR based tests, documenting the clinical spectrum can play a vital role in the syndromic clinical diagnosis of COVID-19. A plethora of atypical symptoms also aids in guiding better treatment and remains as a source for further research. It is, therefore, crucial to understand the common and uncommon clinical manifestations of SARS-COV-2 infection and its variability across different geographic regions.

**Keywords:** COVID-19, clinical spectrum, geographic variation, pandemic, surveillance, asymptomatic.

1. INTRODUCTION

The pandemic of coronavirus disease 2019 (COVID-19) has created a phenomenal global crisis and posed an immense challenge to public health. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent for COVID-19, has infected more than 25 million people worldwide and claimed over 800,000 lives and still counting [1]. As the novel virus is moving across the borders, it has gradually been evolving over the last several months. Initially, COVID-19 was regarded predominantly as a disease of the respiratory system, as such that the World Health Organization (WHO) advised using fever and at least one respiratory symptom to identify suspected COVID-19 cases. However, an increasing number of patients are now being diagnosed without fever or with extrapulmonary symptoms. Additionally, there are numerous reports of confirmed SARS-CoV-2 infection in patients who simply do not exhibit any clinical symptoms [2].

SARS-CoV-2 interacts with host cells using the angiotensin-converting enzyme 2 (ACE2) receptor. Although ACE2 is expressed highly in alveolar epithelial cells of the lungs, it is also found in many extrapulmonary tissues, including the gastrointestinal system, heart, kidney, and vessels. Thus, while the virus predominantly causes respiratory symptoms, it can also damage other organs [3, 4]. A recent study indicated that the determinants of clinical outcome of SARS-COV-2 infection were linked to host factors such as age, reduced lymphocyte counts, and its associated cytokine storm [5]. Accordingly, there are now numerous reports documenting a myriad of clinical presentations involving systems other than the respiratory tract [6-8]. Studies also suggest that there may be a considerable clinical and epidemiological variation in SARS-COV infection across different geographical locations [8, 9].

In this context, comprehensive knowledge of the clinical complexities of COVID-19 is essential for epidemiologists and clinicians around the world to understand this new disease better and to devise population-specific prevention and management plans. In this review, we aim to summarize the clinical spectrum of COVID-19 and categorize them according to the system involved. In addition, we tried to explore clinical and epidemiological variations in SARS-COV-2 infection across different geographic regions. To the best of
our knowledge, this is the first review compiling clinical features of SARS-CoV-2 infection according to the system involved.

2. CLINICAL SPECTRUM OF COVID-19

The clinical manifestations of SARS-CoV-2 infection can vary widely, ranging from an asymptomatic state to severe illness requiring hospitalization and, sometimes, to critical conditions leading to death [10]. According to the summary report of 72,314 cases from China, more than 81% of cases showed mild symptoms, followed by around 14% severe and 5% critical cases [11]. The data available so far, from across the world, show no clear gender predilection of SARS-CoV-2 infection [12]. All age groups are susceptible to infection. However, according to most studies, the infection rate is reported to be the highest among middle-aged people ranging from 30-60 years [8, 11, 13, 14]. COVID-19 predominantly causes acute respiratory illness, while the most common symptoms reported include fever and cough followed by fatigue, myalgia, anorexia, shortness of breath, sputum production, sore throat, and rhinorrhea [14-16]. One systematic review and meta-analysis of 43 studies involving 3,600 patients reported the incidence of fever at 83%, cough at 60%, and fatigue at 38%. The estimated prevalence was below 30% for increased sputum production, shortness of breath, and myalgia [14]. Another meta-analysis, including a total number of 50,466 patients with COVID-19, also showed the same; the incidence of fever accounted for 89.1% of cases, followed by 72.2% of cough, 42.5% of myalgia, and 14.8% of respiratory distress [15]. Interestingly, in one study on hospitalized patients, fever was present in 43.8% of the patients at admission but developed in 88.7% later during the hospital course [17]. Conversely, one recent study conducted on 1,420 patients with mild to moderate COVID-19 patients reported fever in only 45.4% [8]. It implies that a substantial number of COVID-19 patients might not develop a fever during their illness.

