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Data-Driven Knowledge Management Frameworks for Effective Risk and Crisis Management: A Cross-Industry Approach

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Abstract

In today's interconnected world, organizations across industries face a wide range of risks, from cyber threats to economic crises, which demand agile, data-driven crisis management strategies. Knowledge Management (KM) systems have become essential in managing these challenges by enabling real-time decision-making through data-driven insights. This study examines the role of KM frameworks integrated with advanced data science techniques, such as sentiment analysis and big data analytics, in improving crisis management across various sectors. Additionally, emerging technologies, including Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and cloud computing, have been incorporated into KM frameworks to enhance risk mitigation, communication, and organizational resilience during crises. A cross-industry comparison reveals that while the finance sector has successfully integrated these technologies into its KM systems, other sectors, such as manufacturing, struggle with knowledge retention and data security. The study highlights the value of sentiment analysis in understanding stakeholder perceptions, which refines decision-making in crisis scenarios. The results indicate that KM practices contribute to a 60% reduction in risk, a 65% improvement in crisis resolution speed, and a 62% increase in organizational resilience. Furthermore, the integration of advanced technologies within KM frameworks reduces crisis response times by 82%. Despite these benefits, sectors like healthcare and manufacturing continue to face challenges in knowledge sharing and data security. The study emphasizes the importance of addressing these barriers and incorporating advanced technologies into KM frameworks to optimize crisis management effectiveness. These findings underscore the critical role of KM systems in strengthening organizational resilience, supporting proactive risk management, and enabling quick responses to future crises.

Keywords: Knowledge Management, Data Driven, Crisis Management, Emerging Technologies, Sentiment Analysis

1. Introduction

In today's interconnected world, organizations face a diverse range of challenges, including financial instability, cyber threats, and the disruptive impacts of global crises like the COVID-19 pandemic. As a result, the need for robust resilience strategies has become essential to ensure business continuity amidst these complex risks. Proactive measures such as digital communication and public-private partnerships have proven critical in mitigating the impact of crises and maintaining organizational stability [1], [2]. The COVID-19 pandemic, in particular, has exposed vulnerabilities in crisis preparedness and adaptive capacity across sectors, notably in healthcare and education. Studies suggest that adopting comprehensive risk management and adaptive frameworks allows organizations to anticipate, respond to, and recover from such disruptions more effectively. Integrating strategic leadership with resilience-oriented practices has emerged as crucial for navigating uncertainties in today's dynamic global environment.

KM has become central in these crises, facilitating organizations in the identification, creation, retention, and sharing of critical information that supports data-driven decision-making [3]. By leveraging big data analytics, KM frameworks enhance the real-time processing and contextualization of information, enabling decision-makers to respond to complex challenges in a timely manner [3], [4]. Furthermore, effective KM systems codify crisis-related knowledge, transitioning from mere information sharing to enabling distributed decision-making. This integration ensures that insights are systematically archived and disseminated among stakeholders, enhancing situational awareness and collaborative problem-solving [5]. Additionally, integrating social network platforms into KM initiatives improves

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transparency, ensuring that accurate data informs decision-making processes during public health emergencies and other crises [6].

Technology-driven innovation is integral in enhancing crisis management by improving data flow, enabling rapid actions, and supporting thorough data analysis for informed decision-making. Digital transformation strengthens organizational resilience by combining legacy IT systems with new digital tools [7]. Empirical evidence demonstrates that innovation management techniques, such as patent analytics, can foster responses to crises, allowing organizations to adapt continuously. For instance, digital strategies provide emergency managers with the ability to quickly process large volumes of data, ensuring timely responses [8]. These technologies have proven particularly valuable in accelerating public health responses during crises, highlighting the critical role of innovation in effective crisis management.

Data-driven decision-making has become increasingly essential in crisis management, allowing organizations to integrate diverse data streams into their KM practices. Sentiment analysis plays a key role in this process by quantifying stakeholder emotions and perceptions, which inform adaptive KM strategies during crises [9]. Systematic reviews have shown how sentiment analysis can rapidly detect public attitudes during health emergencies, enabling faster decision-making and more nuanced responses [9]. Emerging technologies, such as ChatGPT, are also used to analyze latent sentiments in textual data, allowing managers to address stakeholder concerns and enhance emotion-based decision-making [10]. Additionally, integrating social network data with official statistics facilitates comprehensive profiling of social sentiment, which can be leveraged to refine crisis-related KM practices [11].

