Contents lists available at IOCS

Science Midwifery

journal homepage: www.midwifery.iocspublisher.org

Cost of illness coronavirus disease 2019 (covid-19) with comorbidities in a hospital in west java

Alfi Nurul Islamiyah[1], Oskar Skarayadi[2*], Nur Hafidah Turrahmat[3], Siti Susiani[4]
[1,2,3,4]Faculty of Pharmacy, Universitas Jenderal Achmad Yani, Cimahi, Indonesia

ARTICLE INFO

Article history:

Received Feb 02, 2023
Revised Feb 16, 2023
Accepted Feb 28, 2023

Keywords:

COVID-19
Comorbid
Cost of Illness
Length of Stay

ABSTRACT

Epidemiological evidence has suggested that individuals with chronic disease may have a 10-fold risk of developing severe COVID-19 disease compared to individuals without comorbidities. The analysis that estimates the cost of treating COVID-19 patients is still very limited, especially in Indonesia. Thus, in this study, disease costs will be carried out to analyze the costs of clinical management of COVID-19 in patients with comorbidities during hospitalization. This study is a descriptive study using the economy evaluation method, in which the burden of the economy of the COVID-19 disease is included in the direct costs. Sampling was carried out with a purposive sampling method in inpatient COVID-19 patients who had comorbidities at a hospital in West Java during the second wave of COVID-19 in Indonesia (June, July, and August 2021). Ninety-six patients were diagnosed with COVID-19 with comorbid CAP and comorbid Type 2 DM, whose cost data were evaluated with the cost of illness. The total cost of COVID-19 patients with comorbid CAP is Rp. 1,773,944,688 with an average cost of Rp. 25,342,067 ± 10,550,734, and comorbid type 2 diabetes is Rp. 782,391,792 with an average cost of Rp. 30,091,992 ± 14,773,533. The average length of stay for COVID-19 patients with comorbid CAP was 10.1 ± 3.6 days, and comorbid type 2 DM was 11.3 ± 4.5 days. These results indicate that COVID-19 with comorbidities provides a considerable burden on patients, increases the length of treatment for patients, and is quite expensive.

Corresponding Author:

Oskar Skarayadi,
Faculty of Pharmacy,
Universitas Jenderal Achmad Yani,
Jalan Terusan Jenderal Sudirman PO BOX 148, Cimahi, 40533, Indonesia,
Email: oskar.skarayadi@lecture.unjani.ac.id

INTRODUCTION

Since late 2019, the world has been facing a pandemic caused by a novel coronavirus named severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), the virus that causes Coronavirus Disease 2019 (COVID-19). Epidemiologic evidence has shown that severe complications appear to worsen in elderly COVID-19 patients (>60) and/or in COVID-19 patients with one or more comorbidities. The presence of these comorbidities may predispose patients with COVID-19 to

develop severe complications from the viral infection. Preliminary data on clinical characteristics from Wuhan, China, showed that 32% of COVID-19-positive patients had underlying diseases, including cardiovascular disease, hypertension, diabetes, and chronic obstructive pulmonary disease (COPD) (Huang et al., 2020). Sometime later, national statistics from China on the clinical characteristics and outcomes of COVID-19 patients also revealed that among diagnosed cases, most patients had one or more comorbidities (Guan et al., 2020). Furthermore, preliminary data from the United States, EU/EEA also confirmed that individuals with comorbidities, especially cardiovascular disease, hypertension, diabetes, COPD, renal failure, and malignancy, appear to be at higher risk than those without these conditions for developing severe COVID-19 complications (ECDC, 2020; Liang et al., 2020). Overall, data shows that individuals with chronic diseases have a 10-fold higher risk of suffering from severe COVID-19 disease compared to individuals without comorbidities (Rodriguez-Morales et al., 2020).

