Health Science Monitor
2024; 3(3): 261-268
Published online (http://hsm.umsu.ac.ir)

Original Article

The performance of a cardiovascular hospital in COVID-19 pandemic: a case study of a Middle East developing country

Bahram Nabilou [1], Anita Hamdollahzadeh [1], Hasan Yusefzadeh [1*]

[1]. Department of health economics and management, school of Public Health, Urmia University of Medical Sciences, Urmia, Iran

***Corresponding author:** Hasan Yusefzadeh, **Address**: Department of Health Economics and Management, School of Public Health, Urmia University of Medical Sciences, Nazloo Paradise, Sero Road, Urmia, West Azerbaijan, Iran,
Email: yusefzadeh.h@umsu.ac.ir, **Tel**: +98 (44) 32752300

Abstract

***Background & Aims*:** The performance of hospitals has been affected by the COVID-19 pandemic. This study investigated the performance of a cardiovascular hospital using indicators such as admissions and revenue.

***Materials & Methods*:** The medical records of patients with selected cardiovascular diseases were studied in a teaching cardiovascular hospital in the capital city of West Azerbaijan in the second quarter of 2019 and 2020. Data were collected from the medical records, including length of stay, hospitalization type, sex, age, insurance, deaths, and readmissions. Bills were collected from the revenue department and the hospital information system. Two performances, two results, and two control indicators were used. Revenue, length of stay, and bed occupancy rate were calculated for both periods. Data were analyzed using SPSS (version 16) and the Mann-Whitney statistical test.

***Results*:** One thousand three hundred and forty-one cases were studied in two study periods, with 57% being hospitalized in 2019, showing a decline of 14% in 2020. A decrease was observed in the average length of stay and total revenue during the pandemic. The difference in the mean total revenue was significant for 2 years ($P = 0.00$). The percentage of readmissions decreased slightly, and deaths increased in 2020.

***Conclusion*:** The COVID-19 pandemic undermined hospital performance. The analysis of the studied indicators showed that hospitalizations, bed occupancy rates, and total revenue followed a similar decreasing pattern in the selected hospital during the COVID-19 pandemic. The hospital should adopt appropriate strategies so that, in conditions identical to the COVID-19 pandemic, its performance is accompanied by the proper management of resources, efficiency, and minimal reduction in revenue.

***Keywords*:** Cardiovascular, COVID-19, Death, Hospital revenue, Urmia

Received 02 April 2024; accepted for publication 16 June 2024

Introduction

In late December 2019, an emerging infectious disease named coronavirus disease 2019 (COVID-19) spread rapidly worldwide (1, 2). In March 2020, the WHO classified COVID-19 as a pandemic (3). In addition to its direct impact on morbidity and mortality, the pandemic has caused collateral damage to healthcare for other diseases (4).

The latest COVID-19 pandemic statistics indicate 7,611,583 confirmed cases with 146,253 deaths in Iran from January 3, 2020, to May 31, 2023, as one of the first countries to become involved in the pandemic (5, 6).

In 2020, during the COVID-19 pandemic, studies in many countries showed changes in the admission patterns of hospitals with an unexpected reduction in admissions including cardiovascular diseases (CVDs) (7-9). CVDs are the leading cause of death worldwide and are responsible for the loss of 17.9 million lives every year, of which a significant number occur in people under 70 years old (10).

With increasing expenses due to COVID-19 and revenue losses from canceled outpatient visits, elective procedures, and surgeries, hospitals encountered financial challenges (11). The admission rate decreased compared to pre-pandemic years (12). Medical services and revenue of public hospitals declined drastically during the COVID-19 pandemic (13). The decline in the number of hospitalized patients for CVDs has been reported in studies during the pandemic (1, 2, 10, 14-16). The COVID-19 pandemic has also affected the performance of health service providers and reduced the admissions and revenues of hospitals in Iran (17, 18).

In Iran, infectious and diarrheal diseases, which are the primary causes of mortality, have been associated with cardiovascular disease (CVD) over the past few decades. Iran belongs to the group of countries in the Eastern Mediterranean Region that are most affected by CVDs. These diseases were the leading cause of mortality, with one million disability-adjusted life years (DALYs) resulting in 46% of all deaths and 20-23% of the disease burden in the country (19, 20).

