Factor Contributing Length of Stay of COVID-19 Patients in Hospitals: Scoping Review

Nana Septiana Widayati[1*)]; Titin Andri Wihastuti[1]; Laily Yuliatun[1]; Kumboyono[1]

[1*)] School of Nursing Brawijaya University Malang

ARTICLE INFO

A B S T R A C T

The very high transmission of COVID-19 has had a massive impact on the current health system, one of which is in hospitals. Understanding the length of stay for COVID-19 patients is needed in a pandemic because the demand for patient care in hospitals is increasing. This paper aims to understand the factors that can affect the length of stay of COVID-19 patients in the hospital. Searches were done on online databases at ScienceDirect, EBSCO, and Google Scholar. A systematic review was carried out on journals published in the last three years, namely 2019-2022, and in English, and met the inclusion and exclusion criteria that had been set. The search results found 12 articles that met the criteria and discussed various factors influencing the severity and length of hospital stay. Several factors identified as having an effect were comorbid, gender, smoking, gender, type of virus, severity, age, and laboratory finding. Hospital preparedness is needed to deal with fluctuations in COVID-19 patients and the number of requests for treatment facilities during the pandemic.

A B S T R A K

Penularan COVID-19 yang sangat cepat menimbulkan dampak yang besar pada sistem kesehatan saat ini salah satunya di rumah sakit. Pemahaman mengenai lama perawatan di rumah sakit (length of stay) pada pasien COVID-19 sangat diperlukan dalam kondisi pandemi dikarenakan permintaan perawatan pasien di rumah sakit meningkat. Tujuan dari penulisan ini adalah untuk memahami faktor-faktor yang dapat berpengaruh pada lama rawat inap pasien COVID-19 di rumah sakit. Pencarian dilakukan pada database online di ScienceDirect, EBSCO dan Google Schoolar. Tinjauan sistematis dilakukan pada jurnal yang terbit pada 3 tahun terakhir yaitu tahun 2019-2022 dan berbahasa inggris serta memenuhi kriteria inklusi dan eksklusi yang telah ditetapkan. Hasil pencarian didapatkan 12 artikel yang memenuhi kriteria dan membahas berbagai faktor yang berpengaruh pada keparahan dan lama perawatan pasien di rumah sakit. Beberapa faktor yang diidentifikasi dapat berpengaruh adalah komorbid, jenis kelamin, merokok, jenis kelamin, jenis virus, tingkat keparahan, usia, dan hasil laboratorium. Diperlukan kesiapsiagaan rumah sakit dalam menghadapi fluktuasi pasien COVID-19 dan jumlah permintaan tempat perawatan selama pandemi berlangsung.

INTRODUCTION

Coronavirus disease (COVID-19) is a contagious respiratory disease caused by a virus, namely Severe Acute Respiratory Syndrome Corona virus 2 (SARS-Cov-2)(Alali et al., 2021). This disease infected more than 200 countries and were finally designated a worldwide pandemic by the World Health Organization (WHO) in January 2020(Seidu et al., 2021). Data shows that globally until the end of June 2021, there have been 180,492,131 cases with a death toll of 3,916,771(WHO, 2021). COVID-19 has a high-speed transmission. The main transmission is through droplets from coughs or sneezes of COVID-19 sufferers or droplets of saliva or liquid from the nose of the sufferer(Seidu et al., 2021). Epidemiological and virological studies indicate that transmission occurs mainly from symptomatic and asymptomatic persons to others by direct contact with respiratory fluids, contaminated objects, surfaces, or aerosol action (Diaz et al., 2021)

The rapid spread of COVID-19 is having a significant impact on health systems worldwide(Vekaria et al., 2021). The risk of overwhelmed health services is reported in Italy, where there is a rapid increase in COVID-19 cases requiring inpatient care to 3.2 beds per 1000 population(Rees et al., 2020). The Intensive Care Unit (ICU) is required for 20% of patients with many morbidities, and patients with hospitalization have a mortality rate of >13% (Rodriguez-Morales et al., 2020). The rapid increase raises serious concerns over the possible impact on more resource-constrained health systems, particularly in low- and middle-income countries(Rees et al., 2020). It is necessary to understand and predict the demand for the number of inpatient beds and beds in the intensive care unit to optimize the effectiveness of hospital planning in dealing with the COVID-19 pandemic(Rees et al., 2020). Hospitals need to predict and calculate service capacity for COVID-19 patients in two ways, namely predicting the incidence (disease incidence) and estimating the total days of patient care (length of stay) based on the variation and severity and need for health services (Vekaria et al., 2021). Predicting the demand for hospital services requires an estimate of the number of patients requiring hospitalization and an estimate of how long each patient requires treatment. Estimating the length of stay in the hospital (length of stay) requires notable observations for each individual(Rees et al., 2020).