One of the key components of the economic consequences of the COVID-19 pandemic is the management of infected people whose costs have not been adequately analyzed. To date, analyses estimating the cost of caring for COVID-19 patients are very limited, especially in Indonesia. Cost of Illness (COI), also known as Burden of Disease (BOD), is a form of economic evaluation that evaluates the economic burden of a disease on society, including all health care resources consumed as a result of the disease, whether in a country, region, community, or even an individual. Research in China suggests a high economic burden due to the COVID-19 pandemic, with the estimated healthcare costs associated with COVID-19 being US$0.62 billion. Inpatient care accounted for 44.2% of routine healthcare costs, followed by drugs at 2.5% (Jin et al., 2021). A study in Ghana found that resource use and the average cost of COVID-19 treatment varied significantly based on disease severity and treatment management. From a health system perspective, the average cost for a COVID-19 patient in Ghana was estimated at US$11,925, ranging from US$282 for a patient with mild/asymptomatic disease undergoing self-isolation at home to approximately US$23,382 for a critical patient requiring sophisticated and specialized care in a hospital. Treatment costs increased about 20 times in patients undergoing treatment in the hospital compared to at home (Ismaila et al., 2021). Another study in Germany found that hospitalized COVID-19 patients had heterogeneous disease patterns with varying rates of medical expenses incurred. There was wide variability in the service data, with average treatment costs ranging from EUR 900 to EUR 53,000 per patient, depending on the main diagnosis category and clinical severity (Jeck et al., 2022).

From an economic point of view, this study is intended to help manage scarce health financial resources during the COVID-19 pandemic, by evaluating the hospital care costs of COVID-19 patients with comorbidities. Estimating the cost of COVID-19 care is part of the evidence needed to implement policies and prioritize COVID-19 treatment. Specific evidence gaps in patient care costs tend to potentially slow down rapid resource planning, therefore Cost of Illness analysis seeks to fill these gaps. Cost of Illness studies can illustrate which diseases require increased resource allocation for either prevention or therapy so that the allocation of economic and physical health resources can be implemented efficiently. This study will conduct a Cost of Illness analysis to evaluate the cost of clinical management of COVID-19 in patients who have comorbidities during treatment at one of the hospitals in West Java as an illustration of the economic burden of COVID-19 in Indonesia. This study can provide input for health policymakers to understand the major costs of treating COVID-19 patients with comorbidities, and to allocate economic and physical health resources efficiently.

RESEARCH METHOD

This research design is a descriptive study using the Cost of Illness economic evaluation research method to assess clinical management costs in COVID-19 patients who have comorbidities during hospitalization at one of the hospitals in West Java. The evaluation of the economic burden includes all health care resources consumed as a result of COVID-19 disease, which was included in direct costs, which include room costs, COVID-19 drug costs, comorbid drug costs, medical service costs (doctor visits, doctor consultations), supporting examination costs (radiology, laboratory), administrative costs, and other costs related to patient care during illness and hospitalization.

The population of this study was COVID-19 patients who had comorbidities and were hospitalized during the second wave of COVID-19 in Indonesia (June, July, and August 2021) at one of the hospitals in West Java. Sampling was conducted non-randomly (probability sampling), with a sampling method with certain conditions (purposive sampling). The sample criteria included as subjects in this study are as follows.

a. Inclusion Criteria:
   1) Patients >17 years old who are diagnosed with COVID-19 and have comorbidities, with a total number of cases >25 patients
   2) Patients participating in the National Health Insurance
   3) Patients with complete medical data, including:
      - Patient name
      - Gender
      - Age
      - Medical record number
      - Date of hospital admission
      - Date of discharge
      - Diagnosis, including data on comorbidities/comorbidities
   4) Patients with complete direct medical cost data, including:
      - Room charge
      - COVID-19 drug costs
      - Comorbidity drug costs
      - Medical service fees (doctor visits, doctor consultations)
      - Supporting examination costs (radiology, laboratory)
      - Administrative costs
      - Other costs related to patient care during illness and hospitalization

b. Exclusion Criteria:
   1) COVID-19 patients with comorbidities who have a total number of cases <25 patients
   2) Incomplete and illegible patient data, both medical record data and details of direct medical costs
   3) Patients who died during the period of hospitalization at the hospital

Data analysis was carried out quantitatively to describe the cost of clinical management of COVID-19 in patients with comorbidities. Data processing of the research results was analyzed using simple statistical analysis (percentage). The results of this study are expected to provide input for health policymakers to understand the main costs of managing COVID-19 patients with comorbidities so that they can allocate economic and physical health resources efficiently.

