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COVID-19 severe conditions: EMS, pharmacists, and health informatics strategies and community impact: Review article

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***Abstract*---Background**: COVID-19, caused by SARS-CoV-2, has emerged as a global pandemic since late 2019, with significant impacts on health systems and communities worldwide. The virus, which affects respiratory and other systems, has seen the emergence of several variants, including Delta and Omicron, each with distinct impacts on transmissibility and disease severity. **Aim**: This review aims to provide an updated overview of COVID-19's severe conditions, the strategies used by Emergency Medical Services (EMS), pharmacists, and health information for controlling and management, and the overall community impact. **Methods**: A comprehensive literature review was conducted using PubMed and Google Scholar up to December 31, 2021. Search terms included 'COVID,' 'COVID-19,' 'SARS-CoV-2,' and 'coronavirus,' focusing on retrospective and

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prospective studies, systematic reviews, meta-analyses, and clinical guidelines. The review included 194 pertinent sources, emphasizing emergency medicine-related research. **Results**: The review highlights the rapid global spread of COVID-19, the emergence and impact of variants like Delta and Omicron, and their association with increased transmissibility and severe disease outcomes. Key findings include the Delta variant's higher viral loads and association with severe illness, and the Omicron variant's high transmissibility and potential reduced severity of disease. Hospitalization and mortality rates have evolved with advancements in treatment and vaccination. **Conclusion**: COVID-19 continues to challenge healthcare systems with its evolving variants. Effective EMS strategies are crucial in managing severe cases and mitigating community impact. While vaccines remain a critical tool in reducing severe disease, ongoing research and adaptation of clinical guidelines are essential to manage emerging variants and their implications for public health.

***Keywords*---**COVID-19, SARS-CoV-2, Delta variant, Omicron variant, Emergency Medical Services, disease severity, global pandemic.

Introduction

Coronavirus Disease 2019 (COVID-19), induced by Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2), has triggered a worldwide pandemic [1, 2, 3, 4]. The epidemic initially emerged in late 2019, affecting 27 individuals with pneumonia in Wuhan, Hubei Province, China [1, 2]. The virus quickly disseminated globally, and on March 11, 2020, it was officially designated as a pandemic [1, 2, 3]. Recent variants, such as Delta and Omicron, have significantly amplified the number of cases [4]. By December 31, 2021, there were over 287 million reported cases globally, with more than 5.4 million fatalities [4]. In the United States, over 54.5 million cases and more than 825,000 deaths have been recorded [4]. This pandemic has posed considerable global challenges, and our comprehension of the disease remains in development. This document represents the first part of a two-part narrative review aimed at providing an updated overview of COVID-19 presentation and assessment for emergency clinicians. A comprehensive literature review was conducted using PubMed and Google Scholar databases up to December 31, 2021. Search terms included 'COVID' OR 'COVID-19' OR 'SARS-CoV-2' OR 'coronavirus.' The review encompassed retrospective and prospective studies, systematic reviews and meta-analyses, clinical guidelines, and other narrative reviews. Additionally, commentaries and letters were considered. The search was limited to publications or translations in English. The authors evaluated all pertinent articles and selected those for inclusion by consensus, with a particular emphasis on emergency medicine-related research, including guidelines. A total of 194 sources were deemed relevant for inclusion in this review.

Virology and Variants:

SARS-CoV-2 is a positive-stranded RNA virus with an envelope that attaches to the angiotensin-converting enzyme 2 (ACE2) receptor and infiltrates host cells through its spike proteins 1 and 2 [1, 3, 5]. These spike proteins contain multiple cleavage sites, which may enhance the virus's pathogenic potential [1, 3, 5, 6, 7]. The gradual accumulation of minor genetic alterations in these spike proteins leads to antigenic drift, giving rise to various viral variants. Variants are classified into three categories: variants of interest, variants of concern, and variants of high consequence [5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19]. Currently, the most concerning variants are the Delta (B.1.617.2 lineage) and the Omicron variant (B.1.1.529 lineage) [5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19].

COVID-19 Variants [6, 7, 14, 15]:

Variants of COVID-19 are classified into three categories: variants of interest, variants of concern, and variants of high consequence. Variants of interest are those anticipated to affect transmission, diagnosis, or treatment but do not yet have significant evidence of impact. Variants of concern are those that, in addition to the attributes of variants of interest, have demonstrated increased transmissibility, severity, or impact on public health measures. Examples include B.1.1.7 (Alpha), first identified in the United Kingdom, which is associated with a 50% increase in transmission and potential rise in mortality; B.1.351 (Beta), initially detected in South Africa, known for increased immune evasion and a 50% increase in transmission; and B.1.617.2 (Delta), first reported in India, which is approximately 50% more transmissible than Alpha, may reduce vaccine effectiveness, and is associated with higher infection rates and potential increases in mortality. Other notable variants include B.1.427 and B.1.429 (Epsilon) from California, which show a 20% higher risk of transmission; P.1 (Gamma) from Brazil/Japan, which likely increases disease transmissibility and severity; B.1.526 (Iota) from New York, which appears to be more transmissible but does not necessarily cause more severe disease; and B.1.1.529 (Omicron), first detected in South Africa, now prevalent in over 90 countries and the predominant strain in the U.S., with over 50 mutations in the spike protein. As of December 31, 2021, no variants of high consequence have been identified, which would be characterized by evidence of more severe infection, increased hospitalization rates, decreased vaccine and treatment efficacy, or failures in diagnostic detection.

Transmission and Variants of SARS-CoV-2

SARS-CoV-2 viral particles are present in various bodily fluids, including respiratory droplets, aerosols, blood, ocular secretions, urine, and stool; however, the primary mode of transmission is through direct person-to-person respiratory routes [16, 17, 18, 20, 21, 22, 23, 24, 25, 26]. The virus is expelled from the mouth and nose in droplets and smaller aerosolized particles, which can remain airborne and travel beyond six feet [17, 18, 20]. Notably, over 50% of viral transmissions occur from asymptomatic individuals, with viral shedding potentially beginning three days prior to symptom onset [20, 27]. Peak viral loads are observed with the onset of symptoms [20, 27]. Although contaminated

surfaces are not a major transmission pathway, infection can still occur if individuals touch their eyes, nose, or mouth with contaminated hands. The typical incubation period ranges from 4 to 5 days but can vary from 1 to 14 days [13, 28, 29, 30]. Initially, the reproductive number, or R0, was estimated at 4.7–6.6, indicating the number of cases generated from a single infected person [29]. With early interventions and vaccination, this estimate has decreased to approximately 1.5 [30]. The Delta variant is notably more transmissible, with an estimated R0 of 6 to 7 [13, 28]. The Omicron variant exhibits even greater transmissibility, approximately 3.2 times that of Delta, with a rapid 3-day doubling time [31, 32]. Transmission beyond 7–10 days post-symptom onset is considered highly unlikely [28].

The Delta variant is characterized by substantially higher viral loads, up to 1,000 times greater than other strains, and is associated with earlier and prolonged viral shedding [11, 19, 28]. It also correlates with increased hospitalization rates and mortality [11, 19, 28]. One study indicated that the Delta variant is linked to a higher likelihood of requiring oxygen, ICU admission, or death, with an adjusted odds ratio (aOR) of 4.90 (95% confidence interval [CI] 1.43–30.78) [19]. Other studies have reported about double the risk of hospitalization [33]. Analysis of over 40,000 COVID-19 patients also found a higher risk of hospitalization with the Delta variant, showing an adjusted hazard ratio of 2.26 (95% CI 1.32–3.89) [33]. Evidence suggests that vaccinated individuals with the Delta variant have similar nasopharyngeal viral loads compared to unvaccinated individuals, though they generally experience fewer or no symptoms [11].