The rapid spread of the COVID-19 pandemic has severely disrupted CVD-related services in nearly 75% of countries (21). According to one study, there was a considerable reduction in the number of patients with acute coronary syndromes attending the emergency department and in the hospitalization of patients with CVD in England (14). The admission rate of patients with acute coronary syndrome decreased considerably in some countries during the pandemic (22, 23).

Research has highlighted the challenges caused by the COVID-19 pandemic and the time needed to address them (15). A 2020 study provided a narrative of health conditions in some countries and pointed out that the COVID-19 pandemic and the necessary restrictions hindered people's access to health facilities for non-COVID conditions, particularly in slum areas (24).

Regardless of their developmental status, the COVID-19 pandemic affected hospitals in most countries. Evaluating hospital performance is vital to better prepare for future crises and design cost-effective interventions using limited resources in these centers. The impact of the COVID-19 epidemic on hospitals in Iran has not been sufficiently documented. Studying the economic impact of COVID-19 can help policymakers and health-decision makers to better allocate resources and provide needed funds and programs. This study aimed to describe the effect of the COVID-19 pandemic on CVD hospitalizations and changes in occupancy rates and revenues compared to the year before the pandemic in a low-income country’s provincial capital city.

Materials & Methods

This descriptive-analytical study was conducted at a government hospital in Urmia, the capital city of West Azerbaijan Province in Iran, in 2021. The hospital was the only cardiovascular and teaching referral center in the region.

The study population included Medical Records (MRs) of hospitalized patients in the second quarters of 2019 and 2020. Two elective and two emergency CVDs with the highest hospitalization rates were considered according to the frequency of MRs in the Hospital Information System (HIS) in the hospital and interviews with relevant specialists. Disease names and specific codes were determined using the International Classification of Diseases, 10th edition (ICD-10). In both study periods, the census selected MRs from all hospitalized patients. A total of 1,341 MRs were

studied, of which 765 were performed in 2019. The codes of the selected diseases were as follows:

- ACS: Acute coronary syndrome –unstable angina
- MI: myocardial infarction
- CAD: Coronary artery disease – atherosclerotic heart disease
- CHF: Congestive Heart failure

Essential data, including the disease name, MR number, length of stay, type of hospitalization (Elective, Emergency), sex, age, and insurance status, were gathered from the MRs. The Revenue Department provided revenue data. The medical record unit supplied statistics on the number of deaths, readmissions, and bed occupancy rates for the two periods under study. This study utilized six indicators: Average Length of Stay (ALOS), number of hospitalizations, deaths, readmissions, Bed Occupancy Rate (BOR), and revenue.

Due to the rise in medical tariffs in 2020, interviews were conducted with experts in the revenue department (N = 6) to ascertain the adjustment amount in the service's monetary value. During interview sessions, the major items of hospitalized patients' bills were examined. These components included surgery tariffs, anesthesia, bed charges (for private and public rooms), and medication costs. Based on the results of these interviews, tariff amounts were adjusted by 20%.

The selected indices, including ALOS, number of hospitalizations, number of deaths, readmissions, BOR, and revenue, were classified as performance (first two), quality control (second two), and result (last two) indices, respectively.

Data analysis was conducted using SPSS (version 16), and Microsoft Excel was used to create graphs. The frequency or mean of relevant data, such as the number of hospitalizations, length of stay, bed occupancy rate, revenue, deaths, and readmissions, was examined and compared between two periods: before and during the COVID-19 pandemic. Due to the non-normal distribution of the data, the Mann-Whitney U test was utilized to identify significant differences in means. The tests were considered significant at a level of $P \leq 0.05$.

Results

A total of 1,341 cases of selected CVDs were reviewed before and during the COVID-19 pandemic at the cardiovascular hospital affiliated with the Medical Sciences University. The number of patients admitted as emergency cases was higher than that of elective cases.

Table 1. Frequency distribution and percentage of CVDs hospitalizations before and during COVID-19 based on demographic and background information.

