Review Article

doi:10.31674/mjn.2023.v15i01.017

MJN

Could the COVID-19 Open Data Strategy be Adapted to Address Other Global Health Threats Effectively: A Bibliometric Analysis of the Literature

Federico Monaco[1]*, Leopoldo Sarli[1], Evelina Ceccato[1], Paola Masuzzo[2], Rosangela De Simone[1], Elisa Minardi[1], Paolo Giorgi[1], Arianna Ghezzo[1], Antonio Bonacaro[3]

[1]Department of Medicine and Surgery, University of Parma, 43125 Parma PR, Italy
[2]Institute for Globally Distributed Open Research and Education (IGDORE), 9042 Ghent, Belgium
[3]University of Suffolk, School of Nursing, 19 Neptune Quay, Ipswich, IP4 1QJ Ipswich, United Kingdom

**Corresponding Author's Email: federico.monaco@unipr.it*

ABSTRACT

Background: In the wake of the pandemic, open data has made possible mapping, evaluating, and monitoring the COVID-19 rate of transmission at a local, national, and global level. Such a strategy follows WHO's efforts to provide updated and useful information in order to tackle public health issues and provide resources for research in the health sciences. **Methods:** A bibliometric analysis of the literature was conducted. **Results:** Published papers on open data impact on infection risk and rate dramatically increased in the observed period of time (2018–21). Furthermore, it becomes apparent that, while COVID-19-related literature led to such a "critical mass" of publications in 2018–21, papers about open data, antimicrobial resistance, and Antimicrobial Resistance and Healthcare Associated Infections are very few or absent. **Conclusion:** An open data strategy is beneficial in tracking, studying, and adopting measures not only for Covid-19 but also for providing nurses and allied healthcare professionals with rock-solid evidence upon which to develop health plans.

Keywords: Antimicrobial Resistance; COVID-19; Healthcare Associated Infection; Infection Control; Open Data

INTRODUCTION

In the past two years, scientific research has focused a great deal of effort on the COVID-19 pandemic with the aim of contrasting its dramatic effects. Since the beginning of the pandemic, an open data strategy (Gkiouras *et al.*, 2020) has been adopted to avoid data restrictions among healthcare providers, research centers, and governments, all suddenly united in the challenge against COVID-19 (Blake *et al.*, 2020).

However, while COVID-19 stood, equally important global threats like healthcare-associated infections (HAIs) and antimicrobial resistance (AMR) (Laxminarayan *et al.*, 2022) continued to impact negatively in the shadows. In this bibliometric analysis of the literature, we aimed to verify the extent to which research on HAIs and AMR used open data before and during the pandemic. Moreover, a comparison was made based on the evidence of the use of open data for the above-mentioned issues with COVID-19 ones in the years 2020–2021. Epidemiological data in Public Health Emergencies and the need for sharing them (Modjarrad *et al.*, 2016) had already been brought to attention during Ebola and Zika outbreaks (Chretien *et al.*, 2016; Moran *et al.*, 2016). Further studies confirmed that the early availability of epidemiological, clinical, and laboratory data in an epidemic is crucial to understanding risk factors for infection, supporting the public health decision-making process (Morgan, 2019) and forecasting (Desai *et al.*, 2019), and providing the baseline for limiting the impact of disease.

In just over two years, more than 750 million confirmed cases of COVID-19 and almost 7 million deaths in the world have been reported to the World Health Organization (WHO, 2020). Since the beginning of the pandemic, a community of researchers has developed online interactive dashboards to track and trace reported cases of COVID-19 in real time (Dong, Du, & Gardner, 2020). Pandemic open data-based applications started being used in the United States of America (Xu & Kraemer, 2020) and in other countries (Tung & Thanh, 2020), while researchers

Received: February 19, 2023; Received in revised form: June 16, 2023; Accepted: June 21, 2023

began to publish several papers using such data (Blake *et al.*, 2022; Lucas-Dominguez *et al.*, 2021). Since COVID-19 appeared and catalyzed attention from the world of science and the public, healthcare-associated infections (HAIs) (Haque *et al*., 2018) and antimicrobial resistance (AMR) (CDC, 2021) have yet to be properly addressed.

