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REVIEW ARTICLE

Impact of outbreaks caused by respiratory viruses on healthcare and economic systems: A systematic review

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Abstract

A pandemic's socioeconomic disruption can result in deaths due to deprivation, suicide, violence, and trauma, in addition to virus-related consequences. This study seeks to map the scientific literature on the effects of mitigation measures for respiratory virus outbreaks on healthcare and economic systems across countries, as well as the models used to predict those effects. The primary objectives were to identify the main contributions in this field and delineate the major research pathways that can inform a future research agenda. The study uses bibliometric analysis, keyword co-occurrence analysis, and cluster analysis. Keyword linkages were examined to identify possible trends across the retrieved papers. Hierarchical cluster analysis was also applied to categorize related papers into distinct groups. The results facilitated the identification and classification of multiple theoretical perspectives derived from primary research across seven major approaches: (i) economic parameters affected by the COVID-19 crisis; (ii) healthcare crisis management; (iii) predictions of government interventions' impact on the healthcare system; (iv) impacts of influenza virus in a global economic scenario; (v) general impacts of outbreaks in European and Asia Pacific countries; (vi) operating statistical stability in data analysis; and (vii) statistical trends regarding healthcare in a global economy over a pandemic crisis. Overall, the review synthesizes the main themes in the literature and highlights priority areas related to economic systems, healthcare systems, and predictive modeling. The findings highlight the strong interconnections among economic stability, healthcare system resilience, and public policy, while identifying key health and economic parameters that may inform predictive models assessing the effects of mitigation measures.

Keywords: Bibliometrics; Healthcare system; Economic system; Pandemic's socioeconomic disruption; COVID-19; SARS-CoV-2

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1. Introduction

Respiratory diseases have historically been a major concern in modern as well as traditional medicine, having a considerable influence on morbidity and mortality globally (Adil *et al*., 2021; Boncristiani, 2009). Over the last two centuries, the world has experienced several pandemics and endemic crises, which have been carefully documented. Throughout human history, epidemic events have recurred and often caused substantial mortality, although written documentation is limited for many earlier outbreaks, with the partial exception of the plague (Pollitzer, 1951). Most such events in contemporary history were caused by variants of the influenza virus, such as the Spanish flu (1918), Asian flu (1957), Hong Kong flu (1968), and Swine flu (2009). Some were caused by coronavirus variants that crossed species, resulting in severe acute respiratory syndrome (SARS) in 2002, Middle East respiratory syndrome (MERS) in 2012 (Kim *et al*., 2016), and coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 (Lai *et al*., 2024; Singh *et al*., 2025).

Predictive studies have several applications, including supporting policy decisions related to healthcare guidelines and public regulations (Ardabili *et al*., 2020; Grey & MacAskill, 2020). Data from pandemics, epidemics, and comparable outbreaks may help forecast crisis scenarios and support preparedness in healthcare and economic systems (Aleta *et al*., 2020; Borghi *et al*., 2021; de Oliveira *et al*., 2021; Sahin *et al*., 2020; Wichitaksorn, 2022).

Two points are critical. First, each country or region has distinct characteristics that require context-specific scenario modeling. Second, mitigation measures may impose immediate economic costs (Reissl *et al*., 2022). For example, lockdowns required the closure of non-essential facilities and shifted work and study activities to the home environment. However, these measures were also critical for reducing transmission and preserving hospital capacity (Arabi *et al*., 2021).

As is well recognized, social behavior may significantly impact the spread of an infectious virus. Thus, before the possibility of a massive vaccination campaign, non-pharmaceutical interventions became critical (McCombs & Kadelka, 2020). During the COVID-19 pandemic, different approaches by governments were taken, such as the example of China and South Korea, which focus on a strict lockdown followed by a testing policy that "flattens" the infection curve (Browne *et al*., 2022; Jin *et al*., 2022). On the other hand, European countries and the United States of America focus on a lockdown that is not so strict compared to China, with mandatory use of masks but with some flexibility during holidays, which results in higher infection curves (Carvalho *et al*., 2021). These different approaches resulted directly in the maintenance of healthcare services and the country's economy (Inoue & Todo, 2020).

This article contributes by synthesizing evidence on how respiratory pandemics affect healthcare and economic systems worldwide. It organizes the literature into seven research clusters, proposes a framework to guide future work, and identifies priority features for future predictive models. Consequently, it provides a conceptual foundation for constructing models capable of forecasting the healthcare and economic impacts of future pandemics.

To facilitate the understanding of the proposed analysis, this article is organized as follows: Section 2 (Methods) presents the systematic review procedures, detailing the databases, search strategies, inclusion and exclusion criteria, and bibliometric and cluster analysis techniques. Section 3 (Results) reports the descriptive and statistical findings derived from the literature, emphasizing the main clusters identified and their thematic relevance. Section 4 (Discussion) interprets these findings in light of existing research, highlighting theoretical and practical implications for the prediction of respiratory outbreaks and their socioeconomic impacts. Finally, Section 5 (Conclusion) summarizes the key insights and proposes directions for future studies on predictive frameworks for the healthcare and economic effects of mitigation measures during respiratory pandemics.

2. Methods

The main objective of this paper is to analyze three topics: models for predicting the number of people infected by respiratory pandemics, including influenza and COVID-19; the effects of mitigation measures on the economy and healthcare system; and the relationships among these topics, using a systematic literature review (SLR), keyword co-occurrence, and cluster analysis. The objectives of this study were as follows: (i) to identify relevant papers in scientific databases, specifically Web of Science (WoS) and Scopus, and conduct the review using a systematic methodology; and (ii) to evaluate the current state of forecasting tool development and identify the limitations reported to date.

