Potential solutions for screening, triage, and severity scoring of suspected COVID-19 positive patients in low-resource settings: a scoping review

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ABSTRACT

Objectives Purposefully designed and validated screening, triage, and severity scoring tools are needed to reduce mortality of COVID-19 in low-resource settings (LRS). This review aimed to identify currently proposed and/or implemented methods of screening, triaging, and severity scoring of patients with suspected COVID-19 on initial presentation to the healthcare system and to evaluate the utility of these tools in LRS.

Design A scoping review was conducted to identify studies describing acute screening, triage, and severity scoring of patients with suspected COVID-19 published between 12 December 2019 and 1 April 2021. Extracted information included clinical features, use of laboratory and imaging studies, and relevant tool validation data.

Participant The initial search strategy yielded 15,232 articles; 124 met inclusion criteria.

Results Most studies were from China (n=41, 33.1%) or the United States (n=23, 18.5%). In total, 57 screening, 23 triage, and 54 severity scoring tools were described. A total of 51 tools—31 screening, 5 triage, and 15 severity scoring—were identified as feasible for use in LRS. A total of 37 studies provided validation data: 4 prospective and 33 retrospective, with none from low-income and lower-middle-income countries.

Conclusions This study identified a number of screening, triage, and severity scoring tools implemented and proposed for patients with suspected COVID-19. No tools were specifically designed and validated in LRS. Tools specific to resource limited contexts is crucial to reducing mortality in the current pandemic.

INTRODUCTION

SARS-CoV-2 was declared a global public health emergency on 30 January 2020.1 In the time since, more than 153 million people have been infected and over 3.2 million have died.2 While many low-income and middle-income countries (LMICs) were relatively spared from high mortality rates, public health measures to contain the virus have put enormous strains on health systems and the ability of countries to care for existing disease burdens.3-5 The influx of patients with COVID-19 stressed healthcare systems worldwide by increasing demand for personal protective equipment (PPE), diagnostics, oxygen and mechanical ventilators.6 Low-resource settings (LRS) have limited access to these resources and remain disproportionately challenged during the COVID-19 pandemic.7 8 Even in regions where viral transmission remains low, patients with suspected COVID-19 require precautions, and confirmed cases require costly treatment and care. As the pandemic endures, continued resource demands have the potential to overwhelm LRS healthcare systems.3

Early recognition and treatment of acute conditions are integral to reducing general mortality in LRS.9 Previous evidence suggests three specific processes—screening, triage, and severity scoring of patients—improve patient outcomes in LRS.10 11 These practices reduce resource utilisation across a variety of settings and inform ongoing patient management,12 but appropriate implementation
during public health emergencies can be challenging. The need for screening, triage, and severity scoring tools in real time may lead to the use of both unvalidated and potentially ineffective protocols.

Although emergency care has developed rapidly in LMICs over the past two decades, it remains undeveloped in many regions, particularly outside of urban areas. Many healthcare systems lack formal emergency units (EUs), and those with dedicated spaces for emergency and acute care may not routinely screen or triage patients. Implementing these tools can be challenging in LRS, where equipment, staff and systems are lacking. Despite the limitations, the exceptional risks of COVID-19 have placed screening and triage procedures at the forefront: practical screening and triage protocols maximise use of limited available resources and keep patients and providers safe.

Screening refers to the process of identifying and isolating patients with COVID-19 risk factors on initial presentation to the healthcare system, such as to outpatient clinics and EUs. It is a rapid process to evaluate potential risk of infection, typically using basic clinical and historical information. In order to be successful, it must be based on easily understood case definitions, as it is frequently performed by non-healthcare personnel (such as security guards). With screening, high sensitivity is typically prioritised over specificity, so that all cases are identified. This process is fundamentally different from diagnostic testing, which is also referred to as screening in some literature. Triage—a systematic method of sorting patients into priority groups based on the severity of their clinical syndrome, and matching these groups with available resources—is usually conducted following screening. Triage is seen as a fundamental component of effective emergency care. In order for triage to improve patient outcomes, the triage protocol must effectively prioritise the sickest patients for emergency interventions and direct patients to the appropriate levels of care. Severity scoring stratifies patients with a diagnosis (eg, confirmed or suspected COVID-19) based on risk of poor outcomes, such as mortality or admission to the intensive care unit, and can complement the triage process and further inform resource allocation.

To date, there have been no published reviews detailing available tools for identification and triage of patients with COVID-19. This review aimed to identify currently proposed and/or implemented methods of screening, triaging, and early severity scoring of patients with suspected COVID-19 on initial presentation to the healthcare system and to evaluate the utility of these tools in LRS.

METHODS

Search strategy

A systematic search was conducted to identify literature describing screening, triage, and severity scoring practices that have been implemented or proposed for use with patients with suspected COVID-19 on first presentation to emergency or acute care settings.

Four electronic databases (Embase, Ovid/Medline, PubMed and Web of Science) were searched using keywords, with adaptations made based on controlled vocabulary standards for each database. Initial search terms included “COVID,” “COVID” and “SARS-CoV-2”, coupled with “screening,” “triage,” “severity,” “risk,” and “stratification,” “prediction,” “tool,” “index,” and “score,” (online supplemental appendix 1). A secondary search was completed after reviewer comments with the inclusion of emergency specific search terms to help refine the search given the overwhelming growth in the published literature on COVID-19 related topics. Targeted searches were conducted to identify grey literature through Google Scholar and Open Grey. Websites of key regional and international health organisations were also searched, including the European Centre for Disease Prevention and Control, Infection Control Africa Network, International Committee of the Red Cross, Medecins Sans Frontieres, UNICEF, US Agency for International Development, US Centers for Disease Control and Prevention, and WHO.

Inclusion and exclusion criteria

All studies published in English between 1 December 2019 and 1 April 2021 were eligible for inclusion. Multiple forms of literature, including published and preprint manuscripts, correspondence, reports and published guidelines, were considered. Studies were required to describe screening, triage and/or severity scoring of suspected positive or confirmed COVID-19 patients performed by general practitioners or emergency care providers in the prehospital, hospital or clinic setting. Both previously existing tools applied to patients with COVID-19 and novel tools developed specifically for the COVID-19 response were eligible for inclusion. A description of the tool, including inputs (eg, hypoxia) and any relevant parameters (eg, value of input, such as oxygen saturation <93%), was required. As this review aims to describe all tools that may be in use, outcomes data from implementation and/or validation studies were not requisite. Tools could be either proposed or in use, with or without validation. There were no restrictions on the populations that tools may be used in.

Studies in languages other than English or published prior to 1 December 2019 were excluded. Studies describing screening, triage and/or severity scoring only by specialist physicians and those lacking a complete description of the tool were not included. Community-based and population-based screening efforts, performed by healthcare providers or otherwise, were excluded, as were at-home self-triage tools. Descriptions of physical screening or triage infrastructure (eg, a walk-up or drive-through facility) and methods of administering screening (eg, telehealth) were not included.

Data extraction and analysis

Multiple reviewers (SH, JLP, CB and AVN) independently assessed studies for eligibility at the title, abstract, and full-text
levels. Any discrepancies were resolved via discussion and a third independent reviewer (AVN, EJCH and CB) where necessary. Relevant data were extracted from eligible texts, including, year of publication, country and setting in which the tool was proposed or implemented, status of the tool as proposed or implemented, and any tool inputs (eg, comorbidities, clinical symptoms and findings and diagnostic and laboratory results). A second researcher reviewed all data extractions to ensure accuracy.

Descriptive analyses were performed, and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Extension for Scoping Reviews checklist was used to guide analysis and reporting of these results.17 Feasibility of inputs for use in LRS was determined based on investigation of key literature, including The World Bank’s Disease Control Priorities, Third Edition, and the African Federation for Emergency Medicine’s 2013 consensus statement describing facility level specific, expected capacities for emergency care delivery on the continent.18,19 As with any other setting, LRS have health facilities of varying capacities. In this review, feasibility was targeted towards district level hospitals, as it is these facilities that the majority of LRS populations are likely to initially present to.18 Additionally, as fully resourced health facilities have struggled with the COVID-19 surge, these feasibility inputs may also apply when excess patient volume consumes critical resources or makes imaging difficult.

Patient and public involvement
Given the nature of this review, it was not appropriate to involve patients or the public in this study’s design or execution.

RESULTS
The search strategy yielded a total of 15232 articles (figure 1). After duplicates were removed, 11091 unique titles were assessed for inclusion. Following title and abstract screening, 472 articles remained. Full-text review resulted in 124 articles for full inclusion and data extraction (online supplemental appendix 2, tables 1–3).

At the time of inclusion, most articles were peer reviewed (n=99, 79.8%) or preprint manuscripts (n=9, 7.3%). Three articles from the grey literature were also included in the review, reporting on three tools. Articles originated from 27 countries, with the majority published or conducted in China (n=41, 33.1%), followed by the USA (n=23, 18.5%) and Italy (n=10, 8.1%). International recommendations were described in three articles (2.4%).

The majority of the available literature described severity scoring tools (n=54 articles, 43.5%). Screening tools were described in 48 (38.7%) and triage in 12 (9.7%). Some studies described more than one triage or severity scoring tool. In 10 studies, both screening and triage were described. In total, 57 screening, 23 triage and 54 severity scoring tools were described (table 1).

Many tools were designed for hospital-wide (n=51, 38.1%) or EU (n=19, 14.2%) use. More than one-third (n=52, 38.8%) did not have a specified setting and were considered to be designed for broad use throughout the healthcare system. Seven tools (6.4%)—five for screening and two for triage—were specific to paediatric settings; nearly all others (n=115, 85.8%) lacked age specifications.

More than one-quarter of tools (n=37, 27.6%) provided validation data supporting their use (online supplemental appendix 2, table 4), with four (of 37; 10.8%) validated prospectively. Most tools were validated against the following outcomes: diagnosis of severe COVID-19 disease (n=8, 21.6%), confirmation of COVID-19 via RT-PCR (n=5, 13.5%) or 30-day mortality (n=4, 10.8%). Only four screening tools (7.0%) and two triage tools (8.7%) had associated validation data, while 29 severity scoring tools (53.7%) did. All of these tools were validated in high-income (n=18, 48.6%) or upper middle-income (n=19, 51.4%) country settings. Of those validated in upper middle-income countries (n=19), 16 were validated in China (84.2%), 2 in Turkey (10.5%) and 1 in Mexico (5.3%).

A total of 204 unique inputs were included in the screening, triage and severity scoring algorithms (table 2 and online supplemental appendix 2, table 5).

Screening tools had a median of four (IQR: 3–7) inputs. Most (n=36, 63.2%) included epidemiological risk factors. Fever was commonly included as a reported symptom (n=31, 54.4%) or a measured vital sign (n=17, 29.8%). Triage tools had a median of eight (IQR: 2.5–13.5) inputs. Oxygen saturation was the vital sign most commonly used (n=22, 16.4%), followed by tachypnoea (n=20, 14.9%). Concurrently diagnosed acute conditions were present in multiple triage tools (n=6, 26.1%). Severity scoring tools had a median of five inputs (IQR: 1–8.5). The most
Table 1  Overview of tools used to screen, triage and evaluate the severity of patients with COVID-19

| Setting                        | Screening tools (n=57) | Triage tools (n=23) | Severity scoring tools (n=54) | All tools* (n=134) |
|-------------------------------|-----------------------|--------------------|-------------------------------|---------------------|
|                               | n | %    | n | %    | n | %    | n | %    |
| Setting                       |   |      |   |      |   |      |   |      |
| Hospital                      | 16 | 28.1 | 5 | 21.7 | 30 | 55.6 | 51 | 38.1 |
| Hospital-based emergency care | 12 | 21.1 | 4 | 17.4 | 3  | 5.6  | 19 | 14.2 |
| Outpatient/general practitioner| 8 | 14.0 | 2 | 8.7  | 0 | 0.0  | 10 | 7.5  |
| Prehospital emergency care    | 2 | 3.5  | 0 | 0.0  | 0 | 0.0  | 2 | 1.5  |
| Not specified                 | 19 | 33.3 | 12| 52.2 | 21 | 38.9 | 52 | 38.8 |
| Country income level          |   |      |   |      |   |      |   |      |
| High-income country           | 29 | 50.9 | 14| 60.9 | 29 | 53.7 | 72 | 53.7 |
| Upper middle-income country   | 23 | 40.0 | 5 | 21.7 | 22 | 40.7 | 50 | 37.3 |
| Lower middle-income country   | 3 | 5.3  | 3 | 13.0 | 3 | 5.6  | 9 | 6.7  |
| Low-income country            | 1 | 1.8  | 0 | 0.0  | 0 | 0.0  | 1 | 0.7  |
| Not applicable                | 19 | 33.3 | 12| 52.2 | 21 | 38.9 | 52 | 38.8 |
| Age group                     |   |      |   |      |   |      |   |      |
| Adults                        | 1 | 1.8  | 3 | 13.0 | 4 | 7.4  | 8 | 6.0  |
| Paediatrics                   | 5 | 8.8  | 2 | 8.7  | 0 | 0.0  | 7 | 5.2  |
| All ages                      | 3 | 5.3  | 1 | 4.3  | 0 | 0.0  | 4 | 3.0  |
| Not specified                 | 48 | 84.2 | 17| 73.9 | 50 | 92.6 | 115| 85.8 |
| Implementation                |   |      |   |      |   |      |   |      |
| Proposed                      | 22 | 38.6 | 15| 65.2 | 54 | 100.0 | 91 | 67.9 |
| Implemented                   | 35 | 61.4 | 8 | 34.8 | 0 | 0.0  | 43 | 32.1 |
| Validation setting            |   |      |   |      |   |      |   |      |
| High-income country           | 2 | 3.5  | 1 | 4.3  | 15| 27.8 | 18 | 13.4 |
| Upper middle-income country   | 1 | 1.8  | 1 | 4.3  | 17| 31.5 | 19 | 14.2 |
| Lower middle-income country   | 0 | 0.0  | 0 | 0.0  | 0 | 0.0  | 0 | 0.0  |
| Low-income country            | 0 | 0.0  | 0 | 0.0  | 0 | 0.0  | 0 | 0.0  |
| Not validated                 | 54 | 94.7 | 21| 91.3 | 22| 40.7 | 97 | 72.4 |
| Feasibility in low-resource settings |   |      |   |      |   |      |   |      |
| Likely                        | 31 | 54.4 | 5 | 21.7 | 15| 27.8 | 51 | 38.1 |
| Unlikely                      | 26 | 45.6 | 18| 78.3 | 39| 72.2 | 83 | 61.9 |

*The total number of tools (n=134) does not equal the total number of papers (n=124), as some papers reported on more than one tool.

Table 2  Overview of inputs in tools used to screen, triage and evaluate the severity of patients with COVID-19

|                     | Screening tools (n=57) | Triage tools (n=23) | Severity scoring tools* (n=54) |
|---------------------|-----------------------|--------------------|-------------------------------|
|                     | No. unique inputs     | %                  | No. unique inputs             | %                  | No. unique inputs | %                  |
| Total combined inputs† | 76                    | 100.0              | 108                           | 100.0              | 116               | 100.0              |
| Clinical interventions received | 0                     | 0.0                | 5                             | 4.6                | 1                 | 0.9                |
| Comorbid conditions   | 6                      | 7.9                | 15                            | 13.9               | 24                | 20.7               |
| Concurrent acute conditions | 2                     | 2.6                | 14                            | 13.0               | 9                 | 7.8                |
| Demographics          | 2                      | 2.6                | 4                             | 3.7                | 7                 | 6.0                |
| Imaging investigations | 3                      | 3.9                | 3                             | 2.8                | 3                 | 2.6                |
| Laboratory investigations | 22                   | 28.9               | 32                            | 29.6               | 42                | 36.2               |
| Other characteristics | 3                      | 3.9                | 4                             | 3.7                | 2                 | 1.7                |
| Signs and symptoms    | 28                     | 36.8               | 16                            | 14.8               | 11                | 9.5                |
| Vital signs           | 10                     | 13.2               | 15                            | 13.9               | 17                | 14.7               |

*The total number of tools (n=134) does not equal the total number of papers (n=124), as some papers reported on more than one tool.
†Per cents are out of the total combine inputs, not the number of tools.
frequently used inputs in these tools were age (n=22, 40.1%), lactate dehydrogenase (n=11, 20.4%), respiratory rate (n=7, 37.0%) and temperature (n=5, 9.3%).

Several studies used pre-existing tools to stratify suspected-positive COVID-19 patients: 11 for triage and 19 for severity scoring (online supplemental appendix 2, table 6). The most common tools for severity scoring were the qSOFA and CURB-65 scores and were used in five and four studies, respectively.