HAIs, which occur when a patient is receiving care (WHO, 2022), still represent a major Public Health problem because of their high prevalence rates of 4% in the United States of America (Haque *et al.*, 2018), 5.7% in the European Union (Cassini *et al.*, 2016), and 7.1% in Italy (Salzo *et al.*, 2021). However, further investigation is needed to better understand the impact of environmental hygienic interventions (Peters *et al.*, 2022; Christenson *et al.*, 2021). Only high-quality research papers reported greater infection rates for developing countries (Allegranzi *et al.*, 2011), while HAIs are also playing their part in significantly increasing healthcare costs in countries with advanced healthcare systems (Marchetti & Rossiter, 2013; Zimlichman *et al.*, 2013). The World Health Organization and several research teams agree that the spread of AMR is an urgent issue that needs to be addressed by a global, coordinated action plan (Antimicrobial Resistance Collaborators, 2022; CDC, 2021). In fact, AMR is a "multifaceted phenomenon" (Prestinaci, Pezzotti, & Pantosti, 2015) whose impact on health and economy should push policy makers and health authorities to work together cooperatively to find a global solution and to consider it as one of the first priorities to be addressed in national health plans (Laxminarayan *et al.*, 2013; Prestinaci, Pezzotti, & Pantosti, 2015; Anderson *et al.*, 2019).

In the course of the COVID-19 pandemic, even trial data were made freely available online in a format that allowed their re-use for multiple purposes (Li *et al.*, 2021). Open Data can be defined as structured data that is machine-readable, freely sharable, and usable without any restriction (Theodi, 2022). Moreover, according to a five-star model (Masuzzo, 2022), "open data" should fulfill at least the requirements for the first three stars: an open license and a structured, open, and non-proprietary file format (Besançon *et al.*, 2021), which is freely available and reusable.

The COVID-19 pandemic has shown that there are at least three reasons for adopting open data by the scientific community, which are: a) the enhancement of experimental reproducibility, which is the minimal standard for research validity (same data, same analysis code, same results); b) the acceleration of discoveries and solutions (i.e., vaccine development); and c) knowledge delivery in an open scientific framework (Pecoraro & Luzi, 2021). The COVID-19 pandemic made possible reworking the relationship between scientific research and open data, but it also brought a new insight on how science should reorganize itself to undertake better research (Kucharski, Funk, & Eggo, 2020).

Despite being recognized as equally important Public Health problems, the COVID-19 pandemic, AMR, and HAIs have been seen from different perspectives. In fact, the scientific community and governmental health agencies emphasized the use of the open data strategy in the management of the COVID-19 pandemic only (Uohara, Weinstein, & Rhew, 2020; Kraemer *et al.*, 2020; Xu *et al.*, 2020) and invested considerable funds for further research in this area. Consequently, we hypothesize that the researchers who have been dealing with HAIs and AMR have not had the opportunity to avail themselves of open data.

This bibliometric analysis aims to suggest how different global health issues could be tackled similarly by the scientific community and to demonstrate that the COVID-19 pandemic represents an exception in the adoption of open data strategies in battling infection risk issues.

METHODOLOGY

A bibliometric analysis of the literature was conducted to answer the following research question:

Has the successful open data strategy adopted for the COVID-19 pandemic been used for tackling HAI and AMR?

Prior to the beginning of the study, ethics approval was sought and successfully obtained in writing from the President of the University Research Ethics Board.

The analysis of the literature covered publications from 2012 to 2021, divided into different search time spans: 2012–2021, 2018–2019, and 2020–2021.