This study on the Cost of Illness in COVID-19 patients with comorbidities conducted at one of the hospitals in West Java has obtained Ethics Committee approval permit Number: 070/4077/KEPKRSUD.Al.Ihsan/2022 on May 23, 2022. COVID-19 patients with comorbidities who were hospitalized at the hospital during the second wave of COVID-19 in Indonesia were 247

patients, consisting of COVID-19 patients with comorbid CAP (Community-Acquired Pneumonia) as many as 171 patients, COVID-19 patients with comorbid Type 2 DM as many as 29 patients, COVID-19 with comorbid CKD (Chronic Kidney Disease) as many as 11 patients, COVID-19 patients with comorbid severe ARI (Acute Respiratory Infection) were ten patients, COVID-19 patients with comorbid CAD (Coronary Artery Disease) were nine patients, COVID-19 patients with comorbid Tuberculosis were six patients, COVID-19 patients with comorbid BP (Bronchopneumonia) were six patients, and COVID-19 patients with comorbid CHF (Congestive Heart Failure) were five patients. The study obtained data on patients who met the inclusion criteria of 96 patients consisting of 70 COVID-19 patients with comorbid CAP and 26 COVID-19 patients with comorbid Type 2 DM. The research sampling stages are shown in the figure.

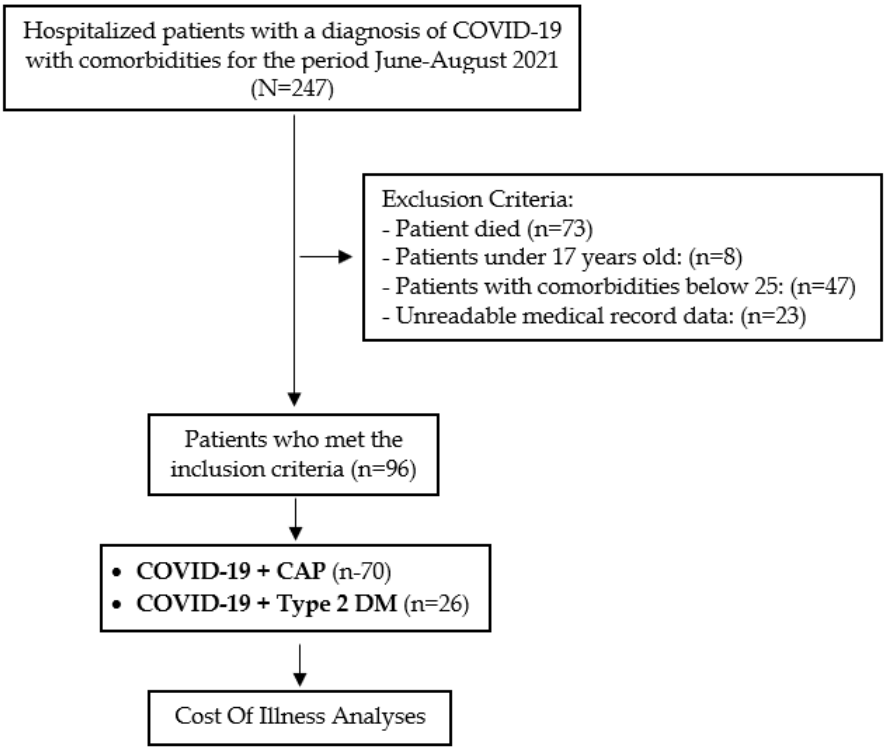

Figure 1. Research sampling stages

RESULTS AND DISCUSSIONS

Demographic Data

Demographic data of inpatients at one of the hospitals in West Java are shown in Table 1 Of the 96 patients who fit the inclusion criteria, 70 patients were COVID-19 patients with comorbid CAP consisting of 32 female patients (45.7) and 38 male patients (54.3%). While the other 26 patients were COVID-19 patients with comorbid Type 2 DM consisting of 7 female patients (26.9%) and 19 male patients (73.1%).