The methodological design adopted in this paper presents the following advantages that strengthen the reliability and comprehensiveness of its findings. The SLR applied predefined inclusion and exclusion criteria to ensure thematic alignment with the study's goals. Only papers addressing forecasting or modeling of respiratory outbreaks, impacts on healthcare systems, or economic consequences of mitigation policies were retained. Studies focused on unrelated domains, such as environmental

effects, psychological outcomes, vaccine development, chronic diseases, or molecular virology, were excluded because they do not provide measurable parameters relevant to the proposed scope. Articles were excluded when they were inaccessible in full text or did not meet the predefined eligibility criteria to preserve data accuracy and reproducibility.

The choice of WoS and Scopus as data sources is justified by their methodological rigor and comprehensive coverage of high-impact scientific production. Both databases index peer-reviewed journals with strict quality criteria. Moreover, their multidisciplinary scope is particularly relevant to the present research, which spans epidemiology, public health, economics, and forecasting models.

Study selection was conducted by a single reviewer using predefined inclusion and exclusion criteria aligned with Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) reporting recommendations.

2.1. Risk-of-bias assessment

Potential sources of bias in the review process were considered during study identification, screening, and quality appraisal.

One major concern is selection bias during study identification and screening, particularly when eligibility criteria are unclear or inconsistently applied. To mitigate this bias problem, establishing defined inclusion and exclusion criteria before starting the review and using comprehensive databases, not only the most popular ones, is important. Moreover, the time bias may be minimized with a well-described range of years under study. In the case of this paper, a range of 20 years was chosen for the research to collect data from SARS until the SARS-CoV-2 studies.

Another important source of bias is the subjectivity in the quality appraisal of included studies. This bias can be mitigated by using validated assessment tools. In the present review, PRISMA was used to guide transparent reporting of the process, and ROBIS was applied to evaluate the risk of bias.

2.2. Sample data collection and processing methods

In order to select the keywords to research in the chosen databases more precisely, a professor of economics and management was consulted to assist with the economic topics, and a nurse who was active during the COVID-19 crisis in healthcare topics was consulted. Accordingly, Table 1 presents the selected topics and representative search terms.

The economics expert reviewed and validated the economic terminology, ensuring that the selected terms accurately reflected macroeconomic indicators commonly used in empirical research. Similarly, the nurse evaluated the healthcare-related concepts, confirming their relevance to clinical practice and public health reporting.

Because the two databases use different search rules, the search methodology was described separately for each platform. In WoS, the four topics could be combined in a single search, yielding 128 papers. In Scopus, the search had to be divided into two combinations: topics (1), (2), and (3), and topics (1), (2), and (4), yielding 515 and 74 papers, respectively. The first combination mainly retrieved papers on economic topics, whereas the second mainly retrieved papers on healthcare topics. The screening step was conducted by one reviewer.

Table 1. Research keywords

No.	Topic	Keywords
1	Algorithm modeling	"Forecasting" OR "Predictions" OR "Modeling" OR "Estimation" OR "Foresight"
2	Respiratory diseases	"COVID-19" OR "SARS-CoV-2" OR "Influenza" OR "Swine Flu" OR "Hong Kong flu" OR "SARS" OR "MERS"
3	Affected economic parameters	"Unemployment rate" OR "Level of unemployment" OR "Investment rate" OR "Inflation rate" OR "Level of Inflation" OR "Interest rate" OR "Interest charge" OR "Gross Domestic Product" OR "GDP"
4	Healthcare-related parameters	"Hospitalization rate" OR "ICU hospitalization rate" OR "Deaths caused by COVID-19" OR "Number of medical appointments" OR "Number of public consultations" OR "Number of public hearings" OR "Hiring of services in healthcare system rate" OR "Number of elective surgeries" OR "Number of non-urgent surgeries" OR "Healthcare system investments"

2.3. Study selection and exclusion criteria

Study selection followed PRISMA recommendations. Records were screened by title and abstract, followed by full-text review. Additional eligible studies were identified through backward citation tracking of included papers. Figure 1 demonstrates the study selection process.

The excluded criteria included studies focused primarily on environmental effects, telephone inquiries, mental health, vaccine development or testing, opinion pieces, chronic diseases, clinical procedures unrelated to the review objectives, and purely biological or virological features of the virus. Records that could not be retrieved in full text were also excluded. A total of 265 studies were included in the review (Figure 1).

VOSviewer (version 1.6.20; https://www.vosviewer.com/) was used to generate keyword co-occurrence maps and identify clusters based on recurring terms in the included studies. Clustering the subjects provides grounds for organizing scientific outcomes.

3. Results

All scientific articles included in the sample were reviewed for (i) performance, i.e., descriptive statistical data, and (ii) cluster trends, as well as cluster descriptions.

3.1. Performance

Interest in the economic and healthcare impacts of respiratory virus outbreaks increased markedly after the onset of COVID-19. Studies published after 2023 were cited only for background context and were not included in the reviewed sample. Publication output was relatively low in earlier years (2004 to 2019: 11.2%) but rose sharply from 2020 onward (2020: 10.4%, 2021: 28.4%, 2022: 25.5%, and 2023: 24.3%) (Figure 2). This increase likely reflects the surge in research activity associated with the COVID-19 pandemic.