The analysis of the literature was conducted on four search engines (PubMed, CINAHL, Google Scholar, and Scopus), providing a strong representation of the scientific production in nursing and allied health sciences. In order to focus more on the possible "pandemic effect" of literature about open data and infection risk, the following period of time was considered: 2012-2021; 2018-2019; 2020-2021.

RESULTS

The initial hypothesis of the research was that the use of open data in nursing and allied health sciences publications relating to healthcare-related infections and antibiotic resistance (AMR) was minimal before the COVID-19 pandemic. According to the results, the use of open data is still almost exclusively limited to SARS-CoV-2 infections. As previously described, the literature search was carried out using four search engines, such as PubMed, CINAHL, Scopus, and Google Scholar. Although the latter is not a database, it indexes the full text or metadata of academic literature also available in repositories not indexed by PubMed and other repositories. Thus, Google Scholar was included with the aim of taking into consideration any existing gray literature. Given the absence of a common thesaurus among the four search engines, specific search strings were then considered for each database. The identified databases were searched according to the following keywords:

- Open data and equivalents
- Infection risk and equivalents
- COVID (both MeSH and term)
- Cross infections and equivalents
- Antimicrobial resistance (AMR) equivalent

And subsequent combinations:

- Open data and equivalents + infection risk and equivalents
- COVID-19 and equivalents + open data and equivalents
- Cross infections and equivalents + open data and equivalents
- AMR and equivalents + open data and equivalents

Literature search PubMed results are shown in table 1, table 2, table 3 and table 4.

Table 1: PubMed Literature Search Results

QUERY	RESULTS		
	2012 2021	**2018 2019**	**2020 2021**
(("dataset"[Title/Abstract] OR open access to information"[Title/Abstract] OR "open data"[Title/Abstract] OR "sharing data"[Title/Abstract] OR "data sharing"[Title/Abstract] OR "public data"[Title/Abstract] OR "patient data"[Title/Abstract]))	94524	23307	37963
(infection risk[MeSH Terms])	102320	21064	25368
(infection risk[Title/Abstract])	4452	922	1798

Table 2: PubMed Literature Search Results with Regards to COVID-19 and Open Data (results for 2020-2021 only)

(COVID [MeSH Terms])	150498
(COVID[Title/Abstract])	213086
(COVID [MeSH Terms]) AND (("dataset"[Title/Abstract] OR "open access to information" [Title/Abstract] OR "open data"[Title/Abstract] OR "sharing data"[Title/Abstract] OR "data sharing"[Title/Abstract] OR "public data"[Title/Abstract] OR "patient data"[Title/Abstract]))	1443
(COVID[Title/Abstract]) AND (("dataset"[Title/Abstract] OR "open access to information" [Title/Abstract] OR "open data"[Title/Abstract] OR "sharing data"[Title/Abstract] OR "data sharing"[Title/Abstract] OR "public data"[Title/Abstract] OR "patient data"[Title/Abstract]))	2734

Table 3: PubMed Literature Search Results with Regards to AMR and Open Data

((antimicrobial resistance[Title/Abstract]) OR (antibiotic resistance [MeSH Terms])) AND (("dataset" [Title/Abstract] OR "open access to information" [Title/Abstract] OR "open data" [Title/Abstract] OR "sharing data"[Title/Abstract] OR "data sharing" [Title/Abstract] OR "public data "[Title/Abstract] OR "patient data" [Title/Abstract]))	347	78	150

Table 4: PubMed Literature Search Results with Regards to HAIs and Open Data

("cross infection" [Title/Abstract] OR "nosocomial infection" [Title/Abstract] OR "health care associated infections"[Title/Abstract] OR "healthcare associated infections" [Title/Abstract] OR "HCAI"[Title/Abstract] OR "hospital acquired infections" [Title/Abstract] OR "hospital acquired infection" [Title/Abstract] OR "HAI" [Title/Abstract])	12277	2649	3768
(("cross infection" [Title/Abstract] OR "nosocomia l infection" [Title/Abstract] OR "health care associated infections" [Title/Abstract] OR "healthcare associated infections" [Title/Abstract] OR "HCAI" [Title/Abstract] OR "hospital acquired infections" [Title/Abstract] OR "hospital acquired infection"[Title/Abstract] OR "HAI" [Title/Abstract])) AND (("dataset" [Title/Abstract] OR "open access to information" [Title/Abstract] OR "open data" [Title/Abstract] OR "sharing data" [Title/Abstract] OR "data sharing" [Title/Abstract] OR "public data" [Title/Abstract] OR "patient data" [Title/Abstract]))	100	17	37

