

## Original Research Article

# COVID-19 scoring

Sayonee Das<sup>1\*</sup>, Abhijit Ray<sup>2</sup>

<sup>1</sup>Department of Medicine, KPC Medical College and Hospital, Kolkata, West Bengal, India

<sup>2</sup>CCST Trainee, Royal College of Physician of Edinburgh

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### \*Correspondence:

Dr. Sayonee Das,

E-mail: sayoneedas@gmail.com

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### ABSTRACT

**Background:** Triage of COVID-19 patients. Coronavirus disease 2019 (COVID-19) pandemic has posed a threat both to lives of common people as well as to the existing overburdened healthcare system. There has been dearth of hospital beds which has led to chaos. In such a situation triaging of patients is of utmost importance to avoid unnecessary hospital admission which results in both anxiety in patients and increases load on hospitals. We hereby propose a scoring system which incorporates all the points that must be seen in suspected and tested positive COVID-19 patients and gives a score following which patients can be divided into different stages as per severity namely mild, moderate and severe. Mild cases can be advised for home quarantine/isolation with warning signs explained and this reduces unnecessary admissions. Moderate and severe cases which requires admission can be triaged with respect to ward and intensive care unit (ICU) admissions. This prevents unnecessary ICU admissions as well as prevents delay in ICU shifting of moderate cases on deterioration.

**Methods:** We have conducted a cross-sectional study on 500 suspected and real time-polymerase chain reaction (RT-PCR) tested positive COVID-19 patients using this scoring system in order to triage them.

**Result:** Out of 500 patients including both suspected and positive COVID-19 patients only 373 required admissions whereas 127 admissions were successfully avoided as they could be sent for home quarantine/isolation.

**Conclusion:** Triage of patients, especially during a pandemic where the case load is immense, is very important. Presence of a concise score which incorporate all important points serves the purpose.

**Keywords:** COVID-19, TRACE-SLIP score, Triage

### INTRODUCTION

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), a novel coronavirus, initially presented as a cluster of pneumonia cases in Wuhan, China (December 2019). Since then, there has been a worldwide outbreak wreaking havoc over 160 countries. Till August 2020, there have been over 26 million cases causing at least 0.8 million deaths globally.

Coronavirus disease 2019 (COVID-19) affects different people in different ways. Most infected people develop mild to moderate illness and recovers without

hospitalization. Fever, dry cough, anosmia, tiredness are the most common symptoms whereas lesser common symptoms are aches and pains, sore throat, diarrhea, conjunctivitis, headache, rash on skin, or discoloration of fingers or toes. Serious symptoms include difficulty breathing or shortness of breath, chest pain or pressure, loss of speech or movement.<sup>1</sup>

Diagnosis of COVID-19 is usually based on detection of SARS-CoV-2 by Polymerase chain reaction (PCR) testing of a nasopharyngeal swab or other specimen. Evaluation and management of COVID-19 depends on the severity of the disease; patients with mild disease typically recover at

home. Patients with moderate or severe COVID-19 are usually hospitalized for observation and supportive care. Patients with severe COVID-19 may become critically ill with acute respiratory distress syndrome that typically begins approximately 1 week after the onset of symptoms. Thrombosis and renal failure are well-recognized complications of severe COVID-19. There are no proven therapies for COVID-19; thus, referral of patients to clinical trials is critical.<sup>2,3</sup>

India houses almost 1.3 billion people and has seen 3 million cases and about 67 thousand deaths and still counting. Due to such increasing number of cases in a densely populated country, the current situation has taken a toll on the healthcare system leading to severe dearth of availability of hospital beds, even for critically ill patients.

**Table 1: Trace-slip score.**

Parameters	(0)	(1)	(2)
<b>T</b> Temperature	<37.3°C	37.3°C-39°C	>39°C
<b>R</b> Respiratory rate	12-22/min	23-30/min	>30/min
<b>A</b> Age	<30 years	30-65 years	>65 years
<b>C</b> Comorbidities	Nil	T2DM	Hypertension/ immunocompromised and others
<b>E</b> Elevated acute phase reactants (CRP, Ferritin, D-dimer, etc.)	Not raised	Mildly raised	Highly raised
<b>S</b> Saturation of oxygen	>95% and no tachypnea	>95% but tachypneic	<95% or happy hypoxia
<b>L</b> Lymphopenia	>20%	20%-5%	<5%
<b>I</b> Infiltrates in lungs	No infiltrates	U/L or B/L infiltrate	>50% of both lung fields involved
<b>P</b> P/F ratio	>300	<300-200	<200

We would hereby like to propose a compact scoring system which would help in triaging of the patient thereby allowing strategic admission when needed and refraining from unnecessary admissions at the same time. This scoring system will triage the patients according to the severity of symptoms the patient presents with. Following the triaging, the patients would be redirected to appropriate treatment and follow up as per the current guidelines.

