Journal of Information Systems Engineering and Management
2025, 10(12s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Knowledge Management Model for Managing Public Health Interventions, Policy, Procedure, Governance, and Technology Innovation in Indonesia COVID-19 Mitigation

Mardhani Riasetiawan[1*], Ahmad Ashari[2]
[1,2]*Department of Computer Science and Electronics, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Indonesia*

ARTICLE INFO

Received: 15 Nov 2024
Revised: 28 Dec 2024
Accepted: 14 Jan 2025

ABSTRACT

The COVID-19 pandemic has highlighted the need for efficient knowledge management systems that leverage big data to enhance public health responses. This study focuses on developing a knowledge management framework to support COVID-19 mitigation efforts across diverse regions in Indonesia, specifically in Purwokerto, Samarinda, Medan, and Yogyakarta. By utilizing a big data approach, we aggregated and analysed vast datasets, including public health interventions, policy, procedure, governance, and technology innovation, to provide actionable insights for decision-makers. The proposed knowledge management framework organizes information into accessible formats, allowing health officials to respond rapidly to evolving conditions. The findings underscore the importance of integrating big data into knowledge management systems for improved resource allocation, public health communication, and policy formulation in response to future health crises. This framework provides a replicable model for other regions and pandemics, showcasing the potential of big data to enhance resilience in public health systems.

Keywords: Knowledge Management, Models, Covid-19, Mitigation

INTRODUCTION

The COVID-19 pandemic has underscored the importance of effective public health systems and swift responses to mitigate the impacts of a rapidly spreading virus. For Indonesia, a vast archipelago with diverse regional populations, COVID-19 posed unique challenges to healthcare, governance, and social structures. The need for comprehensive, data-driven approaches became evident as policymakers struggled to implement interventions that would balance public health and economic stability [1]. Leveraging big data for knowledge management (KM) offers a powerful solution to inform and coordinate COVID-19 mitigation efforts across the country, especially in heterogeneous settings like Purwokerto, Samarinda, Medan, and Yogyakarta. Each of these cities represents different demographic, economic, and healthcare conditions, which can provide valuable insights for a KM framework that enhances COVID-19 mitigation in Indonesia [2].

Knowledge management involves the systematic collection, organization, and dissemination of information to improve decision-making and organizational resilience [3],[4]. In the context of a pandemic, KM enables the rapid sharing of critical information related to virus spread, intervention effectiveness, and resource allocation. By utilizing big data, KM can aggregate real-time data from diverse sources, including health facilities, social media, mobility data, and regional healthcare records. Such data allows for identifying COVID-19 hotspots, assessing public health intervention effectiveness, and tailoring responses to local needs [5]. The regions selected for this study—Purwokerto, Samarinda, Medan, and Yogyakarta—exemplify the diversity of Indonesia's healthcare infrastructure and public health capacities [2]. Each city faced different challenges and implemented varying public health interventions based on local needs and resources, such as social distancing regulations, contact tracing, and vaccination programs [6]. By gathering data from these locations, this study aims to identify patterns in COVID-19 spread, understand the impact of public health policies, and evaluate the adaptability of responses across regions. The knowledge gained from this regional diversity will help inform an integrated KM framework that can be applied nationwide [7]. Public health interventions during the pandemic in Indonesia included a range of policies such as large-scale social restrictions (PSBB), vaccination rollouts, and digital contact tracing applications like PeduliLindungi. These interventions were shaped by policy guidelines that emphasized both centralized decision-