CINAHL doesn't allow for articulated search strings. The identified keywords were entered in the single fields, and a literature search was performed in the title and abstract of the indexed articles. CINAHL literature search results with regards to COVID-19 and open data are shown in Table 5.

Table 5: CINAHL Literature Search Results with Regards to COVID-19 and Open Data

data sharing AND COVID-19 (TI)	5
data sharing AND COVID-19 (AB)	10

Google Scholar allows the use of advanced search tool thus the combination of different keywords while including in the search all articles with no chance to exclude papers based on the abstract content. Google Scholar literature search results are shown in table 6.

Table 6: Google Scholar Literature Search Results with Regards to Open Data, AMR, and HAI

"COVID 19" AND "Open data" everywhere in the article 2018-2019: 359 results 2020-2021: 179.000 results
"**Cross infection" AND "Open data"** everywhere in the article 2018-2019: 37 results 2020-2021: 267 results
"Antibiotic resistance" AND "Open data" everywhere in the article 2018-2019: 220 results 2020-2021: 308 results
"**Antimicrobial resistance" AND "Open data"** everywhere in the article 2018-2019: 256 results 2020-2021: 367 results

Literature search results on SCOPUS about HAIs and AMR are shown in Table 7.

Table 7: Scopus Literature Search Results with Regards to Open Data, AMR and HAI

"Open data" Range: 2012-2021: 13209 results Range: 2018-2019: 3458 results Range: 2020-2021: 3859 results
"Open data" AND "infection risk" Range: 2012-2021: 32 results Range: 2018-2019: 4 results Range: 2020-2021: 23 results
"Open data" AND "hospital infection" Range: 2012-2021: 13 results Range: 2018-2019: 3 results Range: 2020-2021: 9 results
"Antibiotic resistance" Range: 2012-2021: 98106 results Range: 2018-2019: 22014 results Range: 2020-2021: 27028 results
"Open data" AND "antibiotic resistance" Range: 2012-2021: 3 results Range: 2018-2019: 1 result Range: 2020-2021: 2 results

DISCUSSION

The bibliometric analysis has documented the number of publications pertaining to open data and COVID-19 published in 2020 and 2021. During the COVID-19 pandemic, institutions and researchers around the world shared invaluable open data (Althaus, 2020; Grantz, Metcalf, & Lessler, 2020), as confirmed by the present literature search. Real-time statistical analysis and timely reports have provided crucial information on virus rates of transmission, mutation, and severity (de Jesus *et al.*, 2020).

The most representative part of the retrieved literature was indexed by PubMed. Therefore, we compared the literature produced from 2012 to 2021 with the one published two years before and two years after the beginning of the pandemic.

The results we had by combining COVID-19 and open data in the queries are the following: 1,443 as results from a MeSH search and 2,734 from title or abstract terms. Considering that open data, databasing, and other similar keywords are synonyms, it is worth highlighting that searching by free keywords doubled the results in comparison to the use of MeSH. This could depend on the fact that there are not yet matching MeSH to index open data and/or that open data have not been considered relevant, at least until the pandemic outbreak.

