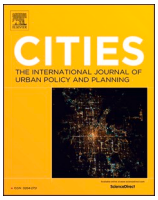
Cities 130 (2022) 103865

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities



Discovering COVID-19 state sustainable policies for mitigating and ending the pandemic

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ARTICLE INFO

Keywords:
COVID-19
The number of deaths
Scoring policies
Test-isolation policy

ABSTRACT

COVID-19 policy outcomes are influenced by urban policy and governance. The goal of this paper is to navigate the sustainable solution of the COVID-19 pandemic using evidence-based research for cities. The number of deaths from COVID-19 is one good indicator to evaluate the results of individual policies by country, state and cities. A policy assessment of urban agglomerations is essential to scientific research. Scoring policies with a single determinant is calculated by dividing the number of deaths by the population in millions. The lower the score, the better the policy. The score monotonically increases so that policymakers can suppress it, but they cannot improve or decrease it. Thus, mistakes by policymakers cannot be corrected and are fatal forever. Many countries have used a pharmacological approach alone such as vaccination with boosting, not sustainable, but their scores are poor and their policies are not effective against the pandemic. Sustainable and optimal policies to mitigate the pandemic were discovered by sorting the scores. This paper introduces two new policy scoring tools such as scorev and usscore. Both tools revealing sustainable approaches are designed for policy-poor states or urban agglomerations to learn the good strategies from countries with excellent scores.

Although the efficacy of vaccines against COVID-19 has been published in many papers (Nasreen et al., 2022; Olson et al., 2022; Polack et al., 2020; Tang et al., 2021; Tregoning et al., 2021; Wood, 2022), real-world results show that the claims have not been fulfilled yet.

Clare Watson reported that we may need to take a deep breath and re-evaluate which approaches really give the most enduring immunity when overlaid on what we have so far (Watson, 2022). COVID vaccine boosters are proving a useful tool against Omicron, but scientists say that endless boosting might not be a practical or sustainable strategy (Watson, 2022). The current endless boost is not sustainable and we need to find a sustainable approach to mitigate and end the COVID-19 pandemic. Scoring individual policies plays a key role in revealing the best and sustainable policy in the world with sorted scores.

The proposed Python tools help policymakers make their decisions: cdcdeaths for showing COVID-19 is old lives matter, scorev for revealing the best policy and calculating sorted scores in the world, and usscore for calculating sorted state scores in the US.

CDC (Centers for Disease Control and Prevention) data from January 1, 2020 to March 5, 2022 showed that the older the age, the more deaths due to COVID-19 as shown in Fig. 1: https://data.cdc.gov/api/views/9bhg-hcku/rows.csv.

This paper emphasizes how to prevent unnecessary deaths due to COVID-19.

In Fig. 1, the vertical axis shows the number of deaths due to COVID-19 in the US and the horizontal axis indicates age groups. Fig. 1 is generated by a PyPI tool, cdcdeaths using the latest data (https://pypi.org/project/cdcdeaths, n.d.). Fig. 1 shows that the COVID-19 problem is that old lives matter.

cdcdeaths tool is validated via Code Ocean for software reproducibility and quality: cdcdeaths for visualizing the number of deaths due to COVID-19 by age groups.

The scorecovid is the world's first policy scoring tool using the number of deaths due to COVID-19 and the population in millions (Takefuji, 2021a). In the scorecovid tool, the score is calculated by dividing the number of deaths due to COVID-19 by the population in millions. The lower the score, the better the COVID-19 policy. The sorted scores can play a key role in revealing which countries have been handling COVID-19 very well or not.

scorecovid has been downloaded by 12,352 users worldwide according to https://pepy.tech/project/scorecovid. However, scorev was a newly developed tool which can subsume scorecovid with a new feature of vaccination rates added (Takefuji, 2022a).