No	Variable		2019		2020	
			N	%	N	%
1	Sex	Male	457	59.73	395	68.57
		Female	308	40.27	181	31.43
2	Age group	< 20	1	0.13	0	0
		20- 29	5	0.65	5	.86
		30- 39	22	2.87	9	1.56
		40- 49	98	12.81	62	10.76
		50- 59	189	24.7	163	28.29
		> 60	450	58.93	337	58.53

No	Variable		2019		2020	
			N	%	N	%
3	Hospitalization type	Elective	181	23.66	132	22.91
		Emergency	584	76.34	444	77.09
4	Insurance coverage	Yes	763	99.74	576	100
		No	2	0.26	0	0

Based on the demographic and background characteristics, hospitalizations for the studied diseases decreased by 24.5% in 2020 compared to 2019. This decrease was higher in females and the age group (> 60) (Table 1).

Table 2. Average length of stay of selected CVDs during the study periods.

NO	Diseases' name	Diseases' code	ALOS (standard deviation)		ALOS decrease or Increase in 2020 VS 2019
			Second quarter of 2019	Second quarter of 2020	
1.	Acute coronary syndrome	ACS	5.06 (2.58)	4.14 (2.46)	-.92
2.	Coronary artery disease	CAD	6.71 (3.59)	4.91 (3.84)	-1.8
3.	Congestive heart failure	CHF	6.64 (3.45)	4.89 (2.26)	-1.75
4.	Myocardial infarction	MI	6.53 (2.83)	4.13 (2.9)	2.4

The ALOS of the studied diseases decreased during the pandemic. The Mann-Whitney test showed that the difference between the ALOS was significant in the selected CVDs in the two periods ($P \leq 0.001$) (Table 2).

BOR, as an outcome index, was calculated based on ALOS and the frequency of hospitalizations in the study periods. The BOR of CVDs was decreased from 78.1 in 2019 to 37.47 in 2020.The revenue comparison in the study periods showed a decrease in all selected CVDs during the pandemic (Table 3).

Table 3. The percentage of decrease or increase in the total revenue of selected CVDs during the study periods.

No	Diseases' Code	Total revenue				2020/2019 Ratio	Changes in total revenue (± %)
		2019	N (%)	2020	N (%)		
1.	ACS	350	10,698,344,700 (29)	221	10,330,801,418 (33)	96.56	-3.44
2.	CAD	245	17,098,924,738 (46)	201	13,591,334,736 (43)	79.49	-20.51
3.	CHF	85	2,843,581,441 (8)	71	1,777,633,065 (6)	62.51	-37.49

No	Diseases' Code	Total revenue				2020/2019 Ratio	Changes in total revenue (± %)
		2019		2020			
			N (%)		N (%)		
4.	MI	85	6,421,915,389 (17)	83	5,720,171,454 (18)	89.00	-11.00
5.	Total	765	37,062,766,268 (100)	576	31,419,940,673 (100)	84.78	-15.22

The lowest decrease in total revenue in selected diseases was in acute coronary syndrome (3.43%) in 2020 compared to 2019, and the most significant decrease was in heart failure (37.48%). Overall, an average decrease of 15.22 % was observed in 2020. The Mann-Whitney test showed a significant difference in mean revenue between the two periods (p = 0.03). Readmissions and deaths as quality indices were investigated in the two study periods. The results showed some differences between the periods (Table 4).

Table 4. Frequency and percentage of readmissions and deaths compared to hospitalizations during study periods

NO	Diseases' Code	2019			2020		
		Hospitalizations	Readmissions (N / %)	Deaths (N / %)	Hospitalizations	Readmissions (N / %)	Deaths (N / %)
1.	ACS	350	3 (0.86)	0 (0.0)	221	1 (0.45)	3 (1.36)
2.	CAD	245	4 (1.63)	2 (0.81)	201	2 (0.9)	3 (1.5)
3.	CHF	85	1 (1.2)	6 (7.05)	71	0 (0.0)	3 (4.22)
4.	MI	85	1 (1.2)	1 (1.17)	83	2 (2.4)	4 (4.81)
	Total	765	9 (1.18)	9 (1.18)	576	5 (0.87)	13 (2.18)

The percentage of readmissions in the first quarter of 2020 was lower than in 2019. This comparison was reversed for mortality over the two periods. The percentage of mortality approximately doubled in the first quarter of 2020 (Table 4).

Generally, performance indicators (admissions and ALoS) and outcome indicators (BOR and total revenue) decreased during the pandemic. The percentage of readmissions decreased, and the percentage of deaths increased as quality indices.