Making and regional adaptation to local conditions. Effective governance was essential to coordinate these policies, yet varying degrees of compliance and resource limitations highlighted the need for a KM system that could capture and manage local data more effectively [8]. The role of governance in KM for COVID-19 mitigation involves setting up protocols for data sharing, protecting patient privacy, and ensuring that real-time information flows to local authorities for timely action [9]. Technological innovation is at the core of utilizing big data in KM. Innovations such as mobile applications, real-time data analytics, and AI-based predictive modeling have been crucial for managing COVID-19 data and informing public health responses globally. By integrating big data with technology-driven KM frameworks, Indonesia can improve the accessibility and usability of health data for regional authorities, enabling quicker and more precise public health interventions [10]. This study contributes to the growing field of big data in public health by developing a KM framework that enhances COVID-19 mitigation efforts in Indonesia. Through the collection and analysis of data from Purwokerto, Samarinda, Medan, and Yogyakarta, this research aims to inform best practices in policy, procedure, and governance, ultimately facilitating a more resilient and adaptive public health system. By examining the effectiveness of various interventions and the role of technology in KM, this study provides a scalable model that can guide future pandemic responses, not only in Indonesia but also in other resource-limited settings [2].

LITERATURE STUDY

The COVID-19 pandemic has led to extensive research on effective knowledge management (KM) systems that can support pandemic mitigation efforts by harnessing big data. For Indonesia, where diverse regional needs and resources affect public health responses, KM frameworks provide an essential tool for integrating real-time data to support public health interventions, policy-making, governance, and technological innovations. This literature review explores the role of KM and big data in managing COVID-19, with a focus on public health interventions, policies, procedures, governance frameworks, and technology-driven solutions.

Public Health Interventions

Effective public health interventions during COVID-19 include social distancing measures, quarantine protocols, contact tracing, and vaccination efforts. Studies have shown that timely and data-driven interventions can significantly reduce the spread of the virus and mortality rates [11]. In Indonesia, large-scale social restrictions (Pembatasan Sosial Berskala Besar, or PSBB) were implemented in major cities to curb transmission, relying on data for planning and enforcing these measures [12]. The Research highlights that regional differences in resources and compliance levels impacted the effectiveness of these interventions, stressing the need for a KM system to monitor, evaluate, and adapt interventions locally. Knowledge management systems facilitate these interventions by centralizing data on COVID-19 cases, vaccination coverage, and compliance with health protocols [13]. Data integration from multiple sources allows for a comprehensive understanding of intervention effectiveness, enabling authorities to target high-risk populations and adjust strategies in real time [14]. have demonstrated that the integration of health and mobility data can predict and manage disease spread, making such KM frameworks invaluable for future pandemic preparedness [15].

Policy and Procedure

The policy-making for pandemic response requires a balance between centralized directives and regional flexibility, especially in a geographically and demographically diverse country like Indonesia. Research on policy responses to COVID-19 emphasizes the importance of data-driven policies informed by real-time epidemiological data and predictive analytics [16]. The big data enables the design of dynamic policies that can be adapted as situations evolve, enhancing the agility of responses [17]. A robust KM system supports policymakers by tracking policy outcomes, evaluating the public's response, and identifying areas needing adjustment [18]. The study argue that centralized KM frameworks allow policymakers to standardize best practices and procedures across regions, enhancing coherence and effectiveness in response.

Governance

Governance frameworks for pandemic management require coordinated action across national, regional, and local levels, with a strong emphasis on data transparency and inter-agency collaboration. Governance models that incorporate KM frameworks are better equipped to respond to pandemics, as they facilitate data sharing, accountability, and a unified response approach [11]. Indonesia’s decentralized governance structure poses

challenges for standardized pandemic management [6] who emphasize the need for governance models that adapt to regional needs while maintaining overall coherence. The literature indicates that KM can improve governance by ensuring that decision-makers have access to relevant and timely information [4],[8]. Effective governance duringCOVID-19 also involves creating policies for data privacy and ethical data usage, which are critical to

maintaining public trust and compliance [13], [2]. Governance research suggests that integrating big data into KM frameworks can enable better coordination across government entities, ensuring swift responses to localized outbreaks while maintaining national oversight.