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https://doi.org/10.1016/j.cities.2022.103865
Received 8 June 2022; Received in revised form 18 June 2022; Accepted 1 July 2022
Available online 6 July 2022

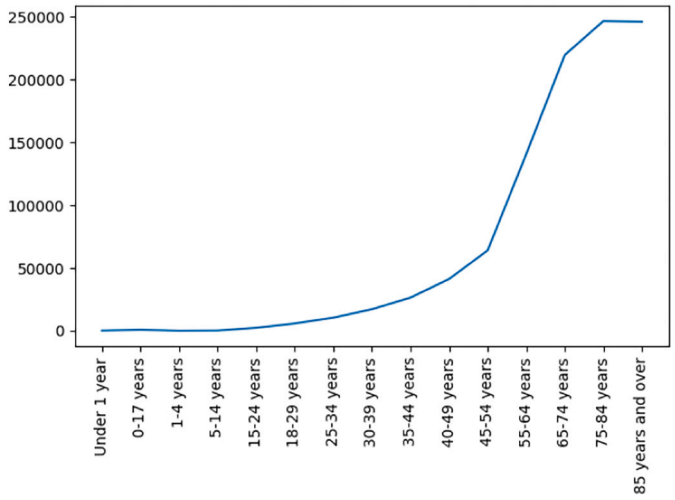

Fig. 1. Deaths due to COVID-19 in the US by age groups.

In order to navigate and guide the solution of the COVID-19 pandemic, two tools including scorev (Takefuji, 2022a) and usscore (Takefuji, 2022b) for scoring individual policies have been developed. Both tools are available in public and can be easily installed by a Python Package Index (PyPI) tool using the pip command. These tools run on Windows, MacOS, and Linux operating systems for maximum software dissemination to the world.

A single metric or single determinant for evaluating the COVID-19 policy was proposed in the debate on herd immunity in Sweden and its single determinant was validated in NEJM (Takefuji, 2021b). The lower the number of COVID-19 deaths, the better the policy.

In other words, the single metric is based on dividing the number of deaths due to COVID-19 by the population in millions. The herd immunity failed in Sweden due to the large number of elderly deaths due to COVID-19. In addition, the single metric assessing the outcomes of COVID-19 policies was validated by the total of three peer-reviewed journals (Takefuji, 2021a; Takefuji, 2021b; Takefuji, 2021c).

The latest study showed that COVID-19 variants with spike mutations and immune escape fail to establish herd immunity at high vaccination rates (Takefuji, Accepted). Therefore, this paper's contribution with sustainable approach will be significant for mitigating the COVID-19 pandemic.

The data from scorev tool showed that a test-isolation strategy plays a key role in mitigating the pandemic. In other words, non-pharmacological approaches work well for pandemics.

According to the scorev tool, the US is one of the worst scored counties in the world about the COVID-19 policy. We have also investigated COVID-19 state policies in the United States. The usscore tool was newly developed to observe which state policies are responding well to the pandemic, and the calculation method is similar to the scorecovid or scorev tool, with the score calculated by dividing the number of deaths by the population in millions. The lower the score, the better the COVID-19 policy.

This paper using scoring tools such as scorev and usscore with the single metric will calculate sorted scores and reveal the best score by country in the world and the best score by state in the US.

The goal of this paper is for poorly scored countries in the world or states in the US to learn good policies from counties with excellent scores for mitigating and ending the COVID-19 pandemic.

1. Methods and results

scorev is a useful tool for scoring individual policies against COVID-19 (Takefuji, 2022a). The purpose of the scorev tool is for countries with poor scores to learn good strategies from countries with excellent scores.

In order to run PyPI scorev tool, you must install Python3.8 on your PC. In order to install scorev, run the following command. ($) character indicates the prompt from the system terminal.

```
$ pip install scorev
```

The scorev runs on Windows, MacOS, and Linux operating systems respectively.

The number of deaths due to COVID-19 is a good indicator for scoring individual policies with vaccination rates. Fig. 2 shows the result of sorted scores of 36 countries including the UK, the US, New Zealand, Taiwan and others. Taiwan has the best score while Hungary has the worst one.