The most recent variant of concern, Omicron (B.1.1.529), was first detected in South Africa on November 9, 2021, and reported to the World Health Organization (WHO) on November 24, 2021 [14, 15]. The WHO classified it as a variant of concern on November 26, 2021 [14]. By November 28, 2021, Omicron had been identified in South Africa, Belgium, Botswana, Hong Kong, Israel, Italy, the Netherlands, and the United Kingdom. By December 25, 2021, it was present in over 90 countries and accounted for over 58% of new infections in the United States [32]. Omicron, possessing over 50 mutations, quickly became the dominant strain in many countries [14, 15, 32, 35]. While prior SARS-CoV-2 infection was initially thought to provide an approximate 80% reduction in susceptibility to other strains, evidence indicates that Omicron has an increased capacity to evade immunity from previous infections [32, 36, 37, 38, 39, 40]. Fortunately, recent studies suggest that vaccination provides robust protection against severe illness from Omicron [41, 42, 43]. Despite two vaccine doses without a booster being less effective at preventing Omicron infection compared to other strains, they still substantially reduce the risk of severe disease [41, 42, 43]. The association between Omicron and reduced disease severity is debated, with some reports indicating a decrease in severity, including a 29% reduction in hospitalization rates and a 20–25% reduced risk of any hospitalization, and a 40–45% reduced risk of multiday hospitalization [43, 44, 45]. Further research is ongoing to evaluate vaccine efficacy, and the severity of disease associated with the Omicron variant.

Disease Severity in COVID-19

COVID-19 infection severity is categorized into symptomatic and asymptomatic cases, with symptomatic cases further divided into critical, severe, and non-severe [2, 46]. Over 80% of COVID-19 patients experience mild disease [2, 3, 46, 47, 48, 33]. Clinically asymptomatic infections may account for approximately 33% of positive cases based on meta-analyses, although this rate can vary [20, 47, 48]. Severe disease, characterized by hypoxia or more than 50% lung involvement, occurs in over 15% of patients, while critical disease, including respiratory failure, multiorgan injury, or shock, affects up to 5% of patients, contingent on the population studied [1, 2, 3, 26, 48, 49]. Recently, a third category—pre-symptomatic—has emerged, suggesting that as many as 50% of individuals who test positive without initial symptoms may develop symptoms later [47, 50, 51].

Critical cases involve acute respiratory distress syndrome, sepsis, septic shock, or other conditions necessitating life-sustaining therapies such as mechanical ventilation or vasopressor support. Severe cases are defined by oxygen saturation levels below 90% or signs of severe respiratory distress, such as the use of accessory muscles and difficulty speaking in full sentences. The 90% threshold is a guideline rather than a definitive criterion and should be interpreted within the broader clinical context. Non-severe cases are those not meeting the criteria for critical or severe classifications. Hospitalization, mechanical ventilation, and mortality rates for COVID-19 vary widely due to factors such as patient age, healthcare access, testing availability, and containment measures. Early in the pandemic, hospitalization and mortality rates were high, but advancements in treatment and vaccination have since reduced these risks [1, 2, 20, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67]. Initially, mortality rates for admitted patients were approximately 20%, and those admitted to the ICU faced mortality rates around 40% [1, 2, 20, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67]. However, as the pandemic has progressed, ICU survival rates have improved from 58% to 80% [62]. Among hospitalized COVID-19 patients, up to 35% require ICU admission [20, 48, 52]. Recent data suggest a case fatality rate of less than 2% across all COVID-19 patients, though this rate varies with age: 6.4% for those over 60 years, over 13% for those over 80 years, and over 25% for those over 90 years [20, 48, 57].

Several factors have been identified that contribute to worse outcomes in COVID-19 patients. Severe disease is more likely in individuals over 75 years old, those with diabetes, cancer, a history of transplantation, hypertension, or prior cardiac or pulmonary disease [23, 26, 52, 63, 64, 65, 66, 67]. Obesity, independent of race, sex, or other comorbidities, is linked to increased mortality and a greater need for intubation, particularly in patients under 65 years of age [68, 69]. Mortality rates are reportedly four times higher in patients with a body mass index (BMI) greater than 45 [69]. Heart failure is associated with longer hospital stays, increased intubation and ventilation needs, and higher mortality [70]. The Delta variant is also associated with more severe outcomes, including higher rates of hospitalization, ICU admission, and mortality [33, 71]. Additional poor prognostic indicators include an initial oxygen saturation below 88%, lymphopenia, thrombocytopenia, acute kidney injury, elevated lactate

dehydrogenase, C-reactive protein (CRP) levels above 200 mg/L, D-dimer levels over 2500 ng/mL, and elevated troponin and ferritin levels [23, 26, 52, 63].

Clinical Presentation of COVID-19

Approximately 98% of individuals who develop symptoms of COVID-19 will do so within 12 days following exposure to the virus [3, 20]. Symptomatic patients commonly present with a range of signs, including fever, alterations in taste or smell, myalgias, and respiratory symptoms such as cough [1, 2, 3, 20, 52, 72, 73, 74, 75, 76]. However, there are no clinical features with sufficient specificity to distinguish COVID-19 reliably from other infections [75]. The literature identifies cough (60–86%), shortness of breath (53–80%), and disturbances in taste or smell (64–80%) as the most prevalent symptoms [72, 73, 74, 75, 76]. Fever is present in approximately 50% of patients at initial presentation, with overall studies reporting that 20–99% of patients experience fever throughout their illness [1, 2, 18, 23, 49, 53, 72]. The definition of fever varies across studies, with some using a threshold as low as 37.1°C [75, 77, 78].

COVID-19 can lead to viral pneumonia, hypoxemic respiratory failure, and acute respiratory distress syndrome (ARDS), with hypoxemic respiratory failure being the predominant reason for ICU admissions [1, 2, 3, 20, 23, 60, 74, 75]. Co-infections, including bacterial or fungal, occur in up to 8% of patients and contribute significantly to morbidity and mortality. In one study, secondary infections were found in half of the patients who died [23, 80, 81]. Common bacterial respiratory pathogens include Streptococcus pneumoniae, Klebsiella pneumoniae, and Haemophilus influenzae, while fungal infections such as pulmonary aspergillosis and mucormycosis are also reported [80, 81, 82, 83, 84, 85, 86, 87]. Mucormycosis has been primarily observed in India, with diabetes and corticosteroid treatment being notable risk factors [84, 85, 86, 87]. Concurrent viral infections are also frequent, with one study indicating that 20.7% of COVID-19 patients were simultaneously infected with at least one other virus [82].

Extrapulmonary Presentations and Complications of COVID-19

Cardiac: As the pandemic has evolved, a range of extrapulmonary effects has been identified, including various cardiac complications. Myocardial involvement is observed in over 20% of patients admitted to the ICU with COVID-19 [22]. These cardiac issues can manifest as dysrhythmias, including atrioventricular (AV) blocks, bradycardia, and both supraventricular and ventricular tachycardias [22, 88, 89, 90]. Torsades de pointes may occur due to QT interval prolongation, which can be induced by electrolyte imbalances (e.g., diarrhea, dehydration), systemic inflammation, and preexisting cardiac conditions [88, 91, 92]. Acute coronary syndrome (ACS) is thought to be linked to severe inflammation, which may lead to plaque rupture and ST elevation myocardial infarction [88, 89, 90, 91, 92, 93, 94, 95, 96].

Cardiomyopathy, heart failure, and myocarditis are other significant cardiac complications. Acute left heart failure is present in approximately 23% of patients, and it is associated with increased mortality, affecting 52% of those who

died in one study [23, 88, 90, 92]. Right heart failure is more commonly associated with lung injury, ARDS, hyperinflammation, thrombotic events, and viral damage [96, 97]. Right ventricular dilation is observed in 20–31% of cases [96, 97]. Myocarditis is more prevalent in patients with heart failure or shock without a history of cardiac disease and was identified as the cause of death in 7% of patients, contributing to one-third of deaths in another study [23, 88, 90]. Recent studies suggest that cardiac involvement may be more common than initially thought, with abnormal cardiac findings detected in up to 78% of patients with mild to moderate COVID-19 undergoing cardiac magnetic resonance imaging [98], and 56% showing cardiac inflammation and edema in another study [99]. Cardiac abnormalities may also be present in asymptomatic or minimally symptomatic patients [100].