The length of stay of patients in the hospital (length of stay/LOS) is one indicator of the effectiveness of patient care. The effectiveness of care for patients in hospitals can also be seen from several other indicators besides LOS, namely the infection rate, the incidence of patient falls, and complications after spesificmedical actions are carried out (Murray, 2017). Many factors affect the LOS of patients in hospitals, including patient factors, hospital factors, environmental factors, and nurse factors(Murray, 2017). An assessment of the factors that play a role in the length of patient care in hospitals is needed from the patient's side is needed. So that it can provide information so that it can help model makers and policymakers better anticipate health care needs during COVID-19, which continues to develop during the current pandemic. This study aims to identify and analyze various factors that may affect the length of stay of COVID-19 patients in the hospital.

METHOD

The research design used the scoping review method by searching for articles and international journals using Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). The data bases used are Science Direct, EBSCO, and Google Scholar using the keywords "factors", "factors affecting", "length of stay", "COVID-19", and "length of hospital" combined withcombined the words "AND" and "OR". Article selection criteria were based on inclusion criteria based on PICO analysis (population, intervention, comparison, outcomes). Research articles are searched according to the topic, full-text articles published in the 2019-2022 period, free of charge, and are articles in English. The exclusion criteria are that the article cannot be accessed in full text. Search and selection of journal articles using the flowchart of the PRISMA method (figure 1.1)

Table 1.
Exclusion and Inclusion Criteria

Criteria	inclusion	Exclusion
Problem	Research subjects focus on COVID-19 patients	Research subjects other than COVID-19 patients
Intervention	Research that affects the length of treatment for COVID-19 patients	Literature review, theory summary
Comparison	No comparison set	No comparison set
Outcome	It aims to find factors that influence the length of treatment for COVID-19 patients in hospitals.	It did not aimto find factors affecting the length of treatment for COVID-19 patients in hospitals.

RESULTS AND DISCUSSION

From the search results, 12 articles related to factors that affect the length of days of care for COVID-19 patients hospitalized. The article finds various factors that play a role in the length of the patient's treatment process. A summary of article results from various studies can be seen in table 2. Various studies show that the following affect on the length of patient care:

Comorbid

Studies show that COVID-19 has a more severe clinical course in the presence of comorbidities, so a more extended hospital stay is required. Patients with underlying medical conditions (comorbid) such as obesity, cardiovascular disease, chronic kidney disease, diabetes, chronic lung disease, and cancer are at risk for COVID-19 infection with severe manifestations (Cascella et al., 2020). Cardiovascular disease includes all non-communicable diseases including the heart and blood vessels(Kumboyono et al., 2022). Comorbid or other diseases that underlie and affect the

severity of COVID-19 patients include hypertension, hyperlipidemia, diabetes, obesity, chronic kidney failure, and other heart diseases (Among et al., 2021). The need for hospitalization in patients with comorbidities is six times higher when compared with the absence of comorbidities. Mortality was 12 times greater in patients with comorbidities than compared in patients without comorbidities (Stokes et al., 2020). The study found it was found that patients with comorbidities, especially diabetes mellitus, had a longer LOS time of 3.2 days compared to patients who did not have comorbidities. Patients with comorbidities are possible because, in diabetic patients, it can damage the function of macrophages and lymphocytes.It affects the growth of T cells and interferon production and causes suppressed immunological functions.In addition, viral infections can cause fluctuations in blood glucose levels, worsening diabetes complications and prolong the recovery process (Wu et al., 2020). Although type 2 diabetes is a factor that can increase the risk of death from severe COVID-19 disease, patients with diabetes and well-controlled blood glucose have lower mortality compared with diabetes and uncontrolled blood glucose (Among et al., 2021). COVID-19 patients with diabetes have organ damage and inflammatory factors and tend to have a poorer prognosis, so more intensive care is needed in patients with comorbid diabetes (Guo et al., 2020).