This study addresses how technology-driven KM frameworks can be employed to manage risks and enable rapid and effective crisis responses. Existing literature suggests that integrating big data analytics into KM strategies significantly enhances risk management in high-pressure environments, as demonstrated by Albastaki and Manap [12]. The adoption of IT-enabled KM tools, such as those explored by Abdalla et al. [13], provides mechanisms for swift information sharing and decision-making during crises. Liu et al. [14] propose a KM framework focused on knowledge-based approaches to crisis response, while Tomé et al. [15] emphasize the role of technology in managing the interplay of people, processes, and data. These studies highlight the goal of this research to explore how KM frameworks, powered by technological innovation and data analytics, can enhance organizational agility and resilience in crisis management.

This study aims to investigate the integration of KM frameworks with data science methods to improve crisis response. Specifically, it examines how statistical techniques and sentiment analysis can be utilized to extract actionable insights from large datasets, thus enhancing risk assessment and decision-making [12]. The research also explores the potential of emerging technologies such as AI, IoT, and blockchain to secure data integrity, ensure real-time information flow, and foster innovative KM solutions in crisis management [11]. Ultimately, the study seeks to develop a comprehensive, data-driven framework that not only aids in understanding complex crisis dynamics but also enhances organizational resilience and agility through advanced technological integration.

2. Relate Works

2.1. Knowledge Management and Crisis Management

KM involves the systematic capture, creation, sharing, and preservation of organizational knowledge—both tacit and explicit to enhance decision-making, drive innovation, and maintain a competitive advantage [17]. In crisis management, KM ensures that critical information is accessible and actionable in real time, supporting rapid responses and effective stakeholder coordination [18]. KM frameworks play a vital role in organizing and retrieving knowledge, enabling organizations to leverage collective intellectual assets in both stable and crisis contexts. This capability to manage knowledge effectively strengthens organizational resilience and adaptability, allowing businesses to thrive in dynamic and unpredictable environments.

KM frameworks are also instrumental in crisis and risk management by integrating data-driven decision-making processes. They consolidate structured and unstructured data, aiding organizations in detecting early warning signs and proactively adapting to emerging risks. Data science techniques, such as sentiment analysis, are pivotal in this process. For example, analyzing social media sentiment provides valuable insights into stakeholder perceptions, supporting

effective crisis communication [16]. Furthermore, merging sentiment profiles with official statistics enhances the timeliness and accuracy of crisis responses, enabling more informed decisions during high-pressure situations [11].

Data science significantly enhances KM frameworks by allowing organizations to analyze diverse information streams and convert raw data into actionable knowledge. Advanced techniques like machine learning and big data analytics further refine decision-making, particularly in public safety and policing applications, where predictive assessments can reduce risks [12]. These technologies, when integrated with robust KM practices, enhance organizational resilience and crisis response efficacy, ensuring that knowledge is continuously leveraged to manage risks and adapt to crises [19].

2.2. Data-Driven in Crisis Management

Data science techniques, including descriptive statistics and regression analysis, are crucial for evaluating the effectiveness of KM frameworks in crisis management. Descriptive statistics provide a quantitative baseline, summarizing key performance indicators and contextual data that help assess the impacts of crises and the organization's responses. For instance, Thumiki and Jurčić [20] demonstrate how these techniques were used to evaluate KM practices during the COVID-19 crisis. Regression analysis refines these insights by modeling the relationships between risk factors and crisis outcomes, enabling predictive evaluations and identification of key performance drivers. However, the reference by Li and Li [21] does not directly support this claim in the context of regression analysis in crisis management.

Incorporating these quantitative methods into data-driven decision-making helps support continuous monitoring and adaptation of KM practices, improving an organization's capacity to manage risks effectively. Studies by Anand et al. [22] highlight the integration of KM and data science in enhancing crisis response. Although Albastaki and Manap [12] focus on policing, their findings underscore the importance of leveraging data science for broader crisis management contexts.

Sentiment analysis plays a central role in KM during crises, enabling organizations to assess stakeholder perceptions and adjust strategies accordingly. Natural Language Processing (NLP) techniques, both traditional and deep learning-based, provide real-time insights into public attitudes, as demonstrated by Velasco-López et al. [11]. These insights can complement official data, enhancing transparency and responsiveness within KM frameworks. Predictive analytics, bolstered by AI, further supports crisis management by forecasting risks and enabling proactive interventions, improving resource allocation and decision-making [12].