In fact, when it comes to generic queries over a ten-year span, the number of scientific publications concerning infection risk has increased progressively in the studied period of time, showing a peak in the last two years, doubling the number of studies published two years earlier. A significant increase in publication in this area may be well attributed to a "COVID-19 effect". The risk of SARS-CoV-2 infection and the effectiveness of the related preventative measures have monopolized research in recent years. It is indeed true that the number of publications pertaining to "open data" and "infection risk" in the two-year period 2020–2021 has almost doubled compared to the previous two-year period. In fact, while 15 relevant full-text papers were published in 2018–2019, 28 full-text publications appeared in 2020–2021. Similarly, in the same studied period of time, respectively, 922 and 1,798 relevant papers were found relevant as per their title and/or abstract.

A similar publication trend has been identified for healthcare-related infections. Keywords such as "healthcare-associated infection and synonyms, when used to search in the title and/or abstract, let us identify 12,277 relevant articles. This result has confirmed to what extent this issue is perceived by the nursing profession and allied health professions (Al-Tawfiq & Tambyah, 2014). The number of publications increased progressively in the decade under review, with a peak in the last two years of over 40% in comparison with the previous two. Once again, this could be well considered a COVID-19 pandemic effect. The same trend was observed when keywords such as "healthcare associated infections" and synonyms and "open data" and synonyms were combined in performing the literature search.

The number of publications in the last two years has more than doubled when compared to the previous two, going from 17 to 37. Over the same period of time, the number of relevant articles searched by title and abstract increased from 2,649 to 3,768. With regards to "AMR" and synonyms and "open data," a literature search showed that only 347 articles were published in the 10-year observed period of time and that a slight increment in publication production occurred between 2018 and 2019 (78) and after the pandemic breakthrough (150).

Open data policy has a dedication to transparency, with the utilization of both traditional and social media for public awareness, and regular updates from the Department of Health and Health Services Executive have all garnered praise (Kennelly *et al.*, 2020). These efforts have resulted in a strong adherence among the general populace to the government's implementation of non-medical measures. Researchers have been showing an increasing interest in AMR and open data, as shown by the apparent positive trend in literature publications in the past ten years, which doubled in the last two studied years. Health care professional like nurses must increase their knowledge and skills (Priyantini, Irawandi, & Poddar, 2022) and must keep track of the e-health information system (Sachdeva *et al.*, 2019). In this way further study may help to ensure that open data strategy are maintained at high levels which will assist to mitigate future pandemic.

CONCLUSION

In the last two years, the number of publications valuing the importance of "open data" has increased by more than 60%. This significant trend has been clearly documented in this bibliometric analysis of the literature. The pandemic appears to have maintained the correlation between "open data," "infection risk," and increased publication production. When it comes to HAIs and AMR and the role of open data in tackling them, literature search results from research are almost absent. Given the unprecedented situation caused by the COVID-19 pandemic, open data has been adopted since the beginning of its spread, as confirmed by the literature. The creation of global open data sets for tackling HAIs and AMR should be a priority for the international scientific community and governmental agencies. Open data plays an essential role in the successful management of the COVID-19 pandemic, and it would be paramount to introduce and equip researchers, policymakers, and practitioners all around the world with such a tool. This would definitely contribute to creating more resilient, smart, and cost-effective healthcare systems and communities.

Conflict of Interest

The authors declare that they have no conflict of interests.

ACKNOWLEDGEMENT

The research received no financial support. The authors are thankful to the institutional authority for completion of the work.

REFERENCES

Allegranzi, B., Nejad, S. B., Combescure, C., Graafmans, W., Attar, H., Donaldson, L., & Pittet, D. (2011). Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *The Lancet, 377*(9761), 228-241. https://doi.org/10.1016/s0140-6736(10)61458-4

Al-Tawfiq, J. A., & Tambyah, P. A. (2014). Healthcare Associated Infections (HAI) perspectives. *Journal of Infection and Public Health, 7*(4), 339–344. https://doi.org/10.1016/j.jiph.2014.04.003

Althaus, C. (2020). Estimating case Fatality Ratio of COVID-19 from Observed Cases outside China. https://github.com/calthaus/ncov-cfr. Accessed on 5th February , 2023.