Discussion

A significant finding was the decrease in hospitalizations and revenue during the 2020 pandemic. The ALOS for the studied CVDs was higher in 2019. The BOR saw a decline in 2020 compared to 2019. The total revenue generated by the hospital from the selected CVDs also decreased in 2020. There was an increase in hospitalizations leading to death, while re-hospitalization rates decreased during the pandemic.

The decline in the number of hospitalized patients for CVDs has also been reported during the pandemic in other studies in Brazil, Italy, and several other countries (1, 2, 10, 14-16). Due to the COVID-19 pandemic and the possibility of patients getting infected during this period, the desire of doctors and their patients to stay for a long time decreased, and the evidence supports this. Maung et al. reported a

reduction in CVD admissions in 2020. Also, the number of CVD-related deaths increased in 2020 (25).

The majority of hospitals reported a decrease in hospitalization rates and revenue from 2019 to 2020 (26). Hospitals should consider financial sustainability. In this regard, the occurrence of a natural and catastrophic event, such as the COVID-19 pandemic, is recognized by healthcare policymakers as a financial risk associated with the organization that deserves continuous leadership attention to avoid economic consequences (27).

Teaching hospitals are under constant financial need, largely due to the admission of patients with complex needs and increased costs associated with staffing and postgraduate medical education (28). The COVID-19 pandemic has created extraordinary economic situations for hospitals, including sudden drops in elective and ambulatory services, increased costs of supplies and labor, and more admissions of patients to intensive care units (29).

Coinciding with the decrease in hospitalizations for CVD during the pandemic, additional mortality from natural causes was also observed in hospitals (30, 31). Excess mortality quantifies the number of deaths surpassing the anticipated rate within a specific timeframe, thereby illustrating the direct and indirect impacts of a pandemic on mortality within a particular population (32). Studies show that the COVID 19 pandemic alone may not account for all anticipated deaths during this time (33).

Conclusions

The findings of this study are highly relevant to CVD clinicians, hospitals, and health system authorities. They demonstrate the significant impact of the COVID-19 pandemic on hospital performance indicators, underscoring the necessity for strategic interventions to address the challenges of increased hospitalizations in the coming years, particularly in the face of potential future lockdowns. This emphasizes the importance of raising awareness among healthcare professionals and policymakers.

The hospital should be prepared to face similar conditions in its strategic plan and adopt appropriate measures in conditions identical to the COVID-19 pandemic. In critical situations, it is essential to maintain hospital performance to respond to society and control costs.

Acknowledgments

Thanks to the University Vice Chancellor of Research and Technology and CVD hospital authorities that helped us conduct the project. We also appreciate the Health Information Technology Department for providing access to patients' medical records.

Authors' Contributions

B.N., A.H. and H.Y. wrote the main manuscript. B.N. and A.H. Prepared tables. B.N. and H.Y. drafted the article. Final approval of the English version to be published: H.Y. and B.N.

Data Availability

The raw data supporting the conclusions of this article are available from the authors upon reasonable request.

Conflict of Interest

The authors have no conflict of interest in this study.

Ethical Statement

The project was approved by the ethics committee of the Vice Deputy of Research and Technology in UUMS (IR.UMSU.REC.1400.138) and data collection permission was obtained.

Funding/Support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel

coronavirus in Wuhan, China. The lancet. 2020;395(10223):497-506. https://doi.org/10.1016/S0140-6736(20)30183-5

2. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. New England journal of medicine. 2020;382(8):727-33. https://doi.org/10.1056/NEJMoa2001017
3. Dashash M, Almasri B, Takaleh E, Abou Halawah A, Sahyouni A. Educational perspective for the identification of essential competencies required for approaching patients with COVID-19. Eastern Mediterranean Health Journal. 2020;26(9):1011-7. https://doi.org/10.26719/emhj.20.111
4. De Filippo O, D'Ascenzo F, Angelini F, Bocchino PP, Conrotto F, Saglietto A, et al. Reduced rate of hospital admissions for ACS during Covid-19 outbreak in Northern Italy. New England Journal of Medicine. 2020;383(1):88-9. https://doi.org/10.1056/NEJMc2009166
5. Asdaghpour E, Baghaei R, Jalilifar N, Radmehr H, Shirzad M, Mirzaaghayan MR, et al. Iranian society of cardiac surgeons position statement for the treatment of patients in need of cardiac surgery in the COVID-19 pandemic period (Version I). Multidisciplinary Cardiovascular Annals. 2020;11(1). https://doi.org/10.5812/mca.104296
6. WHO. COVID-19 pandemic statistics. datadot [Internet]. [cited 2024 Jul 29]. COVID-19 cases | WHO COVID-19 dashboard. Available from: https://data.who.int/dashboards/covid19/cases 2023.
7. Normando PG, Araujo-Filho JdA, Fonseca GdA, Rodrigues REF, Oliveira VA, Hajjar LA, et al. Redução na Hospitalização e Aumento na Mortalidade por Doenças Cardiovasculares durante a Pandemia da COVID-19 no Brasil. Arquivos Brasileiros de Cardiologia. 2021;116:371-80. https://doi.org/10.36660/abc.20200821
8. Maselli-Schoueri JH, de Carvalho LEW, Rezende LF, Fonseca FLA, Ferrari G, Adami F. Hospital admissions associated with noncommunicable diseases during the COVID-19 outbreak in Brazil. JAMA Network Open. 2021;4(3):e210799-e. https://doi.org/10.1001/jamanetworkopen.2021.0799
9. Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of acute coronary syndrome admissions in Austria since the outbreak of COVID-19: the pandemic response causes cardiac collateral damage. European heart journal. 2020;41(19):1852-3. https://doi.org/10.1093/eurheartj/ehaa314
10. Cardiovascular Diseases Geneva, Switzerland: Wold HealthOrganization [Internet]; 2020. (accessed on 7 June 2023) Available Online: https://www.who.int/health-topics/cardiovascular-diseases.
11. Satiani B, Davis CA. The financial and employment effects of coronavirus disease 2019 on physicians in the United States. Journal of vascular surgery. 2020;72(6):1856-63. https://doi.org/10.1016/j.jvs.2020.08.031
12. Shah SA, Brophy S, Kennedy J, Fisher L, Walker A, Mackenna B, et al. Impact of first UK COVID-19 lockdown on hospital admissions: Interrupted time series study of 32 million people. EClinicalMedicine. 2022;49. https://doi.org/10.1016/j.eclinm.2022.101462
13. Chen Y, Cai M, Li Z, Lin X, Wang L. Impacts of the COVID-19 pandemic on public hospitals of different levels: six-month evidence from Shanghai, China. Risk Management and Healthcare Policy. 2021:3635-51. https://doi.org/10.2147/RMHP.S314604
14. Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, et al. COVID-19 pandemic and admission rates for and management of acute coronary syndromes in England. The Lancet. 2020;396(10248):381-9. https://doi.org/10.1016/S0140-6736(20)31356-8
15. Khalid A, Ali S. COVID-19 and its Challenges for the Healthcare System in Pakistan. Asian bioethics review. 2020;12(4):551-64. https://doi.org/10.1007/s41649-020-00139-x
16. Ribeiro EG, Pinheiro PC, Nascimento BR, Cacique JPP, Teixeira RA, Nascimento JdS, et al. Impact of the COVID-19 pandemic on hospital admissions for cardiovascular diseases in a large Brazilian urban center. Revista da Sociedade Brasileira de Medicina Tropical. 2022;55:e0264-2021. https://doi.org/10.1590/0037-8682-0264-2021
17. Behzadifar M, Aalipour A, Kehsvari M, Darvishi Teli B, Ghanbari MK, Gorji HA, et al. The effect of COVID-19

on public hospital revenues in Iran: An interrupted time-series analysis. Plos one. 2022;17(3):e0266343. https://doi.org/10.1371/journal.pone.0266343