Smoke

Smoking is one of the main factors that cause high mortality and morbidity rates in patients. Smoking is also a predisposing factor that can exacerbate the incidence of diseases caused by bacteria that cause lung and viral pneumonia(Chousein et al., 2020). Smoking causes damage to the upper respiratory tract and decreases the immune system in the lungs (Patanavanich & Glantz, 2020). Smoking contains nicotine which is addictive and causes various diseases(Kumboyono et al., 2021). The study states that smoking increases the severity of COVID-19 sufferers by 1.91 times higher when compared to patients who do not smoke (Patanavanich & Glantz, 2020). Previous research conducted in Iran found that smoking can increase the length of hospital stay when compared to patients who do not smoke. The LOS difference in patients who smoked was 5.21 days longer when compared to patients who had never smoked, while the LOS of former smokers was 2.19 days longer compared to patients who had never smoked (Sari et al., 2016). Although several studies have concluded that smoking is significantly associated with LOS, some suggest the opposite (Patanavanich & Glantz, 2020). Several studies suggest that COVID-19 primarily targets the lungs; smoking-related lung disorders often overlap with other respiratory comorbidities in COVID-19 patients, such as chronic bronchitis, chronic obstructive pulmonary disease, and emphysema (Alluhaymid et al., 2020). However, research remains on smoking as a risk factor for a worse COVID-19 prognosis and calls for quitting smoking amid the pandemic (Khalil et al., 2021).
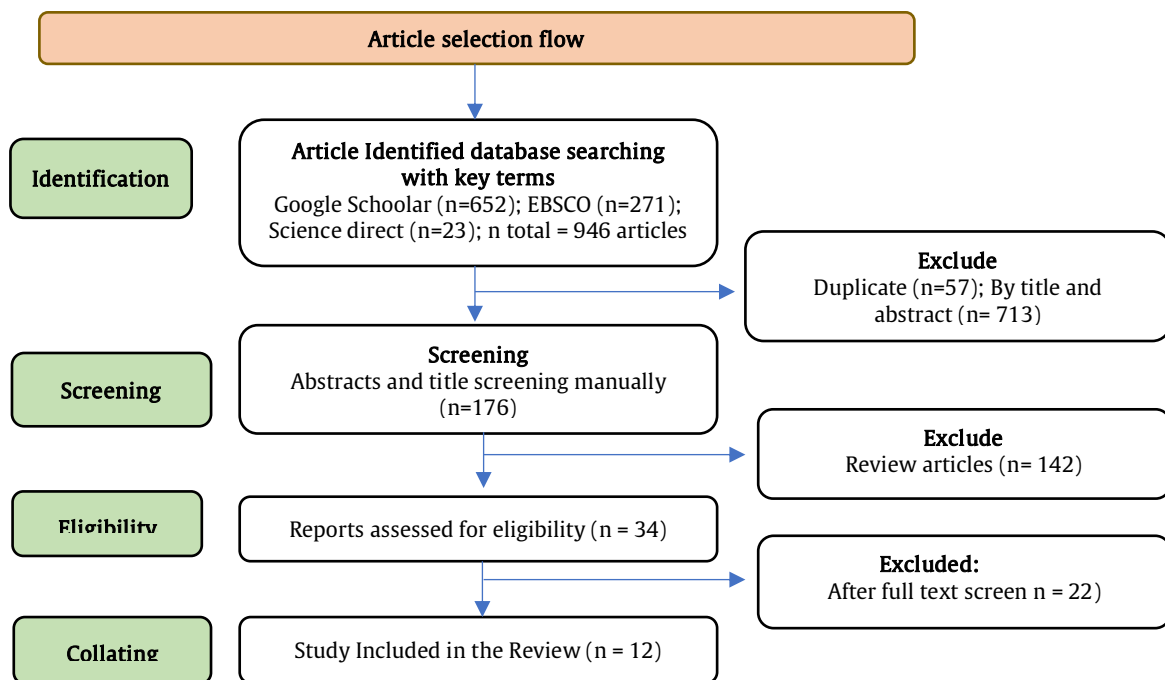
Article selection flow

Identification

Article Identified database searching with key terms
Google Schoolar (n=652); EBSCO (n=271); Science direct (n=23); n total = 946 articles

Exclude
Duplicate (n=57); By title and abstract (n= 713)

Screening

Screening
Abstracts and title screening manually (n=176)

Exclude
Review articles (n= 142)

Eligibility

Reports assessed for eligibility (n = 34)

Excluded:
After full text screen n = 22)

Collating

Study Included in the Review (n = 12)

Figure 1. Article search flow based on the PRISMA method

Table 2
Article Summary

No	Writer	Research design	Sample	Research result
1	(Li et al., 2021)	This research is a retrospective cohort study on COVID-19 patients with	102 patients were diagnosed with COVID-19 between January 2020 and March 2020 at	LOS increased with age in the 3-day groups (LOS 10 days, 11-18 days, and >19 days). Older age (≥50 years), high ALT and AST levels (both 40 U/L), critical and severe pneumonia, and high myoglobin levels (≥