Many atypical clinical presentations of SARS-CoV-2 infection, other than pulmonary involvement, have also been reported (Table 1). The latest research shows that SARS-CoV-2 can productively infect gut enterocytes [18]. A range of gastrointestinal (GIT) symptoms, including diarrhea, abdominal pain, nausea, vomiting, and anorexia, have been described. One study reported the incidence of GIT symptoms in 55 (39.6%) patients out of 139 hospitalized COVID-19 patients. The most common symptom was nausea (17.3%), followed by diarrhea (12.9%) and anorexia (12.2%) [19]. Another study on 204 hospitalized COVID-19 patients reported that up to 50% of patients experienced digestive symptoms including anorexia (78.6%), diarrhea (34%), vomiting (3.9%), and abdominal pain (1.9%) [20].

The neuroinvasive potential of the SARS-CoV-2 virus was also described in a few studies [21-24]. In a case series of 214 patients with confirmed COVID-19, 36.4% of patients showed neurological manifestations [25]. The most common central nervous system (CNS) symptoms were dizziness (16.8%) and headache (13.1%), while the most common peripheral nervous system (PNS) symptoms were taste (5.6%) and smell impairment (5.1%). Interestingly, more than 60% of patients reported taste and smell impairment in a few studies [8, 26]. An app-based study estimated that the predictive ability of loss of smell and taste might be higher than fever or persistent cough [27]. Acute cerebrovascular diseases (mainly ischemic stroke), impaired consciousness, seizure, ataxia, and loss of consciousness were rarely reported. Notably, neurological manifestations were significantly higher in patients with severe infections and one study suggested that the invasion by the virus into the central nervous system could potentially contribute to respiratory failure [21, 28]. Another systematic review investigating neurological involvement documented CNS manifestations in up to 25% of the COVID-19 patients [29]. Rare case reports of Guillain–Barré syndrome and acute necrotizing hemorrhagic encephalopathy have been published as well [30, 31].

As about 7% of cardiac cells can express ACE2, SARS-CoV-2 can potentially infect and produce cardiovascular manifestations [4]. Besides, pro-inflammatory mediators associated with cytokine storm produced by SARS-CoV-2 may lead to cardiac injury [42, 57]. A cohort of 671 severe COVID-19 cases reported the prevalence of myocardial injury in 15.8% of patients on admission [57]. The incidence was found to be much higher in critically ill patients [42, 57]. Moreover, cardiac injury is consistently associated with a significantly higher risk of in-hospital mortality in patients with COVID-19 [58]. Notably, the National Health Commission of China (NHC) described cases of confirmed COVID-19 who first presented with cardiovascular symptoms (palpitations and chest tightness) rather than respiratory symptoms [59]. Different manifestations observed in SARS-CoV-2 infection include arrhythmia, heart failure, tachycardia, myocarditis, shock, hypotension, and acute coronary syndrome [43].

Accumulating evidence suggests that renal involvement is frequent in SARS-CoV-2 infection [60]. A retrospective cohort of 5,449 patients admitted with COVID-19 reported acute kidney injury (AKI) in 36.6% of cases during hospitalization. Most of them developed stage 1 AKI (46.5%), followed by stage 3 (31.1%) and stage 2 (22.4%); and about 14% of patients required renal replacement therapy (RRT). These patients also showed poor prognosis [54]. In another large prospective cohort of 701 hospitalized patients with COVID-19, more than 40% showed evidence of abnormal renal function. However, the incidence of AKI was lower (5.1%) in that cohort [53].

Ocular manifestations in the form of conjunctivitis have been anecdotally reported in patients with COVID-19 [61]. Ocular manifestation, as the first sign of SARS-CoV-2 infection, has also been reported [62]. Many reports on cutaneous manifestations of SARS-CoV-2 have been published [50, 51]. A comprehensive review analyzing studies focusing on cutaneous manifestation found that skin lesions developed even before the onset of respiratory symptoms in 12.5% of patients. The most common cutaneous manifestation obser-
Table 1. Reported atypical clinical manifestations of SARS-COV-2 infection.

