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

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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 scov 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 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.

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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19 (Takefuji, 2022a). The purpose of the scorev tool is for countries with poorly scored states in the US to learn good policies from counties with excellent scores, or scorev tool, with the score calculated by dividing the number of deaths due to COVID-19 by the population in millions. The herd immunity in Sweden failed 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

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 in Sweden failed 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 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.

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 tool is available for Windows, MacOS, and Linux operating systems.

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.

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 loose 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.
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:

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

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

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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:
  \[
  \text{expected deaths} = (\text{Taiwan’s score}) \times (\text{US population}) = 36.04 \times 331 = 11,929
  \]
- unnecessary deaths = (real deaths) – (expected deaths) = 993,164 – 11,929 = 981,235

| 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   | 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.
Unnecessary deaths in the US are 981,235. Similarly, the number of unnecessary deaths in the UK could be calculated:

\[
\text{expected deaths} = (\text{Taiwan's score}) \times (\text{UK population}) = 36.04 \times 67.89 = 2446
\]

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

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 metric 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 metric 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. 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.

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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.

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The table below shows the sorted scores of COVID-19 state policies in the US:

| 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.
Appendix A. PyPI usscore.py source code

```python
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 Marianas 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']).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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