Regarding country-level contributions, the papers originated from 63 countries, and the number of papers from each country is shown in Figure 3.

The high number of publications from Asia, particularly China, can be attributed to several factors (Wang, 2024). Firstly, the region has been significantly impacted by past outbreaks, such as SARS, which led to extensive research efforts to understand and combat such diseases. Moreover, the onset of the COVID-19 pandemic, which was initially detected in China, further intensified research endeavors in the country (Jakovljevic *et al.*, 2023). The lack of publications in the United Kingdom is due to institutions such as Oxford University's scientific journals focusing on the COVID-19 pandemic and the emergence of virus

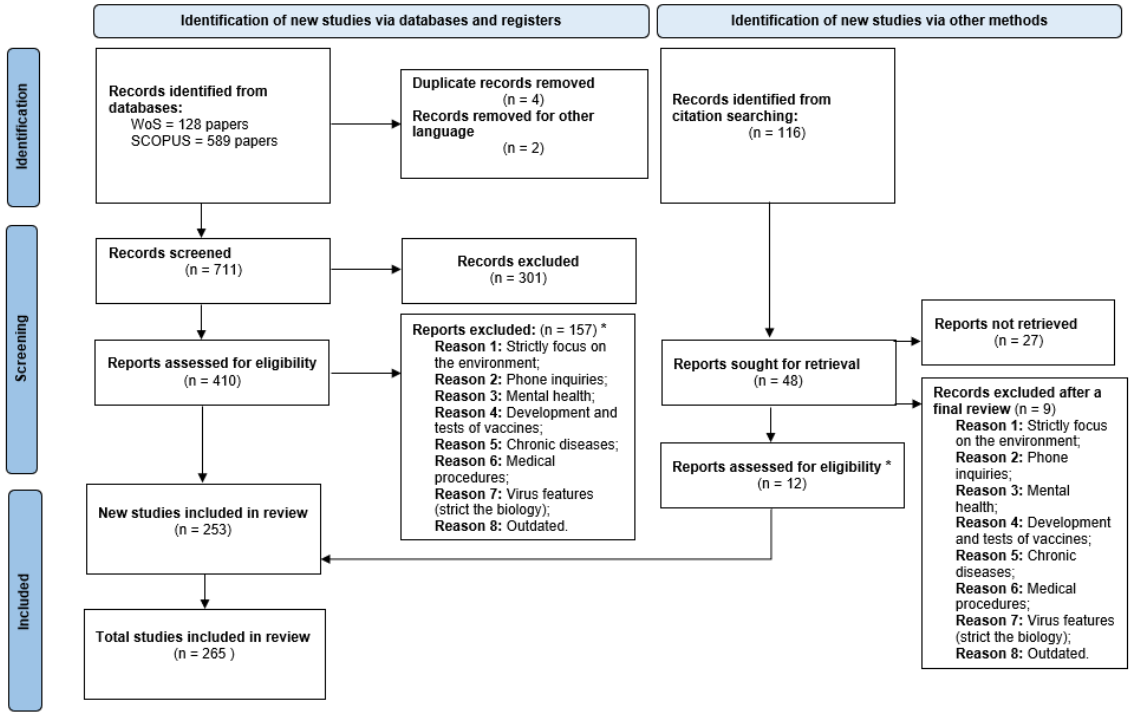

Figure 1. PRISMA flow diagram of the study selection process. Image created by the authors.

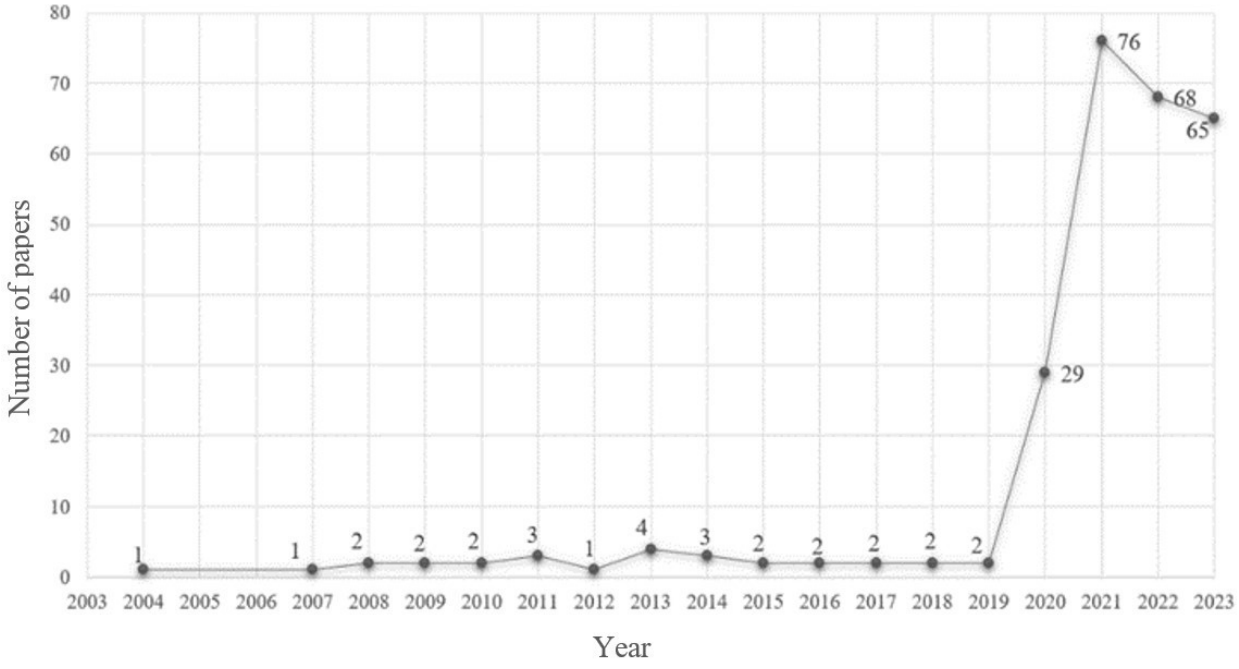

Figure 2. Papers per year. Image created by the authors.