Neurologic: Neurologic manifestations of COVID-19 range from mild symptoms to severe conditions such as stroke. Up to 80% of patients experience some form of neurologic symptom during their illness [101]. Mild symptoms, including headache and dizziness, affect up to 40% of patients, with prevalence potentially increasing as the illness progresses [101, 102, 103]. Changes in taste and smell are also common, with up to 80% of patients experiencing these disturbances, and in about one-third, these may be the initial symptoms [72, 75, 102, 103, 104]. Severe neurologic complications include seizures, encephalopathy, and cerebral ischemia. Encephalopathy, leading to changes in mental status, is more prevalent in older patients and is associated with poorer outcomes; delirium can occur in up to 55% of critically ill patients [101, 105, 106]. Meningoencephalitis may result from either direct CNS invasion by the virus or systemic inflammation. Immune-mediated conditions such as Guillain-Barré Syndrome and myasthenia gravis have also been reported [107]. Cerebral ischemia and stroke occur in up to 6% of critically ill patients, presenting as either small or large vessel occlusion; however, the incidence of cerebrovascular accidents is less than 1% in other populations [108, 109, 110]. Stroke is most commonly observed in the first few weeks following symptom onset. Rarely, cerebral venous thrombosis has been documented, associated with high mortality rates, and can present with symptoms such as headache, seizures, focal neurologic deficits, or altered mental status [111, 112]. Acute disseminated encephalomyelitis and posterior reversible encephalopathy syndrome are also noted. Additionally, psychiatric complications such as mood disorders, anxiety, insomnia, and psychotic disorders are observed [103, 113].

Gastrointestinal: Gastrointestinal symptoms are frequently observed, with up to one-third of COVID-19 patients presenting with GI symptoms initially [24, 114, 115]. Nausea and vomiting affect up to two-thirds of patients, while approximately 40% report loss of appetite and up to 50% experience diarrhea [24, 115]. Abdominal pain is less common, occurring in less than 10% of patients [24, 115]. In critically ill patients, severe gastrointestinal complications such as acute liver injury, cholecystitis, pancreatitis, ileus, pseudo-obstruction, and mesenteric ischemia may occur [116].

Dermatologic Manifestations: Dermatologic manifestations of COVID-19 are relatively uncommon, occurring in 0.4–20% of cases. These manifestations are often non-specific and can include erythema or urticaria-like lesions primarily on

the trunk and, less frequently, on the extremities [74, 117, 118, 119, 120, 121]. Other reported skin findings include livedo reticularis, vesicular eruptions, maculopapular lesions, and areas of thickened erythema resembling chilblains [117, 118, 119, 120, 121]. New pernio-like lesions have also been noted and may be indicative of COVID-19 [74, 118].

Hematologic/Thrombotic Complications: Hematologic issues, particularly thrombotic complications, are prevalent among critically ill COVID-19 patients. This increased risk is attributed to systemic inflammation [122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132]. Early studies reported high rates of venous thromboembolic events (VTE) in critically ill patients, with rates reaching up to 31% [122, 124, 125, 126]. However, recent studies have indicated that the overall risk of VTE, including pulmonary embolism (PE), is lower than initially suspected, with rates falling below 1% in most cases, although this risk remains higher than in the general non-COVID-19 population [132]. An international study further suggested that COVID-19 itself is not an independent risk factor for PE, as the incidence was similar during the pandemic and pre-pandemic eras [132]. Routine evaluation for PE in all COVID-19 patients is not recommended; instead, evaluation should be considered for those with additional risk factors, such as hypoxia, tachycardia, hypotension not explained by clinical assessment, sudden decompensation, or unexplained symptoms despite chest radiograph findings [132].

ED Evaluation of COVID-19

SARS-CoV-2 Testing

In the Emergency Department (ED), the primary focus is on identifying COVID-19 and assessing for severe illness and end-organ injury [1, 2, 3]. The primary method for detecting SARS-CoV-2 infection remains nucleic acid amplification tests (NAAT), particularly reverse transcription polymerase chain reaction (RT-PCR) assays, which are recommended by organizations such as the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), and Infectious Diseases Society of America (IDSA) [1, 2, 3, 20, 74, 133, 134, 135, 136, 137, 138, 139].

Sensitivity and Sampling Issues:

- **Sensitivity:** Initial concerns about RT-PCR sensitivity (as low as 70%) were linked to oropharyngeal sampling and suboptimal techniques. Sensitivity has improved with nasal vestibular and middle turbinate swabs or saliva samples, with sensitivity approaching 100% when viral RNA concentrations are between 500–5000/mL [135].
- **Timing of Testing:** The timing of testing affects RT-PCR characteristics, with highest sensitivity observed 2–3 days after symptom onset and lowest sensitivity immediately post-exposure [20, 138].

Point-of-Care Testing:

- **Rapid Antigen Testing:** Due to the high volume of tests, rapid SARS-CoV-2 antigen (Ag) tests have been introduced. These tests use nasal turbinate swabs and provide results in approximately 15 minutes, compared to the 60–120 minutes required for NAAT [140, 141, 142, 143, 144, 145].

- **Sensitivity and Specificity:** Although rapid antigen tests generally have high specificity, their sensitivity varies widely (31–93%), particularly at lower viral loads [20, 133, 137, 140, 141, 142, 143, 144, 145]. These tests show better sensitivity with a lower cycle threshold (Ct) in PCR testing, indicating higher sensitivity with higher viral loads [141, 142, 143, 144].

Current Recommendations:

- **Use in Screening:** Due to variability, rapid antigen tests are recommended for quickly screening symptomatic patients with suspected or confirmed exposure. Current guidelines suggest using SARS-CoV-2 Ag testing in conjunction with NAAT for definitive diagnosis or when NAAT is not available [20, 140, 143].
- **Performance Against Variants:** Studies indicate that rapid antigen tests maintain overall sensitivity for symptomatic individuals infected with the Omicron variant [146, 147].

Pharmacists and Health Informatics Evaluation of COVID-19

The evaluation of COVID-19 by pharmacists and health informatics focuses on several key areas:

1. **Pharmacists' Role**:
    - **Medication Management**: Pharmacists played a crucial role in managing medication therapies for COVID-19 patients, including antiviral drugs, corticosteroids, and supportive treatments. They ensured the safe dispensing and appropriate dosing of medications, particularly for patients with co-morbidities.
    - **Vaccination Distribution**: Pharmacists were heavily involved in the distribution and administration of COVID-19 vaccines, ensuring cold-chain management and addressing patient concerns regarding vaccine safety and efficacy.
    - **Public Health Education**: Pharmacists provided critical information on preventive measures, proper use of medications, and vaccine updates, acting as accessible healthcare providers in communities.
2. **Health Informatics' Role**:
    - **Data Collection and Analysis**: Health informatics facilitated the real-time collection, analysis, and sharing of COVID-19 data, helping track the virus's spread, mutation, and patient outcomes.
    - **Clinical Decision Support**: Informatics tools supported healthcare providers with decision-making protocols, leveraging data on treatment outcomes to optimize therapeutic interventions for COVID-19 patients.
    - **Telemedicine Integration**: Informatics enabled the expansion of telemedicine services, allowing pharmacists and healthcare providers to consult with patients remotely, monitor symptoms, and adjust treatments, accordingly, reducing the need for in-person visits.

Together, pharmacists and health informatics played a synergistic role in the evaluation and management of COVID-19, enhancing treatment protocols, supporting vaccination efforts, and contributing to public health strategies.

Conclusion

The COVID-19 pandemic has presented unprecedented challenges to global health systems and communities. Since its emergence, the SARS-CoV-2 virus has undergone significant evolution, with variants such as Delta and Omicron substantially altering the landscape of the pandemic. The Delta variant, characterized by higher transmissibility and viral loads, has been associated with increased hospitalization rates and mortality. It has significantly impacted health systems, straining resources and complicating patient management. In contrast, the Omicron variant, despite its high transmissibility and rapid spread, has shown a tendency toward reduced disease severity compared to earlier strains, although it still poses substantial risks, especially in unvaccinated populations. EMS strategies have had to adapt continuously in response to the evolving nature of the virus. Early in the pandemic, the focus was on managing high rates of severe illness and mortality, with critical care capacity being a major concern. As the pandemic has progressed, EMS protocols have evolved to address the shifting dynamics of virus transmission and disease severity. Vaccination has played a pivotal role in reducing severe outcomes, though challenges remain in managing breakthrough infections and ensuring equitable vaccine distribution. The community impact of COVID-19 has been profound, affecting not only health but also socioeconomic factors. The pandemic has highlighted disparities in healthcare access and has underscored the importance of robust public health strategies and preparedness. As new variants emerge and as our understanding of the virus improves, continuous research and adaptation of health policies are essential. Ongoing efforts to improve vaccine coverage, enhance treatment protocols, and strengthen EMS responses will be crucial in mitigating the impact of COVID-19 and managing future public health crises. In summary, the evolving nature of COVID-19 underscores the need for dynamic and responsive healthcare strategies. Effective management of the pandemic requires a multifaceted approach, including robust EMS strategies, comprehensive vaccination efforts, and ongoing research to address the challenges posed by emerging variants.