2.3. Emerging Technologies in KM and Crisis Management

Emerging technologies such as blockchain, cloud computing, and the IoT are increasingly critical in enhancing KM frameworks for crisis management. These technologies enable real-time data processing and informed decision-making, which are crucial in emergency situations. Blockchain provides a secure, immutable ledger, ensuring data integrity and transparency in crisis management scenarios [23]. Cloud computing offers scalable infrastructure and real-time analytics, which are essential for processing large volumes of crisis-related data, allowing organizations to quickly adjust their response strategies. Meanwhile, IoT facilitates continuous monitoring through a network of sensors, feeding real-time data into KM systems to enhance situational awareness and improve predictive capabilities for risk mitigation [24]. When integrated, these technologies form a robust KM framework that supports agile, data-driven decision-making, bolstering organizational resilience and response effectiveness during crises.

2.4. Research Gap

Despite significant advances in integrating emerging technologies such as AI for prognostic analytics and real-time decision-making, KM models have limited empirical validation in dynamic crisis environments and lack sector-specific adaptations. This limitation restricts their broader applicability, and further research is necessary to develop flexible KM frameworks that can address the unique challenges posed by different industries during crises.

Additionally, as illustrated in figure 1, the role of KM in enhancing risk and crisis management effectiveness is influenced by key elements of KM. Knowledge creation is critical for generating new insights and solutions during crises, while knowledge sharing and distribution ensure that critical information is communicated across the

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organization for informed decision-making. Knowledge storage involves securely preserving important crisis-related data, enabling quick access when needed. Knowledge utilization is the practical application of stored knowledge to drive effective responses during emergencies. Organizational learning emphasizes the importance of using past experiences to adapt and improve future crisis responses. Finally, technology integration enhances KM by utilizing digital tools to streamline information processing and crisis management.

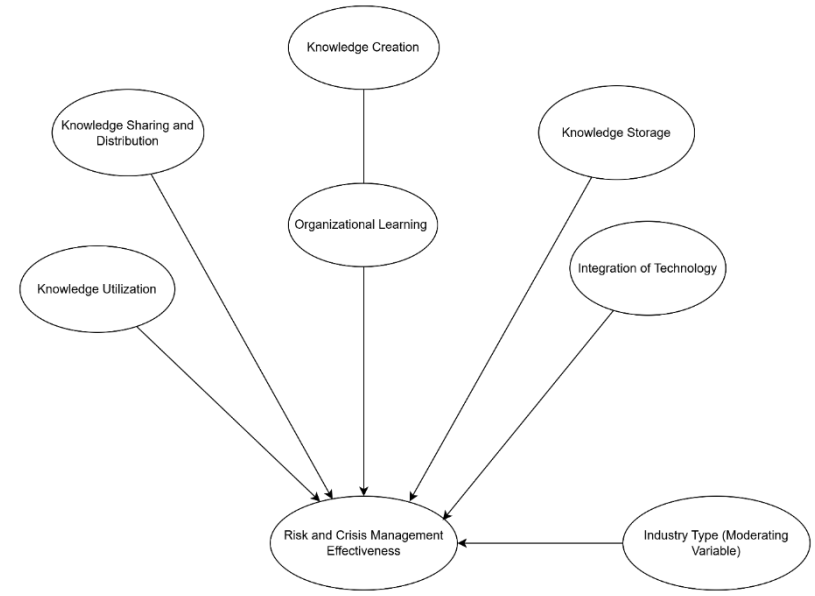

Figure 1. The role of KM in risk management and crisis management

The figure also highlights a moderating variable industry-type suggesting that the effectiveness of KM in crisis management may vary across different sectors. This integrated KM framework, which combines knowledge creation, sharing, storage, utilization, learning, and technology integration, supports organizational resilience and enhances the ability to manage risks and respond effectively during crises. By leveraging these elements, organizations can adapt more quickly, make better decisions, and improve overall crisis management performance.

3. Method

3.1. Research Design

The present study employs a mixed-methods approach, integrating both qualitative and quantitative techniques to provide a comprehensive understanding of how KM frameworks support crisis and risk management. This approach leverages the strengths of both paradigms: quantitative methods provide breadth through statistically significant data that elucidate trends and correlations, while qualitative methods offer depth by capturing the nuances of perceptions and experiences underlying those trends [25].