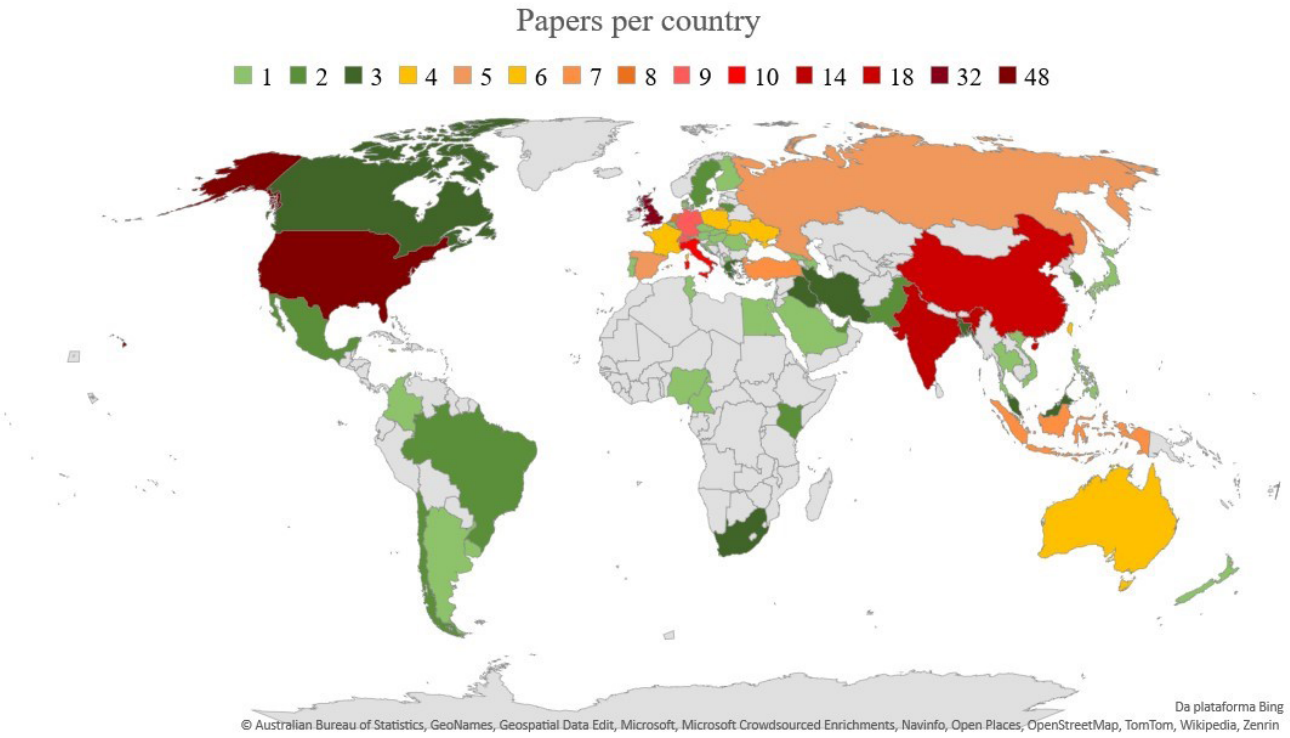

Figure 3. Papers per country. Image created by the authors.
Note: Colors indicate different numbers of papers.

variants such as the Alpha. Similarly, the United States has seen many publications, most likely due to previous experiences with pandemics such as Influenza A H1N1 in 2009. Furthermore, the severe economic consequences of such pandemics and global crises resulted in extensive research into understanding and mitigating their socioeconomic effects.

3.2. Cluster trends

Descriptive analyses were performed based on authors, keywords, and Keyword Plus (retrieved from WoS for each publication), as well as clusters, publications associated with each other, and keyword occurrence frequencies. VOSviewer was used to construct and visualize the bibliometric networks.

To provide an overview of trends in the literature on the proposed theme, cluster analysis was conducted on the 265 studies included after the PRISMA-based literature review. The cluster analysis identified seven clusters, shown in Figure 4 and described in the following subsections: (i) economic parameters affected by the COVID-19 crisis (red), (ii) healthcare crisis management (purple), (iii) predictions of government interventions' impact on the healthcare system (orange), (iv) impacts of influenza virus in a global economic scenario (yellow), (v) general impacts of outbreaks in European and Asia Pacific countries (light blue), (vi) operating statistical stability in data analysis (blue), (vii) statistical trends regarding healthcare in a global economy over a pandemic crisis (green).

In the network, each bubble corresponds to a keyword, and bubble size indicates the number of papers in which that keyword appears. Links between keywords indicate co-occurrence within the same paper, constructed using the Scaling by MAjorizing a COmplicated Function (SMACOF) algorithm. Thicker lines represent more frequent co-occurrence, and shorter distances indicate closer relationships between keywords.