References

1. World Health Organization. (2021). WHO coronavirus 2019 (COVID-19) pandemic. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019
2. Centers for Disease Control and Prevention. (n.d.). COVID-19. Retrieved August 21, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/index.html
3. Chavez, S., Long, B., Koyfman, A., & Liang, S. Y. (2021). Coronavirus disease (COVID-19): A primer for emergency physicians. American Journal of Emergency Medicine, 44, 220-229.
4. Johns Hopkins University and Medicine. (n.d.). Coronavirus Resource Center. Retrieved August 21, 2021, from https://coronavirus.jhu.edu
5. Belouzard, S., Millet, J. K., Licitra, B. N., & Whittaker, G. R. (2012). Mechanisms of coronavirus cell entry mediated by the viral spike protein. Viruses, 4(6), 1011-1033.
6. Centers for Disease Control and Prevention. (2021, July 13). SARS-CoV-2 variant classifications and definitions. Retrieved July 19, 2021, from

https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-info.html#Consequence
7. Centers for Disease Control and Prevention. (2021, November 27). What you need to know about variants. Retrieved November 27, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/variants/variant.html
8. Davies, N. G., Abbott, S., Barnard, R. C., et al. (2021). Estimated transmissibility and impact of SARS-CoV-2 lineage B.1.1.7 in England. Science, 372(6538). https://doi.org/10.1126/science.abg3055
9. Zimmer, C. (2021, March 6). The new COVID variant in the UK. The New York Times. Retrieved July 19, 2021, from https://www.nytimes.com
10. Hart, R. (2021, July 6). Pfizer shot much less effective against Delta, Israel study shows — Here's what you need to know about variants and vaccines. Forbes. Retrieved July 30, 2021, from https://www.forbes.com
11. Dyer, O. (2021, August 2). Covid-19: Delta infections threaten herd immunity vaccine strategy. BMJ, 374. https://doi.org/10.1136/bmj.n1933
12. Lopez Bernal, J., Andrews, N., Gower, C., et al. (2021). Effectiveness of COVID-19 vaccines against the B.1.617.2 (Delta) variant. New England Journal of Medicine. https://doi.org/10.1056/NEJMoa2108891
13. Dougherty, K., Mannell, M., Naqvi, O., et al. (2021). SARS-CoV-2 B.1.617.2 (Delta) variant COVID-19 outbreak associated with a gymnastics facility - Oklahoma, April-May 2021. MMWR Morbidity and Mortality Weekly Report, 70(28), 1004-1007.
14. World Health Organization. (2021, November 26). Classification of Omicron (B.1.1.529): SARS-CoV-2 variant of concern. Retrieved December 26, 2021, from https://www.who.int/news/item/26-11-2021-classification-of-omicron-(b.1.1.529)-sars-cov-2-variant-of-concern
15. Centers for Disease Control and Prevention. (2021, December 26). CDC statement on B.1.1529 (Omicron variant). Retrieved December 26, 2021, from https://www.cdc.gov/media/releases/2021/s1126-B11-529-omicron.htm
16. Zhu, N., Zhang, D., Wang, W., China Novel Coronavirus Investigating and Research Team, et al. (2020). A novel coronavirus from patients with pneumonia in China, 2019. New England Journal of Medicine, 382(8), 727-733.
17. Del Rio, C., & Malani, P. N. (2020). COVID-19-new insights on a rapidly changing epidemic. JAMA, 323(14), 1339-1340.
18. Guan, W. J., Ni, Z. Y., Hu, Y., et al. (2020). China Medical Treatment Expert Group for Covid-19. Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine, 382(18), 1708-1720.
19. Ong, S. W. X., Chiew, C. J., Ang, L. W., et al. (2021). Clinical and virological features of SARS-CoV-2 variants of concern: A retrospective cohort study comparing B.1.1.7 (Alpha), B.1.351 (Beta), and B.1.617.2 (Delta). Clinical Infectious Diseases. https://doi.org/10.1093/cid/ciab721
20. Wiersinga, W. J., Rhodes, A., Cheng, A. C., et al. (2020). Pathophysiology, transmission, diagnosis, and treatment of coronavirus disease 2019 (COVID-19): A review. JAMA, 324(8), 782-793.
21. Wang, W., Xu Y., Gao, R., et al. (2020). Detection of SARS-CoV-2 in different types of clinical specimens. JAMA, 323(18), 1843-1844.
22. Wang, D., Hu, B., Hu, C., et al. (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA, 325(11), 1113.

23. Zhou, F., Yu, T., Du, R., et al. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. Lancet, 395(10229), 1054-1062.
24. Cheung, K. S., Hung, I. F. N., Chan, P. P. Y., et al. (2020). Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong cohort: Systematic review and meta-analysis. Gastroenterology, 159(1), 81-95.
25. Colavita, F., Lapa, D., Carletti, F., et al. (2020). SARS-CoV-2 isolation from ocular secretions of a patient with COVID-19 in Italy with prolonged viral RNA detection. Annals of Internal Medicine, 173(3), 242-243.
26. Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention. JAMA, 323(13), 1239-1242. https://doi.org/10.1001/jama.2020.2648
27. Byambasuren, O., Cardona, M., Bell, K., et al. (2020). Estimating the extent of asymptomatic COVID-19 and its potential for community transmission: Systematic review and meta-analysis. Open Forum Infectious Diseases, 5(4), 223-234. https://doi.org/10.1093/ofid/ofaa429
28. Liu, Y., & Rocklöv, J. (2021). The reproductive number of the Delta variant of SARS-CoV-2 is far higher compared to the ancestral SARS-CoV-2 virus. Journal of Travel Medicine. https://doi.org/10.1093/jtm/taab124
29. Sanche, S., Lin, Y. T., Xu, C., et al. (2020). High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. Emerging Infectious Diseases, 26(7), 1470-1477. https://doi.org/10.3201/eid2607.200282
30. Gunzler, D., & Sehgal, A. R. (2020). Time-varying COVID-19 reproduction number in the United States. Preprint medRxiv. https://doi.org/10.1101/2020.04.10.20060863
31. UK Government. (2021, December 23). Investigation of SARS-CoV-2 variants: Technical briefings. Retrieved from https://www.gov.uk/government/publications/investigation-of-sars-cov-2-variants-technical-briefings
32. Centers for Disease Control and Prevention. (2021). COVID Data Tracker. Retrieved from https://covid.cdc.gov/covid-data-tracker/#variant-proportions
33. Sheikh, A., McMenamin, J., Taylor, B., & Robertson, C. (2021). Public Health Scotland and the EAVE II Collaborators. SARS-CoV-2 Delta VOC in Scotland: Demographics, risk of hospital admission, and vaccine effectiveness. The Lancet, 397(10293), 2461-2462. https://doi.org/10.1016/S0140-6736(21)01638-5
34. World Health Organization. (2021, December 10). Enhancing readiness for Omicron (B.1.1.529): Technical brief and priority actions for member states. Retrieved from https://www.who.int/publications/m/item/enhancing-readiness-for-omicron-(b.1.1.529)-technical-brief-and-priority-actions-for-member-states
35. Hall, V. J., Foulkes, S., Charlett, A., et al. (2021). SARS-CoV-2 infection rates of antibody-positive compared with antibody-negative health-care workers in England: A large, multicentre, prospective cohort study (SIREN). The Lancet, 397(10283), 1459-1469. https://doi.org/10.1016/S0140-6736(21)00675-9