Tool inputs that relied on imaging and nearly all laboratory testing were deemed largely impractical for routine use in many frontline EU’s in LRS. In the context of these restrictions, just over half of screening tools (n=31, 54.4%) were viable for use in LRS EU’s; a smaller number (n=5, 21.7%) of triage and severity scoring (n=15, 27.8%) tools were also feasible. Many studies describing tools inappropriate for LRS EU’s included imaging: 17 screening tools (29.8%), 16 triage tools (69.6%) and 14 (25.9%) severity scoring tools required a chest X-ray, chest CT and/or lung ultrasound. At least one laboratory value was included in seven screening (12.2%), six (26.0%) triage and 28 severity scoring (51.9%) tools. Screening tools were proposed or implemented in six LMICs: 19 in China, 2 in India and 1 each in Mexico, Timor-Leste, Turkey and Uganda, with 16 (55.2%) of these tools deemed feasible for LRS. Triage tools were proposed or implemented in four LMICs: three in China, three in India and one each in Timor-Leste and Turkey, with only four (17.4%) deemed feasible for LRS. Of the 25 severity scoring tools proposed or implemented in LMICs, 18 were from China, 2 were from Pakistan and there was 1 each from Argentina, Brazil, Mexico, Turkey and India; just three (5.6%) are likely feasible in LRS.

**DISCUSSION**

This scoping review identified a wide range of tools being used to screen, triage, and predict the severity of suspected-positive COVID-19 patients worldwide. A disproportionate share of tools were described in three countries: China, the USA, and Italy, a reflection of the combination of early disease burden and host country research capacities. While more than half of screening tools provided some information about implementation, less than half of triage tools and no severity scoring tools did so. Overall manuscript quality was high, with nearly three-quarters from peer-reviewed publications. Uncertainty remains in regard to the accuracy of these tools: only one-quarter were validated, and variations in settings and reporting make it difficult to generalise and compare data. Almost all studies providing both training and prospective validations showed substantial decreases in accuracy with prospective cohorts. There was also variance in accuracy of the same tools—such as National Early Warning Score (NEWS) and NEWS2—across different high-income and upper middle-income settings.

A majority of the tools identified were for screening, followed by severity scoring, and triage. Tool length varied, though most were short (between four and five inputs). Identified tools with fewer inputs likely have more utility in EU’s but, only a small number of tools were purposely designed for EU’s. Despite the impact of severity scoring tools on informing appropriate patient interventions and disposition, there was no literature available to guide the implementation of severity scoring tools in EU’s. While there is substantial variance in presentations in children versus adults, very few tools specified a target age group for utilisation. This, in combination with a lack of paediatric-specific tools, suggests a need for additional investigation into appropriate tools for identification and risk of poor outcomes in suspected COVID-19 in paediatric populations.

Screening is an essential means of separating patients with suspected illness from the general population on presentation to the health system. This is particularly critical in LRS, where laboratory testing for COVID-19 is limited, and PPE and other resources need to be conserved for positive cases. Most of screening tools found in this review recommended conducting screening on patients using epidemiological risk factors and symptoms consistent with the case definition of suspected COVID-19, such as cough and fever. Non-validated use of such tools could be problematic for multiple reasons. First, it is well documented that there is poor, inaccurate self-reporting of epidemiological risk factors, including exposure to other patients and travel history. The impact of epidemiological data in a tool is also limited by the establishment of widespread community transmission, since such transmission indicates that nearly all patients are at risk of exposure. Compounding this is the fact that a substantial portion of COVID-19 cases present atypically, without the commonplace symptoms that providers are screening for using these tools. For example, one study of 1099 confirmed COVID-19 cases demonstrated that only 43.8% of COVID-19 positive cases presented with fever. More than half of screening tools included fever as a symptom, and many of these considered it requisite to meet the suspect case definition. Challenges in capturing the correct epidemiological data and meeting ‘typical’ case definitions suggests that many screening tools may not effectively identify patients with COVID-19. In addition, in many LRS where the infectious disease burden is high, using fever or cough alone for identification and isolation may be insufficiently specific and create excess burden of suspected cases, leading to delays in care and cross-contamination. Also of concern is that, despite the intention of screening as a rapid, first-pass method of identifying patients with suspected COVID-19, many published screening tools relied on laboratory investigations. It is likely that intensive precautions must be taken with these patients while awaiting diagnostic results since, even in the highest resource settings, laboratory results take time. The resources to take these precautions are almost universally limited, and inaccurate screening may place healthcare workers and patients at unnecessary risk.

After screening, patients with suspected COVID-19 should be triaged to determine symptom severity using a
standard triage tool contextually validated. Following this, patients should be further risk stratified using a severity scoring tool in order to guide clinical management and hospital disposition. Among both triage and severity scoring tools, there was a general lack of consensus about key inputs for prognosticating patients with COVID-19. This is unsurprising, given the novelty of SARS-CoV-2 and the numerous typical and atypical presentations of COVID-19 disease. Despite emerging evidence that any comorbidity, as well as obesity, cerebrovascular disease, chronic obstructive pulmonary disease, diabetes, hypertension, and smoking history correlate with the likelihood of more severe COVID-19 disease, there was little agreement on which comorbidities to include in tools. Many triage and severity scoring tools included age as an input, congruent with large-scale data that age is a severity modifier. Fewer tools included male sex, despite similar evidence of its predictive value.

Shortness of breath, cough and fever were used in many tools. A concurrent meta-analysis identified that fever and shortness of breath were significant predictors of severe COVID-19 disease, while cough was not. A core set of five vital signs—heart rate, oxygen saturation, respiratory rate, systolic blood pressure, and temperature—were seen across triage and severity scoring tools. Although limited data are available on the utility of mental status in predicting COVID-19 illness severity, a majority of reporting studies do indicate that abnormal oxygen saturation, respiratory rate, systolic blood pressure, and temperature are significant predictors of poor outcome.

Although a large number of screening, triage, and severity scoring tools were described in the literature, LRS use is likely to be limited. More than half of the screening tools identified in this review are likely feasible in LRS, but only a small number of triage and severity scoring tools are. Of the tools proposed for use in LMICs, 51–31 for screening, 5 for triage, and 15 for severity scoring were deemed feasible in LRS. The most notable of these was the integrated screening and triage process used by Howitt et al in Timor-Leste. The algorithm was adapted from Ayebare et al (Uganda) with the removal of laboratory testing for COVID-19. It uses well-supported inputs, including oxygen saturation and respiratory symptoms, to identify and prognosticate potentially positive COVID-19 patients in a rapid manner. The general lack of validated tools, specifically those for severity scoring, led to the recent development of a contextually appropriate COVID-19 mortality scale for LRS. Though not included in this study due to initial search parameters, the AFEM-CMS is a pragmatic tool that makes use of seven demographic, historical, and clinical inputs to evaluate potential risk of death in patients with COVID-19: a second tool includes pulse oximetry. While many LRS EUs lack pulse oximeters needed to evaluate for hypoxia, these devices are becoming increasingly available. As such, this review considered pulse oximetry feasible in LRS.

Limitations
Feasibility does not predict that a tool will be accurate or effective. Tools should be validated in the setting of intended use. This review found no tools validated in low-income and lower middle-income countries. Of those validated in upper middle-income countries, nearly all were from well-resourced areas of China, substantially limiting generalisability to LRS. Without contextually appropriate validation data, it is difficult to predict if feasible tools are effective in identifying and risk stratifying patients with COVID-19.

Most of the tools discussed in this review were peer-reviewed publications or guidelines by reputable international organisations, with a smaller number in the form of editorials, published correspondence and preprints. The latter forms of publication often lack peer review and may be of lower quality. Furthermore, this review is likely missing a number of tools. Almost every health system worldwide maintains some form of screening and triage processes, along with processes for further decision making around admission. While in use, both before and during the COVID-19 pandemic, these tools have not been formally published and cannot be described here. Feasibility in LRS was acknowledged if there was a well-described and low-input method of diagnosis available (eg, case definition coupled with vital signs abnormalities) even if it was not necessarily the gold standard of diagnosis in high-resource settings. Risk of bias assessments could not be performed because most articles were in the form of descriptive reviews, rather than the presentation of primary data.

CONCLUSIONS
In LRS, where definitive diagnostic tests for COVID-19, such as RT-PCR, may not be available, screening, triage, and severity scoring of potential COVID-19 patients are critical. Rapid identification and prognostication of patients with suspected COVID-19 in LRS EUs will allow for appropriate precautions and care to be rendered to all patients, resulting in conservation of resources and reductions in morbidity and mortality. At present, no screening, triage, or severity scoring tools have been designed and validated specifically for LRS. In the face of an enduring pandemic, it is critical that such tools be developed, validated, and made available, so that limited resources can be conserved for those in greatest need and unnecessary loss of life is prevented.

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REFERENCES
1 Timeline of WHO’s response to COVID-19 Geneva: World Health Organization. 2020. Available: https://www.who.int/news-room/detail/29-06-2020-covid-timeline
2 World Health Organization. Who coronavirus disease (COVID-19) Dashboard Geneva, 2020. Available: https://covid19.who.int/
3 Bong C-L, Brasher C, Chikumbu E, et al. The COVID-19 pandemic: effects on low- and middle-income countries. Anesthesia Analgesia 2020;131:86–92.
4 Massinga Loembé M, Tahangela A, Salyer SJ, et al. COVID-19 in Africa: the spread and response. Nat Med 2020;26:999–1003.
5 Lone SA, Ahmad A. COVID-19 pandemic - an African perspective. Emerg Microbes Infect 2020;9:300.
6 Careno L, Costantini E, Greco M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. Anaesthesia 2020;75:928–34.
7 Chavula C, Pigoga JL, Katwamfwa M, et al. Cross-Sectional evaluation of emergency care capacity at public hospitals in Zambia. Emerg Med J 2019;36:620–4.
8 Bitter CC, Rice B, Periyanaayagam U, et al. What resources are used in emergency departments in rural sub-Saharan Africa? A retrospective analysis of patient care in a district-level hospital in Uganda. BMJ Open 2018;8:e019024.
9 Reynolds TA, Mfinanga JA, Sawe HR, et al. Emergency care capacity in Africa: a clinical and educational initiative in Tanzania. J Public Health Policy 2012;33 Suppl 1:S126–37.
10 Dalwai M, Taylor-Smith K, Twomey M, et al. Inter-Rater and intrarater reliability of the South African triage scale in low-resource settings of Haiti and Afghanistan. Emerg Med J 2018;35:379–83.
11 Gostic K, Gomez AC, Mummah RO, et al. Estimated effectiveness of symptom and risk screening to prevent the spread of COVID-19. Elife 2020;9: doi:10.7554/elife.55570. [Epub ahead of print: 24 02 2020].
12 Hansoti B, Jenson A, Kironji AG, et al. Screen: a simple layerpso administered screening algorithm in low resource international settings significantly reduces waiting time for critically ill children in primary healthcare clinics. PLoS One 2017;12:e0118350.
13 Jenson A, Hansoti B, Rothman R, et al. Reliability and validity of emergency department triage tools in low- and middle-income countries: a systematic review. Eur J Emerg Med 2018;25:154–60.
14 Organization WH. Emergency triage assessment and treatment (ETAT) manual for participants, 2005. Available: https://www.who.int/publications/i/item/9241546875
15 Oredsson S, Jonsson H, Rognes J, et al. A systematic review of triage-related interventions to improve patient flow in emergency departments. Scand J Trauma Resusc Emerg Med 2011;19:43.
16 Venkatesan S, Myles PR, McCann G, et al. Development of processes allowing near real-time refinement and validation of triage tools during the early stage of an outbreak in readiness for surge: the FLU-CATs study. Health Technol Assess;19:1–132.
17 Tricco AC, Lillie E, Zarir W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med 2018;169:467–73. Electronic.
18 Wang Z, Zhou G, Wang C, et al. Clinical characteristics of children with COVID-19: a rapid review and meta-analysis. Ann Transl Med 2020;8:620.
19 Seidu A-A, Hagan JE, Ameyaw EK, et al. The role of testing in the fight against COVID-19: current happenings in Africa and the way forward. Int J Infect Dis 2020;98:237–40.
20 Smith B, Chu UK, Smith TC, et al. Challenges of self-reported medical conditions and electronic medical records among members of a large military cohort. BMC Med Res Methodol 2008;8:37.
21 Burke RM, Killeby ME, Newton S, et al. Symptom Profiles of a Convenience Sample of Patients with COVID-19 – United States, January-April 2020. MMWR Mortal Wkly Rep 2020;69:904–8.
22 Vilke GM, Brennan JJ, Cronin AO, et al. Clinical features of patients with COVID-19: is temperature screening useful? J Emerg Med 2020;59:952–6.
23 Singh NS, Abraham O, Altare C, et al. COVID-19 in humanitarian settings: documenting and sharing context-specific programmatic experiences. Confl Health 2020;14:79.
24 World Health Organization. Clinical management of COVID-19 interim guidance; 2020:1–58.
25 Kompaniyets L, Goodman AB, Belay B, et al. Body mass index and risk for COVID-19-related hospitalization, intensive care unit admission, invasive mechanical ventilation, and death - United States, march–december 2020. MMWR Mortal Wkly Rep 2021;70:355–61.
26 Fang X, Li S, Yu H, et al. Epidemiological, comorbidity factors with severity and prognosis of COVID-19: a systematic review and meta-analysis. Aging 2020;12:12483–503.
27 Pigoga J, Friedman A, Broccoli M. Clinical and historical features associated with severe COVID-19 infection: a systematic review. Medrxiv 2020.
28 Howitt R, de Jesus GA, Araujo F, et al. Screening and triage at health-care facilities in Timor-Leste during the COVID-19 pandemic. Lancet Respir Med 2020;8:e43.
29 Ayebare RR, Flick R, Okware S, et al. Adoption of COVID-19 triage strategies for low-income settings. Lancet Respir Med 2020;8:e22.
30 Pigoga JL, Omer YO, Wallis LA. Derivation of a contextually-appropriate COVID-19 mortality scale for low-resource settings. Ann Glob Health 2021;87:31.
Appendix 1: Search strategy

Search limits: 01 December 2019 to 01 April 2021, English only, publications only

Search terms:
The initial search terms included the following, formatted to the following databases:

- (COVID-19 OR SARS-CoV-2) AND (Triage OR Screening OR Risk OR Severity) AND (Stratification OR Prediction OR Tool OR Index OR Score)

Given the rapid and logarithmic number of articles on Covid, an updated search led to the inclusion of the following terms specific to emergency care in order to refine the initial articles screened for review.

- ("emergency responders" OR "emergency medical services" OR "emergency treatment" OR "emergency medicine" OR "ambulances" OR "critical care" OR "shock" OR "sepsis" OR "wounds and injuries" OR "pregnancy complications" OR "emergency responder" OR "emergency responders" OR "emergency doctor" OR "emergency doctors" OR "emergency clinician" OR "emergency clinicians" OR "emergency physician" OR "emergency physicians" OR "emergency personnel" OR "emergency medical personnel" OR "emergency service" OR "emergency services" OR "emergency medical service" OR "emergency medical services" OR "emergency medicine" OR "emergency health service" OR "emergency health services" OR "emergency care" OR "emergency healthcare" OR "emergency treatment" OR "emergency treatments" OR "emergency department" OR "emergency departments" OR "emergency room" OR "emergency rooms" OR "emergency ward" OR "emergency wards" OR "emergency unit" OR "emergency units" OR "emergency hospital" OR "emergency hospitals" OR "emergency clinic" OR "emergency clinics" OR "emergency setting" OR "emergency staff" OR "emergency response" OR "emergency medical technician" OR "emergency medical technicians" OR "paramedic" OR "paramedics" OR "ambulance" OR "ambulances" OR "ER" OR "first responder" OR "first responders" OR "rescue work" OR "rescue worker" OR "rescue workers" OR "relief work" OR "relief worker" OR "relief workers" OR "firefighter" OR "firefighters" OR "fire fighter" OR "fire fighters" OR "trauma center" OR "trauma centers" OR "trauma unit" OR "trauma units" OR "critical care" OR "critical illness" OR "critical illnesses" OR "resuscitation" OR "shock" OR "sepsis" OR "septicemia" OR "septicaemia" OR "acute care" OR "acute disease" OR "acute diseases" OR "prehospital" OR "pre hospital" OR "wound" OR "wounds" OR "triage" OR "pregnancy complication" OR "pregnancy complications" OR "obstetric complication" OR "obstetric complications" OR "obstetric emergency" OR "obstetric emergencies")

Table 1. Total number of unique articles for initial screening

| Database      | Number of articles |
|---------------|--------------------|
| Embase        | 7591               |
| Ovid/Medline  | 587                |
| PubMed        | 4206               |
| Web of Science| 2848               |
### Appendix 2: Supplementary Tables