Technology Innovation

Technology innovation has been central to managing COVID-19, from digital contact tracing apps to AI-based predictive models [19]. The study shows that digital innovations enhance public health surveillance, case tracking, and resource allocation. Innovations in artificial intelligence (AI), machine learning (ML), and big data analytics have enabled predictive modeling, helping governments and healthcare providers anticipate case surges and manage healthcare resources accordingly [1],[5]. Research [17] supports the potential of AI-powered KM systems to generate insights from large datasets, identifying trends and informing targeted interventions. These technologies also improve the accuracy of epidemiological modelling, allowing health authorities to make data-informed decisions quickly. The literature emphasizes that while technology-driven KM systems offer substantial benefits, they require investment in infrastructure and training for effective use, particularly in resource-limited settings [18]. Technology adoption is also influenced by social factors, including digital literacy and public willingness to participate in data-sharing initiatives, which can vary widely across regions.

The literature on knowledge management for COVID-19 mitigation through big data reveals that integrating data-driven KM frameworks can enhance public health interventions, policy-making, governance, and technological adaptation. Public health research highlights the value of KM systems for real-time monitoring of interventions, while policy studies underscore the need for adaptable, evidence-based strategies [2],[1]. Governance research indicates that KM can promote coordination across decentralized systems, while technological innovations in AI and big data analytics provide the tools necessary for effective KM. This study builds on these findings to develop a KM framework tailored to Indonesia’s needs, with the aim of enhancing the country’s capacity to manage future pandemics.

PROPOSED FRAMEWORK

The Knowledge Management Framework for COVID-19 Mitigation provides a structured approach for managing and utilizing data and information in a way that enables effective decision-making across various aspects of public health. This framework is designed to support Indonesia's efforts in controlling and mitigating COVID-19 by leveraging big data to inform public health interventions, policies, procedures, governance, and technological innovation. Given the pandemic's dynamic and complex nature, this framework emphasizes a data-driven, responsive, and collaborative approach that integrates diverse data sources, processes them into actionable insights, and disseminates knowledge effectively to stakeholders at all levels of governance. This Knowledge Management (KM) framework is a comprehensive approach designed to systematically handle data and information relevant to public health interventions, policy-making, procedural efficiency, governance, and technological innovation. By effectively managing these key areas, the framework supports data-driven decision-making in a time-sensitive context, like the COVID-19 pandemic response. This long narrative will explore each of the framework’s five primary components in detail, illustrating how they contribute to the development of an organized knowledge base and facilitate improved public health outcomes. The framework is composed of five interconnected components, each serving a distinct purpose but working in harmony to enable an end-to-end knowledge management process. These components are Data Collection and Acquisition, Data Processing and Analysis, Knowledge Storage and Retrieval, Knowledge Dissemination, and Feedback and Continuous Improvement, shown in Figure 1. Each of these components is carefully designed to handle specific functions, yet collectively they form a robust system that transforms raw data into insights that can guide public health decisions.

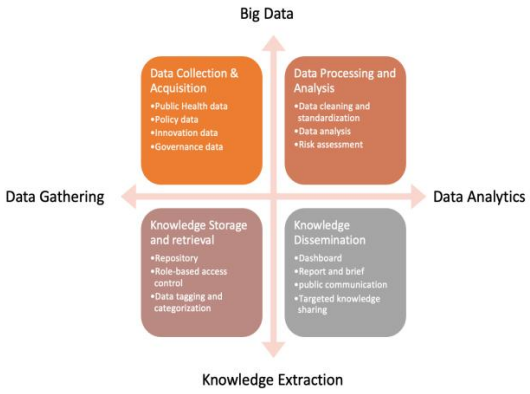

Figure 1. A Proposed Framework.

Data Collection and Acquisition

The foundation of this framework begins with data collection and acquisition, where raw data is gathered from multiple reliable sources. This phase is crucial as it provides the primary inputs that will fuel the entire knowledge management process. Data sources are varied, reflecting the multidimensional nature of public health responses.

- Public Health Data includes case numbers, infection rates, vaccination statistics, hospitalization rates, and mortality figures. This type of data allows health officials to track the virus's spread and understand how effective current health interventions are.
- Policy Data is collected from governmental entities, capturing public health policies, guidelines, and restrictions. This data is essential for evaluating how different regions are implementing COVID-19 policies and adjusting them in response to local needs and conditions.
- Innovation Data covers the latest technological advancements, such as contact-tracing applications, telehealth services, and other digital tools. By monitoring innovation data, the framework ensures that the best available technology is leveraged to combat COVID-19 and other public health crises.
- Governance Data includes information on regional governance practices, such as compliance rates, resource allocation, and inter-agency coordination. This data is vital for understanding how effectively different regions manage resources and implement policies.