Table 1. Patients by Gender

Gender	Number of Patients (%)	
	COVID-19 + CAP (N = 70)	COVID-19+Type 2 DM (N = 26)
Female	32 (45,7)	7 (26,9)
Male	38 (54,3)	19 (73,1)
Total	**70 (100)**	**26 (100)**

Based on Table 1, it can be seen that the number of COVID-19 patients with comorbid CAP and COVID-19 patients with comorbid Type 2 DM is more experienced by male patients, namely 38 patients (54.3%) and 19 patients (73.1%). Although the sex data for COVID-19 shows an equal number of cases between men and women, there appear to be sex differences in mortality and susceptibility to COVID-19 disease. Epidemiological evidence suggests that more men develop severe conditions than women, potentially due to sex-based immunological or lifestyle differences such as smoking patterns and prevalence (Fidler et al., 2020). Other contributing factors are men's high levels of mobility as well as men's unhealthy lifestyles (Sharifi & Ryan, 2020). Androgen hormones, such as testosterone and dihydrotestosterone, are steroid hormones produced in males and females whose levels increase with puberty. Androgen hormone levels are higher in men than women, and it is thought that these hormones have a role in the development of COVID-19 disease (Mohamed et al., 2021). Studies show that androgens have a role in the development of COVID-19 disease, and many hospitalized patients have androgen-mediated conditions (Wambier et al., 2020).

Tabel 2. Patients by Age

Age Group	Age (years)	Number of Patients (%)	
		COVID-19 + CAP (N = 70)	COVID-19 + Type 2 DM (N = 26)
Late adolescence	17 – 25	1 (1,4)	0 (0)
Early adulthood	26 – 35	7 (10)	1 (3,8)
Late adulthood	36 – 45	10 (14,3)	2 (7,7)
Early old age	46 – 55	22 (31,4)	10 (38,5)
Late elderly	56 – 65	17 (24,3)	7 (26,9)
Elderly	> 65	13 (18,6)	6 (23,1)
Total		**70 (100)**	**26 (100)**

Based on age, patients are divided into six age groups, namely, in COVID-19 patients with comorbid CAP (1) the age group 17-25 years is one patient, (2) the age group 26-35 is seven patients, (3) the age group 36-45 years is ten patients, (4) the age group 46-55 is 22 patients, (5) the age group 56-65 is 17 patients, (6) the age group >65 is 13 patients. In COVID-19 patients with comorbid Type 2 DM, (1) the age group 17-25 years had no patients, (2) the age group 26-35 had one patient, (3) the age group 36-45 years had two patients, (4) the age group 4655 had ten patients, (5) the age group 56-65 had seven patients, (6) the age group >65 had six patients.

Table 2 shows that COVID-19 patients with CAP comorbidity and Type 2 DM comorbidity aged 46-55 years have a high percentage compared to other ages. This is because in this age range, productivity is still high, but the body's physiological functions begin to decline. The results obtained are in line with the research of da Costa Sousa et al. in one of the hospitals in Brazil, showing that the average number of COVID-19 patients is in the age range of 20-51 years, as many as 202 patients and in the age range of 52-64 years as many as 196 patients (da Costa Sousa et al., 2022).

***Cost of Illness* Analyses**

Cost of illness analysis estimates the total economic burden (including prevention, treatment, losses due to morbidity and mortality, etc.) of disease on society. This study was conducted from a hospital perspective, so the data used were direct medical cost data consisting of room costs, COVID-19 drug costs, comorbidity drug costs, medical service costs (doctor visits, doctor consultations), supporting examination costs (radiology, laboratory), administrative costs, and other costs related to patient care during illness and hospitalization. Below is a table showing the number, average, and percentage of costs of COVID-19 patients with comorbid CAP and COVID-19 with comorbid Type 2 DM. Table 3 and Table 4 show the total cost and average cost of COVID-19 therapy with comorbid CAP and comorbid Type 2 DM. Follow-up costs are the highest cost

component, with an average cost of Rp. 13,117,199, and Rp. 14,565,945, while radiology costs are the lowest expenditure component of Rp. 202,388 and Rp. 179,375. Cost burden (COI) and average expenditure of COVID-19 patients with comorbid CAP and comorbid Type 2 DM were obtained by averaging all patient costs incurred during treatment.