| System               | Manifestations                        | Reported Frequency | References                          |
|----------------------|---------------------------------------|--------------------|--------------------------------------|
| Gastrointestinal     | Diarrhea                              | 2.0 – 38.1%        | [6-8, 17, 19, 32-36]                 |
|                      | Abdominal Pain                        | 5.8 – 19.1%        | [8, 19, 32]                          |
|                      | Nausea                                | 1.1 – 19.2%        | [6, 8, 17, 19]                       |
|                      | Vomiting                              | 4.0 – 16%          | [19, 32, 33]                         |
| Neurological         | Headache                              | 1.3 – 70.3%        | [6, 8, 17, 29, 32-34, 37-39]         |
|                      | Dizziness/Confusion                   | 6.7 - 20%          | [28, 29, 32, 35]                     |
|                      | Altered consciousness                 | 7.5%-8%            | [28, 29]                             |
|                      | Anosmia/Impairment of smell           | 5.1 - 85.6%        | [8, 37, 39, 40]                      |
|                      | Hypoguesia/Impairment of taste        | 5.6 - 88%          | [8, 37, 39, 40]                      |
|                      | Acute cerebrovascular disease         | 2.8% -5%           | [28, 29]                             |
|                      | Ataxia                                | 0.5%               | [28, 29]                             |
|                      | Nerve pain                            | 2.3%               | [28]                                 |
|                      | Vertigo                               | NA                 | [8]                                 |
|                      | Seizure                               | 1.0%               | [32]                                 |
|                      | Acute necrotizing hemorrhagic encephalopathy | NA | [30]                             |
|                      | Guillain–Barré syndrome               | NA                 | [31]                                 |
| Cardiovascular       | Tachycardia                           | 1-43.1%            | [41]                                 |
|                      | Acute cardiac injury                  | 7.2 - 22.2%        | [42, 43]                             |
|                      | Arrhythmia                            | 4.5 - 16.7%        | [42, 43]                             |
|                      | Shock                                 | 7 - 8.7%           | [42, 43]                             |
|                      | Hypotension                           | 1%                 | [44]                                 |
|                      | Acute myocardial infarction           | NA                 | [45]                                 |
|                      | Heart failure                         | 23%                | [44]                                 |
|                      | Acute myocarditis                     | NA                 | [46]                                 |
|                      | Tako-Tsubo syndrome                   | NA                 | [47]                                 |
|                      | Transient complete heart block        | NA                 | [48]                                 |
|                      | Chest tightness/Pain                  | 1 – 12%            | [6-8, 32, 33]                        |
| Skin                 | Macular or maculopapular exanthem (morbilliform) | 36.1%               | [49-51]                             |
|                      | Papulovesicular rash                  | NA                 | [49-51]                             |
|                      | Urticaria                             | NA                 | [49-51]                             |
|                      | Painful acral papules                 | NA                 | [49-51]                             |
|                      | Livedo reticularis                    | NA                 | [49-51]                             |
|                      | Petechiae                             | NA                 | [49-51]                             |
|                      | Skin ulcer                            | 1%                 | [32]                                 |
|                      | Pseudo-chilblain/chilblain            | NA                 | [49-51]                             |
| Ocular               | Conjunctivitis                        | 31.6%              | [8, 17, 32, 52]                      |
|                      | Conjunctival congestion               | 0.8%               | [8, 17, 32, 52]                      |
| Renal                | Hematuria                             | 26.7%              | [53]                                 |
|                      | Proteinuria                           | 43.9%              | [53]                                 |
|                      | Acute kidney injury (AKI)             | 0.5-36.6           | [54]                                 |
|                      | Collapsing glomerulopathy             | NA                 | [55]                                 |
| Miscellaneous        | Hemoptyis                             | 0.9 – 1.8%         | [17, 36]                             |
|                      | Anorexia                              | 78.64%             | [6, 8, 19, 35]                       |
|                      | Myalgia                               | 3.2 – 62.5%        | [6-8, 17, 32-35, 39, 56]             |
|                      | Chills                                | 10 – 11.5%         | [17, 35]                             |
|                      | Ear pain                              | 25.2%              | [8, 32]                             |
|                      | Face pain                             | 45.4%              | [8]                                 |
|                      | Belching                              | 5%                 | [19]                                 |
ved was macular or maculopapular exanthem, observed in 36.1% of patients, followed by a papulovesicular rash (34.7%), painful acral red-purple papules (15.3%), and urticaria (9.7%). The majority (66.7%) of lesions were localized on the trunk [51]. Case reports of livedo reticularis lesion and petechial rash in COVID-19 patients have been published as well [63, 64].