#### Supplementary Table 1: Screening tool study characteristics (n=57).

| Title                                                                 | First author       | Year | Study location  | Study setting | Age group    | No. tool inputs | Has the tool been proposed or implemented? |
|----------------------------------------------------------------------|--------------------|------|-----------------|---------------|--------------|----------------|------------------------------------------|
| Preparing for emerging respiratory pathogens such as SARS-CoV, MERS-CoV, and SARS-CoV-2(1) | Al-Tawfiq          | 2020 | Dhahran, Saudi Arabia | High-income | Not specified | 7              | Proposed                                 |
| Correlation Between the COVID-19 Respiratory Triage Score and SARS-CoV-2 PCR Test(2) | Aldobyany          | 2020 | Makkah, Saudi Arabia | High-income   | Not specified | 14             | Implemented                              |
| Guidance for building a dedicated health facility to contain the spread of the 2019 novel coronavirus outbreak(3) | Argawal            | 2020 | Pune, India      | Lower-middle-income | Not specified | 4              | Proposed                                 |
| Rapid response infrastructure for pandemic preparedness in a tertiary care hospital: lessons learned from the COVID-19 outbreak in Cologne, Germany, February to March 2020(4) | Augustin           | 2020 | Cologne, Germany | High-income   | Not specified | 3              | Implemented                              |
| Adoption of COVID-19 triage strategies for low-income settings(5)     | Ayebare            | 2020 | Uganda           | Low-income    | Outpatient / general practitioner | 6              | Proposed                                 |
| Development, evaluation, and validation of machine learning models for COVID-19 detection based on routine blood tests(6) | Cabitza            | 2021 | Italy            | High-income   | Hospital     | 23             | Proposed                                 |
| Hospital Emergency Management Plan During the COVID-19 Epidemic(7)     | Cao                | 2020 | Chengdu, China   | Upper-middle-income | Not specified | 3              | Implemented                              |
| Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy(8) | Carenzo            | 2020 | Milan, Italy     | High-income   | Hospital     | 4              | Implemented                              |
| Standard Operating Procedure for Triage of suspected COVID-19 patients in non-US Healthcare settings(9) | Centers for Disease Control and Prevention | 2020 | United States    | High-income   | Not specified | 4              | Proposed                                 |
| Study Title                                                                 | Author     | Year | Location                      | Setting                      | Type                          | Outpatient/general practitioner | Proposed/Implemented |
|---------------------------------------------------------------------------|------------|------|-------------------------------|------------------------------|-------------------------------|--------------------------------|---------------------|
| Enhancing the triage and cohort of patients in public primary care clinics in response to the coronavirus disease 2019 (COVID-19) in Hong Kong: an experience from a hospital cluster | Chan       | 2020 | Hong Kong, China              | Outpatient/general practitioner | Not specified                 | 3                  | Implemented         |
| Infection control measures of a Taiwanese hospital to confront the COVID-19 pandemic                          | Chang      | 2020 | Kaohsiun, Taiwan               | Hospital                     | Not specified                 | 3                  | Implemented         |
| Fangcang shelter hospitals: a novel concept for responding to public health emergencies                          | Chen       | 2020 | Wuhan, China                  | Hospital                     | Not specified                 |                   | Implemented         |
| Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARS-CoV-2 in Hong Kong                          | Cheng      | 2020 | Hong Kong, China              | Hospital                     | Not specified                 | 4                  | Implemented         |
| Onsite telemedicine strategy for coronavirus (COVID-19) screening to limit exposure in ED                           | Chou       | 2020 | Texas, United States           | Hospital-based emergency care | Not specified                 | 3                  | Implemented         |
| Mobilization and Preparation of a Large Urban Academic Center During the COVID-19 Pandemic                          | Chowdhury  | 2020 | Pennsylvania, United States    | Hospital                     | Not specified                 | 13                 | Implemented         |
| Revised Triage and Surveillance Protocols for Temporary Emergency Department Closures in Tertiary Hospitals as a Response to COVID-19 Crisis in Daegu Metropolitan City                          | Chung      | 2020 | Daegu, Korea                  | Hospital-based emergency care | Not specified                 | 7                  | Proposed            |
| Infection control practices in children during COVID-19 pandemic: differences from adults                          | Devrim     | 2020 | Izmir, Turkey                 | Paediatric                   | 4                  |                  | Implemented         |
| Calculated Decisions: Brescia-COVID Respiratory Severity Scale (BCRSS)/Algorithm                               | Duca       | 2020 | United States                  | Hospital-based emergency care | Not specified                 | 1                  | Implemented         |
| Triage decision-making at the time of COVID-19 infection: the Piacenza strategy                                 | Erika      | 2020 | Piacenza, Italy                | Hospital-based emergency care | Not specified                 | 4                  | Implemented         |
| Lung Ultrasound vs. Chest X-Ray Study for the Radiographic Diagnosis of COVID-19 Pneumonia in a High-Prevalence Population                          | Gibbons    | 2021 | United States                  | Hospital-based emergency care | Not specified                 | 7                  | Proposed            |
| Immersion in an emergency department triage center during the Covid-19 outbreak: first report of the Liège University hospital experience                      | Gilbert    | 2020 | Liège, Belgium                | Hospital-based emergency care | Not specified                 | 5                  | Implemented         |
| Study Title                                                                 | Author(s)  | Year | Country          | Income Level          | Setting                          | Role                  | Implementation Status | Study Type |
|---------------------------------------------------------------------------|------------|------|------------------|------------------------|----------------------------------|-----------------------|-----------------------|------------|
| An effective screening and management process in the outpatient clinic for patients requiring hospitalization during the COVID-19 pandemic | Guo        | 2020 | Beijing, China   | Upper-middle-income    | Outpatient / general practitioner | Not specified         | 4         | Proposed   |
| How to transform a general hospital into an "infectious disease hospital" during the epidemic of COVID-19   | He         | 2020 | China            | Upper-middle-income    | Hospital                         | Not specified         | 2         | Implemented |
| Screening and triage at health-care facilities in Timor-Leste during the COVID-19 pandemic | Howitt      | 2020 | Timor-Leste      | Lower-middle income    | Not specified                    | 2                     | Implemented |
| Application and effects of fever screening system in the prevention of nosocomial infection in the only designated hospital of coronavirus disease 2019 (COVID-19) in Shenzhen, China | Huang       | 2020 | Shenzhen, China  | Upper-middle-income    | Hospital                         | Not specified         | 5         | Implemented |
| The role of emergency medical services in containing COVID-19 | Jaffe       | 2020 | Israel           | High-income            | Prehospital emergency care      | Not specified         | 2         | Implemented |
| An algorithmic approach to diagnosis and treatment of coronavirus disease 2019 (COVID-19) in children: Iranian expert’s consensus statement | Karimi      | 2020 | Tehran, Iran     | Upper-middle-income    | Not specified                    | Paediatric            | 9         | Proposed   |
| 2019-nCoV: The Identify-Isolate-Inform (3I) Tool Applied to a Novel Emerging Coronavirus | Koenig      | 2020 | United states    | High-income            | Not specified                    | 3                     | Proposed   |
| Diagnosis and clinical management of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection: an operational recommendation of Peking Union Medical College Hospital (V2.0): Working Group of 2019 Novel Coronavirus, Peking Union Medical College Hospital | Li          | 2020 | Beijing, China   | Upper-middle-income    | Not specified                    | 1                     | Proposed   |
| A Double Triage and Telemedicine Protocol to Optimize Infection Control in an Emergency Department in Taiwan During the COVID-19 Pandemic: Retrospective Feasibility Study | Lin         | 2020 | Taipei, Taiwan   | High-income            | Hospital                         | Adult                 | 3         | Implemented |
| Optimizing screening strategies for coronavirus disease 2019: A study from Middle China | Liu         | 2020 | Changsa, China   | Upper-middle-income    | Not specified                    | Not specified         | 3         | Proposed   |
| Study Title                                                                 | Author(s)    | Year | Region/Country                      | Income Level | Setting | Phase       | Implementation Status |
|-----------------------------------------------------------------------------|--------------|------|-------------------------------------|--------------|---------|-------------|-----------------------|
| A COVID-19 Risk Assessment Decision Support System for General Practitioners: Design and Development Study | Liu          | 2020 | Hangzhou, China                     | Upper-middle-income | Outpatient / general practitioner | Not specified | Proposed |
| Reorganization of a large academic hospital to face COVID-19 outbreak: The model of Parma, Emilia-Romagna region, Italy | Meschi       | 2020 | Parma, Italy                        | High-income   | Hospital-based emergency care    | Not specified | 3 Implemented |
| How emergency departments prepare for virus disease outbreaks like COVID-19 during the Outbreak in Bergamo, Italy | Möckel       | 2020 | Germany                             | High-income   | Hospital-based emergency care    | Not specified | 3 Implemented |
| Clinical Triaging in Cough Clinic Alleviates COVID-19 Overload in Emergency Department in India | Nayan        | 2020 | West Bengal, India                  | Lower-middle-income | Hospital            | Not specified | 8 Implemented |
| A Pediatric Emergency Department Protocol to Avoid Interhospital Spread of SARS-CoV-2 during the Outbreak in Bergamo, Italy | Nicastro     | 2020 | Bergamo, Italy                      | High-income   | Hospital            | Paediatric    | 3 Implemented |
| The ultrasound guided triage: a new tool for prehospital management of COVID-19 pandemic | Piliego      | 2020 | Italy                               | High-income   | Not specified        | Not specified | 7 Proposed |
| Screening and managing of suspected or confirmed novel coronavirus (COVID-19) patients: experiences from a tertiary hospital outside Hubei province | Pu           | 2020 | Chengdu, China                      | Upper-middle-income | Hospital            | Not specified | 2 Implemented |
| Reorganising the emergency department to manage the COVID-19 outbreak | Quah         | 2020 | Singapore                           | High-income   | Hospital-based emergency care    | Not specified | 7 Implemented |
| Diagnostic accuracy of symptoms as a diagnostic tool for SARS-CoV-2 infection: a cross-sectional study in a cohort of 2,173 patients | Romero-Gameros | 2021 | Mexico City, Mexico                | Upper-middle-income | Hospital-based emergency care    | Not specified | 11 Proposed |
| Can You Catch It? Lessons Learned and Modification of ED Triage Symptom- and Travel-Screening Strategy | Schwedhelm   | 2020 | Nebraska, United States            | High-income   | Hospital-based emergency care    | Not specified | 4 Implemented |
| Emergency Responses to Covid-19 Outbreak: Experiences and Lessons from a General Hospital in Nanjing, China | Shen         | 2020 | Nanjing, China                      | Upper-middle-income | Hospital            | Not specified | 5 Implemented |
| A quickly, effectively screening process of novel corona virus disease 2019 (COVID-19) in children in Shanghai, China | Shi          | 2020 | Shanghai, China                    | Upper-middle-income | Hospital            | Paediatric   | 3 Implemented |
| The response of Milan's Emergency Medical System to the COVID-19 outbreak in Italy | Spina        | 2020 | Milan, Italy                       | High-income   | Prehospital emergency care       | Not specified | 2 Implemented |
| Reducing hospital admissions for COVID-19 at a dedicated screening centre in Singapore | Tan          | 2020 | Singapore                          | High-income   | Hospital            | Not specified | 3 Implemented |
| Title                                                                 | Author | Year | Location          | Type                        | Income Level       | Setting                      | Age | Status  |
|----------------------------------------------------------------------|--------|------|-------------------|-----------------------------|--------------------|------------------------------|-----|---------|
| The role of triage in the prevention and control of COVID-19(43)      | Wang   | 2020 | Xi’an, China      | Upper-middle-income         | Hospital           | Not specified                | 7   | Implemented |
| Providing uninterrupted care during COVID-19 pandemic: experience from Beijing Tiantan Hospital(44) | Wang   | 2020 | Beijing, China    | Upper-middle-income         | Hospital           | Not specified                | 4   | Implemented |
| Containing COVID-19 in the Emergency Department: The Role of Improved Case Detection and Segregation of Suspect Cases(45) | Wee    | 2020 | Singapore         | High-income                 | Hospital-based emergency care | All ages                     | 2   | Implemented |
| Redesigning emergency department operations amidst a viral pandemic(46) | Whiteside | 2020 | United States     | High-income                 | Hospital-based emergency care | Not specified               | 3   | Proposed    |
| Clinical Management of COVID-19 Interim Guidance(47)                  | World Health Organization | 2020 | Not applicable    | Not applicable              | Not specified      | All ages                     | 4   | Proposed    |
| Strategies for qualified triage stations and fever clinics during the outbreak of COVID-2019 in the county hospitals of Western Chongqing(48) | Wu     | 2020 | Western Chongqing, China | Upper-middle-income         | Outpatient / general practitioner | Not specified               | 17  | Implemented |
| Therapeutic and triage strategies for 2019 novel coronavirus disease in fever clinics(49) | Zhang  | 2020 | Wuhan, China      | Upper-middle-income         | Outpatient / general practitioner | Not specified               | 10  | Implemented |
| Analysis and suggestions for the preview and triage screening of children with suspected COVID-19 outside the epidemic area of Hubei Province(50) | Zhang  | 2020 | Chongqing, China  | Upper-middle-income         | Outpatient / general practitioner | Paediatric                   | 5   | Implemented |
| COVID19: A Systematic Approach to Early Identification and Healthcare Worker Protection(51) | Zhao   | 2020 | Shanghai, China   | Upper-middle-income         | Not specified      | Not specified                | 4   | Proposed    |
| Primary stratification and identification of suspected Corona virus disease 2019 (COVID-19) from clinical perspective by a simple scoring proposal(52) | Zhou   | 2020 | Gansu, China      | Upper-middle-income         | Not specified      | Not specified                | 10  | Proposed    |
| Proposed Clinical Indicators for Efficient Screening and Testing for COVID-19 Infection from Classification and Regression Trees (CART) Analysis(53) | Zimmerman | 2020 | Pennsylvania, United States | High-income         | Outpatient / general practitioner | Not specified               | 5   | Proposed    |
| Application of Critical Care Ultrasound in Patients With COVID-19: Our Experience and Perspective(54) | Zou    | 2020 | Chengdu, China    | Upper-middle-income         | Not specified      | Not specified                | 7   | Proposed    |
**Supplementary Table 2: Triage tool study characteristics (n=23).**

| Title                                                                 | First author                  | Year | Study location          | Study setting income level | Study setting         | Age group | No. tool inputs | Has the tool been proposed or implemented? |
|-----------------------------------------------------------------------|-------------------------------|------|-------------------------|---------------------------|-----------------------|-----------|-----------------|------------------------------------------|
| Point-of-Care Ultrasound in the Evaluation of COVID-19 (55)           | Abrams                        | 2020 | United States           | High-income               | Hospital              | Not specified | 1               | Proposed                                 |
| Emergency Department COVID-19 Severity Classification (56)            | American College of Emergency Physicians | 2020 | United States           | High-income               | Not specified         | Adults     | 41              | Proposed                                 |
| Fangcang shelter hospitals: a novel concept for responding to public health emergencies (12) | Chen                          | 2020 | Wuhan, China            | Upper-middle-income       | Hospital              | Not specified | 12              | Implemented                              |
| Mobilization and Preparation of a Large Urban Academic Center During the COVID-19 Pandemic (15) | Chowdhury                     | 2020 | Pennsylvania, United States | High-income              | Hospital              | Not specified | 16              | Implemented                              |
| Revised Triage and Surveillance Protocols for Temporary Emergency Department Closures in Tertiary Hospitals as a Response to COVID-19 Crisis in Daegu Metropolitan City (16) | Chung                         | 2020 | Daegu, Korea            | High-income               | Hospital-based emergency care | Not specified | 8               | Proposed                                 |
| Early prediction of the risk of severe coronavirus disease 2019: A key step in therapeutic decision making (57) | Côté                          | 2020 | Quebec, Canada          | High-income               | Not specified         | Not specified | 21              | Proposed                                 |
| Infection control practices in children during COVID-19 pandemic: differences from adults (17) | Devrim                        | 2020 | Izmir, Turkey           | Upper-middle-income       | Not specified         | Paediatric | 5               | Implemented                              |
| Using Lung Point-of-care Ultrasound in Suspected COVID-19: Case Series and Proposed Triage Algorithm (58) | Duggan                        | 2020 | United States           | High-income               | Not specified         | Not specified | 1               | Proposed                                 |
| Simple, fast and affordable triaging pathway for COVID-19 (59)        | Eggleton                      | 2020 | United Kingdom          | High-income               | Not specified         | Not specified | 1               | Proposed                                 |
| How is COVID-19 affecting South Korea? What is our current strategy? (60) | Her                           | 2020 | South Korea             | High-income               | Not specified         | Not specified | 2               | Implemented                              |
| Screening and triage at health-care facilities in Timor-Leste during the COVID-19 pandemic (24) | Howitt                        | 2020 | Timor-Leste             | Lower-middle income      | Not specified         | Not specified | 4               | Implemented                              |
| Study Title                                                                 | Author | Year | Location                  | Setting                      | Income Level       | Phase | Status  |
|---------------------------------------------------------------------------|--------|------|---------------------------|------------------------------|--------------------|-------|---------|
| An algorithmic approach to diagnosis and treatment of coronavirus disease 2019 (COVID-19) in children: Iranian expert’s consensus statement | Karimi | 2020 | Tehran, Iran              | Upper-middle-income          | Not specified      | Paediatric | 15     | Proposed |
| Diagnosis and clinical management of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection: an operational recommendation of Peking Union Medical College Hospital (V2.0) | Li     | 2020 | Beijing, China            | Upper-middle-income          | Hospital           | Not specified | 11     | Proposed |
| A Double Triage and Telemedicine Protocol to Optimize Infection Control in an Emergency Department in Taiwan During the COVID-19 Pandemic: Retrospective Feasibility Study | Lin    | 2020 | Taipei, Taiwan            | High-income                  | Hospital           | Adult        | 8      | Implemented |
| Proposed Modifications in the 6-minute Walk Test for Potential Application in Patients with mild Coronavirus Disease 2019 (COVID-19): A Step to Optimize Triage Guidelines | Mantha | 2020 | India                     | Lower-middle income         | Not specified      | Not specified | 6      | Proposed |
| Reorganization of a large academic hospital to face COVID-19 outbreak: The model of Parma, Emilia-Romagna region, Italy | Meschi | 2020 | Parma, Italy              | High-income                  | Hospital-based emergency care | Not specified | 8      | Implemented |
| A Dynamic Bayesian Model for Identifying High-Mortality Risk in Hospitalized COVID-19 Patients | Momeni-Boroujeni | 2021 | New York, United States   | High-income                  | Hospital           | Not specified | 11     | Proposed |
| The ultrasound guided triage: a new tool for prehospital management of COVID-19 pandemic | Piliego | 2020 | Italy                     | High-income                  | Not specified      | Not specified | 9      | Proposed |
| Pattern recognition of high-resolution computer tomography (HRCT) chest to guide clinical management in patients with mild to moderate COVID-19 | Rajalingam | 2021 | South Tamilnadu, India    | Lower-middle-income         | Outpatient/ general practitioner | Not specified | 1      | Proposed |
| COVID-19 Outpatient Screening: A Prediction Score for Adverse Events | Sun    | 2020 | Massachusetts, United States | High-income                  | Outpatient / general practitioner | Adult        | 20     | Proposed |
| Study Description                                                                 | Author | Year | Location       | Country Income Level | Age Groups     | Allocation | Status  |
|----------------------------------------------------------------------------------|--------|------|----------------|----------------------|----------------|------------|---------|
| Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province | Sun    | 2020 | Nanjing, China | Upper-middle-income  | Not specified  | Not specified | 6       | Implemented |
| Clinical Management of COVID-19 Interim Guidance                                  | World Health Organization | 2020 | Not applicable | Not applicable       | Not specified  | All ages   | 18      | Proposed    |
### Supplementary Table 3: Severity scoring / prognostication tool study characteristics (n=54).