18. Kazempour-Dizaji M, Sheikhan F, Varahram M, Rouzbahani R, Vand MY, Khosravi B, et al. Changes in a hospital's costs and revenues before and after COVID-19: A case study of an Iranian hospital. Health Scope. 2021;10(3). https://doi.org/10.5812/jhealthscope.111620
19. Sarrafzadegan N, Mohammmadifard N. Cardiovascular disease in Iran in the last 40 years: prevalence, mortality, morbidity, challenges and strategies for cardiovascular prevention. Archives of Iranian medicine. 2019;22(4):204-10.
20. Saki N, Karandish M, Cheraghian B, Heybar H, Hashemi SJ, Azhdari M. Prevalence of cardiovascular diseases and associated factors among adults from southwest Iran: Baseline data from Hoveyzeh Cohort Study. BMC cardiovascular disorders. 2022;22(1):309. https://doi.org/10.1186/s12872-022-02746-y
21. Organization WH. Rapid assessment of service delivery for NCDs during the COVID-19 pandemic. Geneva: World Health Organization. 2020.
22. Zuin M, Mugnai G, Zamboni A, Zakja E, Valle R, Turiano G, et al. Decline of admission for acute coronary syndromes and acute cardiovascular conditions during COVID-19 pandemic in Veneto region. Viruses. 2022;14(9):1925. https://doi.org/10.3390/v14091971
23. Bhatt AS, Moscone A, McElrath EE, Varshney AS, Claggett BL, Bhatt DL, et al. Fewer hospitalizations for acute cardiovascular conditions during the COVID-19 pandemic. Journal of the American College of Cardiology. 2020;76(3):280-8. https://doi.org/10.1016/j.jacc.2020.05.038
24. Ahmed SAS, Ajisola M, Azeem K, Bakibinga P, Chen Y-F, Choudhury NN, et al. Impact of the societal response to COVID-19 on access to healthcare for non-COVID-19 health issues in slum communities of Bangladesh, Kenya, Nigeria and Pakistan: results of pre-COVID and COVID-19 lockdown stakeholder engagements. BMJ global health. 2020;5(8):e003042. https://doi.org/10.1136/bmjgh-2020-003042
25. Maung KK, Marques-Vidal P. Impact of COVID-19 pandemic on cardiovascular diseases hospitalisation, management and mortality in Switzerland. Open Heart. 2023;10(1):e002259. https://doi.org/10.1136/openhrt-2023-002259
26. da Silva Etges APB, Cardoso RB, Marcolino MS, Ruschel KB, Coutinho AP, Pereira EC, et al. The economic impact of COVID-19 treatment at a hospital-level: investment and financial registers of Brazilian hospitals. Journal of health economics and outcomes research. 2021;8(1):36. https://doi.org/10.36469/jheor.2021.22066
27. Etges APBdS, Grenon V, Lu M, Cardoso RB, de Souza JS, Kliemann Neto FJ, et al. Development of an enterprise risk inventory for healthcare. BMC health services research. 2018;18:1-16. https://doi.org/10.1186/s12913-018-3400-7
28. Langabeer JR, Lalani KH, Yusuf RA, Helton JR, Champagne-Langabeer T. Strategies of High-Performing teaching hospitals. Hospital topics. 2018;96(2):54-60. https://doi.org/10.1080/00185868.2017.1416962
29. Lalani K, Helton J, Vega FR, Cardenas-Turanzas M, Champagne-Langabeer T, Langabeer JR, editors. The impact of COVID-19 on the financial performance of largest teaching hospitals. Healthcare; 2023: MDPI. https://doi.org/10.3390/healthcare11141996
30. Banerjee A, Pasea L, Harris S, Gonzalez-Izquierdo A, Torralbo A, Shallcross L, et al. Estimating excess 1-year mortality associated with the COVID-19 pandemic according to underlying conditions and age: a population-based cohort study. The Lancet. 2020;395(10238):1715-25. https://doi.org/10.1016/S0140-6736(20)30854-0
31. Giattino C, Ritchie H, Roser M, Ortiz-Ospina E, Hasell J. Excess mortality during the Coronavirus pandemic (COVID-19). Our World Date. 2021.
32. Leon DA, Shkolnikov VM, Smeeth L, Magnus P, Pechholdová M, Jarvis CI. COVID-19: a need for real-time monitoring of weekly excess deaths. The Lancet. 2020;395(10234):e81. https://doi.org/10.1016/S0140-6736(20)30933-8
33. Woolf SH, Chapman DA, Sabo RT, Weinberger DM, Hill L. Excess deaths from COVID-19 and other causes, March-April 2020. Jama. 2020;324(5):510-3. https://doi.org/10.1001/jama.2020.11787