Final triage methods to decide on home-isolation versus hospitalization in COVID-19 pandemic: a challenge for clinicians

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Abstract
Objective: Final patient triage determines which patients can be home-isolated and which patients require hospitalization on the basis to predict the patient's prognosis most accurately. Final triage is an important link in the clinical management chain of the coronavirus disease 2019 (COVID-19) pandemic, and a comprehensive review of various patient triage methods is very important to guide decision making and triage efficiency. Decision by clinicians about hospitalization or home-discharge is one of the main challenges in places with limited hospital facilities compared to the high volume of COVID-19 patients. This review was designed to guide clinicians on how to address this challenge.
Methods: In this mini review we searched scientific databases to obtain the final triage methods of COVID-19 patients and the important criteria in each method. In order to conducted searches a period from December 2019 to July 2020 was considered. All searches were done in electronic databases and search engines.
Results: Findings revealed four current methods for final triage (decision-making regarding home-isolation or hospitalization of COVID-19 patients). These methods included 1) demographic and background information, 2) clinical information, 3) laboratory indicators and 4) initial chest CT-scan. Each of the aforementioned methods encompassed significant criteria according to which decisions on the patient's prognosis and final triage were made. Finally, by evaluating each final triage method, we found that each method had some limitations.
Conclusion: An effective and quick final triage requires simultaneous complementary use of all four methods to compensate for each other's weaknesses and add to each other's strengths. It is therefore suggested to assure that clinicians are trained in all four COVID-19 patient's triage methods and their useful criteria in order to achieve evidence-based performance for better triage (decision between home-isolation versus hospitalization).
Keywords: Coronavirus, SARS-CoV-2, Prognosis, Triage, Emergency, Infection

Introduction

A novel coronavirus disease (COVID-19) was identified in China in 2019 and quickly became a global pandemic (1). Over 12 million people have been infected and 549 000 have lost their lives by July 10, 2020 (2). Symptoms of the early stages of COVID-19 include fever, coughing, headache, anosmia, lost sense of taste, fatigue, gastrointestinal symptoms, and shortness of breath (3,4). The mortality rate of COVID-19 is approximately 3.4% (5).

The severity of the COVID-19 infection varies by patient age, ethnic background, and co-morbid conditions and the disease trajectory can be divided into mild, moderate, severe and critical (6). Due to the large number of patients, lack of hospital facilities (such as intensive care unit (ICU) beds and access to ventilators) in many countries, and the lengthy treatment process, make efficient and quick final triage of COVID-19 patients a major challenge for healthcare systems (7-10). Final patient triage determines

which patients can be home-isolated and which patients require hospitalization on the basis to predict the patient's prognosis most accurately (11-13) ( ).

Highlight

Final triage is an important link in the clinical management chain of the COVID-19 pandemic, and a comprehensive review of various patient triage methods is very important to guide decision making and triage efficiency (14,15). The current COVID-19 patient triage system is different for patients requiring hospitalization (in the regular ward or the ICU) from patients that can be home-isolated in the upcoming hours or days. Therefore, identifying the best strategies to make the triage system more effective using various methods will be very beneficial for many health systems. Decision by clinicians about hospitalization or home-discharge is one of the main challenges in places with limited hospital facilities compared to the high volume of COVID-19 patients. This review was designed to guide clinicians on how to address this challenge.

Methods

In this mini review we searched scientific databases to obtain final triage methods of COVID-19 patients and the important and significant indicators in each method. In order to obtain relevant studies, electronic databases and search engines such as Google Scholar, PubMed, Scopus, Science Direct, ProQuest, Medline, Elsevier, and Web of Science were searched from December 2019 to July 2020. Search terms included combinations of (COVID OR Coronavirus OR Sars-Cov-2) AND (Triage OR Clinical features OR CT features OR Laboratory characteristics OR Demographic OR Prognosis). In the primary search, 452 studies were found. Only studies that dealt with screening methods of determining the initial prognosis of patients for final triage were selected and reviewed.

Results

The results of this review highlighted four current methods for final triage (decision-making regarding home-isolation or hospitalization of COVID-19 patients). These methods included 1) demographic and background information, 2) clinical information, 3) laboratory indicators and 4) initial chest CT-scan. Multiple studies have compared different criteria of each item among different clinical types of COVID-19 (mild to critical) (3, 16-20). Each of the aforementioned methods included significant criteria according to which decisions on the patient's prognosis and final triage were made. Figure 2 shows the flowchart of triage methods of COVID-19 patients and the important criteria for each method.

Table 1 shows the indicators for each method in more details to help decision making by clinicians (3,7,12,16-27).