| Title                                                                 | First author | Year | Study location     | Study setting income level | Study setting | Age group          | No. tool inputs | Has the tool been proposed or implemented? |
|-----------------------------------------------------------------------|--------------|------|--------------------|---------------------------|---------------|--------------------|----------------|------------------------------------------|
| Isaric 4c Mortality Score As A Predictor Of In-Hospital Mortality In Covid-19 Patients Admitted In Ayub Teaching Hospital During First Wave Of The Pandemic. | Ali          | 2021 | Abbottabad, Pakistan | Lower-middle-income        | Hospital      | Not specified      | 8              | Proposed                                 |
| Development and validation of a prediction model for severe respiratory failure in hospitalized patients with SARS-Cov-2 infection: a multicenter cohort study (PREDICO study) | Bartoletti    | 2020 | Bologna, Italy     | High-income                | Hospital      | Not specified      | 8              | Proposed                                 |
| Lung ultrasonography for risk stratification in patients with COVID-19: a prospective observational cohort study | Brahier      | 2020 | Switzerland        | High-income                | Hospital      | Not specified      | 1              | Proposed                                 |
| Prediction of severe illness due to COVID-19 based on an analysis of initial fibrinogen to albumin ratio and platelet count | Bi            | 2020 | Taizhou, China     | Upper-middle-income        | Hospital      | Not specified      | 2              | Proposed                                 |
| Chest X-ray in new Coronavirus Disease 2019 (COVID-19) infection: findings and correlation with clinical outcome | Cozzi         | 2020 | Florence, Italy    | High-income                | Hospital      | Not specified      | 1              | Proposed                                 |
| Predicting CoVID-19 community mortality risk using machine learning and development of an online prognostic tool. | Das           | 2020 | South Korea        | High-income                | Not specified | Not specified      | 3              | Proposed                                 |
| A novel simple scoring model for predicting severity of patients with SARS-CoV-2 infection | Dong          | 2020 | Wuhan, China       | Upper-middle-income        | Hospital      | Not specified      | 3              | Proposed                                 |
| Correlation between the variables collected at admission and progression to severe cases during hospitalization among patients with COVID-19 in Chongqing | Duan          | 2020 | Chongqing, China   | Upper-middle-income        | Not specified | Not specified      | 3              | Proposed                                 |
| A multipurpose machine learning approach to predict COVID-19 negative prognosis in São Paulo, Brazil | Fernandes     | 2021 | São Paulo, Brazil  | High-income                | Upper-middle-income | Not specified | 5              | Proposed                                 |
The utility of established prognostic scores in COVID-19 hospital admissions: a multicentre prospective evaluation of CURB-65, NEWS2, and qSOFA

Frost 2020  Liverpool, England  High-income  Hospital  Not specified  2  Proposed

A clinical risk score to identify patients with COVID-19 at high risk of critical care admission or death: An observational cohort study

Galloway 2020  London, United Kingdom  High-income  Hospital  Not specified  10  Proposed

Prognostic Accuracy of the SIRS, qSOFA, and NEWS for Early Detection of Clinical Deterioration in SARS-CoV-2 Infected Patients

Geol Jang 2020  Daegu, Korea  High-income  Not specified  Not specified  3  Proposed

Predictive value of National Early Warning Score 2 (NEWS2) for intensive care unit admission in patients with SARS-CoV-2 infection

Gidari 2020  Perugia, Italy  High-income  Hospital  Not specified  1  Proposed

A Tool for Early Prediction of Severe Coronavirus Disease 2019 (COVID-19): A Multicenter Study Using the Risk Nomogram in Wuhan and Guangdong, China

Gong 2020  Guangzhou, China  Upper-middle-income  Hospital  Not specified  7  Proposed

Development and validation of a prognostic model based on comorbidities to predict COVID-19 severity: a population-based study

Gude-Sampedro 2021  Galicia, Spain  High-income  Not specified  Not specified  10  Proposed

Evaluation of the clinical profile, laboratory parameters and outcome of two hundred COVID-19 patients from a tertiary centre in India

Gupta 2020  India  Lower-middle-income  Not specified  Not specified  12  Proposed

Development and validation of the quick COVID-19 severity index (qCSI): a prognostic tool for early clinical decompensation

Haimovich 2020  Connecticut, United States  High-income  Not specified  Not specified  3  Proposed

Predictive Value of 5 Early Warning Scores for Critical COVID-19 Patients

Hu 2020  Wuhan, China  Upper-middle-income  Hospital-based emergency care  Not specified  5  Proposed

COVID-19 Severity Index: predictive score for hospitalized patients

Huespe 2020  Buenos Aires, Argentina  Upper-middle-income  Hospital  Not specified  16  Proposed
| Study Title                                                                 | Author(s)      | Year | Location          | Income Level | Setting | Study Type          | n  | Proposed |
|----------------------------------------------------------------------------|----------------|------|-------------------|--------------|---------|---------------------|----|----------|
| COVID-19: Symptoms, course of illness and use of clinical scoring systems for the first 42 patients admitted to a Norwegian local hospital | Ihle-Hansen    | 2020 | Viken county, Norway | High-income  | Hospital | Not specified       | 1  | Proposed |
| Clinical Characteristics and Prognostic Factors for Intensive Care Unit Admission of Patients With COVID-19: Retrospective Study Using Machine Learning and Natural Language Processing | Izquierdo      | 2020 | Castilla-La Mancha, Spain | High-income  | Not specified | Not specified       | 3  | Proposed |
| Development and validation of a model for individualized prediction of hospitalization risk in 4,536 patients with COVID-19 | Jehi           | 2020 | Guangzhou, China  | Upper-middle-income | Not specified | Not specified       | 8  | Proposed |
| The association of chest radiographic findings and severity scoring with clinical outcomes in patients with COVID-19 presenting to the emergency department of a tertiary care hospital in Pakistan | Kaleemi        | 2021 | Pakistan          | Lower-middle-income | Adult | Hospital-based emergency care | 1  | Proposed |
| The performance of the National Early Warning Score and National Early Warning Score 2 in hospitalised patients infected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) | Kostakis       | 2020 | United Kingdom    | High-income  | Hospital | Not specified       | 1  | Proposed |
| Clinical Frailty Scale for risk stratification in patients with SARS-CoV-2 infection | Labenz         | 2020 | Mainz, Germany    | High-income  | Hospital | Not specified       | 1  | Proposed |
| Triage tool for suspected COVID-19 patients in the emergency room: AIFELL score | Levenfus       | 2020 | Zurich, Switzerland | High-income  | Hospital | Not specified       | 6  | Proposed |
| A simple algorithm helps early identification of SARS-CoV-2 infection patients with severe progression tendency | Li             | 2020 | Shanghai, China   | Upper-middle-income | Not specified | Not specified       | 3  | Proposed |
| Development and Validation of a Clinical Risk Score to Predict the Occurrence of Critical Illness in Hospitalized Patients With COVID-19 | Liang          | 2020 | Guangzhou, China  | Upper-middle-income | Not specified | Not specified       | 10 | Proposed |
| Early triage of critically ill COVID-19 patients using deep learning | Liang          | 2020 | Guangzhou, China  | Upper-middle-income | Not specified | Not specified       | 10 | Proposed |
| Title                                                                 | Author(s) | Year | Location                        | Setting                          | Income Level       | Type            | Proposed | Disease Severity | paediatric | Adult    | Published in                                      |
|----------------------------------------------------------------------|-----------|------|---------------------------------|----------------------------------|--------------------|-----------------|----------|------------------|------------|----------|--------------------------------------------------|
| Development and validation of a risk stratification model for screening suspected cases of COVID-19 in China | Ma        | 2020 | Wuhan, China                    | Not specified                    | Not specified      | 23              | Proposed |                  |            |          | BMJ Open 2020                                    |
| National Early Warning Score 2 (NEWS2) on admission predicts severe disease and in-hospital mortality from Covid-19 - a prospective cohort study | Myrstad   | 2020 | Oslo, Norway                    | High-income                      | Hospital            | 1               | Proposed |                  |            |          | BMJ Open 2020                                    |
| A score combining early detection of cytokines accurately predicts COVID-19 severity and intensive care unit transfer | Nagant    | 2020 | Brussels, Belgium               | High-income                      | Hospital            | 3               | Proposed |                  |            |          | BMJ Open 2020                                    |
| A nomogram to predict the risk of unfavourable outcome in COVID-19: a retrospective cohort of 279 hospitalized patients in Paris area | Nguyen    | 2020 | Paris, France                   | High-income                      | Hospital            | 7               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Automated EHR score to predict COVID-19 outcomes at US Department of Veterans Affairs | Osborne  | 2020 | California, United States       | High-income                      | Not specified       | 25              | Proposed |                  |            |          | BMJ Open 2020                                    |
| NEWS can predict deterioration of patients with COVID-19(101)        | Peng      | 2020 | Huazhong, China                 | Upper-middle-income              | Not specified       | 2               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Examining the utility of extended laboratory panel testing in the emergency department for risk stratification of patients with COVID-19: a single-centre retrospective service evaluation | Ponsford  | 2021 | Cardiff, United Kingdom         | High-income                      | Hospital            | 8               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Association between Clinical Frailty Scale score and hospital mortality in adult patients with COVID-19 (COMET): an international, multicentre, retrospective, observational cohort study | Sablerolles | 2021 | Europe                          | High-income                      | Hospital            | 1               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Performance of pneumonia severity index and CURB-65 in predicting 30-day mortality in patients with COVID-19(104) | Satici    | 2020 | Istanbul, Turkey                | Upper-middle-income              | Hospital            | 2               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Model-based Prediction of Critical Illness in Hospitalized Patients with COVID-19(105) | Schalekamp | 2020 | Amersfoort, The Netherlands     | High-income                      | Not specified       | 7               | Proposed |                  |            |          | BMJ Open 2020                                    |
| Scoring systems for predicting mortality for severe patients with COVID-19(106) | Shang | 2020 | Wuhan, China | Upper-middle-income | Hospital | Not specified | 5 | Proposed |
|---|---|---|---|---|---|---|---|---|
| Evaluating a Widely Implemented Proprietary Deterioration Index Model Among Hospitalized COVID-19 Patients(107) | Singh | 2020 | Michigan, United States | High-income | Not specified | Not specified | 1 | Proposed |
| Development and validation of a simple risk score for diagnosing COVID-19 in the emergency room(108) | Sung | 2020 | Maryland, United States | High-income | Hospital | Not specified | 10 | Proposed |
| Prediction of Sepsis in COVID-19 Using Laboratory Indicators(109) | Tang | 2021 | Tongji, China | Upper-middle-income | Not specified | Not specified | 7 | Proposed |
| Development of a data-driven COVID-19 prognostication tool to inform triage and step-down care for hospitalised patients in Hong Kong: A population based cohort study(110) | Tsui | 2020 | Hong Kong, China | Upper-middle-income | Hospital | Not specified | 7 | Proposed |
| Personalized predictive models for symptomatic COVID-19 patients using basic preconditions: Hospitalizations, mortality, and the need for an ICU or ventilator(111) | Wollenstein-Betech | 2020 | Mexico | Upper-middle-income | Not specified | Not specified | 9 | Proposed |
| Development of a Clinical Decision Support System for Severity Risk Prediction and Triage of COVID-19 Patients at Hospital Admission: An International Multicenter Study(112) | Wu | 2020 | Maastricht, the Netherlands | High-income | Hospital | Not specified | 7 | Proposed |
| Development and validation of the HNC-LL score for predicting the severity of coronavirus disease 2019(113) | Xiao | 2020 | Guangzhou, China | Upper-middle-income | Not specified | Not specified | 5 | Proposed |
| Point-of-Care Lung Ultrasound for COVID-19: Findings and Prognostic Implications From 105 Consecutive Patients(114) | Yasukawa | 2021 | Washington D.C., United States | High-income | Hospital | Not specified | 1 | Proposed |
| A Novel Scoring System for Prediction of Disease Severity in COVID-19(115) | Zhang | 2020 | Beijing, China | Upper-middle-income | Hospital | Not specified | 5 | Proposed |
| Development and validation of a risk factor-based system to predict short-term survival in adult hospitalized patients with COVID-19: a multicenter, retrospective, cohort study(116) | Zhang | 2020 | Honghu, China | Upper-middle-income | Hospital | Not specified | 1 | Proposed |
| Study Description                                                                 | Author | Year | Location         | Income Level | Hospital Type | Hospital Year | Country          | Proposed |
|----------------------------------------------------------------------------------|--------|------|------------------|--------------|---------------|---------------|------------------|----------|
| Lung Ultrasound Score in Evaluating the Severity of Coronavirus Disease 2019 (COVID-19) Pneumonia (117) | Zhao   | 2020 | Shanghai, China  | Upper-middle-income | Not specified | 1              | Proposed |
| Development and validation a nomogram for predicting the risk of severe COVID-19: A multi-center study in Sichuan, China (118) | Zhou   | 2020 | Sichuan, China  | Upper-middle-income | Not specified | 6              | Proposed |
| Acute Physiology and Chronic Health Evaluation II Score as a Predictor of Hospital Mortality in Patients of Coronavirus Disease 2019 (120) | Zou    | 2020 | Wuhan, China    | Upper-middle-income | Hospital     | 1              | Proposed |

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## Supplementary Table 4: Summary of validation data for tools being used to screen, triage, and prognosticate COVID-19 patients.