3.3. Cluster description

The following step involved reading and analyzing all articles in each cluster to see if they addressed the research objective. The analysis identified common characteristics and key differences, forming research categories for each cluster.

The definitions of the seven clusters under study are provided below:

(i) Cluster 1: Economic parameters affected by the COVID-19 crisis

The cluster "Economic Parameters Affected by the COVID-19 Crisis", comprising 79 papers, focused on economic parameters, such as the financial market, gross domestic product (GDP), macroeconomic variables, i.e., tourism, unemployment rate, and inflation rate.

Macroeconomic data are critical information for public and private sector decision-making. The growing link

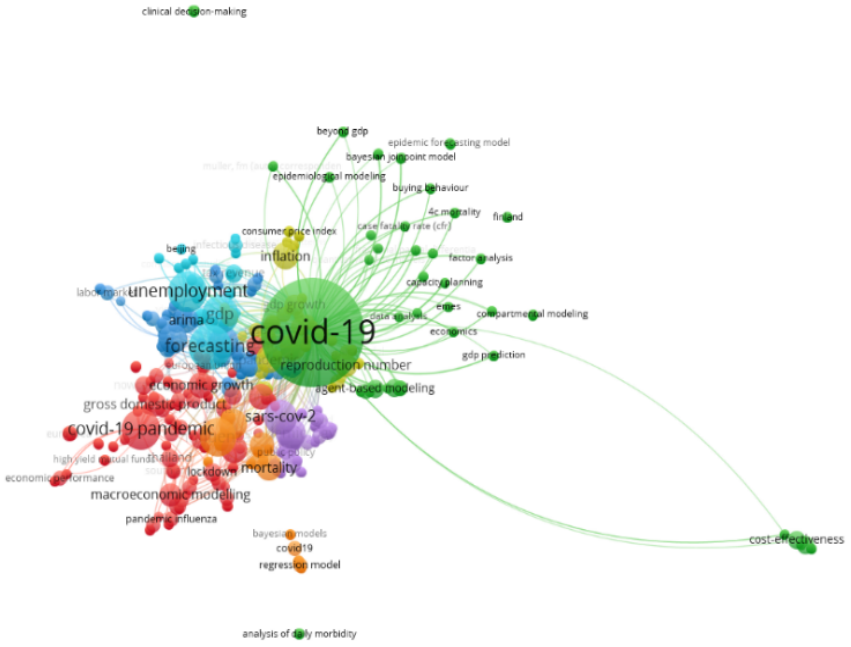

Figure 4. Cluster network. The image was generated using VOSviewer.

between credit and business cycles necessitates an extensive knowledge of the factors driving bank lending growth and their implications and relevance for real economic activity (Wu *et al*., 2022). Historically, global financial circumstances and capital flows have significantly affected local credit cycles (Ali, 2024). However, in the last few years, governments have increasingly used macroprudential guidelines and credit support measures to influence bank lending, minimize financial stability risks, or boost economic activity during downturns (Büyükbaşaran *et al*., 2022). The decline in economic activity has severely impacted government budgets worldwide, causing debt to rise due to a swollen budget deficit caused by falling tax revenues and rising spending (Bizuneh & Geremew, 2021).

Gross domestic product is a key indicator that reflects market conditions and people's incomes, playing a crucial role in assessing a country's financial and economic strength (Jakovljevic, 2016). Disease outbreaks, industrial disruptions, and, more lately, inflation have made policy-making exceedingly tricky (Sharma *et al*., 2022).

Due to the COVID-19 pandemic, governments worldwide have had to adopt a series of measures to slow the spread of the virus. One of these measures was to limit travel. These policies directly impacted regional and global economic growth, impeding efforts to sustain and accelerate economic progress. One of the repercussions is that many people lost their jobs or sources of income, diminishing their and their families' income (Do & Pham, 2023; Krumel *et al*., 2023).

The main goal has moved to designing economic policy to reduce the effects of the COVID-19 pandemic. Short-term economic indicators must be analyzed in order to control economic development in real-time, make operational decisions, and provide decision-makers with early indicators of economic activity turning points (Huseynova *et al*., 2022). Consequently, politicians, corporations, and households struggle to forecast future growth and evaluate the shape of the recovery. In periods of economic and financial trouble, politicians and market participants demand frequent updates and prospective measures of the economy's expected direction (Jakovljevic, 2016).

The coronavirus pandemic has not only led to economic consequences but has also been linked to negative impacts on various sectors, including the labor market (Jin *et al*., 2024). The embraced restrictions, which were and continue to be necessary to reduce mortality, have caused significant economic and social damage (Gormsen & Koijen, 2020). Mass unemployment is an immediate consequence of a demand for several mitigation procedures due to a rise in COVID-19 cases and prevention efforts (Katris, 2021). At the beginning of the pandemic, unemployment increased. However, according to Eurostat's official statistics, the Eurozone's seasonally adjusted unemployment rate fell to 8.3% in November 2020 (Petrou & Jakovljevic, 2024).

Likewise, the COVID-19 pandemic had an important effect on recreational and tourism activities worldwide, particularly in the hospitality sector, affecting tourism dependency, the market structure, rural accommodation supply, and pandemic-related health outcomes (P. Nguyen *et al*., 2021). COVID-19 has particularly impacted the tourism sector because limiting people's mobility has been one of the main strategies implemented to combat the pandemic (Mustafa *et al*., 2021). Domestic tourism in China, such as in other countries (Vayá *et al*., 2023), has been severely restricted by lockdowns designed to control and rapidly limit the virus's transmission.