Demographic and background variables: Significant criteria between different intensities of COVID-19 infection (mild to critical) include patient age, body mass index (BMI), co-morbidities, and received immunosuppressive medications.

Clinical information: Significant criteria between different intensities of COVID-19 infection (mild to critical) include the level of SpO2, the degree of dyspnea, the respiratory rate, body temperature, heart rate, LOC (level of consciousness).

The laboratory indicators: Significant criteria between different intensities of COVID-19 infection (mild to critical) include leukocyte count, lymphocyte (%), D-dimer, CRP (C-reactive protein), ESR (erythrocyte sedimentation rate), ferritin level, LDH (lactate dehydrogenase), CPK (creatine Phosphokinase).

Initial chest CT-scan: Both quantitative and qualitative interpretations can be helpful in evaluating CT scans.

Discussion

By evaluating each method, we found out that each method had limitations. Demographic and background information (e.g. age and underlying diseases) were potentially useful in the triage method of COVID-19 patients. An important point to consider, however, was that a patient may, for example, have an underlying disease but a good prognosis, or no underlying disease but a bad prognosis. Therefore, relying solely on
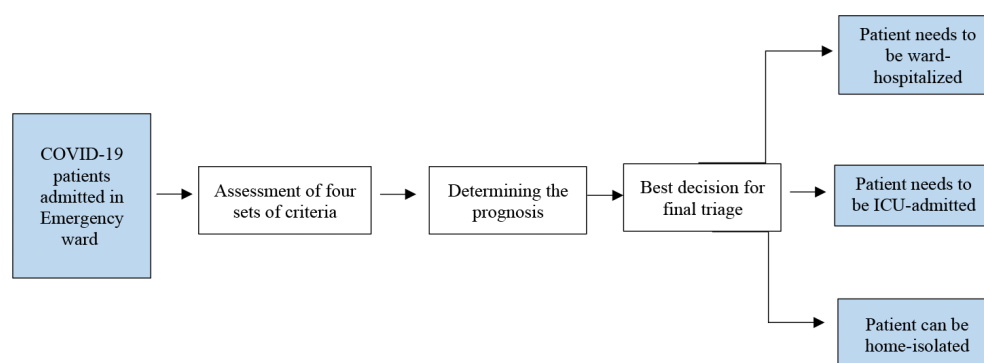

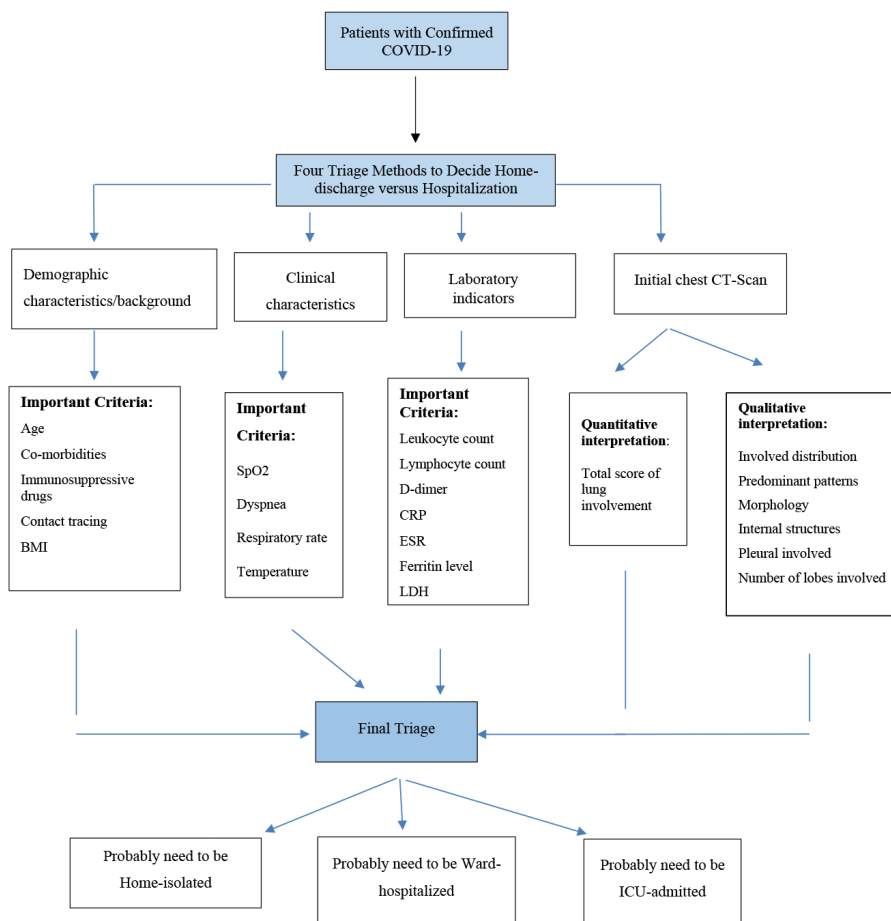**Figure 1.** Chart of Triage process in COVID-19 patients.