A sequential design is adopted in this study, where initial quantitative results inform the subsequent qualitative inquiry. The quantitative phase involves the collection of numerical data through surveys and performance metrics, establishing a baseline for understanding how KM practices are implemented during crises and their measurable impacts. Following this, qualitative data are gathered through interviews or focus groups to further explore and contextualize the statistical findings, aligning with the sequential design commonly used in mixed-methods research [25]. This structure is particularly effective in crisis management research, where the complexities of decision-making and dynamic environmental factors benefit from both empirical generalizability and rich, contextual interpretation.

Moreover, the integration of these methodologies allows for triangulation of data, which enhances the robustness of the findings and strengthens the validity of the conclusions drawn. As indicated by Mwange et al. [26], combining different methodological perspectives helps overcome the limitations associated with single-method studies, enabling researchers to corroborate results across diverse sources. The detailed planning and methodological rigor in both the quantitative and qualitative components ensure that each set of data is conceptually developed before being effectively

merged to address the overarching research questions [27]. This methodological synergy is fundamental to understanding the multifaceted phenomena at hand, particularly the interplay between technology-driven KM practices and crisis management outcomes.

3.2. Data Collection

The data collection phase of this study incorporates both primary and secondary data sources to comprehensively examine KM frameworks and sentiment analysis in crisis management. Primary data is gathered through structured surveys and semi-structured interviews with industry professionals, providing both quantitative measures and in-depth qualitative insights. The surveys are designed to capture measurable aspects of KM practices, such as the frequency of technology use, the integration of predictive analytics, and the application of sentiment analysis techniques in crisis response. In contrast, the interviews allow for a deeper exploration of personal experiences and perceptions regarding the implementation and efficacy of these frameworks during crises. This approach aligns with methodologies used in similar studies, where triangulation of data from surveys and interviews has been shown to enhance the robustness and validity of research findings [28].

Secondary data is obtained from a range of academic journals, case studies, and industry reports that document developments and best practices in KM frameworks and sentiment analysis. These sources include peer-reviewed articles and industry reports that provide established theoretical perspectives and empirical evidence on the application of data-driven decision-making in crisis situations. The secondary dataset complements the primary data by offering a well-documented context, which validates the primary data and enhances the depth of the analysis. For example, studies in telecommunications have successfully integrated survey-based quantitative findings with case-based qualitative insights to assess organizational knowledge sharing and innovation capabilities [28]. This integration of diverse secondary sources improves the ability to compare and contrast findings, providing a holistic view of the subject matter and ensuring that the conclusions reflect the dynamics of KM in crisis management.

By combining surveys and interviews with a thorough review of relevant secondary literature, this mixed-methods design enriches the dataset and helps to elucidate the complex relationships between KM frameworks, sentiment analysis, and effective crisis response.

3.3. Analytical Approach

The analytical approach integrates both statistical analysis and sentiment analysis to evaluate the effectiveness of KM in crisis management. Descriptive statistics and regression methods quantify the relationships between KM variables and crisis outcomes, ensuring that empirical data supports the evaluation of KM practices. For example, structural equation modeling, as used by Albastaki and Manap [12], elucidates the mediating effects of big data analytics on crisis and risk management. Additionally, scenario analysis and empirical techniques are employed to simulate the impact of digital intervention strategies on crisis management, showcasing how digital technologies influence crisis responses.

Complementing these statistical methods, sentiment analysis techniques are applied to textual data from surveys and social media. Both lexicon-based and machine learning-driven classifiers are used to extract and quantify stakeholder sentiment trends, offering insights into perceptions regarding the timeliness and effectiveness of KM practices. Furthermore, multi-criteria decision-making tools such as the ISM-DEMATEL method z are used to identify causal relationships among KM enablers, thereby enhancing the understanding of how KM practices support proactive crisis management.

The analysis is conducted in a sequential manner, where quantitative and qualitative methods complement each other. Descriptive statistics are used to summarize survey responses by calculating frequencies, percentages, means, and variances, establishing a quantitative baseline of how KM practices are implemented in crisis management. Regression analysis further quantifies the relationships among KM variables and crisis outcomes, enabling the identification of key factors that drive effective crisis response. Concurrently, qualitative data from interviews and focus groups are analyzed using a systematic six-phase thematic analysis process, which includes familiarization, coding, theme development, review, and final synthesis. This process allows for the extraction of rich insights into stakeholder perceptions and emerging trends.