Anderson, M., Schulze, K., Cassini, A., Plachouras, D., & Mossialos, E. (2019). A Governance Framework for Development and Assessment of National Action Plans on Antimicrobial Resistance. *The Lancet Infectious Diseases, 19*(11), e371-e384. https://doi.org/10.1016/S1473-3099(19)30415-3

Antimicrobial Resistance Collaborators. (2022). Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The Lancet, 399*(10325), 629–655. https://doi.org/10.1016/S0140-6736(21)02724-0

Besançon, L., Peiffer-Smadja, N., Segalas, C., Jiang, H., Masuzzo, P., Smout, C., ... & Leyrat, C. (2021). Open science saves lives: lessons from the COVID-19 pandemic. *BMC Medical Research Methodology, 21*(1), 1-18. https://doi.org/10.1186/s12874-021-01304-y

Blake, M., Murray, R. C., Williams, J., Gara, J., Belros, D., & Choudhury, S. (2022). A Role for the Library in Public Research: The Global COVID-19 Dashboard. *portal: Libraries and the Academy, 22*(1), 7-25. https://doi.org/10.1353/pla.2022.0007

Cassini, A., Plachouras, D., Eckmanns, T., Abu Sin, M., Blank, H. P., Ducomble, T., ... & Suetens, C. (2016). Burden of six healthcare-associated infections on European population health: estimating incidence-based disability-adjusted life years through a population prevalence-based modelling study. *PLoS Medicine, 13*(10), e1002150. https://doi.org/10.1371/journal.pmed.1002150

CDC (Centers for Disease Control and Prevention). (2021). CDC antibiotic resistance threats in the United States, 2019. https://www.cdc.gov/drugresistance/biggest-threats.html. Accessed on 1st February, 2023.

Chretien, J. P., Rivers, C. M., & Johansson, M. A. (2016). Make data sharing routine to prepare for public health emergencies. *PLoS Medicine, 13*(8), e1002109. https://doi.org/10.1371/journal.pmed.1002109

Christenson, E. C., Cronk, R., Atkinson, H., Bhatt, A., Berdiel, E., Cawley, M., ... & Bartram, J. (2021). Evidence map and systematic review of disinfection efficacy on environmental surfaces in healthcare facilities. *International Journal of Environmental Research and Public Health, 18*(21), 11100. https://doi.org/10.3390/ijerph182111100

de Jesus, J.G., Sacchi, C., Claro, I., Salles, F., Manulli, E., da Silva, D., de Paiva, T.M., Pinho, M., Afonso, A.M.S., Mathias, A., Prado, L., de Carvalho Avelino, A.L., de Oliveira Santos, K.C., Romero, F., dos Santos, F., Gonçalves, C., Timenetsky, M.C., Quick, J., Pybus, O.G.,Faria, N.R. (2020). First Cases of Coronavirus Disease (COVID-19) in Brazil, South America Virological. https://virological.org/t/first-cases-of-coronavirus-disease-covid-19-in-brazil-south-america-2-genomes-3rd-march-2020/409. Accessed on 20th January , 2023.

Desai, A. N., Kraemer, M. U., Bhatia, S., Cori, A., Nouvellet, P., Herringer, M., ... & Lassmann, B. (2019). Real-time epidemic forecasting: challenges and opportunities. *Health Security, 17*(4), 268-275. https://doi.org/10.1089/hs.2019.0022

Dong, E., Du, H., & Gardner, L. (2020). An Interactive Web-Based Dashboard to Track COVID-19 in Real Time. *The Lancet Infectious Diseases, 20*(5), 533-534. https://doi.org/10.1016/s1473-3099(20)30120-1

Gkiouras, K., Nigdelis, M. P., Grammatikopoulou, M. G., & Goulis, D. G. (2020). Tracing open data in emergencies: The case of the COVID-19 pandemic. *European Journal of Clinical Investigation, 50*(9), e13323. https://doi.org/10.1111/eci.13323

Grantz, K., Metcalf, C. J. E., & Lessler, J. (2020). Dispersion vs. control. https://hopkinsidd.github.io/nCoV-Sandbox/DispersionExploration.html. Accessed on 22nd January , 2023.