Observe each score of New Zealand, Taiwan, the US, the UK and Hungary as shown in Fig. 2. The score of Taiwan is more than 80 times better than scores in the United States and 70 times better than that of the United Kingdom. This is because the robust test-isolation strategy is quite effective against the COVID-19 pandemic. Fig. 2 shows that vaccination rates do not significantly affect calculated scores.

In the robust test-isolation policy, early testing can identify infected individuals and can isolate them from uninfected people during the quarantine period. The term, “robust” means that the policy is mandatory or regulated by law. In other words, the current policies in the US and the UK have caused unnecessary deaths.

usscore is also a newly developed scoring tool for scoring COVID-19 state policies in the US[11]. usscore is validated via Code Ocean for software reproducibility and quality.

The result is shown in Fig. 3. In Fig. 3, Hawaii has the best score of 991 while Arizona has the worst score of 4230. Hawaii's COVID-19 policy score appears to be more than 4 times better than Arizona's.

The result is generated by usscore: a Python Package Index (PyPI). Although, usscore was newly developed several weeks ago, the usscore tool has been downloaded by 4674 users worldwide.

In order to reduce the unnecessary deaths due to COVID-19, we seriously should investigate the rational reasons. Although Hawaii has the best score in the US, Taiwan is 25 times better than Hawaii.

In order to run usscore, install usscore by the following pip command:

```
$ pip install usscore
```

Run the following command:

```
$ usscore
```

2. Discussion

The result of scorev as shown in Fig. 2 revealed that the current pharmacological approach alone cannot mitigate the COVID-19 pandemic. We need to use the robust test-isolation strategy for reducing the number of unnecessary deaths due to COVID-19 which has been adopted in Taiwan. The robust test-isolation strategy is sustainable while the endless boosting is not sustainable.

The result as shown in Fig. 3 indicates that further research is needed to determine what determinants significantly can change scores between Hawaii and Arizona. The investigation can influence the effectiveness of policies in the future. Hawaii's score is four times better than Arizona's score.

As noted earlier, poorly scored states and nations should learn good strategies from excellent scored countries. In other words, we should learn the effective strategies from New Zealand and Taiwan. However, the score of New Zealand is getting a little worse because of recently loosen regulations on COVID-19.

In general, we should update the ineffective policies against the COVID-19 pandemic in the world and adopt the best policy as soon as possible.

country	deaths	population	score	1dose	full	booster
Taiwan	860	23.86	36.04	82.74	78.12	58.93
New Zealand	696	5.13	135.67	83.65	79.82	51.87
Japan	29508	126.05	234.1	81.83	80.49	52.43
Australia	7187	25.79	278.67	86.39	83.45	52.03
Iceland	119	0.37	321.62	34	34	34
South Korea	22724	51.31	442.88	87.77	86.83	68.53
Norway	2932	5.47	536.01	79.31	73.78	53.59
Finland	3939	5.55	709.73	81.28	77.87	52.57
Canada	39189	38.07	1029.39	88.69	82.21	48.99
Denmark	6135	5.81	1055.94	83.21	82.55	62.39
Israel	10695	9.29	1151.24	72.19	66.04	56.93
Turkey	98751	85.04	1161.23	67.99	62.36	43.09
Netherlands	22346	17.17	1301.46	78.4	72.23	54.09
Ireland	7076	4.98	1420.88	81.86	80.74	59.99
Switzerland	13710	8.72	1572.25	69.77	68.78	42.68
Germany	135292	83.9	1612.54	76.87	76.77	63.52
Luxembourg	1064	0.63	1688.89	75.71	33	58.8
Sweden	18772	10.16	1847.64	77.04	75.11	52.06
Estonia	2537	1.33	1907.52	64.94	63.75	35.21
Austria	18117	9.04	2004.09	75.44	73.06	57.37
France	145780	67.42	2162.27	80.18	77.93	55.45
Portugal	22248	10.17	2187.61	18	18	18
Spain	104227	46.75	2229.45	88.14	86.46	52.98
Mexico	324254	130.26	2489.28	65.87	1	34.65
United Kingdom	174863	68.21	2563.6	77.98	72.91	57.54
Belgium	31439	11.63	2703.27	79.41	78.56	63.3
Italy	163244	60.37	2704.06	84.09	79.36	65.67
Greece	29073	10.37	2803.57	76.28	73.44	56.95
United States	993164	332.92	2983.19	77.58	66.15	30.27
Chile	57495	19.21	2992.97	93.23	90.85	91.49
Poland	116022	37.8	3069.37	59.92	59.34	31.5
Latvia	5759	1.87	3079.68	72.03	69.84	27.91
Slovenia	6588	2.08	3167.31	60.86	58.75	31.24
Lithuania	9085	2.69	3377.32	72.52	69.69	34.52
Slovakia	19879	5.45	3647.52	51.77	50.75	30.21
Hungary	46189	9.63	4796.37	66.5	64.28	43.08