Methods for data collection are both automated and manual. Automated processes include API integration with health systems and social media monitoring, allowing for real-time data acquisition. Manual methods, such as surveys and reports from health workers, provide qualitative data to complement the automated sources.

Data Processing and Analysis

Once data is gathered, it undergoes processing and analysis to extract meaningful insights. This step involves several sophisticated techniques to transform raw data into actionable knowledge.

- Data Cleaning and Standardization are necessary to ensure data consistency. For example, data from different regions may use varying formats or languages, so standardization aligns these differences. Sensitive data is anonymized to comply with privacy regulations.
- Data Analytics play a critical role in generating insights. Descriptive analytics provides summaries of trends, such as daily case rates and recovery numbers, while predictive analytics uses historical data to forecast infection peaks, healthcare demand, and potential outbreaks. Epidemiological models simulate different scenarios, helping decision-makers assess the potential impact of various interventions.
- Risk Assessment tools identify high-risk areas based on infection rates, healthcare capacity, and population demographics. By pinpointing these hotspots, health officials can prioritize interventions and allocate resources efficiently.

This phase is where the data's value is fully realized, transforming it into structured information that can guide

informed decision-making across public health, governance, and policy planning.

Knowledge Storage and Retrieval

The processed data is stored in a centralized knowledge repository. This phase ensures that information is accessible to relevant stakeholders when they need it.

- Centralized Repository: The storage solution is typically cloud-based, providing scalable storage that can accommodate large datasets. This centralized repository ensures that all stakeholders, from local health officials to national policymakers, can access the same information and work with a unified understanding of the situation.
- Role-Based Access Control (RBAC): Security is maintained by restricting data access based on user roles. For instance, public health officials may need access to health data and procedural guidelines, while policy advisors might focus on intervention outcomes and public sentiment data.
- Data Tagging and Categorization: To facilitate efficient data retrieval, knowledge assets are organized using standardized tags and metadata. For example, each piece of data might be tagged by topic (e.g., vaccination, public compliance) or region, making it easy for users to locate relevant information. By categorizing knowledge assets based on themes, such as public health interventions or governance practices, the framework ensures that users can quickly retrieve the information they need to make timely decisions.

Knowledge Dissemination

The dissemination phase distributes insights and information to stakeholders who rely on it for decision-making. This phase uses multiple communication channels to ensure that insights reach the right audiences effectively.

- Dashboards: Real-time dashboards display data in an easily digestible format, allowing public health officials and government bodies to track key metrics and make quick decisions. These dashboards might show live infection rates, healthcare capacity, or compliance levels by region.
- Reports and Briefs: Detailed reports on the pandemic's progression, the effectiveness of policies, and the public's response are shared with stakeholders regularly. Reports are tailored to the needs of different audiences, such as policymakers, health departments, and governance bodies, to support specific decision-making needs.
- Public Communication Platforms: Knowledge is shared with the general public via websites, social media, and mobile applications. Clear, accurate information helps people understand current COVID-19 trends, health guidelines, and safety protocols, which is essential for maintaining public compliance and trust.
- Targeted Knowledge Sharing: Regional authorities receive localized insights, allowing them to implement interventions suited to their area's unique needs. For example, a high-risk region might receive tailored guidance on resource allocation, while another region with higher compliance might focus on policy adjustments.

Continuous Improvement

The final component of the KM framework is continuous feedback and improvement. This phase is crucial for adapting the framework to changing circumstances, ensuring its relevance, and enhancing its effectiveness over time.