| Title                                                                 | Validation endpoint                                                                 | Tool training/development validation data | Other validation data                      |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------------|
| A Novel Scoring System for Prediction of Disease Severity in COVID-19(94)| ICU admission                                                                       | AUC 0·91                                  | Sensitivity 0·71 NPV 0·89                  |
| A novel simple scoring model for predicting severity of patients with SARS-CoV-2 infection(62) | COVID-19 confirmed by RT-PCR                                                           |                                          |                                          |
| A quickly, effectively screening process of novel corona virus disease 2019 (COVID-19) in children in Shanghai, China(38) | COVID-19 diagnosis                                                                  | AUC 1                                     | Sensitivity 0·71 Specificity 0·18 PPV 1   |
| A simple algorithm helps early identification of SARS-CoV-2 infection patients with severe progression tendency(74) | Severe COVID-19 disease                                                              |                                          |                                          |
| A Tool for Early Prediction of Severe Coronavirus Disease 2019 (COVID-19): A Multicenter Study Using the Risk Nomogram in Wuhan and Guangdong, China(67) | Severe COVID-19 disease                                                              | AUC 0·91                                  | Sensitivity 0·86 Specificity 0·88         |
| Acute Physiology and Chronic Health Evaluation II Score as a Predictor of Hospital Mortality in Patients of Coronavirus Disease 2019(93) | In-hospital mortality                                                                | AUC 0·97                                  | Sensitivity 0·96 Specificity 0·86         |
| Clinical Characteristics and Prognostic Factors for Intensive Care Unit Admission of Patients With COVID-19: Retrospective Study Using Machine Learning and Natural Language Processing. | ICU admission                                                                        | AUC 0·76                                  |                                          |
| Containing COVID-19 in the Emergency Department: The Role of Improved Case Detection and Segregation of Suspect Cases(43) | COVID-19 confirmed by RT-PCR                                                         | AUC 0·842 (95% CI [0·736-0·919])          | Sensitivity 0·648 (95% CI [0·625-0·670])  |
| COVID-19 Outpatient Screening: A Prediction Score for Adverse Events(57) | Hospitalisation, ICU care, need for mechanical ventilation, or death within 7 days of an | AUC 0·80 (hospitalisation); 0·82 (critical illness); |                                          |
| Development and Validation of a Clinical Risk Score to Predict the Occurrence of Critical Illness in Hospitalized Patients With COVID-19(75) | outpatient medical encounter | 0.87 (death) |
| Development and validation of a prediction model for severe respiratory failure in hospitalized patients with SARS-CoV-2 infection: a multicenter cohort study (PREDI-CO study)(59) | Critical COVID-19 disease | 72% (95% CI [65%-79%]) (at risk score >3) 86% (95% CI [89%-92%]) (at risk score >3) 74% (95% CI [67%-80%]) (at risk score >3) 89% (95% CI [85%-91%]) (at risk score >3) |
| Development and validation of a prognostic model based on comorbidities to predict COVID-19 severity: a population-based study. | Mortality | 0.89 |
| Development and validation of a risk factor-based system to predict short-term survival in adult hospitalized patients with COVID-19: a multicenter, retrospective, cohort study(89) | Severe respiratory failure | 0.89 (95% CI [0.86-0.92]) |
| Development and validation of a risk stratification model for screening suspected cases of COVID-19 in China(77) | 28-day mortality | 0.86 0.83 0.78 0.32 0.97 |
| Development and validation of a simple risk score for diagnosing COVID-19 in the emergency room. | COVID-19 confirmed by RT-PCR | 0.796 0.709 |
| Development and validation of the HNC-LL score for predicting the severity of coronavirus disease 2019(88) | COVID-19 confirmed by RT-PCR | 0.86 0.83 0.78 0.32 0.97 |
| Development and validation of the quick COVID-19 severity index (qCSI): a prognostic tool for early clinical decompensation(68) | Severe or critical COVID-19 disease | 0.88 0.85 0.74 0.75 0.85 |
| Development of a Clinical Decision Support System for Severity Risk Prediction and Triage of COVID-19 Patients at Hospital Admission: An International Multicenter Study(87) | Respiratory failure within 24 hours of admission | 0.86 0.85 0.76 |
| Development of a data-driven COVID-19 prognostication tool to inform triage and step-down care | Severe COVID-19 disease | 0.913 (Day-1 model) and |

| Development and validation of a prediction model for severe respiratory failure in hospitalized patients with SARS-CoV-2 infection: a multicenter cohort study (PREDI-CO study)(59) | Retrospective | 80% (95% CI [73%−85%]) (at risk score >3) 76% (95% CI [70%−81%]) (at risk score >3) 69% (95% CI [60%−74%]) (at risk score >3) 85% (95% CI [80%−89%]) (at risk score >3) |
| Development and validation of a prognostic model based on comorbidities to predict COVID-19 severity: a population-based study. | Mortality | 0.879 (95% CI [0.856-0.900]) |
| Development and validation of a risk factor-based system to predict short-term survival in adult hospitalized patients with COVID-19: a multicenter, retrospective, cohort study(89) | Severe respiratory failure | 0.87 0.82 0.77 0.26 0.98 |
| Development and validation of a risk stratification model for screening suspected cases of COVID-19 in China(77) | 28-day mortality | 0.86 0.83 0.78 0.32 0.97 |
| Development and validation of a simple risk score for diagnosing COVID-19 in the emergency room. | COVID-19 confirmed by RT-PCR | 0.796 0.709 |
| Development and validation of the HNC-LL score for predicting the severity of coronavirus disease 2019(88) | COVID-19 confirmed by RT-PCR | 0.86 0.83 0.78 0.32 0.97 |
| Development and validation of the quick COVID-19 severity index (qCSI): a prognostic tool for early clinical decompensation(68) | Severe or critical COVID-19 disease | 0.88 0.85 0.74 0.75 0.85 |
| Development of a Clinical Decision Support System for Severity Risk Prediction and Triage of COVID-19 Patients at Hospital Admission: An International Multicenter Study(87) | Respiratory failure within 24 hours of admission | 0.86 0.85 0.76 |
| Development of a data-driven COVID-19 prognostication tool to inform triage and step-down care | Severe COVID-19 disease | 0.913 (Day-1 model) and |
| Study Title                                                                 | Score | CI         | Score | CI         | Score | CI         | Score | CI         | Score | CI         |
|---------------------------------------------------------------------------|-------|------------|-------|------------|-------|------------|-------|------------|-------|------------|
| ICU-level care, mechanical ventilation, or in-hospital death               | 0.942 | (Day-5 model) |       |            |       |            |       |            |       |            |
| 28-day mortality                                                          | 0.77  |            |       |            |       |            |       |            |       |            |
| Severe COVID-19 disease                                                   | 0.96  | (95% CI [0.772-0.999]) | 0.899 | (95% CI [0.863-0.928]) |       |            |       |            |       |            |
| Severe COVID-19 disease                                                   | 0.82  |            | 0.8   |            | 0.84  |            |       |            |       |            |
| Severe and critical COVID-19 disease                                      | 0.84  |            |       |            |       |            |       |            |       |            |
| Mortality                                                                 | 0.63  |            |       |            |       |            |       |            |       |            |
| Predicting COVID-19 community mortality risk using machine learning and    | 0.83  |            | 0.692 |            | 0.968 |            |       |            |       |            |

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| Table Title                                                                 | Severe COVID-19 Disease | 28-day Mortality | COVID-19 Confirmed by RT-PCR | 30-day Mortality |
|---------------------------------------------------------------------------|-------------------------|-----------------|-----------------------------|-----------------|
| Prediction of severe illness due to COVID-19 based on an analysis of initial Fibrinogen to Albumin Ratio and Platelet count(60) | 0.863 (95% CI [0.640–0.964]); 0.593 (95% CI [0.485–0.694]); 0.339 (95% CI [0.222–0.479]); 0.9474 (95% CI [0.845–0.986]) | 0.918 (NEWS); 0.760 (qSOFa); 0.744 (SIRS) | 0.78; 0.96; 0.53; 0.14; 0.99 | 0.75 (CURB-65 ≥2); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.85 (CURB-65 ≥2); 0.85 (CURB-65 ≥3); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.47 (CURB-65 ≥2); 0.73 (CURB-65 ≥3); 0.92 (NEWS2 ≥2); 0.92 (qSOFa ≥2) | 0.12 (CURB-65 ≥2); 0.17 (CURB-65 ≥3); 0.10 (NEWS2 ≥2); 0.484(qSOFa ≥2) | 0.97 (CURB-65 ≥2); 0.96 (CURB-65 ≥3); 0.98 (NEWS2 ≥2); 0.94 (qSOFa ≥2) |
| Predictive value of National Early Warning Score 2 (NEWS2) for intensive care unit admission in patients with SARS-CoV-2 infection(66) | Severe COVID-19 Disease | 28-day Mortality | COVID-19 Confirmed by RT-PCR | 30-day Mortality |
| Pro-spective                                                              | 0.857 (95% CI [0.420–0.992]); 0.593 (95% CI [0.485–0.694]); 0.333 (95% CI [0.143–0.479]); 0.9 (95% CI [0.541–0.994]) | 0.918 (NEWS); 0.760 (qSOFa); 0.744 (SIRS) | 0.78; 0.96; 0.53; 0.14; 0.99 | 0.75 (CURB-65 ≥2); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.85 (CURB-65 ≥2); 0.85 (CURB-65 ≥3); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.47 (CURB-65 ≥2); 0.73 (CURB-65 ≥3); 0.92 (NEWS2 ≥2); 0.92 (qSOFa ≥2) | 0.12 (CURB-65 ≥2); 0.17 (CURB-65 ≥3); 0.10 (NEWS2 ≥2); 0.484(qSOFa ≥2) | 0.97 (CURB-65 ≥2); 0.96 (CURB-65 ≥3); 0.98 (NEWS2 ≥2); 0.94 (qSOFa ≥2) |
| Pro-spective                                                              | 0.857 (95% CI [0.420–0.992]); 0.593 (95% CI [0.485–0.694]); 0.333 (95% CI [0.143–0.479]); 0.9 (95% CI [0.541–0.994]) | 0.918 (NEWS); 0.760 (qSOFa); 0.744 (SIRS) | 0.78; 0.96; 0.53; 0.14; 0.99 | 0.75 (CURB-65 ≥2); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.85 (CURB-65 ≥2); 0.85 (CURB-65 ≥3); 0.78 (NEWS2 ≥2); 0.66 (qSOFa ≥2) | 0.47 (CURB-65 ≥2); 0.73 (CURB-65 ≥3); 0.92 (NEWS2 ≥2); 0.92 (qSOFa ≥2) | 0.12 (CURB-65 ≥2); 0.17 (CURB-65 ≥3); 0.10 (NEWS2 ≥2); 0.484(qSOFa ≥2) | 0.97 (CURB-65 ≥2); 0.96 (CURB-65 ≥3); 0.98 (NEWS2 ≥2); 0.94 (qSOFa ≥2) |

Note: Only common, standardised measures of validation were extracted.  
AUC = area under curve score; PPV = positive predictive value; NPV = negative predictive value.
Supplementary Table 5: Breakdown of inputs used tools used to screen, triage, and prognosticate COVID-19 patients.

| Input                                                                 | Feasible to evaluate or perform in low-resource setting emergency units? | Screening tools (n=57) | Triage tools (n=23) | Severity scoring tools (n=54) |
|-----------------------------------------------------------------------|**************************************************************************|*************************|************************|*****************************|
|                                                                       | No tools using input | %                         | No tools using input | %                         | No tools using input | %                         |
| CONCURRENT ACUTE CONDITIONS (n=20)                                     | No                     | 0.0%                      | 0                  | 0.0%                      | 2                  | 3.7%                      |
| Acute renal failure                                                   | No                     | 0.0%                      | 3                  | 13.0%                     | 0                  | 0.0%                      |
| Acute respiratory distress syndrome                                   | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Animal/insect bites                                                   | Yes                    | 0.0%                      | 2                  | 8.7%                      | 0                  | 0.0%                      |
| Bacterial coinfection                                                 | No                     | 0.0%                      | 2                  | 8.7%                      | 0                  | 0.0%                      |
| Cardiac arrest                                                        | Yes                    | 0.0%                      | 2                  | 8.7%                      | 0                  | 0.0%                      |
| Current level of physical fitness                                    | Yes                    | 0.0%                      | 0                  | 0.0%                      | 2                  | 3.7%                      |
| Encephalopathy                                                        | Yes                    | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Major trauma                                                          | Yes                    | 0.0%                      | 0                  | 0.0%                      | 0                  | 0.0%                      |
| Metabolic acidosis                                                    | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Multilobe infiltrate                                                  | Yes                    | 0.0%                      | 0                  | 0.0%                      | 0                  | 0.0%                      |
| Organ failure                                                         | No                     | 0.0%                      | 1                  | 4.3%                      | 2                  | 3.7%                      |
| Pericarditis                                                          | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Pleural effusion                                                      | Yes                    | 0.0%                      | 0                  | 0.0%                      | 1                  | 1.9%                      |
| Pneumonia                                                             | Yes                    | 0.0%                      | 2                  | 3.5%                      | 3                  | 13.0%                     |
| Respiratory distress                                                  | Yes                    | 1.8%                      | 3                  | 13.0%                     | 2                  | 3.7%                      |
| Pneumothorax                                                          | No                     | 0.0%                      | 3                  | 13.0%                     | 0                  | 0.0%                      |
| Respiratory failure                                                   | Yes                    | 0.0%                      | 3                  | 13.0%                     | 4                  | 7.4%                      |
| Septic shock                                                          | Yes                    | 0.0%                      | 3                  | 13.0%                     | 1                  | 1.9%                      |
| Systemic inflammatory response syndrome (SIRS)                         | Yes                    | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Unknown clinical inputs (proprietary algorithm)                       | No                     | 0.0%                      | 0                  | 0.0%                      | 1                  | 1.9%                      |
| CLINICAL INTERVENTIONS RECEIVED (n=5)                                 |                                                                                   |                       |                         |
| Nasal intermittent positive pressure ventilation                      | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Need for supplemental oxygen                                          | Yes                    | 0.0%                      | 1                  | 4.3%                      | 7                  | 13.0%                     |
| High-flow nasal canula                                                | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Mechanical ventilation                                                | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| Vasopressors                                                          | No                     | 0.0%                      | 1                  | 4.3%                      | 0                  | 0.0%                      |
| DEMOGRAPHICS (n=7)                                                    |                                                                                   |                       |                         |
|                  | Yes |  %  | Yes |  %  | Yes |  %  | Yes |  %  | Yes |  %  |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Age              |     |     |     |     |     |     |     |     |     |     |
| YES              | 4   | 7·0%| 9   | 39·1%| 28  | 51·9%|
| Sex              |     |     |     |     |     |     |     |     |     |     |
| YES              | 2   | 3·5%| 3   | 13·0%| 12  | 22·2%|
| Ethnicity        |     |     |     |     |     |     |     |     |     |     |
| YES              | 0   | 0·0%| 0   | 0·0% | 2   | 3·7% |
| Marital status   |     |     |     |     |     |     |     |     |     |     |
| YES              | 0   | 0·0%| 0   | 0·0% | 1   | 1·9% |
| Pregnancy        |     |     |     |     |     |     |     |     |     |     |
| YES              | 0   | 0·0%| 0   | 0·0% | 1   | 1·9% |
| Race             |     |     |     |     |     |     |     |     |     |     |
| YES              | 0   | 0·0%| 1   | 4·3% | 1   | 1·9% |
| Welsh Index of Multiple Deprivation | Yes | 0 % | 0 % | 0 % | 0 % | 1 % |
| COMORBIDITIES (n=29) |     |     |     |     |     |     |     |     |     |     |
| Amyotrophic lateral sclerosis | Yes | 0 % | 0 % | 1 | 4·3% | 1 | 0·0% |
| Any comorbidity  | Yes | 2 | 3·5% | 3 | 13·0% | 2 | 3·7% |
| Asthma           | Yes | 0 % | 0 % | 0 % | 0 % | 1 | 1·9% |
| Atrial fibrillation | Yes | 0 % | 0 % | 0 % | 0 % | 1 | 1·9% |
| Body mass index  | Yes | 1 | 1·8% | 2 | 8·7% | 6 | 11·1% |
| Chronic kidney disease | Yes | 2 | 3·5% | 1 | 4·3% | 5 | 9·3% |
| Chronic obstructive lung disease | Yes | 0 | 0 % | 1 | 0 % | 1 | 1·9% |
| Connective tissue disease | Yes | 0 | 0 % | 2 | 8·7% | 7 | 11·1% |
| Coronary artery disease / congestive heart failure | Yes | 2 | 3·5% | 1 | 4·3% | 2 | 13·0% |
| Cystic fibrosis  | Yes | 0 % | 0 % | 0 | 4·3% | 1 | 0·0% |
| Dementia         | Yes | 0 % | 0 % | 0 | 0 % | 0 | 0·0% |
| Depression       | Yes | 0 % | 0 % | 0 % | 0 % | 1 | 1·9% |
| Diabetes         | Yes | 0 % | 0 % | 1 | 4·3% | 6 | 11·1% |
| Functional disorder | Yes | 0 % | 0 % | 0 | 0 % | 1 | 1·9% |
| Hypertension     | Yes | 0 % | 0 % | 3 | 13·0% | 6 | 11·1% |
| Immunocompromise | Yes | 3 | 5·3% | 0 | 0 % | 4 | 7·4% |
| Liver disease    | Yes | 0 % | 0 % | 0 | 0 % | 3 | 5·3% |
| Malignancy       | Yes | 0 | 0 % | 2 | 8·7% | 6 | 11·1% |
| Malnutrition     | Yes | 0 % | 0 % | 0 | 0 % | 1 | 1·9% |
| Myasthenia gravis | Yes | 0 % | 0 % | 1 | 4·3% | 0 | 0·0% |
| Pancreatitis     | Yes | 0 % | 0 % | 1 | 4·3% | 0 | 0·0% |
| Peripheral vascular disease | Yes | 0 | 0 % | 0 | 0 % | 1 | 1·9% |
| Psychiatric disorder | Yes | 1 | 1·8% | 0 | 0 % | 1 | 1·9% |
| Seizure disorder | Yes | 0 % | 0 % | 1 | 4·3% | 0 | 0·0% |
| Smoking history  | Yes | 0 | 0 % | 2 | 8·7% | 1 | 1·9% |
| Spinal muscular atrophy | Yes | 0 | 0 % | 0 | 0 % | 1 | 1·9% |
| Stroke           | Yes | 0 | 0 % | 1 | 4·3% | 1 | 1·9% |
| Transplant history | Yes | 0 | 0 % | 0 | 0 % | 1 | 1·9% |
| Laboratory Investigation                  | Sample Size | Yes | 0.0% | 0 | 0.0% | 1 | 1.9% |
|------------------------------------------|-------------|-----|------|---|------|---|------|
| Valvular heart disease                   | Yes         | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| **LABORATORY INVESTIGATIONS (n=64)**     |             |     |      |  |      |   |      |
| Albumin                                  | No          | 0   | 0.0% | 1 | 4.3% | 3 | 5.6% |
| Alanine aminotransferase                 | No          | 0   | 0.0% | 2 | 8.7% | 0 | 0.0% |
| Albumin/globulin ratio                   | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Alkaline phosphatase                     | No          | 0   | 0.0% | 1 | 4.3% | 0 | 0.0% |
| **Arterial blood gas**                   |             |     |      |  |      |   |      |
| Aspartate aminotransferase               | No          | 0   | 0.0% | 1 | 4.3% | 1 | 1.9% |
| Basophil count                           | No          | 3   | 5.3% | 1 | 4.3% | 0 | 0.0% |
| Blood urea nitrogen                      | No          | 0   | 0.0% | 2 | 8.7% | 5 | 9.3% |
| C-reactive protein                       | No          | 2   | 3.5% | 7 | 30.4%| 14| 25.9%|
| Calcium                                  | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Cardiovascular abnormalities             | No          | 0   | 0.0% | 2 | 8.7% | 0 | 0.0% |
| CD3                                      | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| CD4                                      | No          | 0   | 0.0% | 0 | 0.0% | 2 | 3.7% |
| Chloride                                 | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Complete blood count                     | No          | 0   | 0.0% | 1 | 4.3% | 0 | 0.0% |
| Creatine kinase                          | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Creatinine                               | No          | 0   | 0.0% | 4 | 17.4%| 5 | 9.3% |
| D-dimer                                  | No          | 0   | 0.0% | 3 | 13.0%| 5 | 9.3% |
| Direct bilirubin                         | No          | 0   | 0.0% | 1 | 4.3% | 4 | 7.4% |
| Eosinophil count                         | No          | 2   | 3.5% | 2 | 8.7% | 0 | 0.0% |
| Erythrocyte sedimentation rate           | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Ferritin                                 | No          | 0   | 0.0% | 1 | 4.3% | 0 | 0.0% |
| Fibrinogen to albumin ratio              | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Globulin                                 | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Glomerular filtration rate               | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Glucose                                  | Yes         | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Haematocrit                              | No          | 2   | 3.5% | 0 | 0.0% | 3 | 5.6% |
| Haemoglobin                              | No          | 2   | 3.5% | 0 | 0.0% | 0 | 0.0% |
| IL-2R                                    | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| IL-6                                     | No          | 0   | 0.0% | 0 | 0.0% | 2 | 3.7% |
| IL-8                                     | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| IL-10                                    | No          | 0   | 0.0% | 0 | 0.0% | 1 | 1.9% |
| Immature granulocyte percentage          | No          | 1   | 1.8% | 0 | 0.0% | 0 | 0.0% |
| Influenza test                           | No          | 1   | 1.8% | 0 | 0.0% | 0 | 0.0% |
| **INR** | No | 0 | 0% | 1 | 4.3% | 0 | 0% |
| **Lactate** | No | 0 | 0% | 1 | 4.3% | 0 | 0% |
| **Lactate dehydrogenase** | No | 0 | 0% | 3 | 13.0% | 11 | 20.4% |
| **Leukocyte count** | No | 2 | 3.5% | 1 | 4.3% | 1 | 1.9% |
| **Lymphocyte count** | No | 6 | 10.5% | 4 | 17.4% | 1 | 1.9% |
| **Lymphocyte percentage** | No | 0 | 0% | 1 | 4.3% | 1 | 1.9% |
| **Mean corpuscular haemoglobin** | No | 2 | 3.5% | 0 | 0% | 0 | 0% |
| **Mean corpuscular haemoglobin concentration** | No | 1 | 1.8% | 0 | 0% | 0 | 0% |
| **Mean corpuscular volume** | No | 3 | 5.3% | 0 | 0% | 0 | 0% |
| **Mean platelet volume** | No | 1 | 1.8% | 0 | 0% | 0 | 0% |
| **Comprehensive metabolic panel** | No | 0 | 0% | 3 | 13.0% | 0 | 0% |
| **Mononuclear cell count** | No | 2 | 3.5% | 0 | 0% | 1 | 1.9% |
| **Neutrophil count** | No | 1 | 1.8% | 2 | 8.7% | 5 | 9.3% |
| **Neutrophil to lymphocyte ratio** | No | 1 | 1.8% | 2 | 8.7% | 5 | 9.3% |
| **Nucleated red blood cells** | No | 1 | 1.8% | 0 | 0% | 0 | 0% |
| **pH** | No | 0 | 0% | 0 | 0% | 0 | 0% |
| **Platelet count** | No | 3 | 5.3% | 3 | 13.0% | 5 | 9.3% |
| **Platelet distribution width** | No | 2 | 3.5% | 0 | 0% | 0 | 0% |
| **Platelet haematocrit** | No | 2 | 3.5% | 0 | 0% | 0 | 0% |
| **Potassium** | No | 0 | 0% | 0 | 0% | 4 | 7.4% |
| **Prealbumin** | No | 0 | 0% | 0 | 0% | 0 | 0% |
| **Procalcitonin** | No | 0 | 0% | 1 | 4.3% | 1 | 1.9% |
| **Red cell count** | No | 0 | 0% | 1 | 4.3% | 0 | 0% |
| **Red cell distribution width** | No | 2 | 3.5% | 1 | 4.3% | 1 | 1.9% |
| **SARS-CoV-2 RT-PCR** | No | 9 | 15.8% | 1 | 4.3% | 0 | 0% |
| **Sodium** | No | 0 | 0% | 0 | 0% | 3 | 5.6% |
| **Total protein** | No | 0 | 0% | 0 | 0% | 1 | 1.9% |
| **Troponin** | No | 0 | 0% | 3 | 13.0% | 1 | 1.9% |
| **Urea** | No | 0 | 0% | 1 | 4.3% | 3 | 5.6% |
| **White blood cell count** | No | 0 | 0% | 2 | 8.7% | 2 | 3.7% |