Table 3. Cost of Illness of COVID-19 with Comorbid CAP

Cost Components	Total (Rp.)	Average (Rp.)	Percentage (%)
Room Fee	246,101,000	3,515,729	13,6
Consultation Fee	78,835,000	1,126,214	4,6
Procedure Fee	918,203,929	13,117,199	48,4
Radiology Fee	13,560,000	202,388	16,4
Laboratory Fee	167,423,210	2,462,106	0,5
Drug Costs	267,822,244	3,826,032	9,8
Administration Fee	77,048,600	1,375,868	6,1
Other Costs	167,423,210	2,462,106	0,6
Total CoI	1,773,944,688	25,342,067± 10,550,734	100

Table 4. Cost of Illness of COVID-19 with Comorbid Type 2 DM

Cost Components	Total (Rp.)	Average (Rp.)	Percentage (%)
Room Fee	106,550,000	4,098,077	13,8
Consultation Fee	36,100,000	1,388,462	4,4
Procedure Fee	378,714,569	14,565,945	51,7
Radiology Fee	4,305,000	179,375	15
Laboratory Fee	75,819,000	2,916,115	0,7
Drug Costs	128,600,451	4,946,171	9,4
Administration Fee	5,050,000	194,231	4,3
Other Costs	47,252,772	1,968,866	0,7
Total CoI	782,391,792	30,091,992± 14,773,533	100

Based on Table 5, the average direct medical costs incurred in COVID-19 patients with comorbid CAP and comorbid Type 2 DM during the June-August 2021 period were IDR 25,342,067 ± 10,550,734 and IDR 30,091,992 ± 14,773,533, respectively. Statistically, there is no difference in the average total cost between COVID-19 patients with comorbid CAP and COVID-19 with comorbid Type 2 DM where the p-value is 0.112 (p> 0.05). Similar research was conducted by Rahmawati et al. related to a prevalence-based disease cost study using a retrospective Top-Down approach at the NTB Provincial Hospital in 2020. The results of this study obtained the cost of illness for COVID-19 patients with comorbidities of Rp. 71,926,056 (Rahmawati et al., 2022). Another study conducted by Karim et al. related to a prevalence-based disease cost study, using the Bottom-Up approach conducted at Vali-e-Asr Hospital from March 2020 to July 2020 showed that the total direct medical costs in COVID-19 patients were estimated at 3362.49 ± 2853.895 PPP (Nakhaei et al., 2021).

Table 5. Total Costs during Hospitalization

COVID-19 + Comorbid	N	∑ Costs (Rp) *Mean ± SD*	*p value**
COVID-19 + CAP	70	25,342,067 ± 10,550,734	0,112
COVID-19 + Type 2 DM	26	30,091,992 ± 14,773,533	
**Mann-Whitney Test significant p value*			

Length of Stay Analyses

Table 6. Average Treatment Costs based on Length of Stay

Length of Stay	Total patients	Average costs/week COVID-19 + CAP (N = 70)	Average costs/week COVID-19+Type 2 DM (N = 26)
1-7 days (1 week)	19 (19,8)	Rp 15,977,206	Rp 13,832,476

8-14 days (2 weeks)	64 (66,7)	Rp 25,460,142	Rp 27,988,819
15-21 days (3 weeks)	13 (13,5)	Rp 43,245,266	Rp 48,899,522

Length of hospitalization is the length of patient care from admission until the patient is discharged by the doctor in charge of the patient, documented through records in the medical record. The average length of stay can be calculated by summing up all lengths of stay and then dividing by the number of patients. Patients are then grouped based on the average length of treatment to compare the average costs incurred to analyze whether the length of treatment affects the high costs that must be incurred. Data on the average length of treatment and the average cost of treatment can be seen in Table 6.

The length of stay for COVID-19 patients with comorbid CAP who were treated for 1-7 days (1 week) cost Rp 15,977,206. Patients who were treated for 8-14 days (2 weeks) cost Rp 25,460,142, and patients who were treated for 15-21 days (3 weeks) cost Rp 43,245,266. In COVID-19, patients with comorbid Type 2 DM who were treated for 1-7 days (1 week) incurred costs IDR 13,832,476, patients treated for 814 days (2 weeks) incurred costs IDR 27,988,819, patients treated for 15-21 days (3 weeks) incurred costs IDR 48,899,522. Based on Table 6 above, the overall data shows that the longer the treatment will cause, the higher the costs must be incurred. The longer the treatment illustrates that, the more drugs are needed, and the actions taken in handling the patient become more frequent. This results in higher costs incurred. Table 7 shows the difference in length of hospitalization between COVID-19 patients with comorbid CAP and COVID-19 with comorbid Type 2 DM.