- Feedback Collection: Regular feedback is gathered from users at all levels, including health officials, community leaders, and policymakers, to understand the usability and practical impact of the KM system. Additionally, public surveys capture public sentiment and satisfaction, allowing for adjustments in how data and information are presented.
- Monitoring and Evaluation: Key Performance Indicators (KPIs) are tracked to evaluate the framework's success in meeting its goals. Metrics such as infection rate reduction, resource allocation efficiency, and public compliance are monitored to assess the impact of knowledge management on public health outcomes.
- System Adaptation: Feedback is used to refine the KM system continually. For instance, if policymakers require more localized insights or health officials need faster updates, adjustments are made to meet those needs. Moreover, lessons learned from managing COVID-19 are integrated to improve the framework for future public health crises.

Table 1. Selected & Knowledge Data (4 from 193 items)

Area/City	Title	Category	Inisiator	Desc	Goals	Status	Notes	Partners	Impcat
Yogyakarta	Knowledge Management Berbasis Analitik Mitigasi Covid-19 dengan Big Data	Teknologi	Universitas Gadjah Mada	identifikasi kasus covid-19 di Indonesia, mengadakan data gathering melalui in-depth interview	membangun big data management dan analytic data covid-19 pada skala nasional, mencari rumusan kekurangan sebagai antisipasi tata kelola/kebijakan yang sudah ada, mendata inisiatif/movement yang selama penanganan covid-19, dapat mengumpulkan data knowledge berbasis informasi yang berasal dari informasi lokal	Continue	Diawali dengan melakukan analisis data covid-19 yang melibatkan mahasiswa S1 dan S2, yang dilanjutkan dengan support bigdata untuk mitigasi COVID-19 sebagai contoh : menunjukkan adanya perselisihan/perbedaan data antara dinkes dan kenyataan di lapangan, sehingga dapat saling mengoreksi. Memonitoring data penanganan covid-19 pada 5 kota di Indonesia (2023) dan akan berkembang menjadi 10 kota pada tahun 2024 ini.	Kementrian BUMN RI, dan BNPB	dapat membantu memonitoring data penanganan covid-19 yang ada pada 5--10 kota yang ada di Indonesia
Purwokerto	Lesson Learned : COVID-19	Prosedur	Universitas Jendral Soedirman (fakultas kesehatan masyarakat)	Pengadaan Vaksinasi COVID-19	sebagai bentuk penanggulangan COVID-19	Done	salah satu peran yang berhasil dalam penanggulangan covid adalah vaksinisasi, dari berbagai studi sebelumnya penyakit menular sangat diperlukannya data-data sebelumnya dan cara pengendalian penyakit menular adalah dengan vaksinisasi.		
Purwokerto	Lesson Learned : COVID-19	Prosedur	Universitas Jendral Soedirman (fakultas kesehatan masyarakat)	studi kepuasaan penerimaan vaksin terhadap layanan vaksinasi covid-19	sebagai bahan evaluasi kinerja pelayanan vaksinasi COVID-19	Done	melihat bagaimana tingkat kepuasaan masyarakat pada layanan vaksinasi, yang menunjukkan adanya 49,9 persen masyarakat tidak puas dengan layanan vaksinasi dikarenakan lokasi vaksinasi,		dampak mengimprovisasi hasil kinerja untuk melakukan layanan vaksinasi selanjutnya

							penyediaan hadiah/snack, penyediaan kontak darurat pasca vaksinasi, waktu observasi pasca vaksinasi.		
Purwokerto	Pencegahan COVID-19 oleh tim covid-19 Universitas Jendral Soedirman	Prosedur	Tim COVID-19 Universitas Jendral Soedirman	sosialisasi covid-19, melakukan pelatihan untuk petugas perawatan jenazah, pelatihan pembuatan masker kain	melakukan pencegahan covid-19, membantu menanggulangi permasalahan pada tata kelola jenazah pasien covid-19, dan memberdayakan masyarakat yang terkendala ekonomi	Done	Penolakan masyarakat menjadi salah satu penghalang diawal masa covid-19, dimana masyarakata merasa ketakutan tenaga medis juga merasa takut karena ini merupakan virus baru. Salah satu upaya yang dilakukan adalah pelatihan untuk petugas perawatan jenazah dengan media boneka yang dilumuri tepung dengan mengibaratkan sebagai virus covid agar dapat membayangkan cara membersihkan jenazah dengan prosedur yang sesuai	tim petugas perawatan jenazah, masyarakat dan mahasiswa (dalam pelatihan pembuatan masker kain)	diharapkan hal ini dapat menumbuhkan kewaspadaan, dan mengajak masyarakat untuk tetap kreatif dan bisa saling membantu di era COVID-19