There is now growing evidence pointing to patients with SARS-CoV-2 infection who never develop symptoms (asymptomatic infection) [65-68]. The magnitude of asymptomatic infection is not well understood since the asymptomatic cases are not routinely tested. However, two studies offer some insight; one study among 3,711 passengers and crew members on board the Diamond Princess cruise ship estimated that 17.9% (95% credible interval 15.5–20.2%) of those with confirmed SARS-CoV-2 infection remained asymptomatic [69]. Another study on 565 Japanese nationals evacuated from Wuhan, China, found that an estimated 30.8% (95% confidence interval: 7.7–53.8%) of those who had tested positive for SARS-CoV2 remained asymptomatic [70]. A recent CDC analysis estimated the number of asymptomatic cases to be 35%, of which 100% remain infectious enough to spread the virus [71].

Clinical outcomes of SARS-CoV-2 viral infection can vary depending on the patient’s age, sex, immune status, and comorbidities [32]. Based on available data on confirmed COVID-19 cases, the death rate ranges from 0.06% in Singapore to 22.76% in Yemen [72]. However, true estimates could be even lower as a significant proportion of asymptomatic cases are potentially being left out of detection. To give an idea, a COVID-19 antibody seroprevalence study in Santa Clara County, California, estimated an infection fatality rate (IFR) of only 0.1–0.2% [73, 74]. The cause of death is mostly related to respiratory complications followed by cardiac. In a retrospective study, death-related complications were acute respiratory distress syndrome (ARDS) (98.4%), acute respiratory failure (90.3%), acute myocardial injury (30.6%), acute heart failure (19.4%), multiple organ failure syndrome (9.7%), shock (6.5%), and sudden death (1.6%) [57].

Male patients have a consistently higher mortality rate than females [75]. Patients with comorbidity are at the highest risk and the risk of severe outcome increases consistently with age. Therefore, older males with comorbidity are at the highest risk of dying from SARS-CoV-2 infection [76, 77]. In children, the range of clinical manifestations is essentially the same [78, 79]. Most children have mild symptoms and rarely critical outcomes [80]. Pregnant women also did not appear to be at higher risk of severe disease in COVID-19, and vertical transmission from mother to baby is less likely [81, 82].

2.1. Geographical Variations

SARS-CoV-2 was first identified in Wuhan, China, in late December 2019. In a matter of weeks to months, it infected nearly every country in the world, causing one of the largest known global pandemics in human history. In a phylogenetic network analysis of SARS-Cov-2 genomes, three distinct variants in three different geographical regions have been identified, indicating an active on-going evolution of the virus inside the human population [83]. Besides, the variable expression of ACE2 in different populations suggests there would be differences in the clinical spectrum [84]. As such, although published studies are not homogenous, a noticeable difference in the clinical spectrum is clearly discernible across different regions and countries (Table 2). For example, data suggest that clinical outcomes may be significantly different among different provinces of China. One study on hospitalized COVID-19 patients in Zhejiang province observed that patients experienced a relatively milder course of illness compared to Wuhan, where the epidemic of COVID-19 took place [85]. Published studies also suggested that patients from Wuhan reported significantly higher death rates and more laboratory abnormalities than patients treated outside Wuhan [14, 86]. In addition, the incidence of some symptoms, such as fever and fatigue, were observed in higher frequency in Hubei Province. The reported overall Case Fatality Rate (CFR) was also higher in Hubei than outside Hubei [87].

There seems to be a noticeable epidemiological difference between the Asian and European populations as well. While the most prevalent symptoms among both hospitalized and non-hospitalized COVID-19 patients in Asia were fever, cough, and dyspnea, the most common presentation of mild-to-moderate patients in Europe mainly consists of headache, loss of smell, nasal obstruction, and asthena. The prevalence of fever was less than 50% in the European population, while it was more than 80% in Asia [8, 14]. A lower incidence of fever was also reported in Australia [37]. A study among 5700 patients hospitalized with COVID-19 from the USA recorded fever only in 30.7% of patients [41]. Atypical manifestations that are increasingly being observed in SARS-COV-2 infection are olfactory and gustatory dysfunction [40, 87]. While the majority of the patients from European studies reported olfactory and/or gustatory dysfunctions, they were only rarely reported in the Asian population [8, 25, 88, 89]. Interestingly, a study from Iran reported olfactory dysfunction in 59 of 60 patients hospitalized with COVID-19 [90]. In a self-reported App-based study among 6,452 UK and 726 USA respondents who reported to have confirmed COVID-19, more than 60% of patients experienced the loss of taste and smell while only around 30% of patients reported fever [26]. Therefore, smell and taste dysfunction seems to be the key manifestations of SARS-COV-2 infection outside Asia.