**Table 2: Severity score.**

Severity	Scores
<b>Mild</b>	0-9
<b>Moderate</b>	10-15
<b>Severe</b>	16-18

**Table 3: Level triaging.**

Levels	Case type	Triage area
<b>A1</b>	Suspected mild	Test + Follow-up (Home Quarantine)
<b>A2</b>	Suspected moderate	Isolation ward
<b>A3</b>	Suspected severe	Isolation ICU
<b>B1</b>	Positive mild	Home quarantine
<b>B2</b>	Positive moderate	COVID Positive ward
<b>C</b>	Positive moderate with high risk/severe	COVID Positive ICU

The scoring system focuses on multiple parameters which cumulatively help us suspect and gauge the criticality of a COVID-19 patient. This composite scoring system will allow doctors in the Outpatient clinics and emergency rooms to quickly triage suspected cases; it will also be useful for resident doctors to assess the severity and prognosis of each indoor patient.

#### Temperature

One of the most common symptoms of COVID-19 infections is pyrexia. Hence a clinical suspicion is important if temperature exceeds 37.3°C, getting 1 point. While there has been no reported direct correlation between the degree of fever and severity of disease progression, a temperature above 39°C demands special attention and hence gets 2 points in the scoring system.<sup>4</sup>

#### Respiratory rate

Tachypnoea, apart from being one of the most common symptoms in any lower respiratory tract infection including COVID-19, is a very important factor in determining severity of COVID-19 pneumonia. Mild cases were seen to have respiratory rate up to 22/min, moderate cases usually present with 23-30/min, while patients having respiratory rate above 30/min require non-invasive ventilation (NIV) or mechanical ventilation.<sup>5</sup>

#### Age

Age shows a linear distribution with respect to COVID-19 infections. While most patients below 30 years of age are at low risk of critical illness, those between 30 and 65 are a bit higher risk and shall receive 1 point in our scoring system. Again, those above 65 years of age warrant 2 points because of their higher risk of disease progression.<sup>6</sup>

### Comorbidities

Patients with type 2 Diabetes mellitus (DM) and more so with hypertension has been seen to be at more risk than those without any comorbidities. Again, immunocompromised patients are prone to even more critical illness.

Hypertension, defined by the American college of cardiology (ACC) and American heart association (AHA) as a systolic blood pressure (BP)  $\geq 130$  or diastolic BP  $\geq 80$  mm of Hg, is a primary modifiable risk factor associated with atherosclerotic cardiovascular disease.<sup>7</sup> The prevalence of hypertension in adults is high and higher rates correlate directly with advancing age.<sup>7</sup> Approximately 50% of patients with hypertension are prescribed angiotensin converting enzyme inhibitors (ACE-I), aldosterone receptor blockers (ARB) and aldosterone antagonists, collectively called RAAS inhibitors, and are among the most frequently prescribed anti-hypertensive medications.<sup>8</sup> ACE2 is a modulator of the RAAS, a critical neurohormonal pathway that regulates blood pressure and fluid balance.<sup>9</sup> The end product of the RAAS, angiotensin II, is a key vasoactive hormone that binds to angiotensin II receptor type 1 (AT1) located in the heart, lungs, blood vessels, kidneys, and adrenal glands, and it plays a central role in myocardial hypertrophy and fibrosis, inflammation, vascular remodeling, and atherosclerosis.<sup>10</sup> ACE2 is expressed in many human tissues including the nasal epithelium, heart, kidneys, and lungs, and inactivates angiotensin II diminishing its vasoconstrictive and myoproliferative effects.<sup>11</sup> SARS-CoV-2 binds to the ACE2 receptor via its spike (S) protein to allow entry into host cells. This complex is endocytosed leading to down-regulation of ACE2 and resulting in local accumulation of angiotensin II. It has been shown that ACE inhibitors and ARBs increase ACE2 which could theoretically increase the binding of SARS-Cov-2 to the lung and its pathophysiological effects leading to greater lung injury.