RESULT AND DISCUSSION

This study aimed to develop a knowledge management (KM) framework that could facilitate COVID-19 mitigation efforts in diverse regions of Indonesia, namely Purwokerto, Samarinda, Medan, and Yogyakarta. Through the application of a big data approach, we aggregated and analysed comprehensive datasets encompassing multiple facets of the pandemic, such as public health interventions, policies, procedures, governance, and technological innovations that shows in Figure 2. The use of big data was central to the development of the knowledge management framework. A vast amount of data was sourced from government policies, health interventions (such as quarantine measures and vaccination campaigns), and governance mechanisms. This data was processed and categorized into digestible formats, allowing health officials and decision-makers to access and utilize it effectively.

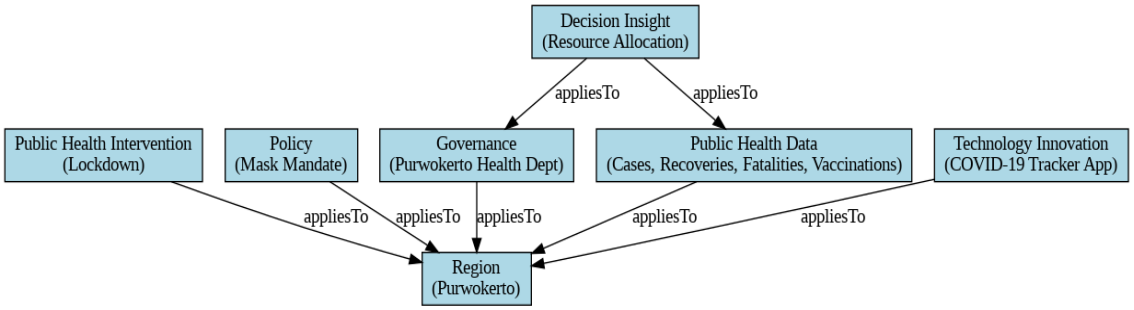

Figure 2. A Model Component Relation.

Table 1 collected datasets were made available in real-time, allowing decision-makers to track the evolution of the pandemic and respond to shifts in the data, such as sudden outbreaks or new policy changes, with greater agility. The integration of these datasets into a unified framework provided key actionable insights for health authorities. For instance, by monitoring the availability and distribution of healthcare resources (such as hospital beds, medical supplies, and vaccines), the framework enabled more efficient resource allocation. Regions with higher infection rates or lower healthcare access were prioritized for additional support. A significant advantage of the framework was its capacity to support real-time decision-making. Health officials were able to make quick, data-driven decisions based on the evolving landscape of the pandemic. For example, during sudden surges in cases, the system could rapidly highlight areas in need of immediate intervention, such as increased testing or lockdown measures, based on live data feeds. The study highlighted that the communication of health guidelines and policies was more effective when it was based on solid data. With a centralized knowledge management system, authorities could ensure that communication to the public was consistent, timely, and adapted to the changing situation. This contributed to better public adherence to health directives and increased trust in the government's handling of the crisis.