(ii) Cluster 2: Healthcare crisis management

This cluster comprises 25 papers and mainly addresses hospitalizations, mortality, epidemic spread, epidemiological modeling, and recovery rates. In the modern era, a few Influenza pandemics have occurred, such as the Spanish Flu (1918) and the Swine Flu (2009). Therefore, each one must be studied thoroughly. Also, seasonal influenza cases cause a moderate mortality rate every year. However, the resulting outbreak can be catastrophic when a new human-transmissible influenza virus appears (L. Nguyen *et al*., 2022).

In 2020, the world faced a new virus (SARS-CoV-2), which led to the COVID-19 pandemic. At its peak, governments struggled to manage massive infection waves, placing immense pressure on national healthcare systems and financial resources. To combat the virus's spread, governments implemented various non-pharmaceutical interventions to minimize infection rates, hospitalizations, and deaths. Nonetheless, these mitigation procedures have brought about consequences in the economic domains (Simonsen *et al*., 2013; van der Schans *et al*., 2023).

The consequences of COVID-19 vary widely and affect multiple aspects of healthcare delivery, including care-seeking behavior. Accordingly, identifying patients at higher risk of poor outcomes may help improve resource allocation (Wahyono *et al*., 2021).

To prepare for new variants of coronavirus, healthcare managers and politicians must forecast future healthcare needs. Several predictive models have been developed and are widely used to assist healthcare facilities and governments in preparing for upcoming patient surges (Aydın *et al*., 2023). Key parameters include the time between case identification and intensive care unit admission, the duration of mechanical ventilation, and the

probability of requiring urgent care, all of which may vary over time (Hashim *et al*., 2020).

(iii) Cluster 3: Predictions of government interventions' impact on the healthcare system

Cluster 3 is central to the present review. It comprises 26 papers and primarily focuses on predictive algorithms used to forecast the impact of government mitigation measures on the healthcare system.

Since the beginning of the coronavirus pandemic, each country has implemented many containment efforts to lessen the impact. The Oxford COVID-19 Government Response Tracker evaluates policy measures made by governments internationally over time. The stringency score (range from 0 to 100) is a quantitative assessment of the amount of confinement policy, taking into account school and workplace closures, restrictions on meetings and public events, lockdowns, the shutdown of public transportation, restrictions on internal and international activity, information campaigns, and whether they applied to the general territory or intended regions (Klement & Walach, 2022). The highly transmissible COVID-19 emerged unexpectedly, raising concerns about the disease's severity and the speed with which vaccines would be approved. Lockdowns, travel restrictions, and quick testing were among the measures implemented by governments worldwide in response to the pandemic (Lilleri *et al*., 2020).

The effect of various COVID-19 mitigation procedures on economic loss and death was studied using a micro-level simulation model that integrates a multi-sector closed economy with an epidemic transmission model. The expanding economic study on the COVID-19 pandemic is mostly based on the typical equation-based SIR model, which includes parameters such as susceptible (S), infectious (I), and recovered or removed (R) of infectious illness, and makes some linkages to economic activity. Measures taken to contain the pandemic typically reduce the potential of production or consumption, leading to an economic shock (Cheteni & Mazenda, 2023).

Due to economic uncertainty, households reduced consumption, while industries delayed investment and hiring. According to the International Monetary Fund, COVID-19 decreased global economic activity, reduced household consumption, particularly harmed the service sector, and dealt a major blow to the labor market and international trade (Bonfiglio *et al*., 2022).

(iv) Cluster 4: Impacts of the influenza virus in a global economic scenario

Cluster 4 comprises 24 papers and focuses on pandemic and seasonal influenza models, other respiratory virus outbreaks, vaccination programs, and analyses using large-scale data.

The 2003 emergence of SARS demonstrated that epidemics of infectious diseases can have essential macroeconomic impacts (Towers & Chowell, 2012). Despite past crises such as the 1918 Spanish Flu, the 1957 Asian Flu, and the 1968 Hong Kong influenza pandemics, the 1997 outbreak of H5N1 avian influenza in Hong Kong raised widespread concerns about the potential threat of a pandemic. In response, in 1998, the Taiwan Center for Disease Control set up an influenza surveillance network to periodically monitor avian influenza. Although increased surveillance, SARS emerged unexpectedly in 2003 (Smith & Keogh-Brown, 2013; Yen *et al*., 2014).

Since then, concerns have increased regarding the possible consequences of a worldwide transmissible pandemic, particularly for the economy. However, preparedness efforts primarily focus on public health and sustaining a functional healthcare system rather than addressing broader economic consequences. The swine flu pandemic had several advantageous characteristics, including its origin in the Americas rather than the developing world, which allowed for early detection, slow disease progression, a relatively high level of adult immunity, and prolonged sensitivity to antiviral treatments. The consequences were far more severe because these criteria were not met, as was the case for the future COVID-19 pandemic (Beutels *et al*., 2009).

The Global Initiative on Sharing Avian Influenza Data provides the infrastructure used predominantly by the Global Influenza Surveillance and Response System for data exchange (Shu & McCauley, 2017). Through this platform, genetic sequences evaluated by the World Health Organization (WHO) Collaborating Centers for the purpose of selecting viruses recommended for the formulation of seasonal and pre-pandemic vaccines are made publicly available. These data can be used by scientific researchers, human and animal health authorities, and pharmaceutical companies. Open access to this updated information contributes significantly to the basis and credibility of WHO guidelines related to the composition of seasonal vaccines and candidate pandemic vaccines (Pang *et al*., 2004).