A range of unique cutaneous manifestations has been reported from different parts of the world. A case study from Thailand reported a patient presenting with a petechial rash that could be mistaken for dengue fever [63]. In Italy, patients presenting with erythematous rash, urticaria, and chilblains-like vesicles have been documented [91]. Dusky acrocyanosis and dry gangrene have been observed in China. Two patients with transient unilateral livedo reticularis have been reported in the USA [64]. In Qatar, two female patients showed cutaneous lesions resembling chilblains disease [49].
Additionally, there seems to be a substantial difference in mortality rates between Asian and European populations. Estimates suggested that there was an over threefold higher risk of death in Italian patients with COVID-19 than in Chinese patients [76]. A meta-analysis estimated that the overall case-fatality rate of COVID-19 in 36 European countries was 4.5%, which is, in fact, similar to that of China [14, 87, 94]. Aside from SARS-CoV-2 genome mutations and ACE2 polymorphisms, population demographics like male sex, advanced age, and the presence of comorbidities have a strong influence on the geographical variability of COVID-19 [95]. Therefore, countries with a greater proportion of the elderly population (i.e., Italy) will have more severe manifestations and a higher risk of mortality.

3. CHALLENGES AHEAD AND RECOMMENDATIONS

Variations in clinical features of COVID-19 challenge the existing generalized strategies to treat the patients and contain the viral transmission. As countries are coming out of lockdown to prevent the economic fallout, the WHO cautions of the second wave of COVID-19 [96]. With the opening of airports, offices, religious settings, and marketplaces, there is an increased need for screening out potential COVID-19 cases to stop the infection transmissions. For now, the COVID-19 surveillance in various places is still largely limited to thermal scanners detecting only body temperature. Since the presentation and spectrum of symptoms can greatly vary across different regions, and a considerable proportion of patients might not have a fever, the current general surveillance strategy based on body temperature is likely to miss out on a large number of COVID-19 cases. This will potentially lead to a massive surge of infection, especially in densely populated countries. Therefore, recognizing the variability and extent of clinical manifestations is of paramount importance in devising an effective regional surveillance strategy, which will lead to earlier detection of SARS-CoV-2 infection and more accurate data collection. Concerned local authorities should regularly update the clinical varieties in patients and make the data available to the researchers for an in-depth study. Otherwise, for example, tropical countries might mistake COVID-19 for dengue, and regions with poor hygiene practices could overlook diarrhea caused by SARS-CoV-2 [63, 97].

In developing countries where resources are limited, documenting the clinical spectrum could potentially play a vital role in