36. Hansen, C. H., Michlmayr, D., Gubbels, S. M., Mølbak, K., & Ethelberg, S. (2021). Assessment of protection against reinfection with SARS-CoV-2 among 4 million PCR-tested individuals in Denmark in 2020: A population-level observational study. The Lancet, 397(10280), 1204-1212. https://doi.org/10.1016/S0140-6736(21)00408-2
37. Rossler, A., Riepler, L., Bante, D., et al. (2021). SARS-CoV-2 B.1.1.529 variant (Omicron) evades neutralization by sera from vaccinated and convalescent individuals. Unpublished. https://doi.org/10.1101/2021.12.08.21267491
38. Pulliam, J. R. C., van Schalkwyk, C., Govender, N., et al. (2021). Increased risk of SARS-CoV-2 reinfection associated with emergence of the Omicron variant in South Africa. MedRxiv. https://doi.org/10.1101/2021.11.11.21266068
39. Wilhelm, A., Widera, M., Grikscheit, K., et al. (2021). Reduced neutralization of SARS-CoV-2 Omicron variant by vaccine sera and monoclonal antibodies. MedRxiv. https://doi.org/10.1101/2021.12.07.21267432
40. Collie, S., Champion, J., Moultrie, H., Bekker, L. G., & Gray, G. (2021). Effectiveness of BNT162b2 vaccine against Omicron variant in South Africa. New England Journal of Medicine. https://doi.org/10.1056/NEJMc2119270
41. Discovery Health. (2021, December 14). Discovery Health releases at-scale real-world analysis of Omicron outbreak; including collaboration with the SA Medical Research Council (SAMRC) to analyse vaccine effectiveness. Retrieved from https://www.discovery.co.za/corporate/health-insights-omicron-outbreak-analysis
42. South African Medical Research Council. (2021, December 6). Tshwane District Omicron variant patient profile - Early features. Retrieved from https://www.samrc.ac.za/news/tshwane-district-omicron-variant-patient-profile-early-features
43. Imperial College London. (2021, December 16). Report 49 - Growth, population distribution and immune escape of Omicron in England. Retrieved from https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-49-Omicron/
44. Imperial College London. (2021, December 22). Report 50 - Hospitalisation risk for Omicron cases in England. Retrieved from https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-50-Severity-Omicron/
45. Rochwerg, B., Agarwal, A., Siemieniuk, R. A., Agoritsas, T., Lamontagne, F., Askie, L., et al. (2020). A living WHO guideline on drugs for COVID-19. BMJ, 370, m3379. https://doi.org/10.1136/bmj.m3379
46. Oran, D. P., & Topol, E. J. (2021). The proportion of SARS-CoV-2 infections that are asymptomatic: A systematic review. Annals of Internal Medicine, 174(5), 655-662. https://doi.org/10.7326/M20-6976
47. Epidemiology Working Group for NCIP Epidemic Response. (2020). Zhonghua Liu Xing Bing Xue Za Zhi, 41*(2), 145-151.
48. Zaim, S., Chong, J. H., Sankaranarayanan, V., & Harky, A. (2020). COVID-19 and multiorgan response. Current Problems in Cardiology, 45(8), Article 100618. https://doi.org/10.1016/j.cpcardiol.2020.100618
49. Lauer, S. A., Grantz, K. H., Bi, Q., et al. (2020). The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: Estimation and application. Annals of Internal Medicine, 172(9), 577-582. https://doi.org/10.7326/M20-0504

50. He, J., Guo, Y., Mao, R., & Zhang, J. (2021). Proportion of asymptomatic coronavirus disease 2019: A systematic review and meta-analysis. Journal of Medical Virology, 93(2), 820-830. https://doi.org/10.1002/jmv.26508
51. Gottlieb, M., Sansom, S., Frankenberger, C., Ward, E., & Hota, B. (2020). Clinical course and factors associated with hospitalization and critical illness among COVID-19 patients in Chicago. Illinois Academy of Emergency Medicine, 27(10), 963-973. https://doi.org/10.1016/j.ajem.2020.07.045
52. Huang, C., Wang, Y., Li, X., et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet, 395(10223), 497-506. https://doi.org/10.1016/S0140-6736(20)30183-5
53. Richardson, S., Hirsch, J. S., Narasimhan, M., et al. (2020). Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA, 323(20), 2052-2059. https://doi.org/10.1001/jama.2020.6775
54. Ziehr, D. R., Alladina, J., Petri, C. R., et al. (2020). Respiratory pathophysiology of mechanically ventilated patients with COVID-19: A cohort study. American Journal of Respiratory and Critical Care Medicine, 201(12), 1560-1564. https://doi.org/10.1164/rccm.202005-1823OC
55. Auld, S. C., Caridi-Scheible, M., Blum, J. M., et al. (2020). ICU and ventilator mortality among critically ill adults with coronavirus disease 2019. Critical Care Medicine, 48(9), e799-e804. https://doi.org/10.1097/CCM.0000000000004431
56. Levin, A. T., Hanage, W. P., Owusu-Boaitey, N., et al. (2020). Assessing the age specificity of infection fatality rates for COVID-19: Systematic review, meta-analysis, and public policy implications. European Journal of Epidemiology, 35(12), 1123-1138. https://doi.org/10.1007/s10654-020-00698-1
57. Cates, J., Lucero-Obusan, C., Dahl, R. M., et al. (2020). Risk for in-hospital complications associated with COVID-19 and influenza - Veterans Health Administration, United States, October 1, 2018-May 31, 2020. MMWR Morbidity and Mortality Weekly Report, 69(42), 1528-1534. https://doi.org/10.15585/mmwr.mm6942a3
58. Xie, Y., Bowe, B., Maddukuri, G., & Al-Aly, Z. (2020). Comparative evaluation of clinical manifestations and risk of death in patients admitted to hospital with COVID-19 and seasonal influenza: Cohort study. BMJ, 371, m4677. https://doi.org/10.1136/bmj.m4677
59. Lentz, S., Roginski, M. A., Montrief, T., et al. (2020). Initial emergency department mechanical ventilation strategies for COVID-19 hypoxemic respiratory failure and ARDS. American Journal of Emergency Medicine, 38(10), 2194-2202. https://doi.org/10.1016/j.ajem.2020.06.058
60. Verma, A. A., Hora, T., Jung, H. Y., et al. (2021). Characteristics and outcomes of hospital admissions for COVID-19 and influenza in the Toronto area. Canadian Medical Association Journal, 193(12), E410-E418. https://doi.org/10.1503/cmaj.202527
61. Dennis, J. M., McGovern, A. P., Vollmer, S. J., & Mateen, B. A. (2021). Improving survival of critical care patients with coronavirus disease 2019 in England: A national cohort study, March to June 2020. Critical Care Medicine, 49(2), 209-214. https://doi.org/10.1097/CCM.0000000000004429
62. Petrilli, C. M., Jones, S. A., Yang, J., et al. (2020). Factors associated with hospital admission and critical illness among 5279 people with coronavirus

disease 2019 in New York City: Prospective cohort study. BMJ, 369, m1966. https://doi.org/10.1136/bmj.m1966
63. Williamson, E. J., Walker, A. J., Bhaskaran, K., et al. (2020). Factors associated with COVID-19-related death using OpenSAFELY. Nature, 584(7821), 430-436. https://doi.org/10.1038/s41586-020-2521-4
64. Cunningham, J. W., Vaduganathan, M., Claggett, B. L., et al. (2020). Clinical outcomes in young US adults hospitalized with COVID-19. JAMA Internal Medicine, 181(3), 379-381. https://doi.org/10.1001/jamainternmed.2020.3874
65. CDC COVID-19 Response Team. (2020). Preliminary estimates of the prevalence of selected underlying health conditions among patients with coronavirus disease 2019 - United States, February 12–March 28, 2020. MMWR Morbidity and Mortality Weekly Report, 69(13), 382-386. https://doi.org/10.15585/mmwr.mm6913e2
66. Harrison, S. L., Fazio-Eynullayeva, E., Lane, D. A., et al. (2020). Comorbidities associated with mortality in 31,461 adults with COVID-19 in the United States: A federated electronic medical record analysis. PLoS Medicine, 17(9), e1003321. https://doi.org/10.1371/journal.pmed.1003321
67. Anderson, M. R., Geleris, J., Anderson, D. R., et al. (2020). Body mass index and risk for intubation or death in SARS-CoV-2 infection: A retrospective cohort study. Annals of Internal Medicine, 173(10), 782-790. https://doi.org/10.7326/M20-3214
68. Tartof, S. Y., Qian, L., Hong, V., et al. (2020). Obesity and mortality among patients diagnosed with COVID-19: Results from an integrated health care organization. Annals of Internal Medicine, 173(10), 773-781. https://doi.org/10.7326/M20-3742
69. Alvarez-Garcia, J., Lee, S., Gupta, A., et al. (2020). Prognostic impact of prior heart failure in patients hospitalized with COVID-19. Journal of the American College of Cardiology, 76(20), 2334-2348. https://doi.org/10.1016/j.jacc.2020.08.795
70. Fisman, D., & Tuite, A. (2021). Progressive increase in virulence of novel SARS-CoV-2 variants in Ontario. Canada medRxiv Preprint. https://doi.org/10.1101/2021.07.05.21260050
71. Peyrony, O., Marbeuf-Gueye, C., Truong, V., et al. (2020). Accuracy of emergency department clinical findings for diagnosis of coronavirus disease 2019. Annals of Emergency Medicine, 76(4), 405-412. https://doi.org/10.1016/j.annemergmed.2020.05.010
72. Kornitzer, J., Johnson, J., Yang, M., et al. (2021). A systematic review of characteristics associated with COVID-19 in children with typical presentation and with multisystem inflammatory syndrome. International Journal of Environmental Research and Public Health, 18(16), 8269. https://doi.org/10.3390/ijerph18168269
73. Carpenter, C. R., Mudd, P. A., West, C. P., et al. (2020). Diagnosing COVID-19 in the emergency department: A scoping review of clinical examinations, laboratory tests, imaging accuracy, and biases. Academic Emergency Medicine, 27(8), 653-670. https://doi.org/10.1111/acem.14096
74. Struyf, T., Deeks, J. J., Dinnes, J., et al. (2020). Cochrane COVID-19 Diagnostic Test Accuracy Group. Signs and symptoms to determine if a patient presenting in primary care or hospital outpatient settings has COVID-