Similarly, in the pancreas, ACE2 was found to be localized to acini and islets following a similar distribution to that of ACE.<sup>12</sup> Ang II is found to be the predominant angiotensin peptide in the pancreas, with lower levels of Ang-(1-7) and low to nondetectable levels of Ang I. SARS-CoV-2 binds to these ACE2 receptors in T2DM patients and enter the cell resulting in its downregulation and accumulation of Ang II. This Ang II can delay insulin secretion and reduces blood flow in the islets of langerhans in a dose-dependent manner. Consistent with this effect of Ang II, blockade of RAS with either ACE inhibitors or Ang II receptor antagonists increases islet blood flow.<sup>13</sup> Moreover, these agents have been shown to attenuate pancreatic inflammation and fibrosis.<sup>14</sup> ACE and ACE2, by regulating the levels of Ang II and/or Ang-(1-7) in pancreatic islets, are involved in the control of insulin secretion to the extent that blood flow is influenced by local levels of angiotensin peptides as noted above. Therefore, ACE2 play a pivotal role in diabetes: A relative

deficiency of ACE2, as in case of SARS-CoV-2 related downregulation, may contribute to decreased insulin secretion, whereas in the kidney glomerulus it may foster proteinuria.

### Elevated acute phase reactants

Acute phase reactants are raised in any inflammation and usually give diagnostic as well as prognostic value since the levels can be correlated with the severity of the disease. The same occurs in COVID-19 patients; CRP, Ferritin, D-Dimer values are raised and their levels are proportionate to the disease severity.<sup>15</sup>

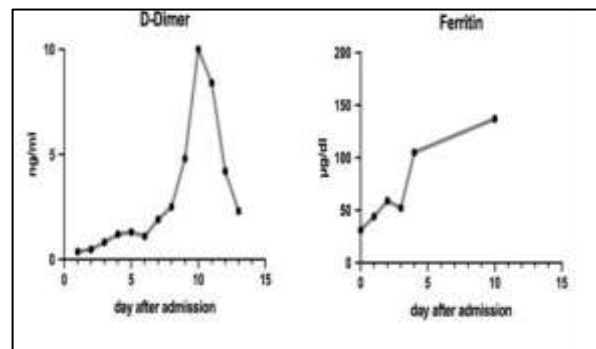


Figure 1: Ferritin and D-dimer in COVID-19.

### Oxygen

#### Saturation

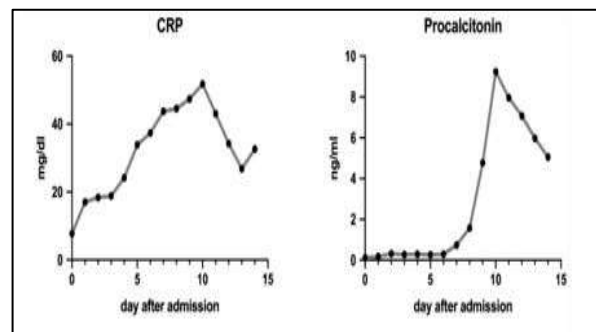


Figure 2: CRP and procalcitonin in COVID-19.

Saturation of Oxygen is an important indicator in any lower respiratory tract infection. One of the salient features of COVID-19 infection is "happy hypoxia" or fall in oxygen saturation without any symptomatic dyspnea. Those with symptomatic dyspnea having saturation more than 95% will receive 1 point from this scoring system, while patients with happy hypoxia, i.e. SpO<sub>2</sub> <95% have chances of severe infection and thus receive 2 points.<sup>16</sup>

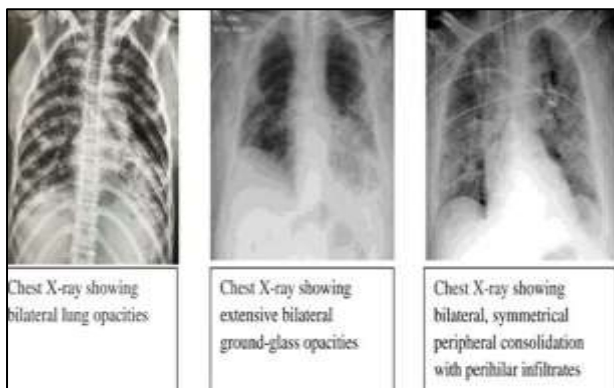
### Lymphopenia

While most viral illnesses show lymphocytosis, a unique feature of COVID-19 is the associated lymphopenia. And this reduction in lymphocyte count is proportional to the

disease severity. Thus, a patient having lymphocytes within 5% to 20% of total leucocyte count will receive 1 point and those with lymphocytes less than 5% will receive 2 points in this system.<sup>17</sup>

#### *Infiltrates in lungs*

X-ray chest (posterior-anterior view) though insensitive in early disease stage, can be helpful in follow up and triaging the patients. It should be ordered on suspicion/admission and repeated on every 3rd day or at worsening of symptoms.<sup>5</sup> Common x-ray chest findings ranges from unilateral/bilateral/ patchy lung infiltrates in initial phases to >50% lung involvement in later stages. Ground glass opacities and interstitial changes which may be seen in moderate to severe stages are considered as poor prognostic signs.