Table 7. Length of stay in COVID-19 patients with comorbid CAP and with comorbid Type 2 DM

COVID-19 + Comorbid	**N**	**∑ Length of stay (days)** ***Mean ± SD***	***p-value****
COVID-19 + CAP	70	10,1 ± 3,6	0,146
COVID-19 + Type 2 DM	26	11,3 ± 4,5	
**Mann-Whitney Test significant pvalue*			

Based on Table 7, the average length of stay in COVID-19 patients with comorbid CAP and comorbid Type 2 DM was 10.1 ± 3.6 days and 11.3 ± 4.5 days, respectively. Most patients (66.7%) were hospitalized for 8-14 days (Table 6). Statistically, there is no difference in the length of hospitalization between COVID-19 patients with comorbid CAP and COVID-19 with comorbid Type 2 DM where the p-value is 0.146 (p> 0.05). Similar research has been conducted by Vanesa et al. (2022), a cross-sectional study conducted at the Riocentro Campaign Hospital located in the western zone of the city of Rio de Janeiro, Brazil, during May 1-24, 2020, showed that the average length of stay of COVID-19 patients in the hospital was 10 ± 8 days. Most patients (66.6%) were hospitalized for at least six days (da Costa Sousa et al., 2022).

CONCLUSION

The cost of Illness of COVID-19 patients with comorbid CAP amounted to Rp. 1,773,944,688 with an average cost of Rp. 25,342,067 ± 10,550,734 and an average length of stay of 10.1 ± 3.6 days. COVID-19 patients with comorbid Type 2 DM amounted to Rp. 782,391,792 with an average cost of Rp. 30,091,992 ± 14,773,533 and an average length of stay of 11.3 ± 4.5 days. These results indicate that COVID-19 with comorbidities provides a considerable burden, increases the length of treatment for patients, and is quite expensive. This study was only conducted for COVID-19 patients with comorbid CAP and Type 2 DM. Further research for other comorbid COVID-19 patients, especially those with comorbidities including other catastrophic diseases, is highly recommended.

ACKNOWLEDGEMENTS

Thank you to the Lembaga Penelitian dan Pengabdian Masyarakat Universitas Jenderal Achmad Yani for providing financial support through competitive research grants in 2022 so that this research can be carried out properly.

References

ECDC. (2020). *Coronavirus disease 2019 (COVID-19) in the EU/EEA and the UK –ninth update, 23 April2020. Stockholm: ECDC; 2020*.

da Costa Sousa, V., da Silva, M. C., de Mello, M. P., Guimarães, J. A. M., & Perini, J. A. (2022). Factors associated with mortality, length of hospital stay and diagnosis of COVID-19: Data from a field hospital. *Journal of Infection and Public Health*, *15*(7), 800–805. https://doi.org/10.1016/j.jiph.2022.06.010

Fidler, S., Stöhr, W., Pace, M., Dorrell, L., Lever, A., Pett, S., Kinloch-de Loes, S., Fox, J., Clarke, A., Nelson, M., Thornhill, J., Khan, M., Fun, A., Bandara, M., Kelly, D., Kopycinski, J., Hanke, T., Yang, H., Bennett, R., … Murray, T. (2020). Antiretroviral therapy alone versus antiretroviral therapy with a kick and kill approach, on measures of the HIV reservoir in participants with recent HIV infection (the RIVER trial): a phase 2, randomised trial. *The Lancet*, *395*(10227), 888–898. https://doi.org/10.1016/S0140-6736(19)32990-3

Guan, W., Ni, Z., Hu, Y., Liang, W., Ou, C., He, J., Liu, L., Shan, H., Lei, C., Hui, D. S. C., Du, B., Li, L., Zeng, G., Yuen, K.-Y., Chen, R., Tang, C., Wang, T., Chen, P., Xiang, J., … Zhong, N. (2020). Clinical Characteristics of Coronavirus Disease 2019 in China. *New England Journal of Medicine*, *382*(18), 1708–1720. https://doi.org/10.1056/nejmoa2002032