Fig. 2. Sorted scores of the UK, the US, New Zealand and Taiwan.

Finally, we will evaluate the number of unnecessary deaths due to the COVID-19 pandemic based on statistics. Policymakers must know the number of unnecessary COVID-19 deaths due to their policies.

If the US had an effective test-isolation strategy adopted in Taiwan against the COVID-19 pandemic, the number of unnecessary deaths could be calculated as follows:

the number of expected deaths in the US due to Taiwan's method is as follows:

$$\text{expected deaths} = (\text{Taiwan's score})*(\text{US population}) = 36.04*331 = 11,929$$

$$\text{unnecessary deaths} = (\text{real deaths}) - (\text{expected deaths}) = 993,164 - 11,929 = 981,235$$

state	deaths	population	score
Hawaii	1443	1.455	991
Vermont	654	0.643	1017
Utah	4765	3.272	1456
Washington	12902	7.705	1674
Alaska	1246	0.733	1699
Maine	2338	1.362	1716
Oregon	7586	4.237	1790
New Hampshire	2520	1.378	1828
District of Columbia	1342	0.69	1944
Nebraska	4240	1.962	2161
Colorado	12712	5.774	2201
Minnesota	12887	5.706	2258
California	91203	39.538	2306
Maryland	14551	6.177	2355
Virginia	20338	8.631	2356
North Carolina	24637	10.439	2360
Wisconsin	14531	5.894	2465
Idaho	4939	1.839	2685
Massachusetts	20478	7.03	2912
Delaware	2939	0.99	2968
Illinois	38068	12.813	2971
North Dakota	2323	0.779	2982
Kansas	8802	2.938	2995
Iowa	9572	3.19	3000
Connecticut	10926	3.606	3029
Texas	88507	29.146	3036
Montana	3385	1.084	3122
Wyoming	1820	0.577	3154
Rhode Island	3562	1.097	3247
Ohio	38590	11.799	3270
South Dakota	2919	0.887	3290
Missouri	20620	6.155	3350
New York	68112	20.201	3371
Georgia	36674	10.712	3423
Florida	74330	21.538	3451
Pennsylvania	44923	13.003	3454
Nevada	10824	3.105	3485
Indiana	23662	6.786	3486
South Carolina	17869	5.118	3491
Kentucky	15855	4.506	3518
Michigan	36218	10.077	3594
New Jersey	33603	9.289	3617
New Mexico	7677	2.118	3624
Oklahoma	14419	3.959	3642
Louisiana	17313	4.658	3716
Tennessee	26040	6.911	3767
Arkansas	11432	3.012	3795
West Virginia	6915	1.794	3854
Alabama	19645	5.024	3910
Mississippi	12465	2.961	4209
Arizona	30259	7.152	4230

Fig. 3. Sorted scores of COVID-19 state policies in the US.

Unnecessary deaths in the US are 981,235.