Also, time series methods allow the estimation of influenza and other virus-related mortality. The Serfling approach's cyclic, harmonic regression model is commonly utilized to model background and non-influenza mortality (L. Nguyen *et al*., 2022).

(v) Cluster 5: General impacts of outbreaks in European and Asia Pacific countries

Cluster 5 comprises 34 papers and focuses on

correlations in the socioeconomic impacts of pandemics across European and Asia-Pacific countries.

Pandemics have affected humanity throughout history. Research has been undertaken to evaluate the effect of population density on infectious diseases. Density relates to interactions among populations; hence, it is a significant variable in the spread of new infectious illnesses. In the case of global pandemics, such as the recent SARS-CoV-2 virus, the larger and denser urban centers, particularly those engaged in tourist activities, were epicenters of a health crisis resulting in the death of thousands (Lau *et al*., 2021).

The COVID-19 crisis has transformed worldwide political, social, economic, and financial systems. Additionally, global stock markets have declined, and tax revenue streams have plummeted. The full long-term impact cannot be determined until the downstream consequences of the pandemic are fully assessed (Navarro-romero *et al*., 2021; P. Verma *et al*., 2021). Despite numerous efforts to mitigate the effects that have been set out, awareness of the overall implications remains restricted since some of the tactics employed are counterproductive (Rostan & Rostan, 2022).

Based on fundamental mathematical methods, it is possible to predict the impact of the COVID-19 crisis on youth unemployment in the European Union by 2020. The youth unemployment rate is expected to rise to 26%, while the number of young people not in education, employment, or training would rise from 4.7 million to 6.7 million. Politicians at the national and international levels must act as soon as possible and make significant efforts to avert these bad outcomes (Tamesberger & Bacher, 2020; Zhuang, 2020).

Since the initial global reports on the spread of the coronavirus, supply chains worldwide have experienced significant disruptions. Economies have faced significant disruptions in both operational and financial flows. These disruptions were driven by reduced demand in some sectors, supply shortages, inventory imbalances, logistical constraints, and declines in productivity (M. Verma & Naveen, 2021). Demand trends differed across commodities; for example, demand for oil declined sharply, resulting in a much lower oil price; demand for consumer goods and medicines increased, creating sector-specific supply pressures (Jakovljevic *et al*., 2016). Furthermore, COVID-19 has significantly influenced consumer spending due to factors such as consumer confidence, unemployment rates, pay decreases, and the cost of living. Expenditure is an important driver of global economic growth (Hysa *et al*., 2022).

(vi) Cluster 6: Operating statistical stability in data analysis

The cluster includes 37 papers and discusses different modeling approaches to forecasting, mostly economic, datasets during and after pandemics. These algorithms are based on robust estimators, data analysis, a multilayer perceptron, and wavelet analysis.

Comparing some examples of models, such as those presented by Jakovljevic *et al*. (2021) and Rahmani & Hosseini Mirmahaleh (2022), both predict post-pandemic scenarios; however, Rahmani and Hosseini Mirmahaleh (2022) forecast GDP numbers using artificial neural networks, and Mitze and Makkonen (2020) estimate the structural relationship between Research, Development, and Innovation funding and economic development in Finnish NUTS-3 areas using pre-COVID-19 data. Another hotspot topic is the unemployment rates, which were studied by Shi *et al*. (2022) using a hybrid approach and Yamacli (2023) using ARIMA.

Moreover, Mashud *et al*. (2021) present a resilient hybrid payment supply chain inventory model for post-COVID-19 recovery. On the other hand, Almehmadi (2021) and Yang (2023) focused on the stock market trends, and Sadovnichiy *et al*. (2022) published a mathematical model of overcoming the COVID-19 pandemic.

(vii) Cluster 7: Statistical trends regarding healthcare in a global economy over a pandemic crisis

Cluster 7 comprises 40 papers and focuses on statistical and machine-learning approaches for forecasting influenza, COVID-19, and related economic outcomes.

Prediction models are increasingly used to forecast pandemic- and outbreak-related outcomes. Although some studies share similar objectives, such as combining qualitative and quantitative data to predict COVID-19-related indicators, they differ in the specific outcomes examined and the methodological tools used. These outcomes include the effects of response stringency, disease incidence in relation to mandatory mask use and vaccination progress, and increases in violence following the SARS-CoV-2 pandemic (Sadovnichiy *et al*., 2022).

Furthermore, in the case of Influenza studies, the present sample relies on papers about influenza-associated respiratory hospitalization and mortality, predictions about seasonal influenza hospitalizations, socioeconomic bias in influenza surveillance, and influenza-associated severe acute respiratory illness hospitalization in Zambia (Farah *et al*., 2023; Leung *et al*., 2022).

In addition, some papers of this cluster present research about the impact of the COVID-19 pandemic on the utilization of healthcare services, especially a full report

about pandemic preparation and action (Akram *et al*., 2024; Fineberg, 2014).

4. Discussion

This study identified seven clusters focused on predicting the development of respiratory illnesses and assessing the impact of mitigation strategies on the economy and healthcare system (Amiri & Solankallio-Vahteri, 2020).