This mixed analytical framework ensures that both statistical trends and narrative insights are utilized to provide a comprehensive understanding of KM frameworks' effectiveness and their role in data-driven decision-making during crises. This integration of quantitative and qualitative methods enhances the depth and rigor of the study's findings, offering a more complete view of the relationship between KM and crisis management.

4. Results and Discussion

4.1. Thematic Analysis

Figure 2 illustrates the process of thematic analysis applied to KM frameworks in crisis management. The primary objective of this analysis is to identify recurring themes that significantly contribute to the effectiveness of KM practices during crises. As shown in the figure, the thematic analysis begins by identifying key themes, such as proactive risk mitigation, real-time knowledge sharing, technology integration in KM, continuous learning, and collaboration and stakeholder engagement. Each of these themes plays a vital role in how organizations can leverage KM to respond effectively in crisis situations.

By analyzing the qualitative data, this approach facilitates a deeper exploration of patterns and strategies that shape the success of KM frameworks. The insights derived from the thematic analysis offer actionable information that guides future decision-making and enhances crisis management practices. This allows organizations to refine their strategies, improve resilience, and optimize their response capabilities during future crises. Figure 2 provides a clear and concise visualization of the key elements identified in the thematic analysis, demonstrating how each theme connects to the overarching goal of improving KM's role in crisis management. The themes are linked directly to organizational strategies that facilitate effective crisis response and knowledge management.

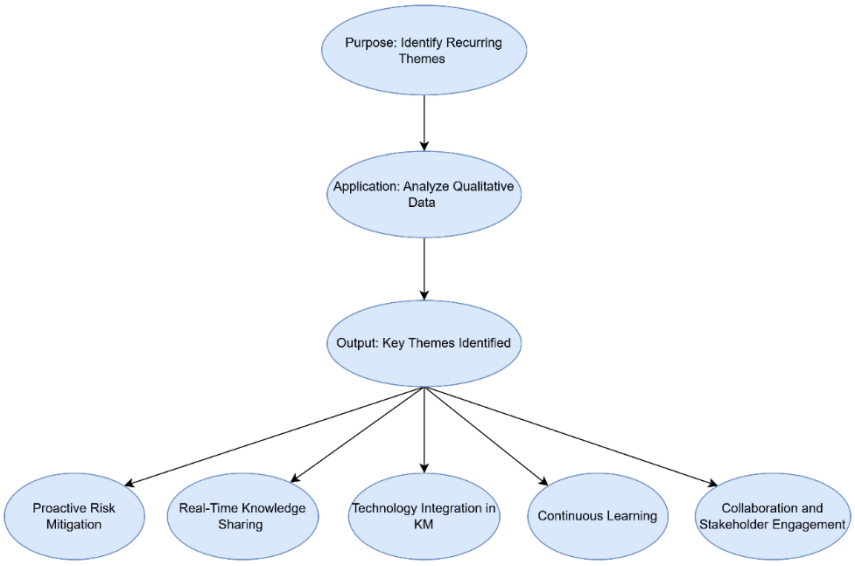

Figure 2. Role of KM in crisis management

In the application stage, the researcher looks for patterns in the qualitative data that relate to the use of KM during crises. The following explanation is presented in table 1, which summarizes the key themes identified through the thematic analysis process. Methods, techniques, and tools used for knowledge management during crises are recognized through the data analysis conducted in this study. Key topics include the most commonly shared approaches to KM and the unique challenges involved in storing, sharing, and utilizing data during crises. Thematic analysis reveals which KM strategies are most effective in reducing the impact of disasters and hazards.

Table 1. Knowledge management for crisis management: key themes

Key Themes	Description
Proactive Risk Mitigation	Knowledge management to detect and mitigate hazards prior to escalation, utilizing preventative strategies and knowledge-sharing methodologies.

Real time knowledge sharing	KM frameworks facilitating swift knowledge transfer for prompt, informed decision-making in crises.
Technology integration in KM	Utilizing technology such as artificial intelligence, big data, and digital platforms to improve knowledge management processes for effective crisis response.
Continuous Learning	Recording and applying insights gained from previous crises to enhance future responses.
Collaborating and Stakeholder Engagement	Enhancing crisis response through knowledge management by facilitating collaboration among departments and external stakeholders.