The findings from this study underscore the importance of integrating big data and knowledge management systems in managing complex public health crises. Key insights from the study can inform the design and implementation of future pandemic responses, both within Indonesia and globally. One of the most significant contributions of the KM framework was its ability to provide real-time, data-driven insights into resource allocation. By utilizing big data, health officials could identify which regions were experiencing the highest strain on resources, such as ICU beds, medical staff, or personal protective equipment. This allowed for more targeted interventions, ensuring that resources were deployed where they were most needed, thus avoiding shortages in critical areas. The dynamic nature of the data allowed health authorities to continually reassess resource needs and make adjustments as conditions evolved. For example, if an outbreak occurred in a specific region, the system would flag that region for additional resources, such as field hospitals or medical teams. Effective public health communication is paramount in a crisis, particularly when misinformation can spread rapidly. By utilizing a KM framework backed by big data, health authorities were able to ensure that public messaging was clear, accurate, and based on the latest available evidence. The integration of data from various sources allowed for targeted communication to specific communities, ensuring that public health messages reached those who needed them the most. Furthermore, the availability of data on public health interventions allowed for communication to be tailored to reflect the changing status of the pandemic, such as updated quarantine measures or vaccination availability. This responsiveness fostered trust between the government and the public, encouraging compliance with health guidelines. The ability to dynamically adjust public health policies was another key strength of the proposed framework. By integrating data from a variety of sources—ranging from infection rates to hospital capacities—decision-makers could make informed policy changes, whether it be introducing stricter lockdown measures, expanding testing efforts, or focusing on specific geographic areas. The study also suggests that, in future health crises, the integration of real-time data into the policy-making process is crucial. The KM framework enabled policymakers to observe the effectiveness of interventions and adjust their strategies quickly, enhancing their ability to mitigate the spread of the virus. Beyond COVID-19, the findings suggest that a KM framework supported by big data is essential for addressing future health crises. Whether responding to future pandemics, natural disasters, or other public health emergencies, having a centralized, real-time knowledge management system will help decision-makers adapt and respond efficiently.

CONCLUSION

In conclusion, this study demonstrates the critical role that a knowledge management framework, powered by big data, can play in responding to public health crises. The integration of diverse datasets into a unified framework allows for more efficient resource allocation, better public health communication, and more responsive policy formulation. As the world faces increasing challenges in managing health crises, the findings of this study provide valuable lessons for improving pandemic response strategies and ensuring that future interventions are more targeted, and data-driven.

Acknowledgement:

Acknowledgments for research support to Universitas Gadjah Mada, Universitas Sumatra Utara, Universitas Mulawarman, and Universitas Jenderal Soedirman. The research has supported by RIIM BRIN LPDP Research

Program 2024.

REFERENCES

[1] Chao K, Sarker MNI, Ali I, Firdaus RBR, Azman A, Shaed MM., (2023). Big data-driven public health policy making: Potential for the healthcare industry. Heliyon. 2023 Aug 31;9(9):e19681. doi: 10.1016/j.heliyon.2023.e19681. PMID: 37809720; PMCID: PMC10558940.

[2] Riasetiawan, M. & Ashari, A. (2023). A Proposed Framework of Knowledge Management for COVID-19 Mitigation based on Big Data Analytic. Emerging Science Journal. 7. 214-224. 10.28991/ESJ-2023-SPER-015.

[3] Conti, F. , Dias, M. , Marcelo, M. , Gauthier, F. , Santos, G. , Bondan, G. , Izidorio, G. , Silva, D. , Dezem, V. and Botelho, L. (2024) Analysis of Knowledge Management Practices for Knowledge Intensive Organizations Self-Management. Open Journal of Social Sciences, 12, 1-23. doi: 10.4236/jss.2024.126001.

[4] Abu Addous, H. & Al Sokkar, A & I., Blaqees. (2018). The Impact of Knowledge Management on Organizational Performance. International Journal of Advanced Computer Science and Applications. 9. 10.14569/IJACSA.2018.090432.

[5] National Academy of Medicine (2023); The Learning Health System Series; Williams A, Lee J, Kadakia K, et al., editors. Emerging Stronger from COVID-19: Priorities for Health System Transformation. Washington (DC): National Academies Press (US); 2023 Feb 10. 5, PUBLIC HEALTH COVID-19 IMPACT ASSESSMENT: LESSONS LEARNED AND COMPELLING NEEDS. Available from: https://www.ncbi.nlm.nih.gov/books/NBK589812/

[6] Ge, Y., Wu, X., Zhang, W. et al. (2023). Effects of public-health measures for zeroing out different SARS-CoV-2 variants. Nat Commun 14, 5270. https://doi.org/10.1038/s41467-023-40940-4

[7] Dei, D.J. (2019). Developing an Integrated Framework for Knowledge Management Practices in Organisations. Mousaion: South African Journal of Information Studies. 37. 10.25159/2663-659X/6324.