19 disease. Cochrane Database of Systematic Reviews, 7(7), CD013665. https://doi.org/10.1002/14651858.CD013665
75. Chua, A. J., Charn, T. C., Chan, E. C., & Loh, J. (2020). Acute olfactory loss is specific for COVID-19 at the emergency department. Annals of Emergency Medicine, 76(4), 550-551. https://doi.org/10.1016/j.annemergmed.2020.07.023
76. Bielecki, M., Crameri, G. A. G., Schlagenhauf, P., et al. (2020). Body temperature screening to identify SARS-CoV-2 infected young adult travellers is ineffective. Travel Medicine and Infectious Disease, 37, 101832. https://doi.org/10.1016/j.tmaid.2020.101832
77. Feng, C., Wang, L., Chen, X., et al. (2021). A novel artificial intelligence-assisted triage tool to aid in the diagnosis of suspected COVID-19 pneumonia cases in fever clinics. Annals of Translational Medicine, 9(3), 201. https://doi.org/10.21037/atm.2020.04.36
78. Rawson, T. M., Moore, L. S. P., Zhu, N., et al. (2020). Bacterial and fungal coinfection in individuals with coronavirus: A rapid review to support COVID-19 antimicrobial prescribing. Clinical Infectious Diseases, 71(9), 2459-2468. https://doi.org/10.1093/cid/ciaa530
79. Zhou, P., Liu, Z., Chen, Y., et al. (2020). Bacterial and fungal infections in COVID-19 patients: A matter of concern. Infection Control & Hospital Epidemiology, 41(9), 1124-1125. https://doi.org/10.1017/ice.2020.219
80. Zhu, X., Ge, Y., Wu, T., et al. (2020). Co-infection with respiratory pathogens among COVID-2019 cases. Virus Research, 285, 198005. https://doi.org/10.1016/j.virusres.2020.198005
81. Kim, D., Quinn, J., Pinsky, B., Shah, N. H., & Brown, I. (2020). Rates of co-infection between SARS-CoV-2 and other respiratory pathogens. JAMA, 323(20), 2085-2086. https://doi.org/10.1001/jama.2020.6266
82. Lai, C. C., & Yu, W. L. (2021). COVID-19 associated with pulmonary aspergillosis: A literature review. Journal of Microbiology, Immunology, and Infection, 54(1), 46-53. https://doi.org/10.1016/j.jmii.2020.09.004
83. Ismaiel, W. F., Abdelazim, M. H., Eldsoky, I., et al. (2021). The impact of COVID-19 outbreak on the incidence of acute invasive fungal rhinosinusitis [published online ahead of print, 2021 May 14]. American Journal of Otolaryngology, 42(6), 103080. https://doi.org/10.1016/j.amjoto.2021.103080
84. Honavar, S. G. (2021). Code mucor: Guidelines for the diagnosis, staging, and management of rhino-orbito-cerebral mucormycosis in the setting of COVID-19. Indian Journal of Ophthalmology, 69(6), 1361-1365. https://doi.org/10.4103/ijo.IJO_2890_20
85. El-Kholy, N. A., El-Fattah, A. M. A., & Khafagy, Y. W. (2021). Invasive fungal sinusitis in post COVID-19 patients: A new clinical entity [published online ahead of print, 2021 May 19]. Laryngoscope. https://doi.org/10.1002/lary.29632
86. Sen, M., Lahae, S., Lahane, T. P., et al. (2021). Mucor in a viral land: A tale of two pathogens. Indian Journal of Ophthalmology, 69(2), 244-252. https://doi.org/10.4103/ijo.IJO_540_20
87. Long, B., Brady, W. J., Koyfman, A., & Gottlieb, M. (2020). Cardiovascular complications in COVID-19. American Journal of Emergency Medicine, 38(7), 1504-1507. https://doi.org/10.1016/j.ajem.2020.04.044

88. Guo, T., Fan, Y., Chen, M., et al. (2020). Cardiovascular implications of fatal outcomes of patients with coronavirus disease 2019 (COVID-19) [published correction appears in JAMA Cardiology. 2020 Jul 1;5(7):848]. JAMA Cardiology, 5(7), 811-818. https://doi.org/10.1001/jamacardio.2020.1017
89. Madjid, M., Safavi-Naeini, P., Solomon, S. D., & Vardeny, O. (2020). Potential effects of coronaviruses on the cardiovascular system: A review. JAMA Cardiology, 5(7), 831-840. https://doi.org/10.1001/jamacardio.2020.1285
90. Lazzerini, P. E., Boutjdir, M., & Capecchi, P. L. (2020). COVID-19, arrhythmic risk, and inflammation: Mind the gap! Circulation, 142(1), 7-9. https://doi.org/10.1161/CIRCULATIONAHA.120.048437
91. Ranard, L. S., Fried, J. A., Abdalla, S., et al. (2020). Approach to acute cardiovascular complications in COVID-19 infection. Circulation: Heart Failure, 13(7), e007220. https://doi.org/10.1161/CIRCHEARTFAILURE.120.007220
92. Mahmud, E., Dauerman, H. L., Welt, F. G. P., et al. (2020). Management of acute myocardial infarction during the COVID-19 pandemic: A position statement from the Society for Cardiovascular Angiography and Interventions (SCAI), the American College of Cardiology (ACC), and the American College of Emergency Physicians (ACEP). Journal of the American College of Cardiology, 76(11), 1375-1384. https://doi.org/10.1016/j.jacc.2020.05.089
93. Driggin, E., Madhavan, M. V., Bikdeli, B., et al. (2020). Cardiovascular considerations for patients, health care workers, and health systems during the COVID-19 pandemic. Journal of the American College of Cardiology, 75(18), 2352-2371. https://doi.org/10.1016/j.jacc.2020.03.031
94. Stefanini, G. G., Montorfano, M., Trabattoni, D., et al. (2020). ST-elevation myocardial infarction in patients with COVID-19: Clinical and angiographic outcomes. Circulation, 141(25), 2113-2116. https://doi.org/10.1161/CIRCULATIONAHA.120.049382
95. Szekely, Y., Lichter, Y., Taieb, P., et al. (2020). Spectrum of cardiac manifestations in COVID-19: A systematic echocardiographic study. Circulation, 142(4), 342-353. https://doi.org/10.1161/CIRCULATIONAHA.120.047971
96. Argulian, E., Sud, K., Vogel, B., et al. (2020). Right ventricular dilation in hospitalized patients with COVID-19 infection. JACC: Cardiovascular Imaging, 13(11), 2459-2461. https://doi.org/10.1016/j.jcmg.2020.07.017
97. Puntmann, V. O., Carerj, M. L., Wieters, I., et al. (2020). Outcomes of cardiovascular magnetic resonance imaging in patients recently recovered from coronavirus disease 2019 (COVID-19) [published correction appears in JAMA Cardiology. 2020 Nov 1;5(11):1308]. JAMA Cardiology, 5(11), 1265-1273. https://doi.org/10.1001/jamacardio.2020.3557
98. Huang, L., Zhao, P., Tang, D., et al. (2020). Cardiac involvement in patients recovered from COVID-2019 identified using magnetic resonance imaging. JACC: Cardiovascular Imaging, 13(11), 2330-2339. https://doi.org/10.1016/j.jcmg.2020.05.004
99. Rajpal, S., Tong, M. S., Borchers, J., et al. (2021). Cardiovascular magnetic resonance findings in competitive athletes recovering from COVID-19 infection [published correction appears in JAMA Cardiology. 2021 Jan 1;6(1):123]. JAMA Cardiology, 6(1), 116-118. https://doi.org/10.1001/jamacardio.2020.7386