**IMAGING INVESTIGATIONS (n=3)**

| **Chest X-ray** | No | 4 | 7.0% | 8 | 34.8% | 7 | 13.0% |
| **Chest CT** | No | 9 | 15.8% | 10 | 43.5% | 3 | 5.6% |
| **Lung ultrasound** | No | 5 | 8.8% | 8 | 34.8% | 2 | 3.7% |

**SIGNS AND SYMPTOMS (n=37)**

| **Abdominal pain** | Yes | 0 | 0% | 1 | 4.3% | 0 | 0% |
| Symptom                          | Yes | No  | Yes% | No%  | Yes%  | No%  |
|---------------------------------|-----|-----|------|------|-------|------|
| Anosmia / agueisa               | 4   | 0   | 7.0% | 0.0% | 1.9%  | 0.0% |
| Any COVID-related symptoms      | 10  | 1   | 17.5%| 0.0% | 4.3%  | 0.0% |
| Any respiratory symptoms        | 26  | 0   | 45.6%| 0.0% | 0.0%  | 0.0% |
| Arthralgia                      | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Chest distress                  | 2   | 0   | 3.5% | 0.0% | 0.0%  | 0.0% |
| Chest pain                      | 3   | 0   | 5.3% | 0.0% | 0.0%  | 0.0% |
| Chest tightness                 | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Chills                          | 6   | 0   | 10.5%| 0.0% | 0.0%  | 0.0% |
| Conjunctival congestion         | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Constipation                    | 0   | 1   | 0.0% | 4.3% | 0.0%  | 0.0% |
| Convulsions                     | 0   | 1   | 0.0% | 4.3% | 0.0%  | 0.0% |
| Cough                           | 23  | 2   | 40.4%| 0.0% | 3.7%  | 0.0% |
| Cyanosis                        | 0   | 1   | 0.0% | 4.3% | 0.0%  | 0.0% |
| Diarrhoea                       | 3   | 1   | 5.3% | 4.3% | 0.0%  | 0.0% |
| Dizziness                       | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Duration of fever               | 2   | 0   | 3.5% | 0.0% | 0.0%  | 0.0% |
| Duration of symptoms            | 0   | 2   | 0.0% | 8.7% | 1.9%  | 0.0% |
| Fatigue                         | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Fever                           | 31  | 2   | 54.4%| 8.7% | 5.6%  | 0.0% |
| Frequency of cough              | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Gastrointestinal symptoms       | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Haematemesis                    | 0   | 2   | 0.0% | 8.7% | 0.0%  | 0.0% |
| Haemoptysis                     | 0   | 0   | 0.0% | 0.0% | 3.7%  | 0.0% |
| Headache                        | 1   | 1   | 1.8% | 4.3% | 1.9%  | 0.0% |
| Inability to breastfeed or drink| 0   | 1   | 0.0% | 4.3% | 0.0%  | 0.0% |
| Myalgia                         | 5   | 0   | 8.8% | 0.0% | 0.0%  | 0.0% |
| Nasal congestion                | 3   | 1   | 5.3% | 0.0% | 1.9%  | 0.0% |
| Nausea                          | 1   | 1   | 1.8% | 4.3% | 0.0%  | 0.0% |
| Rash                            | 1   | 0   | 1.8% | 0.0% | 0.0%  | 0.0% |
| Rhinorrhoea                     | 2   | 1   | 3.5% | 4.3% | 0.0%  | 0.0% |
| Shortness of breath             | 16  | 5   | 28.1%| 0.0% | 9.3%  | 0.0% |
| Sore throat                     | 5   | 1   | 8.8% | 0.0% | 1.9%  | 0.0% |
| Sputum production               | 2   | 0   | 3.5% | 0.0% | 0.0%  | 0.0% |
| Unconsciousness                 | 0   | 1   | 0.0% | 4.3% | 1.9%  | 0.0% |
| Unspecified signs and symptoms  | 1   | 1   | 1.8% | 4.3% | 0.0%  | 0.0% |
| Vomiting                        | 1   | 1   | 1.8% | 4.3% | 0.0%  | 0.0% |
**VITAL SIGNS (n=17)**

| Characteristic                  | Yes | 18% | No | 0% | 100% |
|---------------------------------|-----|-----|----|----|------|
| Altered mental status          | Yes | 1   | 18%| 1  | 9.3% |
| AVPU scale                     | Yes | 0   | 0% | 0  | 0.0% |
| Clinical gestalt               | Yes | 1   | 18%| 1  | 1.9% |
| Diastolic blood pressure       | Yes | 0   | 0% | 0  | 0.0% |
| Exertional oxygen saturation   | Yes | 0   | 0% | 0  | 0.0% |
| FiO2                           | Yes | 0   | 0% | 0  | 1.9% |
| Glasgow Coma Scale             | Yes | 0   | 0% | 4  | 17.4%| 4  | 7.4% |
| Haemodynamic instability       | Yes | 1   | 18%| 1  | 1.9% |
| Heart rate                     | Yes | 1   | 18%| 4  | 14.8%| 8  | 14.8%|
| Hypercapnia                    | No  | 1   | 18%| 0  | 0.0% |
| Oxygen saturation              | Yes | 9   | 15.8%| 14 | 60.9%| 8  | 14.8%|
| Pain severity                  | Yes | 0   | 0% | 1  | 4.3% |
| PaO2/FIO2 < 300                | No  | 0   | 0% | 4  | 17.4%| 0  | 0.0% |
| Respiratory rate               | Yes | 2   | 3.5%| 13 | 56.5%| 16 | 29.6%|
| Systolic blood pressure        | Yes | 1   | 18%| 9  | 39.1%| 9  | 16.7%|
| Temperature                    | Yes | 17  | 29.8%| 5  | 21.7%| 13 | 24.1%|
| Altered mental status          | Yes | 1   | 18%| 2  | 8.7% | 5  | 9.3% |

**OTHER CHARACTERISTICS (n=7)**

| Characteristic                          | Yes | 18% | No | 0% | 100% |
|-----------------------------------------|-----|-----|----|----|------|
| Ability to live and walk independently  | Yes | 1   | 18%| 0  | 0.0% |
| Abnormal ECG findings                   | No  | 0   | 0% | 1  | 4.3% |
| Score on the Braden scale               | Yes | 0   | 0% | 0  | 0.0% |
| Epidemiological history                 | Yes | 36  | 63.2%| 2  | 8.7% | 2  | 3.7% |
| Nursing home resident                   | Yes | 0   | 0% | 1  | 4.3% |
| Status as a healthcare worker           | Yes | 2   | 3.5%| 0  | 0.0% |
| Use of prescription medications        | Yes | 0   | 0% | 1  | 4.3% |
### Supplementary Table 6: Overview of use of established prognostication tools for COVID-19.

| Tool                                           | No. inputs | Inputs                                                                 | Feasible in low-resource settings? | No. studies using tool |
|------------------------------------------------|------------|------------------------------------------------------------------------|------------------------------------|------------------------|
| APACHE II Score(95)                            | 15         | - Acute renal failure                                                  | No                                 | 1                      |
|                                                |            | - Age                                                                  |                                    |                        |
|                                                |            | - Creatinine                                                           |                                    |                        |
|                                                |            | - FiO2                                                                 |                                    |                        |
|                                                |            | - Glasgow Coma Scale                                                  |                                    |                        |
|                                                |            | - Haematocrit                                                         |                                    |                        |
|                                                |            | - Heart rate                                                           |                                    |                        |
|                                                |            | - History of severe organ failure or immunocompromise                 |                                    |                        |
|                                                |            | - Mean arterial pressure                                               |                                    |                        |
|                                                |            | - pH                                                                   |                                    |                        |
|                                                |            | - Potassium                                                            |                                    |                        |
|                                                |            | - Respiratory rate                                                    |                                    |                        |
|                                                |            | - Sodium                                                               |                                    |                        |
|                                                |            | - Temperature                                                          |                                    |                        |
|                                                |            | - White blood cell count                                               |                                    |                        |
| Clinical Frailty Score                         | 1          | - Level of physical fitness                                           | Yes                                 | 3                      |
| CURB-65 Score for Pneumonia Severity          | 5          | - Age                                                                  | No                                 | 4                      |
|                                                |            | - Blood urea nitrogen                                                  |                                    |                        |
|                                                |            | - Confusion                                                            |                                    |                        |
|                                                |            | - Respiratory rate                                                    |                                    |                        |
|                                                |            | - Systolic or diastolic blood pressure                                 |                                    |                        |
| Deyo-Charlson Score(96)                        | 17         | - AIDS                                                                 | Yes                                 | 1                      |
|                                                |            | - Any malignancy                                                       |                                    |                        |
|                                                |            | - Cerebrovascular disease                                              |                                    |                        |
|                                                |            | - Chronic pulmonary disease                                            |                                    |                        |
|                                                |            | - Congestive heart failure                                             |                                    |                        |
|                                                |            | - Dementia                                                             |                                    |                        |
|                                                |            | - Diabetes with complications                                          |                                    |                        |
|                                                |            | - Diabetes without chronic complications                               |                                    |                        |
|                                                |            | - Hemiplegia or paraplegia                                            |                                    |                        |
|                                                |            | - Metastatic solid tumour                                              |                                    |                        |
|                                                |            | - Mild liver disease                                                   |                                    |                        |
|                                                |            | - Moderate/severe liver disease                                        |                                    |                        |
|                                                |            | - Myocardial infarction                                                |                                    |                        |
|                                                |            | - Peptic ulcer disease                                                |                                    |                        |
|                                                |            | - Peripheral vascular disease                                          |                                    |                        |
|                                                |            | - Renal disease                                                        |                                    |                        |
|                                                |            | - Rheumatoid disease                                                  |                                    |                        |
| HEWS                                          |            | - Abdominal pain                                                       |                                    |                        |
| Korean Triage and Acuity Scale(97)            | 17         | - Bites                                                                | Yes                                 | 1                      |
|                                                |            | - Cardiac arrest                                                       |                                    |                        |
|                                                |            | - Chest pain                                                           |                                    |                        |
|                                                |            | - Constipation                                                         |                                    |                        |
|                                                |            | - Diarrhoea                                                            |                                    |                        |
|                                                |            | - Glasgow Coma Scale                                                  |                                    |                        |
|                                                |            | - Haematemesis                                                         |                                    |                        |
|                                                |            | - Headache                                                             |                                    |                        |
|                                                |            | - Major trauma                                                         |                                    |                        |
| Test/Score                                                                 | Components                                                                 | Yes/No | Value |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------|-------|
| **Modified 6-Minute Walk Test**                                           | • Nausea and/or vomiting                                                     |        |       |
|                                                                            | • Prescription medications                                                   |        |       |
|                                                                            | • Respiratory failure                                                        |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
|                                                                            | • Systemic inflammatory response syndrome (SIRS)                             |        |       |
|                                                                            | • Temperature                                                                |        |       |
|                                                                            | • Urinary tract infection                                                    |        |       |
| **Modified Early Warning Score (MEWS) for Clinical Deterioration**         | • AVPU score                                                                |        |       |
|                                                                            | • Heart rate                                                                 |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
|                                                                            | • Temperature                                                                |        |       |
|                                                                            | • Absolute lymphocyte count                                                  |        |       |
|                                                                            | • Age                                                                        |        |       |
|                                                                            | • Bacterial coinfection                                                      |        |       |
|                                                                            | • History of hypertension                                                    |        |       |
|                                                                            | • Multilobe infiltrate                                                       |        |       |
|                                                                            | • Smoking history                                                            |        |       |
| **MuLBSTA Score for Viral Pneumonia Mortality**                            | • Need for supplemental oxygen                                               |        |       |
|                                                                            | • Oxygen saturation                                                          |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
|                                                                            | • Temperature                                                                |        |       |
| **National Early Warning Score (NEWS)**                                   | • Consciousness                                                              |        |       |
|                                                                            | • Heart rate                                                                 |        |       |
|                                                                            | • Hypercapnic respiratory failure                                             |        |       |
|                                                                            | • Need for supplemental oxygen                                               |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
|                                                                            | • Temperature                                                                |        |       |
| **National Early Warning Score 2 (NEWS2)**                                | • Age                                                                        |        |       |
|                                                                            | • Altered mental status                                                      |        |       |
|                                                                            | • Blood urea nitrogen                                                        |        |       |
|                                                                            | • Glucose                                                                    |        |       |
|                                                                            | • Haematocrit                                                                |        |       |
|                                                                            | • Heart rate                                                                 |        |       |
|                                                                            | • History of congestive heart failure                                         |        |       |
|                                                                            | • History of liver disease history                                            |        |       |
|                                                                            | • History of renal disease                                                   |        |       |
|                                                                            | • Neoplastic disease                                                         |        |       |
|                                                                            | • Nursing home resident                                                      |        |       |
|                                                                            | • Partial pressure of oxygen                                                 |        |       |
|                                                                            | • pH                                                                         |        |       |
|                                                                            | • Pleural effusion on X-ray                                                  |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Sex                                                                        |        |       |
|                                                                            | • Sodium                                                                     |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
|                                                                            | • Temperature                                                                |        |       |
| **Pneumonia Severity Index for Community Acquired Pneumonia**              | • Glasgow Coma Scale                                                         |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |
| **qSOFA (Quick SOFA) Score for Sepsis**                                   | • Glasgow Coma Scale                                                         |        |       |
|                                                                            | • Respiratory rate                                                           |        |       |
|                                                                            | • Systolic blood pressure                                                    |        |       |