Haque, M., Sartelli, M., McKimm, J., & Bakar, M. A. (2018). Health care-associated infections–an overview. *Infection*

and Drug Resistance, 11, 2321–2333. https://doi.org/10.2147/idr.s177247

Kennelly, B., O'Callaghan, M., Coughlan, D., Cullinan, J., Doherty, E., Glynn, L., ... & Queally, M. (2020). The COVID-19 pandemic in Ireland: An overview of the health service and economic policy response. *Health Policy and Technology, 9*(4), 419-429. https://doi.org/10.1016/j.hlpt.2020.08.021

Kraemer, M. U., Yang, C. H., Gutierrez, B., Wu, C. H., Klein, B., Pigott, D. M., ... & Scarpino, S. V. (2020). The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science, 368*(6490), 493-497. https://doi.org/10.1126/science.abb4218

Kucharski, A. J., Funk, S., & Eggo, R. M. (2020). The COVID-19 response illustrates that traditional academic reward structures and metrics do not reflect crucial contributions to modern science. *PLoS Biology, 18*(10), e3000913. https://doi.org/10.1371/journal.pbio.3000913

Laxminarayan, R. (2022). The overlooked pandemic of antimicrobial resistance. *The Lancet, 399*(10325), 606-607. https://doi.org/10.1016/s0140-6736(22)00087-3

Laxminarayan, R., Duse, A., Wattal, C., Zaidi, A. K., Wertheim, H. F., Sumpradit, N., ... & Cars, O. (2013). Antibiotic resistance—the need for global solutions. *The Lancet Infectious Diseases, 13*(12), 1057-1098. https://doi.org/10.1016/s1473-3099(13)70318-9

Li, R., von Isenburg, M., Levenstein, M., Neumann, S., Wood, J., & Sim, I. (2021). COVID-19 trials: declarations of data sharing intentions at trial registration and at publication. *Trials, 22*, 1-5. https://doi.org/10.1186/s13063-021-05104-z

Lucas-Dominguez, R., Alonso-Arroyo, A., Vidal-Infer, A., & Aleixandre-Benavent, R. (2021). The sharing of research data facing the COVID-19 pandemic. *Scientometrics, 126*(6), 4975-4990. https://doi.org/10.1007/s11192-021-03971-6

Marchetti, A., & Rossiter, R. (2013). Economic burden of healthcare-associated infection in US acute care hospitals: societal perspective. *Journal of Medical Economics, 16*(12), 1399-1404. https://doi.org/10.3111/13696998.2013.842922

Masuzzo, P. (2022, April 29). The Data I Would Like: How I Would Like Them. Zenodus. https://doi.org/10.5281/zenodo.6503962

Modjarrad, K., Moorthy, V. S., Millett, P., Gsell, P. S., Roth, C., & Kieny, M. P. (2016). Developing global norms for sharing data and results during public health emergencies. *PLoS Medicine, 13*(1), e1001935. https://doi.org/10.1371/journal.pmed.1001935

Moran, K. R., Fairchild, G., Generous, N., Hickmann, K., Osthus, D., Priedhorsky, R., ... & Del Valle, S. Y. (2016). Epidemic forecasting is messier than weather forecasting: The role of human behavior and internet data streams in epidemic forecast. *The Journal of Infectious Diseases, 214*(suppl_4), S404-S408. https://doi.org/10.1093/infdis/jiw375

Morgan, O. (2019). How decision makers can use quantitative approaches to guide outbreak responses. *Philosophical Transactions of the Royal Society B, 374*(1776), 20180365. https://doi.org/10.1098/rstb.2018.0365