**Figure 3: Chest X-ray findings in COVID-19.**

Computed tomography (CT) scan of chest is an imaging one step higher and helps in assessing severity of the disease and predicting worsening/improvement. It even helps in ruling out the infection in early stages where x-ray chest would be insensitive. But it is subjected to availability and accessibility.

Currently the CO-RADS classification is the standardized proposed classification and reporting system for patients with suspected COVID-19 infection developed for a moderate to high prevalence setting. Based on the CT findings, the level of suspicion of COVID-19 infection is graded from very low or CO-RADS 1 up to very high or CO-RADS 5 and the severity and stage of the disease is determined with remarks on comorbidity and a differential diagnosis.<sup>18</sup> The interpretation of the CT findings has to be combined with the duration clinical symptoms as a CT can be negative in the first few days of a mild infection.

#### *P/F ratio*

As in all cases of respiratory failure, even in COVID-19 pneumonia a P/F ratio of more than 300 is considered normal, those between 200 to 300 are moderate cases and patients with P/F ratio less than 200 require immediate intervention.

Once a patient receives points on the basis of each criteria mentioned above, the additive score will help to identify the risk of that patient as either mild, moderate or severe. If the total score is between 0 and 9 points, it is a mild case. Any patient scoring between 10 and 15 should be considered as moderate, while those between 16 and 18 should be treated as severe infections.

The next step is triaging and assessing if the patient will be treated as an outpatient with home quarantine, admitted in wards or will require intensive care setup based on severity. Also, depending on the status of the patient's COVID-19 test report, the patient will be labelled as suspected case or confirmed positive case. Keeping these in mind we propose 3 levels: A, B and C.

#### *Level A*

Deals with suspected cases who are yet to be tested or awaiting test results. These patients shall be further subdivided into 3 categories depending on how they score via the abovementioned TRACE-SLIP system.

A1- These are patients who score between 0 and 9. They do not require admission and should be advised RT-PCR testing for COVID-19 and 14 days of home isolation.

A2- Patients who fall in the moderate category due to a TRACE-SLIP score between 10 and 15 need to be admitted in isolation ward till they receive their test results.

A3- Those patients who have a score between 16 and 18 need to be placed in isolation ICU for monitoring and intervention.

#### *Level B*

Deals with positive cases who are tested positive by RT-PCR testing for COVID-19. These patients shall again be subdivided into 2 categories depending on how they score via the abovementioned TRACE-SLIP system.

B1- These are the positive mild patients who score between 0-9. Barring special situations like uncontrolled co-morbid conditions, they need not be hospitalized. But warning signs should be explained to such patients so that one can report to ER as soon as one develops those. Warning signs includes respiratory rate >24/min, SpO2 <95% in room air, altered sensorium and also infiltrates in chest x-ray and altered liver function test and renal function test.

B2- These are the positive moderate patients who score between 10-12. They might not immediately need ICU support and can be managed in COVID positive wards with proper monitoring and control of co-morbid conditions. These patients must be under strict vigilance to look out for any worsening of condition in which case they shall be placed in category C and managed accordingly.

### Level C

Deal with positive moderate to severe cases with high risk who needs constant monitoring and intervention in COVID positive ICU setting. It includes positive moderate patients who scores between 12-15 and positive severe who scores between 16-18. Early intervention and prompt treatment is mandated in these cases for better recovery.

## METHODS

### Type of study

The study was cross sectional.

### Study setting

The study was conducted at Emergency Department and Fever Clinic.

### Place of study

The study site was Kolkata, West Bengal, India.

### Period of study

The study period was for 4 months (May to August 2020).

### Study population

Patients presenting with undiagnosed fever with symptoms like cough, sore throat, shortness of breath, anosmia, diarrhea with no pain abdomen, headache etc.

### Sample size

Out of all the patients attending the Emergency department or fever clinic, during the study period, first 500 consecutive patients fulfilling the study criteria was selected for the study.