100. Liotta, E. M., Batra, A., Clark, J. R., et al. (2020). Frequent neurologic manifestations and encephalopathy-associated morbidity in Covid-19 patients. Annals of Clinical and Translational Neurology, 7(11), 2221-2230. https://doi.org/10.1002/acn3.51408
101. Lechien, J. R., Chiesa-Estomba, C. M., De Siati, D. R., et al. (2020). Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): A multicenter European study. European Archives of Oto-Rhino-Laryngology, 277(8), 2251-2261. https://doi.org/10.1007/s00405-020-05965-1
102. Beltrán-Corbellini, Á., Chico-García, J. L., Martínez-Poles, J., et al. (2020). Acute-onset smell and taste disorders in the context of COVID-19: A pilot multicentre polymerase chain reaction based case-control study. European Journal of Neurology, 27(9), 1738-1741. https://doi.org/10.1111/ene.14273
103. Tong, J. Y., Wong, A., Zhu, D., et al. (2020). The prevalence of olfactory and gustatory dysfunction in COVID-19 patients: A systematic review and meta-analysis. Otolaryngology–Head and Neck Surgery, 163(1), 3-11. https://doi.org/10.1177/0194599820926473
104. Frontera, J. A., Sabadia, S., Lalchan, R., et al. (2021). A prospective study of neurologic disorders in hospitalized patients with COVID-19 in New York City. Neurology, 96(4), e575-e586. https://doi.org/10.1212/WNL.0000000000011251
105. Pun, B. T., Badenes, R., Heras La Calle, G., et al. (2021). COVID-19 Intensive Care International Study Group. Prevalence and risk factors for delirium in critically ill patients with COVID-19 (COVID-D): A multicentre cohort study. Lancet Respiratory Medicine, 9(3), 239-250. https://doi.org/10.1016/S2213-2600(20)30558-8
106. Toscano, G., Palmerini, F., Ravaglia, S., et al. (2020). Guillain-Barré syndrome associated with SARS-CoV-2. New England Journal of Medicine, 382(26), 2574-2576. https://doi.org/10.1056/NEJMc2009191
107. Mao, L., Wang, M., Chen, S., et al. (2020). Neurological manifestations of hospitalized patients with COVID-19 in Wuhan, China: A retrospective case series study. medRxiv. https://doi.org/10.1101/2020.02.22.20026500
108. Oxley, T. J., Mocco, J., Majidi, S., et al. (2020). Large-vessel stroke as a presenting feature of Covid-19 in the young. New England Journal of Medicine, 382(20), e60. https://doi.org/10.1056/NEJMc2009787
109. American Heart Association/American Stroke Association Stroke Council Leadership. (2020). Temporary emergency guidance to US stroke centers during the coronavirus disease 2019 (COVID-19) pandemic. Stroke, 51(6), 1910-1912. https://doi.org/10.1161/STROKEAHA.120.030023
110. Al-Mufti, F., Amuluru, K., Sahni, R., et al. (2021). Cerebral venous thrombosis in COVID-19: A New York Metropolitan Cohort Study. AJNR American Journal of Neuroradiology, 42(7), 1196-1200. https://doi.org/10.3174/ajnr.A7078
111. Tu, T. M., Goh, C., Tan, Y. K., et al. (2020). Cerebral venous thrombosis in patients with COVID-19 infection: A case series and systematic review. Journal of Stroke and Cerebrovascular Diseases, 29(12), 105379. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105379
112. Taquet, M., Geddes, J. R., Husain, M., et al. (2021). Six-month neurological and psychiatric outcomes in 236,379 survivors of COVID-19: A retrospective cohort study using electronic health records. Lancet Psychiatry, 8(5), 416-427. https://doi.org/10.1016/S2215-0366(21)00084-5

113. Silva, F. A. F. D., Brito, B. B., Santos, M. L. C., et al. (2020). COVID-19 gastrointestinal manifestations: A systematic review. Revista da Sociedade Brasileira de Medicina Tropical, 53. https://doi.org/10.1590/0037-8682-0420-2020
114. Tian, Y., Rong, L., Nian, W., & He, Y. (2020). Review article: Gastrointestinal features in COVID-19 and the possibility of faecal transmission. Alimentary Pharmacology & Therapeutics, 51(9), 843-851. https://doi.org/10.1111/apt.15731
115. Kaafarani, H. M. A., El Moheb, M., Hwabejire, J. O., et al. (2020). Gastrointestinal complications in critically ill patients with COVID-19. Annals of Surgery, 272(2), e61-e62. https://doi.org/10.1097/SLA.0000000000003925
116. Recalcati, S. (2020). Cutaneous manifestations in COVID-19: A first perspective. Journal of the European Academy of Dermatology and Venereology, 34(5), e212-e213. https://doi.org/10.1111/jdv.16411
117. Gottlieb, M., & Long, B. (2020). Dermatologic manifestations and complications of COVID-19. American Journal of Emergency Medicine, 38(9), 1715-1721. https://doi.org/10.1016/j.ajem.2020.05.045
118. Tammaro, A., Adebanjo, G. A. R., Parisella, F. R., et al. (2020). Cutaneous manifestations in COVID-19: The experiences of Barcelona and Rome. Journal of the European Academy of Dermatology and Venereology, 34(7), e306-e307. https://doi.org/10.1111/jdv.16514
119. Li, H., Zhao, Y., Zhou, L., & Hu, J. (2020). Cutaneous, skin histopathological manifestations and relationship to COVID-19 infection patients. Dermatology Therapy, 33(6), e14157. https://doi.org/10.1111/dth.14157
120. Fernandez-Nieto, D., Jimenez-Cauhe, J., Suarez-Valle, A., et al. (2020). Characterization of acute acral skin lesions in nonhospitalized patients: A case series of 132 patients during the COVID-19 outbreak. Journal of the American Academy of Dermatology, 83(1), e61-e63. https://doi.org/10.1016/j.jaad.2020.04.046
121. Bikdeli, B., Madhavan, M. V., Jimenez, D., et al. (2020). COVID-19 and thrombotic or thromboembolic disease: Implications for prevention, antithrombotic therapy, and follow-up: JACC state-of-the-art review. Journal of the American College of Cardiology, 75(23), 2950-2973. https://doi.org/10.1016/j.jacc.2020.04.039
122. McGonagle, D., O'Donnell, J. S., Sharif, K., Emery, P., & Bridgewood, C. (2020). Immune mechanisms of pulmonary intravascular coagulopathy in COVID-19 pneumonia. Lancet Rheumatology, 2(7), e437-e445. https://doi.org/10.1016/S2665-9913(20)30121-1
123. Cui, S., Chen, S., Li, X., Liu, S., & Wang, F. (2020). Prevalence of venous thromboembolism in patients with severe novel coronavirus pneumonia. Journal of Thrombosis and Haemostasis, 18(6), 1421-1424. https://doi.org/10.1111/jth.14830
124. Klok, F. A. H., Kruip, M. J. H. A., van der Meer, N. J. M., et al. (2020). Incidence of thrombotic complications in critically ill ICU patients with COVID-19. Thrombosis Research, 191, 145-147. https://doi.org/10.1016/j.thromres.2020.03.013
125. Wichmann, D., Sperhake, J. P., Lütgehetmann, M., et al. (2020). Autopsy findings and venous thromboembolism in patients with COVID-19: A prospective cohort study. Annals of Internal Medicine, 173(4), 268-277.