[8] Suresh ,M., Amandeep, D., Mahima, M., Zeeshan, A.B. (2021), Future of e-Government: An integrated conceptual framework, Technological Forecasting and Social Change, Volume 173, 2021, 121102, ISSN 0040-1625, https://doi.org/10.1016/j.techfore.2021.121102.

[9] Abdalla W, Renukappa S, Suresh S. (2022). Managing COVID-19-related knowledge: A smart cities perspective. Knowledge and Process Management. doi: 10.1002/kpm.1706. PMCID: PMC9088492.

[10] Putu, W.H., Teguh, D., Faizal, R,M., Av, A.P., Fatimah, A., Achmad, N.H., Denny, A.A., (2021). The regional and referral compliance of online healthcare systems by Indonesia National Health Insurance agency and health-seeking behavior in Indonesia, Heliyon, Volume 7, Issue 9 , e08068, ISSN 2405-8440, https://doi.org/10.1016/j.heliyon.2021.e08068.

[11] Fang, Y. & Nie, Y., Penny, M., (2020). Transmission dynamics of the COVID-19 outbreak and effectiveness of government interventions: A data-driven analysis. Journal of Medical Virology. 92. 10.1002/jmv.25750.

[12] Suraya I , Nurmansyah MI , Rachmawati E., (2020). The Impact of Large-scale Social Restrictions on the Incidence of COVID-19: A Case Study of Four Provinces in Indonesia. Kesmas. 15(5): 49-53
DOI: 10.21109/kesmas.v15i2.3990, Available at: https://scholarhub.ui.ac.id/kesmas/vol15/iss5/10

[13] Seah, B.Z., Jailani, R.I., Law, P.Y., (2023). COVID-19 Close Contact Management: An Evolution of Operations Harnessing the Digital Edge. J Med Syst 47, 24 (2023). https://doi.org/10.1007/s10916-023-01918-3

[14] Zuber, S., Bechtiger, L., Bodelet, J.S., (2023). An integrative approach for the analysis of risk and health across the life course: challenges, innovations, and opportunities for life course research. Discov Soc Sci Health 3, 14. https://doi.org/10.1007/s44155-023-00044-2

[15] Alexi, P.Z., Shuangqi, L., Zhidong, C., Paul, J.H., Jiaojiao, W., Yue, X., Da, X., Xi, L., (2024), AI for science: Predicting infectious diseases, Journal of Safety Science and Resilience, Volume 5, Issue 2, Pages 130-146, ISSN 2666-4496, https://doi.org/10.1016/j.jnlssr.2024.02.002.

[16] Tariq,A., Shahid, A.B., Youssef, B., (2023), A comprehensive systematic review of the literature on the impact of the COVID-19 pandemic on supply chains, Supply Chain Analytics, Volume 3, 100025, ISSN 2949-8635, https://doi.org/10.1016/j.sca.2023.100025.

[17] Mattia,P., (2023), Big data and dynamic capabilities in the digital revolution: The hidden role of source variety, Research Policy, Volume 52, Issue 7, 104812, ISSN 0048-7333, https://doi.org/10.1016/j.respol.2023.104812.

[18] Dufour, Y. & Steane, P. (2007). Implementing knowledge management: A more robust model. Graduate College of Management Papers. 11. 10.1108/13673270710832172.

[19] Chang Z, Zhan Z, Zhao Z, You Z, Liu Y, Yan Z, Fu Y, Liang W, Zhao L.2021. Application of artificial intelligence in COVID-19 medical area: a systematic review. J Thorac Dis. 13(12):7034-7053. doi: 10.21037/jtd-21-747. PMID: 35070385; PMCID: PMC8743418.