### Selection criteria

#### Inclusion criteria

The inclusion criteria for the study was as follows: patients admitted with fever but tested negative for commonly sent infective profile according to local guidelines for infectious disease (Example: Dengue NS1 antigen, MP, MPDA, Typhidot M, viral serology); patients with pyrexia of unknown origin; patients having symptoms like cough, sore throat, shortness of breath, anosmia, diarrhea with no pain abdomen, headache etc. suspected to be having COVID-19 infection; patients who had history of contact in any form with a known COVID-19 patient, including healthcare workers; immunocompromised patients and patients with co-morbidities like type 2 Diabetes Mellitus, hypertension; patients who were supposed to undergo any

invasive procedure (as a routine test to look for COVID-19 by RT-PCR); and patients giving consent for the study.

#### Exclusion criteria

The exclusion criteria for the study was as follows: already diagnosed cases of fever other than COVID-19 and patients not giving consent for the study.

#### Test performed

Nasopharyngeal and Oropharyngeal swab for COVID-19 were sent for testing by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) method for all patients. Specimens were collected as per World Health Organization (WHO) guidelines and placed into sterile tubes containing viral transport media, stored at 2-80C temperature after collection and transported to testing laboratory.

#### Statistical analysis

Cox proportional-hazards model was used for analysis of data.

## RESULT

We screened 500 patients presenting with symptoms akin to COVID-19 infection from the Emergency Department and fever clinic in our hospital. The patients were dealt with by healthcare workers wearing appropriate Personal protective equipment (PPE) and admitted, when necessary, in a separate section of the hospital which was isolated and dedicated to dealing with COVID-19 patients only. Using the abovementioned score triaging the patients to appropriate area had yield good results. Patients with suspected infection were advised RT-PCR testing for COVID-19 and according to severity mild patients were advised home quarantine, moderate to isolation ward and severe to isolation ICU. Similar steps taken for patients who were already tested positive for COVID-19 by RT-PCR. Patients who were advised home quarantine/isolation were explained the warning signs and duly followed up. Out of 168 patients attending the fever clinic 106 were advised home quarantine/isolation (as per report) and only 62 required admission. Similarly, out of 332 patients attending Emergency department 311 required admission and 21 were sent for home quarantine/isolation. So, from 500 patients 373 were admitted and 127 unnecessary admissions were successfully avoided.

**Table 4: Patient distribution.**

Departments	Quarantine/isolation	Admission
<b>Fever clinic</b>	106	62
<b>Emergency department</b>	21	311
<b>Total</b>	127	373

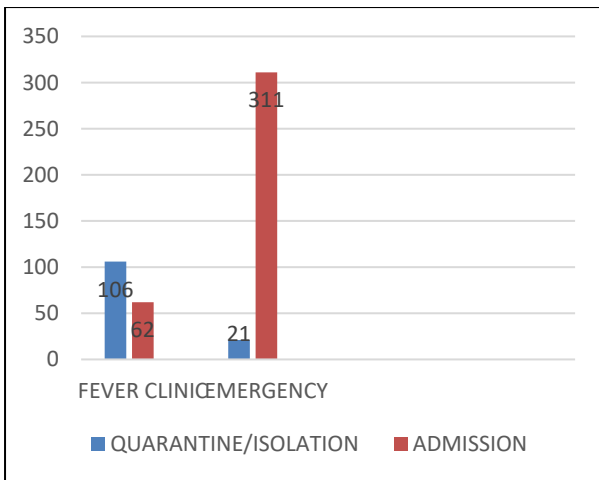


Figure 4: Quarantine admission ratio in COVID-19.

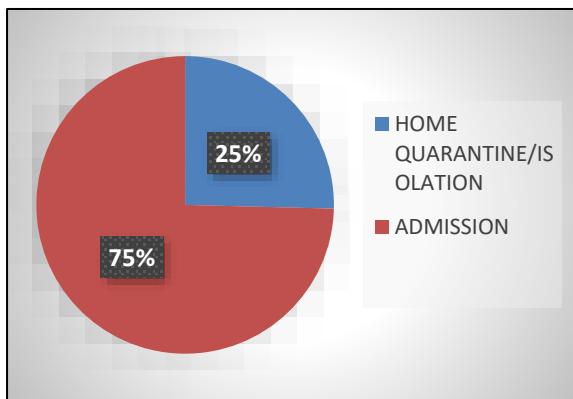


Figure 5: Quarantine admission percentage in COVID-19.