No				
		pneumonia using the Fisher extract test or Chi-square and Mann-Whitney tests.	You A Hospital in Beijing, China	100 g/L) significantly increased the likelihood of a longer LOS. Five associated risk factors affecting LOS were age, ALT, platelets, PF ratio, and pneumonia.
2	(Wu et al., 2020)	This research is a descriptive retrospective analysis to describe the characteristics of patients admitted to Fangcang Hospital, China.	According to the inclusion criteria, there were 136 patients with complete medical records, and 58 patients were included.	LOS was significantly related to gender, comorbidities (cardiovascular and diabetes), lymphocyte level, CT scan results, fever, and duration of symptom onset to hospital admission. Patients with fever prior to hospital admission had a 3.5-day longer LOS than those without fever. In addition, patients with diabetes were hospitalized for 3.2 days longer than those without diabetes. A longer duration of hospitalization among non-severe COVID-19 patients was associated with fever, bilateral pneumonia on CT scans, and diabetes.
3	(Mendes et al., 2021)	A Monocentric retrospective study in a geriatric hospital at Geneva University Hospital Switzerland	The sample consists of 245 patients	In COVID-19 patients, the Nutritional Risk Screening (NRS) value of 5 is associated with a prolonged LOS. LOS can extend up to 3.69 days. However, not associated with patient mortality. NRS is a nutritional screening where a total value of 5 is a high risk of malnutrition. Nutritional risk assessment is needed early on for inpatients, especially the elderly.
4	(Zinellu et al., 2021)	A Retrospective study at Sassari University Hospital, Italy	It consists of 65 COVID-19 patients whom RT-PCR has confirmed.	Patients with the Systemic Inflammation Index (SII) significantly affect the length of hospital stay. Patients had an average LOS of 21 days and a length of 1.36 days in patients with high SII scores.
5	(Chousein et al., 2020)	A Retrospective study in a Turkey hospital	It consists of 114 patients with COVID-19 pneumonia	The highest mortality factor is increasing age. There was no statistically significant effect on smoking in patients with disease severity and LOS and intensive care.
6	(Jeraiby et al., 2021)	Using a retrospective cohort study in Jizan, Kingdom of Saudi Arabia	It consists of 74 patients	The results show that CRP is a predictive factor from laboratory results routinely performed on COVID-19 patients. From the study results, it was found that CRP was significantly associated with the length of stay in patients (LOS) in the hospital.
7	(Wargny et al., 2021)	A Retrospective study of 68 hospitals in France	It consists of 2796 diabetic patients with confirmed COVID-19	In younger patients, taking regular metformin therapy and experiencing a more prolonged onset of symptoms before hospital admission had a positive relationship with patients length of stay (LOS).
8	(Crankson et al., 2022)	A Cross-Sectional Analysis	The total sample consists of 2334 COVID-19 patients at the Ga East Municipal hospital of Ghana	The results showed that the female sex had a longer hospitalization length than the male. Patients with hypertension and diabetes have a 2-day longer hospitalization period (LOS) than patients without comorbidities. Besides that, they have a four times higher chance of getting long COVID.
9	(Wang et al., 2022)	A Retrospective study	The total sample consists of 538 hospital patients in China's Sichuan province	The results showed that the average patient was hospitalized for 19 days, and patients older than 45 years had a longer LOS.
10	(Al-Salameh et al., 2021)	A Retrospective study	The total sample consists of 433 patients at Amiens University Hospital, France	The result was that 37.7% of the patients treated were obese, and 27.4% were overweight. Obesity was significantly associated with length of stay and severity of death. The risk of patient severity and the need for intensive care increases by 2x in patients with a BMI>25 kg/m.
11	(Twohig et al., 2021)	A Cohort study	The number of samples was 43,338 positive COVID-19 patients (8682 with the delta variant and 34,646 with the alpha variant) in the UK	The study results revealed that the risk of patients being admitted to the hospital and being treated was more found in the delta variant when compared to alpha.
12	(Khalil et al., 2021)	A Retrospective study	743 patients at Rafik Hariri University Hospital (RHUH)	The results showed that patients who smoked had a longer LOS of 2.8 days when compared to patients who were not smokers. Patients who smoke are more likely to be admitted to the ICU in COVID-19 patients. Male patients who smoke have a lower survival rate.

Virus type

Corona viruses are divided into four genera namely delta coronavirus, gamma coronavirus, beta coronavirus and alpha coronavirus (Shereen et al., 2020). In November 2021, a new variant called omicron coronavirus was discovered in South Africa(Veneti et al., 2022).Patients with the Delta variant virus had a 2.26 times risk of emergency and hospitalization

for hospitalization compared to patients infected with the alpha variant virus. The delta variant in an unvaccinated population may place a more significant burden on health care services than the alpha variant (Twohig et al., 2021). Meanwhile, in the omicron variant, it was found that the severity of the patient was lower when compared patients infected with the delta variant. Hence,the risk of hospitalization was 73% lower in the omicron variant when compared to the delta variant(Veneti et al., 2022). In patients with the omicron variant, the median LOS was 2.8 days, while the median delta variant LOS was 6.5 days, comparable to the percentage of ICU admissions in the omicron variant (7.7%) compared to the delta variant (24%)(Veneti et al., 2022).

Severity

Disease severity was defined according to the classification proposed in the Chinese guidelines for COVID-19-associated pneumonia*(Xie et al.*, 2020). Moderate severity or moderate casesis a condition with clinical signs of pneumonia (shortness, cough, rapid breathing, and fever) without any symptoms of severe pneumonia (saturation 93%). Meanwhile, severe cases are conditions with clinical signs of pneumonia (shortness, cough, rapid breathing, and fever) plus one of the following conditions, namely severe respiratory distress, respiratory rate > 30x/minute, or saturation <93% with room air without using oxygen (Burhan et al., 2020).In moderate to critically ill COVID-19 patients, oxygen saturation values greater than 90% with supplemental oxygen administration indicate a very high probability of survival, whereas patients with oxygen saturation values less than 90% despite supplemental oxygen are at risk of higher mortality(Xie et al., 2020). The severity of the identified patient can affect patient's length of stay in the hospital. The study results showed that the average LOS of COVID-19 patients in China's Fangchang Hospital was 13 days, whereas, in patients with mild degrees, the LOS was 2.4 days shorter when compared to patients with moderate degrees (Wu et al., 2020). Patients with fever before hospital admission had a significantly longer LOS of 3.5 days than those without fever, and patients with bilateral pneumonia were hospitalized for 3.4 days longer when compared with patients who had a normal CT scan (Wu et al., 2020). In patients with high severity and requiring treatment in the ICU, the average LOS data was 21.1 days, with a median of 17.4 days (Lapidus et al., 2020).