4.2. Flow of Thematic Analysis Process

Figure 3 illustrates the procedural steps of thematic analysis used to understand the role of KM in risk and crisis management. The process begins with defining the Purpose, which is to analyze qualitative data in search of recurring themes related to KM's function during crises. In the Application phase, KM tools, challenges, and solutions are revealed through the identification of patterns within the qualitative data. This stage involves systematically coding and categorizing the data to uncover key themes that emerge from stakeholder perceptions and organizational experiences in crisis contexts. The application phase focuses on uncovering insights that can inform KM practices and improve crisis responses.

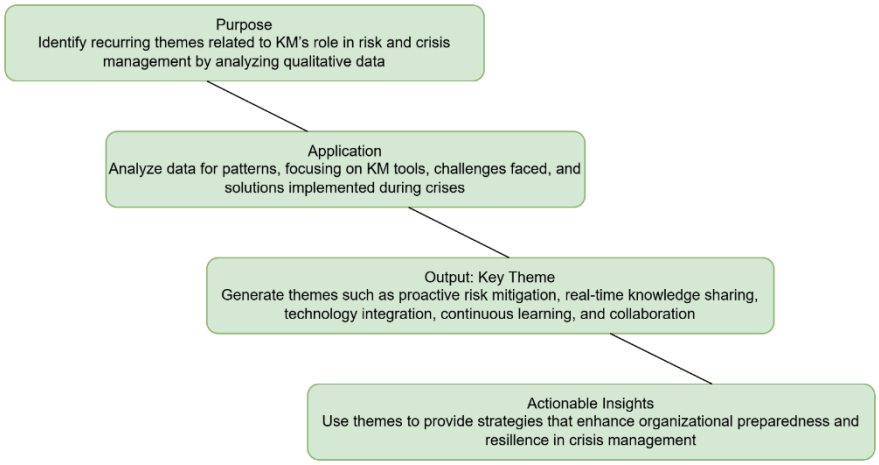

Figure 3. Flow of thematic analysis process for KM in risk and crisis management

The Output is the result of this analysis, highlighting crucial themes such as proactive risk mitigation, real-time knowledge transfer, and the integration of technology and skills in KM frameworks. These themes underscore the critical factors that influence the success of KM systems in managing crises. By identifying these themes, the analysis provides a comprehensive view of how KM can be optimized to respond effectively in crisis situations. Finally, these themes lead to the generation of Actionable Insights. These insights guide organizations in refining their KM practices, enhancing resilience, and improving preparedness for future crises. By understanding and applying these insights, organizations can make informed decisions, optimize their crisis management strategies, and foster better outcomes during crises.

4.3. Comparative Analysis

Table 2 investigates the use of KM tools, crisis management techniques, technological integration, and the effectiveness of information flow across three industries: finance, healthcare, and manufacturing. The table provides insights into how each sector implements KM practices and integrates technology for effective crisis management. The financial industry leads in KM practices, with widespread use of advanced technologies like AI and big data analytics, which help manage risks proactively. In contrast, healthcare primarily utilizes Electronic Health Records (EHRs) to manage patient data, and the industrial sector employs Enterprise Resource Planning (ERP) systems to ensure smooth operations and crisis response.

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Table 2. Comparative analysis

Industry	Finance	Healthcare	Manufacturing
KM Tool Usage Level (Scale 1-5)	5	3	3
KM Tool Usage Level Meaning	5 = High, 1 = Low	5 = High, 1 = Low	5 = High, 1 = Low
Primary Tools	AI, Big Data Analytics	Electronic Health Records (EHRs)	ERP Systems
Crisis Management Focus (Scale 1-5)	5	4	3
Crisis Management Focus Meaning	5 = Proactive, 1 = Reactive	5 = Proactive, 1 = Reactive	5 = Proactive, 1 = Reactive
Technology Integration (Scale 1-5)	5	3	2
Technology Integration Meaning	5 = Extensive, 1 = Limited	5 = Extensive, 1 = Limited	5 = Extensive, 1 = Limited
Knowledge Sharing Effectiveness (Scale 1-5)	5	4	3
Knowledge Sharing Effectiveness Meaning	5 = High effectiveness, 1 = Low effectiveness	5 = High effectiveness, 1 = Low effectiveness	5 = High effectiveness, 1 = Low effectiveness
Regional Adoption Trends (Advanced = 5, Moderate = 3	5	4	3
Regional Adoption Meaning	5 = Advanced, 1 = Low	5 = Advanced, 1 = Low	5 = Advanced, 1 = Low