## DISCUSSION

SARS-CoV-2, also known as COVID-19 infection, has arisen as a pandemic from December 2019 and had a peak in India around the month of July 2020 and still continuing, affecting lives everyday. Patients presents with wide variety of symptoms starting from being asymptomatic to having fever, cough, anosmia, malaise, sore throat, diarrhea, headache etc. Patients with severe disease presents with severe shortness of breath having evidence of viral pneumonia and ARDS, chest pain, neurological problems, vascular complications like thrombosis and vasculitis, renal failure etc.

A metalloproteinase named angiotensin-converting enzyme 2 (ACE 2) has been identified as the functional receptor for SARS-CoV via which the virus enters the body and owing to its abundant presence in the body, it gives rise to such wide array of symptoms<sup>19</sup>.

Diagnosis is by detection of SARS-CoV-2 by RT-PCR testing of a nasopharyngeal and oropharyngeal swab.

Our proposed TRACE-SLIP scoring system incorporates nine important points which must be looked into in a

suspected and tested positive COVID-19 patients. First point is temperature which is the presenting complaint in all the patients and is a symptom of concern and suspicion. Rising temperature indicates bad prognosis and demands special attention. Second point is respiratory rate which is the most common symptom in any patient with pneumonia and determine the degree of severity of lower respiratory tract infection (LRTI) and need for ventilatory support. Third point is age which shows a linear distribution with COVID-19 infection. Fourth point being one of the most important point, deals with comorbidities. Initial reports from COVID-19 hotspots identified higher rates of hypertension among severely ill, hospitalized COVID-19 patients. Severity of COVID-19 illness is skewed towards the elderly population who have a higher prevalence of hypertension. Severe respiratory illness is a hallmark of COVID-19 and a primary cause of morbidity and mortality. Local activation of RAAS is proposed as a mechanism for severe lung injury.<sup>14</sup> ACE2, a homologue of ACE, is a monocarboxypeptidase that preferentially removes carboxy-terminal amino acids from various substrates, including Ang II, Ang I, and apelin (3–6). ACE2 cleaves Ang II to form Ang-(1-7) with a high catalytic efficiency, suggesting an important role in preventing Ang II accumulation, while enhancing Ang-(1-7) formation (7). ACE2 receptor is the binding site for SARS-CoV-2 to enter into host cell resulting in its downregulation and local accumulation of angiotensin II which cause vasoconstriction, is proinflammatory, prothrombotic, profibrotic and arrhythmogenic.

Fifth point includes elevated acute phase reactants like C-reactive protein (CRP), ferritin, D-dimer which are increased in inflammation and has a diagnostic as well as prognostic value in assessment of disease progression. Sixth point is about saturation of oxygen which is probably the most widely monitored variable in COVID-19 infection owing to its easy accessibility and it being a quick respiratory prognostic marker. It helps diagnosing hypoxia, a characteristic feature of COVID-19, in asymptomatic patients. Seventh point includes Lymphopenia, a common blood picture seen in SARS-CoV-2 infection. Eighth point stresses on findings of lung Infiltrates. Findings in chest x-ray and HRCT thorax by CORADS score is quite significant is assessing severity as well as diagnosing the disease. Ninth point deals with the P/F ratio which is the PaO<sub>2</sub>:FiO<sub>2</sub> ratio seen in symptomatic and deteriorating patients which helps in assessing severity of the condition and will prevent any delay of intervention when required.

Patients with mild disease need not get admitted and can be well managed by home quarantine/isolation with warning signs explained and due follow up. Patients with moderate disease may need admission in wards for monitoring to prevent any undue deterioration. Severe disease needs to be managed in an ICU setting with proper ventilatory (non-invasive and invasive) support when required.

Owing to the newness of the disease and apparent lack of treatment evidence, there has been detailed discussion and ongoing clinical trials in the medical fraternity to come up with evidence and protocols to deal with the disease. This has given rise to array of criteria which has to be examined and monitored every time a patient is seen which might not always be possible by a busy healthcare worker, especially during a pandemic with such busy work condition and overburdened healthcare system, to remember. For convenience in such a scenario this scoring system is helpful as it inculcates the important criteria for patient monitoring and acts as a bedside monitoring tool for assessment.

## CONCLUSION

During a pandemic, the need for quick decision making regarding appropriate triaging of the patients in such a densely populated country with overburdened healthcare system is of utmost importance which is the basic aim of our scoring prototype. Not only will the scoring system assess the severity of the disease but will also help in accurate triaging of the patients for better management and care as well as assess the prognosis by score calculation at regular interval and seeing the trend whether increasing or decreasing in severity.

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