Body Mass Index (BMI) and Nutritional Status

BMI has an essential role in the infection and severity of COVID-19 patients of all ages, especially in the elderly population(Malik et al., 2020). COVID-19 patients with obesity are more likely to be hospitalized and have a higher risk of dying in the hospital, especially for younger patients under 50 years, and mechanical ventilation is more often used(Hendren et al., 2021). Obesity is often associated with patients with COVID-19, with data showing that 41.7% of COVID-19 patients undergoing hospital treatment have obesity conditions (Richardson et al., 2020). In addition, it was found that most obese patients had severe manifestations along with an increase in BMI. Patients with obesity and age over 60 years had a nearly 4-fold higher risk of developing severe manifestations and dying, and obesity (BMI 30 kg/m²) had a 1.5-fold risk of hospitalization in younger patients. over 60 years and a 3.6-fold risk in patients over 60 years(Du et al., 2021). In a study conducted, it was found that patients admitted to the intensive care unit were seven times more likely to have a BMI >35 kg/m² (severe obesity) compared to patients with a BMI <25 kg/m² (Simonnet et al., 2020). Patient with obesity admitted to the intensive care unitis possible because obesity is associated with respiratory disorders as a predisposition to lung infection. Obesity (especially abdominal obesity) is accompanied by mild inflammation that can alter the immune response to COVID-19, and obese people often have other cardiometabolic conditions that increase the risk of infection (Al-Salameh et al., 2021). In addition, the nutritional status of patients who are at risk of experiencing malnutrition also has the potential to experience a lengthening hospitalization period, especially in elderly patients(Mendes et al., 2021).

Gender

Gender is reported to affect the severity of the disease. The percentage of male patients requiring inpatient care (16%), admitted to the ICU (3%), and died (6%) was higher than female patients requiring hospitalization (12%), ICU (2%), and died (5%)(Stokes et al., 2020).

Age

Research shows that age > 50 can increase the risk of patient severity, so a long time is needed for in-hospital treatment(Li et al., 2021). Patients over 65 years of age have the highest severity and the lowest in children under 18 years of age(Stokes et al., 2020). Clinical manifestations in children and infants are generally milder than in adults, especially in those without any background in certain diseases or obesity (Diaz et al., 2021). Older age has decreased immune functionand more sensitive cytokine response, and T cells that produce interleukins increase with age, so the induction of proinflammatory cytokines is not controlled (Li et al., 2021).

Laboratory Results

Laboratory results obtained from the blood of COVID-19 patients can be identified as affecting on the patient's LOS. High levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) (>40 U/L) and high myoglobin on laboratory tests were also identified as being able to increase LOS in COVID-19 patients (Li et al., 2021). In addition, the Systemic Inflammation Index (SII) is a count of [neutrophils × platelets]/lymphocytes having a significant effect on the length of hospital stay. Patients had an average LOS of 21 days and a length of 1.36 days in patients with high SII values(Zinellu et al., 2021). The results of other studies state that C-reactive protein is one indicator that is also significant for predicting LOS in COVID-19 patients(Jeraiby et al., 2021). CRP is a biomarker of the inflammatory process, where inflammation is often considered an essential trigger of various disease processes(Kumboyono et al., 2022). CRP is a reactant in the acute phase that plays a role in clearing infection by increasing phagocytosis and activating the complement system. Measuring CRP can provide an appropriate intervention plan to save patients with COVID-19(Jeraiby et al., 2021).

LIMITATIONS

The articles taken in this study are only those related to references to factors that influence the length of treatment

without considering the therapy received by each COVID-19 patient.

CONCLUSIONS AND SUGGESTIONS

Various references show many factors contributing to the length of stay of COVID-19 patients in the hospital.Several factors identified as having an effect were comorbid, gender, smoking, gender, type of virus, severity, age, and laboratory results.From the clinical data of patients, it can be helpful to evaluate the length of stay of patients and optimize the efficiency of the use of beds in hospitals and reduce resources. Hospital preparedness is needed in dealing with fluctuations in COVID-19 patients and the number of requests for care during the pandemic, and further understanding and study in understanding the various factors that play a role in the length of hospital stay.

ETHICAL CONSIDERATION

Conflict of Interest Statement

The author has no conflict of interest, and there are no ethical issues related to this research.

REFERENCES

Al-Salameh, A., Lanoix, JP, Bennis, Y., Andrejak, C., Brochot, E., Deschasse, G., Dupont, H., Goeb, V., Jaureguy, M., Lion, S. , Maizel, J., Moyet, J., Vaysse, B., Desailloud, R., Ganry, O., Schmit, JL, & Lalau, JD (2021). The association between body mass index class and coronavirus disease 2019 outcomes. International Journal of Obesity, 45(3), 700–705. https://doi.org/10.1038/s41366-020-00721-1

Alali, AS, Alshehri, AO, Assiri, A., Khan, S., Alkathiri, MA, Almohammed, OA, Badoghaish, W., AlQahtani, SM, Alshammari, MA, Mohany, M., Alamri, FF, AlRuthia, Y., & Alqahtani, F. (2021). Demographics, Comorbidities, and Outcomes among Young and Middle-Aged COVID-19 Patients in Saudi Arabia. *Saudi Pharmaceutical Journal*, 12(8). https://doi.org/10.1016/j.jsps.2021.06.005

Alluhaymid, YM, Almutairi, FS, Alnakhlie, WS, Alsadiq, ZM, Alanazi, GG, Alqaan, RS, Badr, SY, Alruwaili, EM, Saber, RA, Kersh, GT, & Alfaifi, AA (2020). Prevalence of COPD Concerning Severity of COVID-19 Infection: A Short Systematic Review and Meta-analysis. Annals of Medical and Health Sciences Research, 10(5), 1095–1099.