| Region          | Case (n) | Age (Year) | Sex (Male) | Major Clinical Features | Others       |
|-----------------|---------|------------|------------|-------------------------|--------------|
| China (Wuhan)   | 1663    | 64*        | 50.4%      | Fever: 85.8% | Cough: 36% | Dyspnea: 4.4% | Fatigue: 23.6% | Myalgia: 3.4% | Headache: 1.7% | Sore Throat: – | Diarrhea: 4.6% | Anorexia: 4.2% |
| China (Wuhan)   | 140     | 25-87      | 50%        | Fever: 91.7% | Cough: 75% | Dyspnea: 36.7% | – | Fatigue: 75% | – | – | 12.9% | 12.2% |
| China (Zhejiang)| 944     | 4-96       | 50%        | Fever: 61.9% | Cough: 32.9% | Dyspnea: – | – | Fatigue: 9.9% | – | 8.3% | 6.8% | 2.7% |
| China (Fujian)  | 165     | 33-59      | 55.8%      | Fever: 76.4% | Cough: 60% | Dyspnea: 10.3% | – | Fatigue: 29.7% | – | 6.7% | 8.5% | 3% |
| China (Changsha)| 201     | 33-59      | 50%        | Fever: 67.2% | Cough: 58.7% | Dyspnea: 10.9% | – | Fatigue: 32.3% | 10.4% | 9% | 15.4% | 8.5% |
| China (31 provinces) | 1099 | 35-58       | 58.9% | Fever: 88.7% | Cough: 67.8% | Dyspnea: 18.7% | – | Fatigue: 38.1% | 14.9% | 13.6% | 13.9% | 3.8% |
| Japan           | 1192    | –          | 56.2%      | Fever: 79.3% | Cough: 42.5% | Dyspnea: 20.64% | – | Fatigue: 29.2% | – | – | – | – |
| USA (NYC)       | 257     | 20-90      | 66%        | Fever: 71% | Cough: 66% | Dyspnea: 74% | – | – | 26% | 4% | 6% | 12% |
| Brazil          | 1468    | 0-93       | 54.7%      | Fever: 66.9% | Cough: 70.8% | – | – | 30.7% | – | 32.9% | – | – |
| Canada          | 6840    | 51*        | 46%        | Fever: – | Cough: 75% | Dyspnea: 8% | – | Fatigue: 58% | – | – | 58% | – |
| Australia       | 6600    | 30-62      | 50%        | Fever: 47% | Cough: 69% | – | – | – | 36% | 40% | – | – |
| Italy           | 31851   | 81*        | 59.1%      | Fever: 76% | Cough: 39% | Dyspnea: 73% | – | – | – | – | 6% | – |
| UK              | 11326   | 0-104      | 60%        | Fever: 68.3% | Cough: 69.5% | Dyspnea: 64.6% | 35% | – | 15% | 9% | 7% | 16% |
| Spain           | 6424    | 18-102     | 56.9%      | Fever: 86.2% | Cough: 76.5% | Dyspnea: 57.6% | – | – | – | 47.5% | – | – |
| Iceland         | 1044    | 41.3*      | 49.4%      | Fever: 48.8% | Cough: 31.1% | Dyspnea: – | – | 30.8% | 23.7% | 12.2% | – | – |
| Europe**        | 1420    | 39.17 ± 12.09 | 32.2% | Fever: 45.4% | Cough: 63.2% | Dyspnea: 49.1% | – | 62.5% | 70.3% | – | 38.1% | 45.7% |

* = Present, ** = data not available, NYC = New York City; * = median age, ** = study conducted in France, Italy, Spain, Belgium, and Switzerland
role in the syndromic clinical diagnosis of COVID-19. As countries in South Asia and Africa face a logarithmic rise in new cases, expensive RT-PCR based test lags far behind to cope up with the infection rate. The physicians serving in those resource-deprived and remote areas could resort to clinical diagnosis. Thus, knowledge regarding a plethora of atypical symptoms will equip doctors to make better decisions and ensure early medical care. However, wealthy countries that can support mass-scale expensive testing facilities should continue RT-PCR tests and, additionally, make use of point of care (POC) diagnostics. By effectively quantitatively suspected COVID-19 patients with updated surveillance strategies, it is possible to minimize the spread of infection, especially from the paucisymptomatic carriers. Interestingly, the recent development of selective naked-eye visual identification based colorimetric assay that outputs the results in 10 minutes could be realized as a breakthrough in COVID-19 surveillance [98]. Moreover, digital diagnosis and artificial intelligence-based mobile applications could be used to track the daily self-reported symptoms-data by people and algorithmically predict the patient status in a particular geographical region [27]. Since smell and taste dysfunction was shown to be more prevalent in some areas, the low-cost smell testing facility installed at workplaces and institutions could also curb the amount of unintentional spread of infection [90].

CONCLUSION
As the pandemic could potentially last for years without an effective vaccine, a proper surveillance strategy based on clinical and geographical variability might keep this highly contagious SARS-CoV-2 at bay. Given that reinfection is less likely, serology-based antibody testing remains an option to function as “immune passport” for recovered individuals to allow immediate joining in the workplaces where seronegative individuals may be provided with regular testing facilities. In essence, the local public health bodies can play the determining role to keep the people’s health status in check by following country-specific guidelines. This review, thus, provides a comprehensive clinical spectrum of COVID-19 with geographical variability to help understand the new disease better and inform healthcare authorities as well as public health policymakers to implement an effective preventive and management strategy.

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