Pecoraro, F., & Luzi, D. (2021). Open data resources on COVID-19 in six European countries: Issues and opportunities. *International Journal of Environmental Research and Public Health, 18*(19), 10496. https://doi.org/10.3390/ijerph181910496

Peters, A., Schmid, M. N., Parneix, P., Lebowitz, D., De Kraker, M., Sauser, J., ... & Pittet, D. (2022). Impact of environmental hygiene interventions on healthcare-associated infections and patient colonization: a systematic review. *Antimicrobial Resistance & Infection Control, 11*(1), 38. https://doi.org/10.1186/s13756-022-01075-1

Prestinaci, F., Pezzotti, P., & Pantosti, A. (2015). Antimicrobial resistance: a global multifaceted phenomenon. *Pathogens and Global Health, 109*(7), 309-318. https://doi.org/10.1179/2047773215y.0000000030

Priyantini, D., Irawandi, D., & Poddar, S. (2022). Psychological Impact of Coping Strategies and Nurse Performance During the Covid-19 Pandemic at Rspal Dr. Ramelan Surabaya. *The Malaysian Journal of Nursing (MJN), 14*(2), 109-116. https://doi.org/10.31674/mjn.2022.v14i02.018

Sachdeva, H., Benusic, M., Ota, S., Stuart, R., Maclachlan, J., Dubey, V., & Andonov, A. (2019). Open Science/Open Data: Community outbreak of hepatitis A disproportionately affecting men who have sex with men in Toronto, Canada, January 2017–November 2018. *Canada Communicable Disease Report, 45*(10), 262. https://HYPERLINK "https://doi.org/10.14745%2Fccdr.v45i10a03"10.14745/ccdr.v45i10a03. Accessed on 3rd February , 2023.

Salzo, A., Ripabelli, G., Sammarco, M. L., Mariano, A., Niro, C., & Tamburro, M. (2021). Healthcare-Associated infections and antibiotics consumption: A comparison of point prevalence studies and intervention strategies. *Hospital Topics, 99*(3), 140-150. https://doi.org/10.1080/00185868.2021.1902758

Theodi. (2022). How to Publish Open Data: A List of Advice and Tools. *The Open Data Institute*. https://github.com/theodi/data-publish-list. Accessed on 13th, January 2023.

Tung, L.T. & Thanh, P. T. (2020). Survey data on government risk communication and citizen compliance during the COVID-19 pandemic in Vietnam. *Data in Brief, 33*, 106348. https://doi.org/10.1016/j.dib.2020.106348

Uohara, M. Y., Weinstein, J. N., & Rhew, D. C. (2020). The essential role of technology in the public health battle against COVID-19. *Population Health Management, 23*(5), 361-367. https://doi.org/10.1089/pop.2020.0187

World Health Organization (2020). *Who Coronavirus Disease* (COVID-19) Dashboard: World Health Organization, 2020. WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.int/. Accessed on 27th January , 2023.

World Health Organization. (2022). *Global Report on Infection Prevention and Contro*l. World Health Organization. https://www.who.int/ publications/i/item/9789240051164. Accessed on 10th January , 2023.

Xu, B., & Kraemer, M. U. (2020). Open access epidemiological data from the COVID-19 outbreak. *The Lancet Infectious Diseases, 20*(5), 534. https://doi.org/10.1016/s1473-3099(20)30119-5

Xu, B., Gutierrez, B., Mekaru, S., Sewalk, K., Goodwin, L., Loskill, A., ... & Kraemer, M. U. (2020). Epidemiological data from the COVID-19 outbreak, real-time case information. *Scientific Data, 7*(1), 106. https://doi.org/10.1038/s41597-020-0448-0

Zimlichman, E., Henderson, D., Tamir, O., Franz, C., Song, P., Yamin, C. K., ... & Bates, D. W. (2013). Health care–associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA Internal Medicine, 173*(22), 2039-2046. https://doi.org/10.1001/jamainternmed.2013.9763