Among, I., Hospitalized, A., Covid-, W., March, M., Kompaniyets, L., Pennington, AF, Goodman, AB, Rosenblum, HG, Belay, B., Ko, JY, Chevinsky, JR , Schieber, LZ, Summers, AD, Lavery, AM, Preston, LE, Danielson, ML, Cui, Z., Namulanda, G., Yusuf, H.,

& Gundlapalli, AV (2021). Underlying Medical Conditions and Severe. 1–13.

Burhan, E., Susanto, AD, Nasution, SA, & et al. (2020). COVID-19 MANAGEMENT GUIDELINES (2nd ed.). Indonesian Lung Doctors Association (PDPI). https://www.papdi.or.id/pdfs/938/Pedoman Tatalaksana COVID-19 edition 2.pdf

Cascella, M., Rajnik, M., Cuomo, A., Dulebohn, SC, & Di Napoli, R. (2020). Features, Evaluation, and Treatment of Coronavirus. StatPearls, Cdc, 19. http://www.ncbi.nlm.nih.gov/pubmed/32150360

Chousein, EGU, örtük, M., Cinarka, H., Tanriverdi, E., Turan, D., Yildirim, BZ, Sezen, CB, & zgül, MA (2020). Is there any effect of smoking status on severity and mortality of hospitalized patients with covid-19 pneumonia? Tuberkuloz ve Thorax, 68(4), 371–378. https://doi.org/10.5578/tt.70352

Crankson, S., Pokhrel, S., & Anokye, NK (2022). Determinants of COVID-19-Related Length of Hospital Stays and Long COVID in Ghana: A Cross-Sectional Analysis. International Journal of Environmental Research and Public Health, 19(1). https://doi.org/10.3390/ijerph19010527

Diaz, J., Appiah, J., Askie, L., Baller, A., Banerjee, A., & Barkley, Shannon; Bertagnolio, Silvia; Hemmingsen, Bianca; Bonet, Mercedes; Cunningham, J. (2021). Clinical management Clinical management Living guidance COVID-19. In World Health Organization (Issue January).

Du, Y., Lv, Y., Zha, W., Zhou, N., & Hong, X. (2021). Association of body mass index (BMI) with critical COVID-19 and in-hospital mortality: A dose-response meta-analysis. Metabolism: Clinical and Experimental, 117, 154373. https://doi.org/10.1016/j.metabol.2020.154373

Guo, W., Li, M., Dong, Y., Zhou, H., Zhang, Z., Tian, C., Qin, R., Wang, H., Shen, Y., Du, K., Zhao, L., Fan, H., Luo, S., & Hu, D. (2020). Diabetes is a risk factor for the progression and prognosis of COVID-19. Diabetes/Metabolism Research and Reviews, 36(7), 1–9. https://doi.org/10.1002/dmrr.3319

Hendren, NS, De Lemos, JA, Ayers, C., Das, SR, Rao, A., Carter, S., Rosenblatt, A., Walchok, J., Omar, W., Khera, R., Hegde, AA, Drazner, MH, Neeland, IJ, & Grodin, JL (2021). Association of Body Mass Index and Age with Morbidity and Mortality in Patients Hospitalized with COVID-19: Results from the American Heart Association COVID-19 Cardiovascular Disease Registry. Circulation, 135–144. https://doi.org/10.1161/CIRCULATIONAHA.120.051936

Jeraiby, MA, Hakamy, MI, Albarqi, MB, Areda, RI, Haddad, MA, & Iqbal, J. (2021). Routine laboratory parameters predict serious outcome as well as length of hospital stay in COVID-19. Saudi Medical Journal, 42(11), 1165–1172. https://doi.org/10.15537/smj.2021.42.11.20210429

Khalil, A., Dhingra, R., Al-Mulki, J., Hassoun, M., & Alexis, N. (2021). Questioning the sex-specific differences in the association of smoking on the survival rate of hospitalized COVID-19 patients. PLoS ONE, 16(August 8), 1–10. https://doi.org/10.1371/journal.pone.0255692

Kumboyono, K., Chomsy, IN, Aini, FN, & Wihastuti, TA (2022). Correlation Pattern of oxLDL , cortisol , hsCRP , and Adiponectin Levels in Atherosclerosis Risk Population-Based on Framingham Risk Score. 14(1), 14–20.