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REFERENCES
1. Al-Tawfiq JA, Garout MA, Gautret P. Preparing for emerging respiratory pathogens such as SARS-CoV, MERS-CoV, and SARS-CoV-2. Infez Med. 2020;28(suppl 1):64-70.
2. Aldobyany A, Touman A, Ghaleb N, et al. Correlation Between the COVID-19 Respiratory Triage Score and SARS-COV-2 PCR Test. Front Med (Lausanne) 2020;7:605689. doi: 10.3389/fmed.2020.605689
3. Agarwal A, Nagi N, Chatterjee P, Sarkar S, Mourya D, Sahay RR, et al. Guidance for building a dedicated health facility to contain the spread of the 2019 novel coronavirus outbreak. Indian J Med Res. 2020;151(2 & 3):177-83.
4. Augustin M, Schomers P, Suarez I, Koehler P, Gruell H, Klein F, et al. Rapid response infrastructure for pandemic preparedness in a tertiary care hospital: lessons learned from the COVID-19 outbreak in Cologne, Germany, February to March 2020. Euro Surveill. 2020;25(21).
5. Ayebare RR, Flick R, Okware S, Bodo B, Lamorde M. Adoption of COVID-19 triage strategies for low-income settings. Lancet Respir Med. 2020;8(4):e22.
6. Cabitza F, Campagner A, Ferrari D, et al. Development, evaluation, and validation of machine learning models for COVID-19 detection based on routine blood tests. Clinical Chemistry and Laboratory Medicine 2021;59(2):421-31. doi: 10.1515/cclm-2020-1294
7. Cao Y, Li Q, Chen J, Guo X, Miao C, Yang H, et al. Hospital Emergency Management Plan During the COVID-19 Epidemic. Acad Emerg Med. 2020;27(4):309-11.
8. Carenoz L, Costantini E, Greco M, Barra FL, Rendiniello V, Mainetti M, et al. Hospital surge capacity in a tertiary emergency referral centre during the COVID-19 outbreak in Italy. Anaesthesia. 2020;75(7):928-34.
9. Standard Operating Procedure for Triage of suspected COVID-19 patients in non-US Healthcare settings. Atlanta: Centers for Disease Control and Prevention.
10. Chan PF, Lai KPL, Chao DVK, Fung SCK. Enhancing the triage and cohort of patients in public primary care clinics in response to the coronavirus disease 2019 (COVID-19) in Hong Kong: an experience from a hospital cluster. BJGP Open. 2020;4(2).
11. Chang YT, Lin CY, Tsai MJ, Hung CT, Huw CW, Lu PL, et al. Infection control measures of a Taiwanese hospital to confront the COVID-19 pandemic. Kaohsiung J Med Sci. 2020;36(5):296-304.
12. Chen S, Zhan Z, Yang J, Wang J, Zhai X, Barnighausen T, et al. Fangcang shelter hospitals: a novel concept for responding to public health emergencies. Lancet. 2020;395(10232):1305-14.
13. Cheng VCC, Wong SC, Chen JHK, Yip CCY, Chuang VWM, Tsang OTY, et al. Escalating infection control response to the rapidly evolving epidemiology of the coronavirus disease 2019 (COVID-19) due to SARS-CoV-2 in Hong Kong. Infect Control Hosp Epidemiol. 2020;41(5):493-8.
14. Chou E, Hsieh YL, Woffshoi J, Green F, Bhakta T. Onsite telemedicine strategy for coronavirus (COVID-19) screening to limit exposure in ED. Emerg Med J. 2020;37(6):335-7.
15. Chowdhury JM, Patel M, Zheng M, Abramian O, Criner GJ. Mobilization and Preparation of a Large Urban Academic Center during the COVID-19 Pandemic. Ann Am Thorac Soc. 2020;17(8):922-5.
16. Chung HS, Lee DE, Kim JK, Yeo IH, Kim C, Park J, et al. Revised Triage and Surveillance Protocols for Temporary Emergency Department Closures in Tertiary Hospitals as a Response to COVID-19 Crisis in Daegu Metropolitan City. J Korean Med Sci. 2020;35(19):e189.
17. Devrim I, Bayram N. Infection control practices in children during COVID-19 pandemic: Differences from adults. Am J Infect Control. 2020;48(8):933-9.7.
18. Duca A, Piva S, Foca E, Latronico N, Rizzi M. Calculated Decisions: Brescia-COVID Respiratory Severity Scale (BCRSS)/Algorithm. Emerg Med Pract. 2020;22(5 Suppl):CD1-CD2.

19. Erika P, Andrea V, Cillis MG, Ioannilli E, Iannicelli T, Andrea M. Triage decision-making at the time of COVID-19 infection: the Piacenza strategy. Intern Emerg Med. 2020;15(5):879-82.

20. Gibbons RC, Magee M, Goett H, et al. Lung Ultrasound vs. Chest X-Ray Study for the Radiographic Diagnosis of COVID-19 Pneumonia in a High-Prevalence Population. J Emerg Med 2021 doi: 10.1016/j.jemermed.2021.01.041

21. Gilbert A, Brasseur E, Petit M, Donneau AF, Diep A, Hetzel Campbell S, et al. Immersion in an emergency department triage center during the Covid-19 outbreak: first report of the Liege University hospital experience. Acta Clin Belg. 2020:1-7.

22. Guo F, Du Z, Wang T. An effective screening and management process in the outpatient clinic for patients requiring hospitalization during the COVID-19 pandemic. J Med Virol. 2020.

23. He H, Hu C, Xiong N, Liu C, Huang X. How to transform a general hospital into an "infectious disease hospital" during the epidemic of COVID-19. Crit Care. 2020;24(1).

24. Howitt R, de Jesus GA, Araujo F, Francis J, Marr I, McVean M, et al. Screening and triage at health-care facilities in Timor-Leste during the COVID-19 pandemic. Lancet Respir Med. 2020;8(6):e43.

25. Huang T, Guo Y, Li S, Zheng Y, Lei L, Zeng X, et al. Application and effects of fever screening system in the prevention of nosocomial infection in the only designated hospital of coronavirus disease 2019 (COVID-19) in Shenzhen, China. Infect Control Hosp Epidemiol. 2020;41(8):978-81.

26. Jaffe E, Stugo R, Bin E, Blustein O, Rosenblat I, Alpert E, et al. The role of emergency medical services in containing COVID-19. J Emerg Med. 2020;38:1526-7.

27. Karimi A, Tabatabaei S, Rajabnejad, Pourmoghaddas Z, Rahimi H, Armin S, et al. An algorithmic approach to diagnosis and treatment of coronavirus disease 2019 (COVID-19) in children: Iranian expert's consensus statement. Arch Pediatr Infect Dis. 2020.

28. Koenig KL, Bey CK, McDonald EC. 2019-nCoV: The Identify-Isolate-Inform (3I) Tool Applied to a Novel Emerging Coronavirus. West J Emerg Med. 2020;21(2):184-90.

29. Li T. Diagnosis and clinical management of severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection: an operational recommendation of Peking Union Medical College Hospital (V2.0). Emerg Microbes Infect. 2020;9(1):582-5.

30. Lin CH, Tseng WP, Wu JL, Tay J, Cheng MT, Ong HN, et al. A Double Triage and Telemedicine Protocol to Optimize Infection Control in an Emergency Department in Taiwan During the COVID-19 Pandemic: Retrospective Feasibility Study. J Med Internet Res. 2020;22(6):e20586.

31. Liu L, Hong X, Su X, Chen H, Zhang D, Tang S, et al. Optimizing screening strategies for coronavirus disease 2019: A study from Middle China. J Infect Public Health. 2020;13(6):868-72.

32. Liu Y, Wang Z, Ren J, Tian Y, Zhou M, Zhou T, et al. A COVID-19 Risk Assessment Decision Support System for General Practitioners: Design and Development Study. J Med Internet Res. 2020;22(6):e19786.

33. Meschi T, Rossi S, Volpi A, Ferrari C, Sverzellati N, Brianti E, et al. Reorganization of a large academic hospital to face COVID-19 outbreak: The model of Parma, Emilia-Romagna region, Italy. Eur J Clin Invest. 2020;50(6):e13250.

34. Möckel M, Bachmann U, Behringer W, Pfafflin F, Stegemann MS. How emergency departments prepare for virus disease outbreaks like COVID-19. Eur J Emerg Med. 2020;27(3):161-2.
32. Nayan N, Kumar MK, Nair RK, et al. Clinical Triaging in Cough Clinic Alleviates COVID-19 Overload in Emergency Department in India. SN Compr Clin Med 2021;1-6. doi: 10.1007/s42399-020-00705-2
33. Nicastro E, Mazza A, Gervasoni A, Di Giorgio A, D'Antiga L. A Pediatric Emergency Department Protocol to Avoid Intrahospital Spread of SARS-CoV-2 during the Outbreak in Bergamo, Italy. J Pediatr. 2020;222:231-5.
34. Piliego C, Strumia A, Stone MB, Pascarella G. The ultrasound guided triage: a new tool for prehospital management of COVID-19 pandemic. Anesth Analg. 2020.
35. Pu H, Xu Y, Doig G, Zhou Y. Screening and managing of suspected or confirmed novel coronavirus (COVID-19) patients: experiences from a tertiary hospital outside Hubei province. 2020.
36. Quah LJJ, Tan BKK, Fua TP, Wee CPJ, Lim CS, Nadarajan G, et al. Reorganising the emergency department to manage the COVID-19 outbreak. Int J Emerg Med. 2020;13(1):32.
37. Romero-Gameros CA, Colin-Martínez T, Waizel-Haiat S, et al. Diagnostic accuracy of symptoms as a diagnostic tool for SARS-CoV 2 infection: a cross-sectional study in a cohort of 2,173 patients. BMC Infect Dis 2021;21(1):255. doi: 10.1186/s12879-021-05930-1
38. Schwedhelm MM, Herstein JJ, Watson SM, Mead AL, Maddalena L, Liston DD, et al. Can You Catch It? Lessons Learned and Modification of ED Triage Symptom- and Travel-Screening Strategy. J Emerg Nurs. 2020.
39. Shen Y, Cui Y, Li N, Tian C, Chen M, Zhang YW, et al. Emergency Responses to Covid-19 Outbreak: Experiences and Lessons from a General Hospital in Nanjing, China. Cardiovasc Intervent Radiol. 2020;43(6):810-9.
40. Shi Y, Wang X, Liu G, Zhu Q, Wang J, Yu H, et al. A quickly, effectively screening process of novel corona virus disease 2019 (COVID-19) in children in Shanghai, China. Ann Transl Med. 2020;8(5):241.
41. Spina S, Marrazzo F, Migliari M, Stucchi R, Sforza A, Fumagalli R. The response of Milan's Emergency Medical System to the COVID-19 outbreak in Italy. Lancet. 2020;395(10227):e49-e50.
42. Tan GSE, Ang H, Manuais CM, Chua JM, Gao CQ, Ng FKK, et al. Reducing hospital admissions for COVID-19 at a dedicated screening centre in Singapore. Clin Microbiol Infect. 2020;26(9):1278-9.
43. Wang Q, Wang X, Lin H. The role of triage in the prevention and control of COVID-19 Infect Control Hosp Epidemiol. 2020:1-5.
44. Wang X, Chen Y, Li Z, Wang D, Wang Y. Providing uninterrupted care during COVID-19 pandemic: experience from Beijing Tiantan Hospital. Stroke Vasc Neurol. 2020;5(2):180-4.
45. Wee LE, Fua TP, Chua YY, Ho AFW, Sim XYJ, Conceicao EP, et al. Containing COVID-19 in the Emergency Department: The Role of Improved Case Detection and Segregation of Suspect Cases. Acad Emerg Med. 2020;27(5):379-87.
46. Whiteside T, Kane E, Aljohani B, Alsamman M, Pourmand A. Redesigning emergency department operations amidst a viral pandemic. Am J Emerg Med. 2020;38(7):1448-53.
47. Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected. Interim guidance, 13 March 2020. Geneva: World Health Organization; 2020.
48. Wu X, Zhou H, Wu X, Huang W, Jia B. Strategies for qualified triage stations and fever clinics during the outbreak of COVID-2019 in the county hospitals of Western Chongqing. J Hosp Infect. 2020;105(2):128-9.
49. Zhang J, Zhou L, Yang Y, Peng W, Wang W, Chen X. Therapeutic and triage strategies for 2019 novel coronavirus disease in fever clinics. Lancet Respir Med. 2020;8(3):e11-e2.

50. Zhang N, Deng Y, Li W, Liu J, Li H, Liu E, et al. Analysis and suggestions for the preview and triage screening of children with suspected COVID-19 outside the epidemic area of Hubei Province. Transl Pediatr. 2020;9(2):126-32.

51. Zhao Y, Cui C, Zhang K, Liu J, Xu J, Nisenbaum E, et al. COVID19: A Systematic Approach to Early Identification and Healthcare Worker Protection. Front Public Health. 2020;8:205.

52. Zhou TT, Wei FX. Primary stratification and identification of suspected Corona virus disease 2019 (COVID-19) from clinical perspective by a simple scoring proposal. Mil Med Res. 2020;7(1):16.

53. Zimmerman RK, Nowalk MP, Bear T, Taber R, Sax TM, Eng H, et al. Proposed Clinical Indicators for Efficient Screening and Testing for COVID-19 Infection from Classification and Regression Trees (CART) Analysis. medRxiv. 2020.

54. Zou T, Yin W, Kang Y. Application of Critical Care Ultrasound in Patients With COVID-19: Our Experience and Perspective. IEEE Trans Ultrason Ferroelectr Freq Control 2020;67(11):2197-206. doi: 10.1109/TUFFC.2020.3020628

55. Abrams ER, Rose G, Fields JM, et al. Point-of-Care Ultrasound in the Evaluation of COVID-19. J Emerg Med 2020;59(3):403-08. doi: 10.1016/j.jemermed.2020.06.032

56. Emergency Department COVID-19 Severity Classi-cation: American College of Emergency Physicians; [Available from: https://www.acep.org/globalassets/sites/acep/media/covid-19-main/acep_evidencetool.pdf.

57. Côté A, Ternacle J, Pibarot P. Early prediction of the risk of severe coronavirus disease 2019: A key step in therapeutic decision making. EBioMedicine. 2020;59:102948.