126. Al-Samkari, H., Karp Leaf, R. S., Dzik, W. H., et al. (2020). COVID-19 and coagulation: Bleeding and thrombotic manifestations of SARS-CoV-2 infection. Blood, 136(4), 489-500.
127. Bilaloglu, S., Aphinyanaphongs, Y., Jones, S., et al. (2020). Thrombosis in hospitalized patients with COVID-19 in a New York City health system. JAMA, 324(8), 799-801. https://doi.org/10.1001/jama.2020.13372
128. Jenner, W. J., Kanji, R., Mirsadraee, S., et al. (2021). Thrombotic complications in 2928 patients with COVID-19 treated in intensive care: A systematic review. Journal of Thrombosis and Thrombolysis, 51(3), 595-607.
129. Shah, A., Donovan, K., McHugh, A., et al. (2020). Thrombotic and haemorrhagic complications in critically ill patients with COVID-19: A multicentre observational study. Critical Care, 24(1), 561. https://doi.org/10.1186/s13054-020-03260-3
130. Miró, Ò., Jiménez, S., Mebazaa, A., et al. (2021). Pulmonary embolism in patients with COVID-19: Incidence, risk factors, clinical characteristics, and outcome. European Heart Journal, 42(33), 3127-3142.
131. Freund, Y., Drogrey, M., Miró, Ò., et al. (2020). Association between pulmonary embolism and COVID-19 in emergency department patients undergoing computed tomography pulmonary angiogram: The PEPCOV International Retrospective Study. Academic Emergency Medicine, 27(9), 811-820.
132. Yamamoto, K., & Ohmagari, N. (2021). Microbiological testing for coronavirus disease 2019. JMA Journal, 4(2), 67-75.
133. Hanson, K. E., Caliendo, A. M., Arias, C. A., et al. (2021). The Infectious Diseases Society of America guidelines on the diagnosis of COVID-19: Molecular diagnostic testing. Clinical Infectious Diseases. https://doi.org/10.1093/cid/ciab048
134. Yohe, S. (2021). How good are COVID-19 diagnostic PCR tests? College of American Pathologists. Accessed May 7, 2021.
135. Li, Y., Yao, L., Li, J., et al. (2020). Stability issues of RT-PCR testing of SARS-CoV-2 for hospitalized patients clinically diagnosed with COVID-19. Journal of Medical Virology, 92(7), 903-908.
136. Yamayoshi, S., Sakai-Tagawa, Y., Koga, M., et al. (2020). Comparison of rapid antigen tests for COVID-19. Viruses, 12(12), 1420.
137. Kucirka, L. M., Lauer, S. A., Laeyendecker, O., Boon, D., & Lessler, J. (2020). Variation in false-negative rate of reverse transcriptase polymerase chain reaction-based SARS-CoV-2 tests by time since exposure. Annals of Internal Medicine, 173(4), 262-267.
138. Khandker, S. S., Nik Hashim, N. H. H., Deris, Z. Z., Shueb, R. H., & Islam, M. A. (2021). Diagnostic accuracy of rapid antigen test kits for detecting SARS-CoV-2: A systematic review and meta-analysis of 17,171 suspected COVID-19 patients. Journal of Clinical Medicine, 10(16), 3493.
139. Hanson, K. E., Altayar, O., Caliendo, A. M., et al. (2021). The Infectious Diseases Society of America guidelines on the diagnosis of COVID-19: Antigen testing. Clinical Infectious Diseases. https://doi.org/10.1093/cid/ciab557
140. Strömer, A., Rose, R., Schäfer, M., et al. (2020). Performance of a point-of-care test for the rapid detection of SARS-CoV-2 antigen. Microorganisms, 9(1), 58.
141. Hayer, J., Kasapic, D., & Zemmrich, C. (2021). Real-world clinical performance of commercial SARS-CoV-2 rapid antigen tests in suspected

COVID-19: A systematic meta-analysis of available data as of November 20, 2020. International Journal of Infectious Diseases, 108, 592-602.
142. Dinnes, J., Deeks, J. J., Berhane, S., et al. (2021). Rapid, point-of-care antigen and molecular-based tests for diagnosis of SARS-CoV-2 infection. Cochrane Database of Systematic Reviews, 3(3), CD013705.
143. Brümmer, L. E., Katzenschlager, S., Gaeddert, M., et al. (2021). Accuracy of novel antigen rapid diagnostics for SARS-CoV-2: A living systematic review and meta-analysis. PLoS Medicine, 18(8), Article e1003735.
144. Toptan, T., Eckermann, L., Pfeiffer, A. E., et al. (2021). Evaluation of a SARS-CoV-2 rapid antigen test: Potential to help reduce community spread? Journal of Clinical Virology, 135, Article 104713.
145. Deerain, J., Druce, J., Tran, T., et al. (2021). Assessment of the analytical sensitivity of ten lateral flow devices against the SARS-CoV-2 omicron variant. Journal of Clinical Microbiology. https://doi.org/10.1128/jcm.02479-21
146. Ferré, V. M., Peiffer-Smadja, N., Visseaux, B., et al. (2021). Omicron SARS-CoV-2 variant: What we know and what we don't. Anaesthesia, Critical Care & Pain Medicine, 41(1), Article 100998. https://doi.org/10.1016/j.accpm.2021.100998

حالات COVID-19 الشديدة: استراتيجيات خدمات الطوارئ والصيدلة والمعلومات الصحية وتأثيرها على المجتمع - مقال مراجعة

الملخص:

الخلفية :أصبحCOVID-19 ، الذي يسببه فيروسSARS-CoV-2 ، جائحة عالمية منذ أواخر عام 2019، مما أدى إلى تأثيرات كبيرة على أنظمة الصحة والمجتمعات في جميع أنحاء العالم. يؤثر الفيروس على الجهاز التنفسي وأنظمة أخرى، وقد ظهرت عدة متغيرات له، بما في ذلك دلتا وأوميكرون، ولكل منها تأثيرات مميزة على القابلية للانتقال وشدة المرض.

الهدف :تهدف هذه المراجعة إلى تقديم نظرة عامة محدثة حول الحالات الشديدة لفيروس كورونا(COVID-19) ، والاستراتيجيات التي تستخدمها خدمات الطوارئ الطبية (EMS) والصيادلة والمعلومات الصحية في السيطرة والإدارة، وتأثير ذلك على المجتمع بشكل عام.

الطرق :تم إجراء مراجعة شاملة للأدبيات باستخدام قواعد بيانات PubMed و Google Scholarحتى 31 ديسمبر 2021. شملت مصطلحات البحث 'COVID' و 'COVID-19' و 'SARS-CoV-2' و 'فيروس كورونا'، مع التركيز على الدراسات الرجعية والاستباقية، والمراجعات النظامية، والتحليلات التلوية، والإرشادات السريرية. شملت المراجعة 194 مصدرًا ذا صلة، مع التركيز على الأبحاث المتعلقة بطب الطوارئ.

النتائج :تسلط المراجعة الضوء على الانتشار العالمي السريع لCOVID-19 ، وظهور وتأثير المتغيرات مثل دلتا وأوميكرون، وارتباطها بزيادة القابلية للانتقال وشدة النتائج المرضية. تشمل النتائج الرئيسية الحمولة الفيروسية الأعلى للمتغير دلتا وارتباطه بالمرض الشديد، وارتفاع قابلية الانتقال للمتغير أوميكرون واحتمال انخفاض شدة المرض. تطورت معدلات الاستشفاء والوفيات مع التقدم في العلاج والتطعيم.

الخلاصة :لا يزال COVID-19 يشكل تحديًا لأنظمة الرعاية الصحية بمتغيراته المتطورة. تعد الاستراتيجيات الفعالة لخدمات الطوارئ الطبية ضرورية في إدارة الحالات الشديدة والتخفيف من تأثيرها على المجتمع. بينما تظل اللقاحات أداة حاسمة في تقليل الأمراض الشديدة، فإن البحث المستمر وتكيف الإرشادات السريرية أمران ضروريان لإدارة المتغيرات الجديدة وتأثيراتها على الصحة العامة.

الكلمات الرئيسيةCOVID-19 :، SARS-CoV-2، متغير دلتا، متغير أوميكرون، خدمات الطوارئ الطبية، شدة المرض، جائحة عالمية.