Kumboyono, K., Chomsy, IN, Firdaus, DH, Setiawan, M., & Wihastuti, TA (2022). Protective cardiovascular benefits of exercise training as measured by circulating endothelial cells and high-density lipoprotein in adults. Journal of Taibah University Medical Sciences, in Press, 3–8. https://doi.org/10.1016/j.jtumed.2021.12.003

Kumboyono, K., Nurwidyaningtyas, W., Chomsy, IN, Cesa, FY, & Wihastuti, TA (2021). Smoking increases the premature associated senescence phenotype of circulating Endothelial Progenitor Cells. Jordan Journal of Biological Sciences, 14(4), 867–871. https://doi.org/10.54319/jjbs/140429

Lapidus, N., Zhou, X., Carrat, F., Riou, B., Zhao, Y., & Hejblum, G. (2020). Biased and unbiased estimation of the average length of stay in intensive care units in the Covid-19 pandemic. Annals of Intensive Care, 10(1). https://doi.org/10.1186/s13613-020-00749-6

Li, K., Zhang, C., Qin, L., Zang, C., Li, A., Sun, J., Zhao, Y., Feng, Y., & Zhang, Y. (2021). A Nomogram Prediction of Length of Hospital Stay in Patients with COVID-19 Pneumonia: A Retrospective Cohort Study. Disease Markers, 2021. https://doi.org/10.1155/2021/5598824

Malik, VS, Ravindra, K., Attri, SV, Bhadada, SK, & Singh, M. (2020). Higher body mass index is an important risk factor in COVID-19 patients: a systematic review and meta-analysis. Environmental Science and Pollution Research, 27(33), 42115–42123. https://doi.org/10.1007/s11356-020-10132-4

Mendes, A., Serratrice, C., Herrmann, FR, Gold, G., Graf, CE, Zekry, D., & Genton, L. (2021). Nutritional risk at hospital admission is associated with prolonged length of hospital stay in old patients with COVID-19. Clinical Nutrition, xxxx, 17–20. https://doi.org/10.1016/j.clnu.2021.03.017

Murray, E. (2017). Nursing Leadership. In Nursing Leadership and Management for Patient Safety and Quality Care (1st ed., Vol. 79, Issue 1). Davis Company. https://doi.org/10.1177/0894318413500313

Patanavanich, R., & Glantz, SA (2020). Smoking is associated with COVID-19 progression: A meta-analysis. Nicotine and Tobacco Research, 22(9), 1653–1656. https://doi.org/10.1093/ntr/ntaa082

Rees, EM, Nightingale, ES, Jafari, Y., Waterlow, NR, Clifford, S., Carl, CA, Group, CW, Jombart, T., Procter, SR, & Knight, GM (2020). COVID-19 length of hospital stay: A systematic review and data synthesis. BMC Medicine, 18(1). https://doi.org/10.1186/s12916-020-01726-3

Richardson, S., Hirsch, JS, Narasimhan, M., Crawford, JM, McGinn, T., Davidson, KW, Barnaby, DP, Becker, LB, Chelico, JD, Cohen, SL, Cookingham, J., Coppa, K., Diefenbach, MA, Dominello, AJ, Duer-Hefele, J., Falzon, L., Gitlin, J., Hajizadeh, N., Harvin, TG, … Zanos, TP (2020). Presenting Characteristics, Comorbidities, and Outcomes among 5700 Patients Hospitalized with COVID-19 in the New York City Area. JAMA - Journal of the American Medical Association, 323(20), 2052–2059. https://doi.org/10.1001/jama.2020.6775

Rodriguez-Morales, AJ, Cardona-Ospina, JA, Gutiérrez-Ocampo, E., Villamizar-Peña, R., Holguin-Rivera, Y., Escalera-Antezana, JP, Alvarado-Arnez, LE, Bonilla-Aldana, DK , Franco-Paredes, C., Henao-Martinez, AF, Paniz-Mondolfi, A., Lagos-Grisales, GJ, Ramírez-Vallejo, E., Suarez, JA, Zambrano, LI, Villamil-Gómez, WE, Balbin- Ramon, GJ, Rabaan, AA, Harapan, H., … Sah, R. (2020). Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. Travel Medicine and Infectious Disease, 34(February), 101623. https://doi.org/10.1016/j.tmaid.2020.101623

Sari, AA, Rezaei, S., Arab, M., Majdzadeh, R., Matin, BK, & Zandian, H. (2016). Effects of smoking on cost of hospitalization and length of stay among patients with lung cancer in Iran: A hospital-based study. Asian Pacific Journal of Cancer Prevention, 17(9), 4421–4426. https://doi.org/10.7314/APJCP.2016.17.9.4421

Seidu, S., Kunutsor, SK, Cos, X., & Khunti, K. (2021). Indirect impact of the COVID-19 pandemic on hospitals for cardiometabolic conditions and their management: A systematic review. Primary Care Diabetes, xxxx. https://doi.org/10.1016/j.pcd.2021.05.011

Shereen, MA, Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. Journal of Advanced Research, 24, 91–98. https://doi.org/10.1016/j.jare.2020.03.005