Crisis management priorities differ across sectors. In healthcare, the focus is on improving emergency responses, particularly during health crises. In the industrial sector, companies prioritize maintaining smooth supply chain operations and minimizing disruptions during crises. The financial sector, on the other hand, leverages predictive analytics and advanced technologies to manage risks proactively and ensure business continuity.

Technological integration varies across these industries. The financial sector leads with the most extensive use of machine learning and predictive analytics, while healthcare adopts telemedicine and EHR systems for patient data management. The industrial sector, however, has a more modest use of technology, primarily relying on ERP systems for operations and crisis management.

The knowledge sharing effectiveness across sectors highlights the financial sector's strong interdepartmental collaboration, which facilitates efficient information exchange. Healthcare excels in the exchange of patient data, particularly through EHRs, while manufacturing focuses on knowledge transfer between production units, crucial for operational continuity during crises.

Geographically, the regional adoption trends also differ. The finance sector shows advanced adoption, especially in North America and Europe, where AI and big data are widely used for risk management. Healthcare adoption is prominent in developed countries, with some regional variation, while manufacturing adoption is moderate, with Asia leading innovation in industrial technology.

4.4. Sentiment Analysis

Table 3 provides an overview of stakeholders' perceptions of KM practices across various industries. The analysis examines the feedback from different sources, highlighting the degree of support, neutrality, and concern regarding KM's effectiveness in crisis management across sectors. In the technology sector, 65% of feedback is favorable, emphasizing the effectiveness of KM techniques in addressing crisis circumstances and mitigating risks within technological initiatives. However, 15% of the responses were negative, pointing to minor issues in KM application. In the financial services sector, KM is viewed positively by 55% of respondents, underscoring its role in enhancing crisis management through the dissemination of knowledge. The healthcare sector receives strong endorsement, with 60% of feedback affirming the utility of KM initiatives in managing emergencies, suggesting that healthcare organizations recognize the value of KM during crises.

Table 3. Sentiment analysis

Industry	Source	Statement	Positive (%)	Neutral (%)	Negative (%)
Technology	Employee Feedback	KM techniques proficiently address crisis circumstances and mitigate hazards in technological initiatives.	65%	20%	15%
Financial Services	Annual Reports	The dissemination of knowledge has optimized our crisis management practices.	55%	30%	15%
Healthcare	Social Media Mentions	"KM initiatives assist healthcare professionals in managing emergencies.	60%	25%	15%
Manufacturing	Employee Feedback	We continue to grapple with the storage of knowledge and its use in risk management.	40%	35%	25%
Retail	Annual Reports	Technology integration enhances our risk management capabilities.	50%	35%	15%
Education	Social Media Mentions	There exists potential for enhancement in the application of knowledge management to address crisis circumstances in education.	45%	40%	15%

Manufacturing shows a mixed response, with only 40% favorable feedback, indicating challenges in knowledge retention and application. The 25% negative feedback suggests significant obstacles that hinder effective KM implementation in crisis management. Retail demonstrates moderate performance, with 50% of respondents acknowledging the role of technology integration in enhancing risk management capabilities. However, there is still room for improvement, as indicated by 15% negative feedback and 35% neutral responses. Education yields a split outcome, with 45% favorable and 40% neutral responses, suggesting that while KM has potential in addressing crisis situations, there are considerable opportunities for improvement in its application within the sector. KM approaches are beneficial in certain sectors but require specific enhancements in others. Sectors such as technology, healthcare, and financial services exhibit strong support for KM practices, while sectors like manufacturing, retail, and education face challenges in maximizing KM's effectiveness in crisis management.