Similarly, the number of unnecessary deaths in the UK could be calculated:

the number of expected deaths due to Taiwan's method:

$$\text{expected deaths} = (\text{Taiwan's score})*(\text{UK population}) = 36.04*67.89 = 2446$$

$$\text{unnecessary deaths} = (\text{real deaths}) - (\text{expected deaths}) = 174,863 - 2446 = 172,417$$

Unnecessary deaths in the UK are 172,417.

Policymakers must understand how to reduce the unnecessary deaths due to COVID-19 using the most effective policy. Since a score monotonically increases, there is no improvement expected in the score. However, the score can be suppressed by the best policy. In other words, mistakes by policymakers cannot be corrected and are fatal forever.

The paper makes clear that proposed policy scoring tools such as scorev and usscore are not only useful in identifying which countries and states are responding well to the COVID-19 pandemic, but also that countries with poor scores could potentially reduce unnecessary deaths by adopting the best test-isolation policy. The best policy means that the number of unnecessary COVID-19 deaths is the smallest in the world. The usscore program source code is included in Appendix A.

3. Conclusion

This paper introduces the single matric for scoring individual policies by country in the world and by state in the US and revealing the best policy with sorted scores. The single matric is based on dividing the number of COVID-19 deaths by the population in millions. The lower the score, the better the policy. The country scores in the world and state scores in the US can support the proposed claims with statistical approach. The statistical approach is based on qualitative and quantitative data available in public. Scoring tools such as scorev tool with sorted country scores and vaccination rates and usscore tool with sorted state scores in the US can reveal the best effective policy against COVID-19. Scoring tools are applicable to other countries and cities. This paper demonstrates that the test-isolation strategy with vaccination, which Taiwan has adopted since the early days of the pandemic, is the best approach. The test-isolation policy is to test and detect infected individuals at an early stage and to isolate them from uninfected people during the quarantine period. The test-isolation strategy is sustainable while boosting with vaccination is not sustainable. In other words, vaccination alone did not mitigate the pandemic. The paper showed how many unnecessary COVID-19 deaths would have been avoided if the Taiwan policy had been implemented in the United States and the United Kingdom, respectively. Policymakers must understand how to reduce the unnecessary deaths due to COVID-19 using the most effective policy.

Funding

This research has no fund.

CRediT authorship contribution statement

YT completed this research, wrote the proposed software codes, and wrote this paper.

Declaration of competing interest

The author has no conflict of interest.

Appendix A. PyPI usscore.py source code

```
import requests,re
import pandas as pd
import subprocess as sp
import sys,os
def main():
if os.path.exists('us-states.csv'):
d=pd.read_csv('us-states.csv')
else:
sp.call("wget https://github.com/nytimes/covid-19-data/raw/master/live/us-states.csv",shell=True)
d=pd.read_csv('us-states.csv')
if os.path.exists('PopulationReport.csv'):
p=pd.read_csv('PopulationReport.csv')
else:
sp.call("wget https://github.com/ytakefuji/scoreUS/raw/main/PopulationReport.csv",shell=True)
p=pd.read_csv('PopulationReport.csv')
pp=p.set_index('Name').drop(['United States'])
pp=pp.reset_index()
dd=d.set_index('state').drop(['American Samoa','Guam','Northern Mariana Islands','Puerto Rico','Virgin Islands'])
dd=dd.reset_index()
names=dd.state
L=len(names)
score=pd.DataFrame(
{
"state": names,
"deaths": dd.deaths,
"population": range(L),
"score": range(L),
})
for i in names:
score.loc[score.state==i, 'population']=round(int(str(pp.loc[pp.Name==i,'Pop. 2020'].tolist().pop()).replace(',',''))/1000000,3)
score.loc[score.state==i,'score']=int(score.loc[score.state==i,'deaths']/score.loc[score.state==i,'population'])
score=score.sort_values(by=['score'])
score.to_csv('result.csv',index=False)
score=pd.read_csv('result.csv')
print(score)
if __name__ == "__main__":
main()
```

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