58. Duggan NM, Liteplo AS, Shokoohi H, et al. Using Lung Point-of-care Ultrasound in Suspected COVID-19: Case Series and Proposed Triage Algorithm. Clinical practice and cases in emergency medicine 2020;4(3):289-94. doi: https://dx.doi.org/10.5811/cpem.2020.7.47912

59. Eggleton EJ. Simple, fast and affordable triaging pathway for COVID-19. Postgrad Med J 2021;97(1145):192-95. doi: 10.1136/postgradmedj-2020-138029

60. Her M. How Is COVID-19 Affecting South Korea? What Is Our Current Strategy? Disaster Med Public Health Prep 2020;14(5):684-86. doi: 10.1017/dmp.2020.69

61. Manivel V, Lesnewski A, Shamim S, Carbonatto G, Govindan T. CLUE: COVID-19 lung ultrasound in emergency department. Emerg Med Australas. 2020;32(4):694-6.

62. Mantha S, Tripuraneni SL, Roizen MF, Fleisher LA. Proposed Modifications in the 6-Minute Walk Test for Potential Application in Patients With Mild COVID-19: A Step to Optimize Triage Guidelines. Anesth Analg. 2020;131(2):398-402.

63. Momeni-Boroujeni A, Mendoza R, Stopard II, et al. A Dynamic Bayesian Model for Identifying High-Mortality Risk in Hospitalized COVID-19 Patients. Infect Dis Rep 2021;13(1):239-50. doi: 10.3390/idr13010027

64. Rajalingam B, Narayanan E, Nirmalan P, et al. Pattern recognition of high-resolution computer tomography (HRCT) chest to guide clinical management in patients with mild to moderate COVID-19. Indian J Radiol Imaging 2021;31(Suppl 1):S110-S18. doi: 10.4103/ijri.IJRI_774_20

65. Sun H, Jain A, Leone MJ, Alabsi HS, Brenner LN, Ye E, et al. COVID-19 Outpatient Screening: a Prediction Score for Adverse Events. medRxiv. 2020.

66. Sun Q, Qiu H, Huang M, Yang Y. Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province. Ann Intensive Care. 2020;10(1):33.
67. Ali R, Qayyum F, Ahmed N, et al. Isaric 4c Mortality Score As A Predictor Of In-Hospital Mortality In Covid-19 Patients Admitted In Ayub Teaching Hospital During First Wave Of The Pandemic. J Ayub Med Coll Abbottabad 2021;33(1):20-25.

68. Bartoletti M, Giannella M, Scudeller L, Tedeschi S, Rinaldi M, Bussini L, et al. Development and validation of a prediction model for severe respiratory failure in hospitalized patients with SARS-CoV-2 infection: a multicentre cohort study (PREDI-CO study). Clin Microbiol Infect. 2020.

69. Brahier T, Meuwly JY, Pantet O, et al. Lung ultrasonography for risk stratification in patients with COVID-19: a prospective observational cohort study. Clin Infect Dis 2020 doi: 10.1093/cid/ciaa1408

70. Bi X, Su Z, Yan H, Du J, Wang J, Chen L, et al. Prediction of severe illness due to COVID-19 based on an analysis of initial Fibrinogen to Albumin Ratio and Platelet count. Platelets. 2020;31(5):674-9.

71. Cozzi D, Albanesi M, Cavigli E, Moroni C, Bindi A, Luvara S, et al. Chest X-ray in new Coronavirus Disease 2019 (COVID-19) infection: findings and correlation with clinical outcome. Radiol Med. 2020;125(8):730-7.

72. Das AK, Mishra S, Saraswathy Gopalan S. Predicting COVID-19 community mortality risk using machine learning and development of an online prognostic tool. PeerJ 2020;8:e10083. doi: 10.7717/peerj.10083

73. Dong Y, Zhou H, Li M, Zhang Z, Guo W, Yu T, et al. A novel simple scoring model for predicting severity of patients with SARS-CoV-2 infection. Transbound Emerg Dis. 2020.

74. Duan J, Wang X, Chi J, et al. Correlation between the variables collected at admission and progression to severe cases during hospitalization among patients with COVID-19 in Chongqing. J Med Virol 2020;92(11):2616-22. doi: 10.1002/jmv.26082

75. Fernandes FT, de Oliveira TA, Teixeira CE, et al. A multipurpose machine learning approach to predict COVID-19 negative prognosis in S¸o Paulo, Brazil. Sci Rep 2021;11(1):3343. doi: 10.1038/s41598-021-82885-y

76. Frost F, Bradley P, Tharmaratnam K, Wootton D. The utility of established prognostic scores in COVID-19 hospital admissions: a multicentre prospective evaluation of CURB-65, NEWS2, and qSOFA. 2020.

77. Galloway J, Norton S, Barker R, Brookes A, Carey I, Xlarke B, et al. A clinical risk score to identify patients with COVID-19 at high risk of critical care admission or death: An observational cohort study. J Infect. 2020;81(2):282-8.

78. Jang JG, Ahn JH. The Author's Response: Prognostic Accuracy of the SIRS, qSOFA, and NEWS for Early Detection of Clinical Deterioration in SARS-CoV-2 Infected Patients. J Korean Med Sci. 2020;35(30):e275.

79. Gidari A, De Socio GV, Sabbatini S, Francisci D. Predictive value of National Early Warning Score 2 (NEWS2) for intensive care unit admission in patients with SARS-CoV-2 infection. Infect Dis (Lond). 2020;52(10):698-704.

80. Gong J, Ouy J, Gui X, Jie Y, Chen Y, Yuan L, et al. A Tool for Early Prediction of Severe Coronavirus Disease 2019 (COVID-19): A Multicenter Study Using the Risk Nomogram in Wuhan and Guangdong, China Clinical Infectious Diseases. 2020;71(15):833-81.

81. Gude-Sampedro F, Fernandez-Merino C, Ferreiro L, et al. Development and validation of a prognostic model based on comorbidities to predict COVID-19 severity: a population-based study. Int J Epidemiol 2021;50(1):64-74. doi: 10.1093/ije/dya209

82. Gupta N, Ish P, Kumar R, et al. Evaluation of the clinical profile, laboratory parameters and outcome of two hundred COVID-19 patients from a tertiary centre in India. Monaldi Arch Chest Dis 2020;90(4) doi: 10.4081/monaldi.2020.1507

83. Haimovich A, Ravindra N, Stoytchew S, Young H, Wilson F, van Dijk D, et al.
Development and validation of the quick COVID-19 severity index (qCSI): a prognostic tool for early clinical decompensation. Ann Emerg Med. 2020.

84. Hu H, Yao N, Qiu Y. Predictive Value of 5 Early Warning Scores for Critical COVID-19 Patients. Disaster Med Public Health Prep 2020;1-8. doi: 10.1017/dmp.2020.324

85. Huespe I, Bisso I, Gemeli N, Terrasa S, Di Stefano S, Biurgos V, et al. COVID-19 Severity Index: predictive score for hospitalized patients. 2020.

86. Ihle-Hansen H, Berge T, Tveita A, Ronning EJ, Erno PE, Andersen EL, et al. COVID-19: Symptoms, course of illness and use of clinical scoring systems for the first 42 patients admitted to a Norwegian local hospital. Tidsskr Nor Laegeforen. 2020;140(7).

87. Izquierdo JL, Ancochea J, Soria JB. Clinical Characteristics and Prognostic Factors for Intensive Care Unit Admission of Patients With COVID-19: Retrospective Study Using Machine Learning and Natural Language Processing. J Med Internet Res 2020;22(10):e21801. doi: 10.2196/21801

88. Jehi L, Ji X, Milinovich A, Erzurum S, Merlino A, Gordon S, et al. Development and validation of a model for individualized prediction of hospitalization risk in 4,536 patients with COVID-19. PLoS One. 2020;15(8):e0237419.

89. Kaleemi R, Hilal K, Arshad A, et al. The association of chest radiographic findings and severity scoring with clinical outcomes in patients with COVID-19 presenting to the emergency department of a tertiary care hospital in Pakistan. PLoS One 2021;16(1):e0244886. doi: 10.1371/journal.pone.0244886

90. Kostakis I, Smith GB, Prytherch D, et al. The performance of the National Early Warning Score and National Early Warning Score 2 in hospitalised patients infected by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Resuscitation 2021;159:150-57. doi: 10.1016/j.resuscitation.2020.10.039

91. Labenz C, Kremer WM, Schattenberg JM, Worns MA, Toenges G, Weinmann A, et al. Clinical Frailty Scale for risk stratification in patients with SARS-CoV-2 infection. J Investig Med. 2020;68(6):1199-202.

92. Levenfus I, Ullmann E, Battegay E, Schuurmans MM. Triage tool for suspected COVID-19 patients in the emergency room: AIFELL score. Braz J Infect Dis. 2020.

93. Li Q, Zhang J, Ling Y, Li W, Zhang X, Lu H, et al. A simple algorithm helps early identification of SARS-CoV-2 infection patients with severe progression tendency. Infection. 2020;48(4):577-84.

94. Liang W, Liang H, Ou L, Chen B, Chen A, Li C, et al. Development and Validation of a Clinical Risk Score to Predict the Occurrence of Critical Illness in Hospitalized Patients With COVID-19. JAMA Intern Med. 2020;180(8):1081-9.

95. Liang W, Yao J, Chen A, Lv Q, Zanin M, Liu J, et al. Early triage of critically ill COVID-19 patients using deep learning. Nat Commun. 2020;11(1):3543.

96. Ma J, Shi X, Xu W, Lv F, Wu J, Pan Q, et al. Development and validation of a risk stratification model for screening suspected cases of COVID-19 in China. Aging (Albany NY). 2020;12(14):13882-94.

97. Myrstad M, Ihle-Hansen H, Tveita AA, Andersen EL, Nygard S, Tveit A, et al. National Early Warning Score 2 (NEWS2) on admission predicts severe disease and inhospital mortality from Covid-19 - a prospective cohort study. Scand J Trauma Resusc Emerg Med. 2020;28(1):66.

98. Nagant C, Ponthieux F, Smet J, et al. A score combining early detection of cytokines accurately predicts COVID-19 severity and intensive care unit transfer. International Journal of Infectious Diseases 2020;101:342-45. doi: 10.1016/j.ijid.2020.10.003

99. Nguyen Y, Corre F, Honsel V, Curac S, Zarrouk V, Burtz CP, et al. A nomogram to predict the risk of unfavourable outcome in COVID-19: a retrospective cohort of 279 hospitalized patients in Paris area. Ann Med. 2020;52(7):367-75.
100. Osborne TF, Veigulis ZP, Arreola DM, Roosli E, Curtin CM. Automated EHR score to predict COVID-19 outcomes at US Department of Veterans Affairs. PLoS One. 2020;15(7):e0236554.

101. Peng X, Subbe CP, Zhang L, Luo Z, Peng L. NEWS can predict deterioration of patients with COVID-19. Resuscitation. 2020;152:26-7.

102. Ponsford MJ, Burton RJ, Smith L, et al. Examining the utility of extended laboratory panel testing in the emergency department for risk stratification of patients with COVID-19: a single-centre retrospective service evaluation. J Clin Pathol 2021 doi: 10.1136/jclinpath-2020-207157

103. Sablerolles RSG, Lafeber M, van Kempen JAL, et al. Association between Clinical Frailty Scale score and hospital mortality in adult patients with COVID-19 (COMET): an international, multicentre, retrospective, observational cohort study. Lancet Healthy Longev 2021;2(3):e163-e70. doi: 10.1016/S2666-7568(21)00006-4

104. Satici C, Demirkol MA, Sargin Altunok E, Gursoy B, Alkan M, Kamat S, et al. Performance of pneumonia severity index and CURB-65 in predicting 30-day mortality in patients with COVID-19. Int J Infect Dis. 2020;98:84-9.

105. Schalekamp S, Huisman M, van Dijk RA, Boomsma MF, Freire Jorge PJ, de Boer WS, et al. Model-based Prediction of Critical Illness in Hospitalized Patients with COVID-19. Radiology. 2020:202723.

106. Shang JG, Hur J, Hong KS, Lee W, Ahn JH. Prognostic Accuracy of the SIRS, qSOFA, and NEWS for Early Detection of Clinical Deterioration in SARS-CoV-2 Infected Patients. J Korean Med Sci. 2020;35(25):e234.

107. Singh K, Valley T, Tang S, Li B, Kamran F, Sjoding M, et al. Evaluating a Widely Implemented Proprietary Deterioration Index Model Among Hospitalized COVID-19 Patients. 2020.

108. Sung J, Choudry N, Bachour R. Development and validation of a simple risk score for diagnosing COVID-19 in the emergency room. Epidemiol Infect 2020;148:e273. doi: 10.1017/S0950268820002769

109. Tang G, Luo Y, Lu F, et al. Prediction of Sepsis in COVID-19 Using Laboratory Indicators. Front Cell Infect Microbiol 2020;10:586054. doi: 10.3389/fcimb.2020.586054

110. Tsui E, Lui C, Woo P, Cheung A, Lam P, Tang T, et al. Development of a data-driven COVID-19 prognostication tool to inform triage and step-down care for hospitalised patients in Hong Kong: A population based cohort study. 2020.

111. Wollenstein-Betech S, Cassandras CG, Paschalidis IC. Personalized predictive models for symptomatic COVID-19 patients using basic preconditions: Hospitalizations, mortality, and the need for an ICU or ventilator. Int J Med Inform 2020;142:104258. doi: 10.1016/j.ijmedinf.2020.104258

112. Wu G, Yang P, Xie Y, Woodruff HC, Rao X, Guiot J, et al. Development of a clinical decision support system for severity risk prediction and triage of COVID-19 patients at hospital admission: an international multicentre study. Eur Respir J. 2020;56(2).

113. Xiao LS, Zhang WF, Gong MC, Zhang YP, Chen LY, Zhu HB, et al. Development and validation of the HNC-LL score for predicting the severity of coronavirus disease 2019. EBioMedicine. 2020;57:102880.

114. Yasukawa K, Minami T, Boullware DR, et al. Point-of-Care Lung Ultrasound for COVID-19: Findings and Prognostic Implications From 105 Consecutive Patients. J Intensive Care Med 2021;36(3):334-42. doi: 10.1177/0885066620988831

115. Zhang C, Qin L, Li K, Wang Q, Zhao Y, Xu B, et al. A Novel Scoring System for Prediction of Disease Severity in COVID-19. Front Cell Infect Microbiol. 2020;10:318.

116. Zhang S, Guo M, Duan L, Wu F, Hu G, Wang Z, et al. Development and validation of a risk factor-based system to predict short-term survival in adult hospitalized patients with COVID-19: a multicenter, retrospective, cohort study. Crit Care. 2020;24(1):438.
117. Zhao L, Yu K, Zhao Q, Tian R, Xie H, Xie L, et al. Lung Ultrasound Score in Evaluating the Severity of Coronavirus Disease 2019 (COVID-19) Pneumonia. Ultrasound Med Biol. 2020.

118. Zhou Y, He Y, Yang H, Yu H, Wang T, Chen Z, et al. Development and validation a nomogram for predicting the risk of severe COVID-19: A multi-center study in Sichuan, China. PLoS One. 2020;15(5):e0233328.

119. Zhu JS, Ge P, Jiang C, Zhang Y, Li X, Zhao Z, et al. Deep-learning artificial intelligence analysis of clinical variables predicts mortality in COVID-19 patients. J Am Coll Emerg Physicians Open. 2020.

120. Zou X, Li S, Fong M, Hu M, Bian Y, Ling J, et al. Acute Physiology and Chronic Health Evaluation II Score as a Predictor of Hospital Mortality in Patients of Coronavirus Disease 2019. Crit Care Med. 2020;48(8):e657-e65.

121. APACHE II Score: MDCalc; [Available from: https://www.mdcalc.com/apache-ii-score.

122. Ladha KS, Zhao K, Quraishi SA, Kurth T, Eikermann M, Kaafarani HM, et al. The Deyo-Charlson and Elixhauser-van Walraven Comorbidity Indices as predictors of mortality in critically ill patients. BMJ Open. 2015;5(9):e008990.

123. Ryu JH, Min MK, Lee DS, Yeom SR, Lee SH, Wang IJ, et al. Changes in Relative Importance of the 5-Level Triage System, Korean Triage and Acuity Scale, for the Disposition of Emergency Patients Induced by Forced Reduction in Its Level Number: a Multi-Center Registry-based Retrospective Cohort Study. J Korean Med Sci. 2019;34(14):e114.

124. Laboratories ATSCoPSfCPF. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-7.

125. Modified Early Warning Score (MEWS) for Clinical Deterioration: MDCalc; [Available from: https://www.mdcalc.com/modified-early-warning-score-mews-clinical-deterioration.

126. MuLBSTA Score for Viral Pneumonia Mortality: MDCalc; [Available from: https://www.mdcalc.com/mulbsta-score-viral-pneumonia-mortality.

127. National Early Warning Score (NEWS): MDCalc; [Available from: https://www.mdcalc.com/national-early-warning-score-news.

128. National Early Warning Score (NEWS) 2: MDCalc; [Available from: https://www.mdcalc.com/national-early-warning-score-news-2.

129. PSI/PORT Score: Pneumonia Severity Index for CAP: MDCalc; [Available from: https://www.mdcalc.com/psi-port-score-pneumonia-severity-index-cap.

130. qSOFA (Quick SOFA) Score for Sepsis: MDCalc; [Available from: https://www.mdcalc.com/qsofa-quick-sofa-score-sepsis.