Compared with previous studies on mitigation measures and their impacts on the economy and healthcare system, the present review provides a broader synthesis of the field. First, Blakely *et al*. (2021) used official data from the state of Victoria, Australia, along with other acquired data. An agent-based model was used to estimate daily SARS-CoV-2 infection rates and the duration of five phases of social limitations under four different policy response scenarios: aggressive elimination, moderate elimination, tight suppression, and loose suppression.

Additionally, in Victoria, Australia, Szanyi *et al*. (2023) examined 104 policy packages (two degrees of stringency of public health and social measures, two levels of mask-wearing and respirator supply during outbreaks, and 13 vaccination regimens) for nine potential SARS-CoV-2 variant scenarios. An agent-based model projected morbidity, death, and expenses for each scenario during a 12-month period beginning in October 2022. The 104 policies were ranked using four equally weighted criteria: cost-effectiveness from (a) a health system viewpoint, (b) a combined health system and GDP perspective, (c) total fatalities, and (d) days exceeding hospital occupancy standards. The results indicated that additional vaccination beginning in October 2022 reduced hospitalizations by 12% and deaths by 27% compared to no additional vaccination. This measure was generally cost-saving in terms of both health expenditures and GDP.

Moreover, Santosa *et al*. (2023) investigated the impact of the COVID-19 regulation on dividend policy in Indonesian banking businesses, emphasizing the period 2014–2020. The samples were chosen based on the purposive sampling technique, and statistical analysis of the data was conducted using dynamic regression for panel data, employing two estimation approaches: the first difference generalized method of moments and the system generalized method of moments.

In accordance with these studies, the present review reinforces the premise that mitigation policies generate measurable and simultaneous effects on epidemiological and economic indicators, and that quantitative modeling is essential for supporting governmental decision-making under uncertainty. Both Blakely *et al*. (2021) and Szanyi *et al*. (2023) employed simulation-based approaches to assess the effectiveness of different containment strategies in Australia, quantifying impacts on hospitalizations, mortality, and economic costs; these elements also appear consistently across the clusters identified in this review. Meanwhile, each study operates within a distinct contextual setting: the Australian works reflect a scenario of high testing capacity, structured vaccination rollout, and strong public health governance, whereas Santosa *et al*. (2023) examine financial repercussions in the banking sector of an emerging economy, illustrating how sanitary shocks propagate into corporate behavior and financial markets. By synthesizing literature from heterogeneous economic and healthcare systems, this article broadens the scope of these individual findings and demonstrates that, regardless of development level, containment policies simultaneously alter viral transmission dynamics, healthcare demand, and macroeconomic performance.

Comparing the seven clusters, it is possible to note that they are not isolated analytical units but components of an interdependent system that reflects the multifactorial nature of pandemic dynamics. Clusters related to economic performance (Cluster 1), the healthcare system (Cluster 2), and governmental interventions (Cluster 3) make explicit how policy decisions generate simultaneous epidemiological and macroeconomic effects. Clusters addressing historical and regional perspectives (Clusters 4 and 5) show that structural factors, including governance capacity, population density, and economic vulnerability, regulate these relations. Meanwhile, the analytical clusters (Clusters 6 and 7) highlight the growing need for robust modeling approaches that can capture nonlinear interactions between health and economic systems.

5. Conclusion

This study proposes a framework that categorizes the literature into seven thematic clusters, namely: (i) economic parameters affected by the COVID-19 crisis, (ii) healthcare crisis management, (iii) predictions of government interventions' impact on the healthcare system, (iv) impacts of influenza virus in a global economic scenario, (v) general impacts of outbreaks in European and Asia Pacific countries, (vi) operating statistical stability in data analysis, and (vii) statistical trends regarding healthcare in a global economy over a pandemic crisis.

The identified clusters highlight a set of parameters that may be useful for future models examining the impacts of mitigation procedures on healthcare and economic systems. These parameters are: hospitalization ratio, mortality, recovery rates, GDP, and macroeconomic variables, such as tourism, unemployment rate, and inflation rate.

In summary, this study provides an integrated view of the socioeconomic and healthcare impacts of respiratory pandemics through a systematic and data-oriented approach. The identification of seven thematic clusters revealed the complex interrelations among economic stability, healthcare system resilience, and government intervention strategies. The findings demonstrate that predictive modeling and quantitative analyses play a fundamental role in understanding how prevention measures affect both public health outcomes and macroeconomic dynamics. Moreover, the review highlights the importance of multidisciplinary collaboration between economics, epidemiology, and data science to strengthen preparedness for future outbreaks.

In future studies, the recommended multidimensional parameters can be operationalized within predictive models by integrating epidemiological and economic indicators into unified feature sets. Economic variables, such as GDP, unemployment rate, inflation rate, and tourism, may be standardized and aligned temporally with epidemiological data to capture their lagged or simultaneous responses to mitigation policies. Operationalizing the parameters in this way offers a concrete path toward building integrated predictive systems that estimate not only disease progression but also the parallel socioeconomic impacts of future respiratory pandemics.

Future work will involve developing a model to predict how mitigation procedures during respiratory virus pandemics affect a country's healthcare and economic systems.

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Conflict of interest

Mihajlo Jakovljevic is the Founding Editor-in-Chief and João Paulo Teixeira is an Editorial Board Member of this journal, but were not in any way involved in the editorial and peer-review process conducted for this paper, directly or indirectly. Separately, other authors declared that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The data supporting the conclusions of this paper may be made available by the authors without undue reservation.

Further disclosure

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