Figure 2. Flowchart of Triage methods to decide home-discharge versus hospitalization in COVID-19 patients. Abbreviations: body mass index (BMI), LOC (level of consciousness), CRP (C-reactive protein), ESR (Erythrocyte sedimentation rate), Ferritin level, LDH (Lactate dehydrogenase), CPK (Creatine Phosphokinase).

Table 1. Details of important criteria in each method to guide clinicians

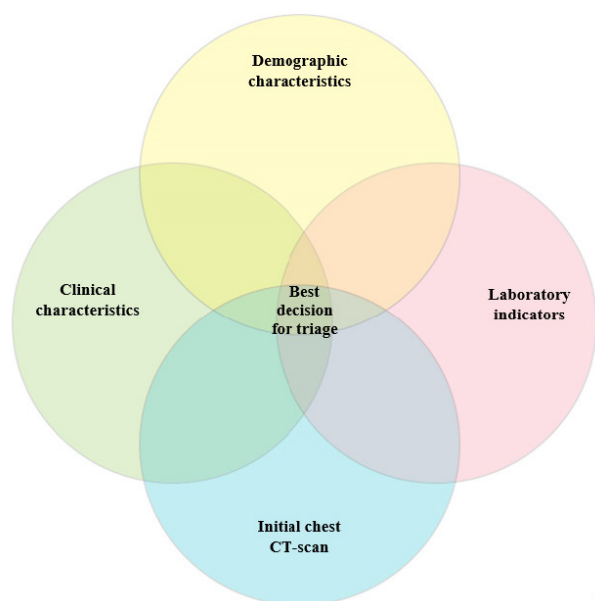| Methods	Important and significant criteria	Probably worse prognosis and need to be hospitalized
Demographic and background characteristics	Age BMI Co-morbidities Immunosuppressive drugs Contact tracing	Increase Yes Received Contact with patient who had sever type of disease
Clinical characteristics	SpO2 Dyspnea Respiratory rate Temperature Heart rate Level of consciousness (LOC)	Less than 93% Yes More than 30/min More than 38 0C Tachycardia Decrease
Laboratory indicators	Leukocyte count Lymphocyte (%) D-dimer CRP ESR Ferritin level LDH CPK	Leukopenia Lymphopenia More than 1000 ng More than 2 plus More than 30 More than 500 ng Increase Above 2 times the normal level
Initial chest CT-scan	Total score of lung involvement Involved distribution Morphology Internal structures Pleural involved Number of lobes involved Predominant patterns	Increase Bilateral involvement- Both peripheral and central Liner morphology Air-bronchogram Yes More than 3 lobes involved Mixed patterns (Ground-gloss opacities + Consolidation + C.P)

Figure 3. Venn diagram of best decision for final triage in COVID-19 patients

demographic information decreased the efficient triage and an effective triage cannot simply rely on demographic information. Clinical information (e.g. anosmia, SpO2, and temperature) was another useful and practical triage method for COVID-19 patients that clinical specialists need to pay attention to it. Clinical information changed rapidly due to the nature of the disease, making decisions on final triage somewhat problematic (6,8-10). According to the literature, the initial chest CT-scans were a powerful tool for the triage of COVID-19 patients, considering it as reliable and could be qualitatively and quantitatively interpreted (7). A problem associated with this method, however, was its inaccessibility for many treatment centres.

Using one method to decide between hospitalization or staying at home quarantine is not very reliable. On the other hand, decision making based on several methods together can make triage more effective. Finally, helping to make decisions about hospitalization or home quarantine can increase the quality of care, improve patient responsiveness and outcome.

Conclusion
In general, the final triage of COVID-19 patients according to the prognosis of patients can be planned on the premise of four methods, each with its advantages and disadvantages. An effective and quick final triage requires simultaneous complementary use of all four methods to compensate for each other's weaknesses and add to each other's strengths (Figure 3). It is therefore suggested to assure that clinicians are trained in all four triage methods for COVID-19 patients and their useful criteria in order to achieve evidence-based performance for better final triage. Research in the future should be focused on designing a checklist tool for combining the four methods

and making triage more safe, efficient and systematic.

Authors' contributions
Study design: MM, NH; Search in database: MM, KZ, MG; Writing – original draft: MM, KZ; Writing – review & editing: NH, MG, KZ, JGV; Supervisor: MM, JGV. All Authors are approved this version.

Ethical Issues
Not applicable.

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