Simonnet, A., Chetboun, M., Poissy, J., Raverdy, V., Noulette, J., Duhamel, A., Labreuche, J., Mathieu, D., Pattou, F., Jourdain, M., Caizzo, R., Caplan, M., Cousin, N., Duburcq, T., Durand, A., El kalioubie, A., Favory, R., Garcia, B., Girardie, P., … Verkindt, H. .(2020). High Prevalence of Obesity in Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) Requiring Invasive Mechanical Ventilation. Obesity, 28(7), 1195–1199. https://doi.org/10.1002/oby.22831

Stokes, EK, Zambrano, LD, Anderson, KN, Marder, EP, Raz, KM, El Burai Felix, S., Tie, Y., & Fullerton, KE (2020). Coronavirus Disease 2019 Case Surveillance – United States, January 22–May 30, 2020. MMWR. Morbidity and Mortality Weekly Report, 69(24), 759–765. https://doi.org/10.15585/mmwr.mm6924e2

Twohig, KA, Nyberg, T., Zaidi, A., Thelwall, S., Sinnathamby, MA, Aliabadi, S., Seaman, SR, Harris, RJ, Hope, R., Lopez-Bernal, J., Gallagher, E., Charlett, A., De Angelis, D., Presanis, AM, Dabrera, G., Koshy, C., Ash, A., Wise, E., Moore, N., … Gunson, R. (2021). Hospital admission and emergency care attendance risk for SARS-CoV-2 delta (B.1.617.2) compared with alpha (B.1.1.7) variants of concern: a cohort study. The Lancet Infectious Diseases, 3099(21), 1–9. https://doi.org/10.1016/s1473-3099(21)00475-8

Vekaria, B., Overton, C., Wiśniowski, A., Ahmad, S., Aparicio-Castro, A., Curran-Sebastian, J., Eddleston, J., Hanley, NA, House, T., Kim, J., Olsen, W., Pampaka, M., Pellis, L., Ruiz, DP, Schofield, J., Shryane, N., & Elliot, MJ (2021). Hospital length of stay for COVID-19 patients: Data-driven methods for forward planning. BMC Infectious Diseases, 21(1), 1–15. https://doi.org/10.1186/s12879-021-06371-6

Veneti, L., Bøås, H., Kristoffersen, AB, Stålcrantz, J., Bragstad, K., Hungnes, O., Storm, ML, Aasand, N., Rø, G., Starrfelt, J., Seppälä, E., Kvåle, R., Vold, L., Nygård, K., Buanes, EA, & Whittaker, R. (2022). Reduced risk of hospitalization among reported COVID-19 cases infected with the SARS-CoV-2 Omicron BA.1 variant compared with the Delta variant, Norway, December 2021 to January 2022. Eurosurveillance, 27(4), 1–8. https://doi.org/10.2807/1560-7917.ES.2022.27.4.2200077

Wang, Z., Liu, Y., Wei, L., Ji, JS, Liu, Y., Liu, R., Zha, Y., Chang, X., Zhang, L., Liu, Q., Zhang, Y., Zeng, J., Dong, T., Xu, X., Zhou, L., He, J., Deng, Y., Zhong, B., & Wu, X. (2022). What are the risk factors of hospital length of stay in the novel coronavirus pneumonia (COVID-19) patients? A survival analysis in southwest China. In PLoS ONE (Vol. 17, Issue 1 January 2022). https://doi.org/10.1371/journal.pone.0261216

Wargny, M., Potier, L., Gourdy, P., Pichelin, M., Amadou, C., Benhamou, PY, Bonnet, JB, Bordier, L., Bourron, O., Chaumeil, C., Chevalier, N., Darmon, P., Delenne, B., Demarsy, D., Dumas, M., Dupuy, O., Flaus-Furmaniuk, A., Gautier, JF, Guedj, AM, … Hadjadj, S. (2021). Predictors of hospital discharge and mortality in patients with diabetes and COVID-19: updated results from the nationwide CORONADO study. Diabetologia, 64(4), 778–794. https://doi.org/10.1007/s00125-020-05351-w

WHO. (2021). COVID-19 Weekly Epidemiological Update 35. World Health Organization, December, 1–3. https://www.who.int/docs/default-

source/coronaviruse/situation-reports/weekly_epidemiological_update_22.pdf

Wu, S., Xue, L., Legido-Quigley, H., Khan, M., Wu, H., Peng, X., Li, X., & Li, P. (2020). Understanding factors influencing the length of hospital stay among non-severe COVID-19 patients: A retrospective cohort study in a Fangcang shelter hospital. PLoS ONE, 15(10 October), 1–15. https://doi.org/10.1371/journal.pone.0240959

Xie, J., Covassin, N., Fan, Z., Singh, P., Gao, W., Li, G., Kara, T., & Somers, VK (2020). Association Between Hypoxemia and Mortality in Patients With COVID-19. Mayo Clinic Proceedings, 95(6), 1138–1147. https://doi.org/10.1016/j.mayocp.2020.04.006

Zinellu, A., Scano, V., Masotto, E., de Riu, G., Vaira, LA, Carru, C., Pirina, P., Babudieri, S., Mangoni, AA, & Fois, AG (2021). The systemic inflammation index on admission is independently associated with length of stay in hospitalized COVID-19 patients. Minerva Respiratory Medicine, 60(3), 65–72. https://doi.org/10.23736/S2784-84777.21.01932-5