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., … Cao, B. (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

Ismaila, H., Asamani, J. A., Lokossou, V. K., Oduro-Mensah, E., Nabyonga-Orem, J., & Akoriyea, S. K. (2021). The cost of clinical management of SARS-COV-2 (COVID-19) infection by level of disease severity in Ghana: a protocol-based cost of illness analysis. *BMC Health Services Research*, *21*(1). https://doi.org/10.1186/s12913-021-07101-z

Jeck, J., Jakobs, F., Kron, A., Franz, J., Cornely, O. A., & Kron, F. (2022). A cost of illness study of COVID-19 patients and retrospective modelling of potential cost savings when administering remdesivir during the pandemic "first wave" in a German tertiary care hospital. *Infection*, *50*(1), 191–201. https://doi.org/10.1007/s15010-021-01685-8

Jin, H., Wang, H., Li, X., Zheng, W., Ye, S., Zhang, S., Zhou, J., & Pennington, M. (2021). Economic burden of covid-19, china, january–march, 2020: A cost-of-illness study. *Bulletin of the World Health Organization*, *99*(2), 112–124. https://doi.org/10.2471/BLT.20.267112

Liang, W. H., Guan, W. J., Li, C. C., Li, Y. M., Liang, H. R., Zhao, Y., Liu, X., Sang, L., Sang, L., Chen, R. C., Tang, C. L., Wang, T., Wang, W., He, Q. H., Chen, Z. S., Wong, S. S., Zanin, M., Liu, J., Xu, X., … He, J. X. (2020). Clinical characteristics and outcomes of hospitalised patients with COVID-19 treated in Hubei (epicentre) and outside Hubei (non-epicentre): A nationwide analysis of China. *European Respiratory Journal*, *55*(6). https://doi.org/10.1183/13993003.00562-2020

Mohamed, M. S., Moulin, T. C., & Schiöth, H. B. (2021). Sex differences in COVID-19: the role of androgens in disease severity and progression. In *Endocrine* (Vol. 71, Issue 1, pp. 3–8). Springer. https://doi.org/10.1007/s12020-020-02536-6

Nakhaei, K., Jalilian, H., Arab-Zozani, M., Heydari, S., Torkzadeh, L., & Taji, M. (2021). Direct and indirect cost of COVID-19 patients in Iran. *Health Policy and Technology*, *10*(4). https://doi.org/10.1016/j.hlpt.2021.100572

Rodriguez-Morales, A. J., Cardona-Ospina, J. A., Gutiérrez-Ocampo, E., Villamizar-Peña, R., Holguin-Rivera, Y., Escalera-Antezana, J. P., Alvarado-Arnez, L. E., Bonilla-Aldana, D. K., Franco-Paredes, C., Henao-Martinez, A. F., Paniz-Mondolfi, A., Lagos-Grisales, G. J., Ramírez-Vallejo, E., Suárez, J. A., Zambrano, L. I., Villamil-Gómez, W. E., Balbin-Ramon, G. J., Rabaan, A. A., Harapan, H., … Sah, R. (2020). Clinical, laboratory and imaging features of

COVID-19: A systematic review and meta-analysis. In *Travel Medicine and Infectious Disease* (Vol. 34). Elsevier USA. https://doi.org/10.1016/j.tmaid.2020.101623

Sharifi, N., & Ryan, C. J. (2020). Editorial: Androgen hazards with COVID-19. In *Endocrine-Related Cancer* (Vol. 27, Issue 6, pp. E1–E3). BioScientifica Ltd. https://doi.org/10.1530/ERC-20-0133

Wambier, C. G., Goren, A., Vaño-Galván, S., Ramos, P. M., Ossimetha, A., Nau, G., Herrera, S., & McCoy, J. (2020). Androgen sensitivity gateway to COVID-19 disease severity. In *Drug Development Research* (Vol. 81, Issue 7, pp. 771–776). Wiley-Liss Inc. https://doi.org/10.1002/ddr.21688