4.5. Descriptive Statistics

Table 4 provides a detailed overview of stakeholder perceptions regarding KM practices within organizations. The responses indicate a generally favorable view of KM techniques and their impact on crisis and risk management. Approximately 85% of participants report robust implementation of KM methods within their organizations. 80% agree that these KM strategies improve their organization's capacity to effectively manage risks and crises. Knowledge sharing is also positively viewed, with 75% of respondents believing that it enhances decision-making during risk and crisis scenarios. Furthermore, 78% of respondents affirm that technology integration plays a crucial role in facilitating KM initiatives within their organizations, underlining the significance of technological support in managing crises.

Table 4. Descriptive statistics

Metric	Statement	Mean	SD	Percentage
KM Adoption	Our organization has extensively implemented Knowledge Management methods.	4.2	0.8	85% of participants indicate the implementation of knowledge management strategies.
Effectiveness of KM in Risk Management	Knowledge management strategies enhance the organization's capacity to successfully manage risks and crises.	4.0	0.7	80% concur that knowledge management enhances crisis response efficiency.
Knowledge Sharing Practices	The dissemination of knowledge improves decision-making in risk and crisis scenarios.	3.8	0.9	75% assert that knowledge sharing improves decision-making.
Technology integration for KM	The incorporation of technology facilitates Knowledge Management initiatives within our organization.	3.9	0.6	Seventy-eight percent assert that technology integration facilitates knowledge management initiatives.
Employee training in Km	Employees are provided with sufficient training on the application of knowledge	3.7	1.0	70% report sufficient training in knowledge management practices.

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	management principles for risk and crisis management.			
KM outcomes in crisis response time	Knowledge management approaches have shortened the response time to emergencies inside the organization.	4.1	0.7	82% concur that knowledge management decreases crisis response duration.
Satisfaction with KM practices	I am satisfied with the existing Knowledge Management procedures within the organization.	3.6	1.1	68% express satisfaction with the existing knowledge management procedures.
Challenges in KM implementation	Our organization encounters difficulties in the successful implementation of knowledge management strategies.	2.9	1.2	45% percent encounter challenges in knowledge management adoption.

Technology integration is regarded as a crucial facilitator of KM practices, with 78% of respondents affirming its importance in supporting KM activities. However, while 70% of participants consider employee training in KM techniques adequate, there is still room for improvement in this area. KM approaches are perceived as effective in shortening crisis response time, with 82% agreeing that KM systems help reduce the time needed to address emergencies within the organization. Satisfaction with current KM practices is moderate, as 68% of respondents expressed contentment with the existing procedures, suggesting potential areas for improvement in KM implementation. Challenges in KM implementation are notable, with 45% of participants reporting obstacles in adopting KM strategies, highlighting the need to address these barriers to optimize KM practices and outcomes.

4.6. Regression Analysis

Table 5 presents the results of the regression analysis, highlighting the significant impact of KM practices on various organizational outcomes. The analysis explores the relationships between KM practices and their influence on risk reduction, crisis resolution speed, cost savings, crisis resolution success rates, and organizational resilience. The regression results indicate that KM practices have a positive and significant influence on risk reduction, with a coefficient of 0.45 and a p-value of 0.01. This suggests that effective KM practices contribute to mitigating risks, explaining 60% of the variance in risk reduction outcomes.

Table 5. Regression Analysis

Dependent Variable	Independent Variable	Coefficient	P-Value	R^2	Significance
Risk Reduction	KM Practices	0.45	0.01	0.60	Significance (KM practices reduce risks)
Crisis Resolution Speed	KM Practices	0.52	0.001	0.65	Significant KM practices (Improve speed)
Cost Savings	KM Maturity	0.38	0.03	0.55	Significant (KM Maturity reduces cost)
Crisis Resolution Success Rates	Knowledge Sharing	0.40	0.02	0.50	Significant (Knowledge sharing improves outcomes)
Organizational Resilience Score	Technology integration in KM	0.48	0.005	0.62	Significant (Technology boost resilience)

KM practices also enhance crisis resolution speed, with a coefficient of 0.52 and a very significant p-value of 0.001. This finding underscores that successful KM practices significantly accelerate crisis response, accounting for 65% of the variation in crisis resolution speed. The analysis further reveals a correlation between KM maturity and cost savings, with a coefficient of 0.38 and a p-value of 0.03, indicating that more advanced KM systems are associated with cost reductions. KM maturity explains 55% of the variance in cost savings, suggesting that the development and integration of KM practices lead to more efficient cost management.

Additionally, knowledge sharing significantly enhances crisis resolution success rates, with a coefficient of 0.40 and a p-value of 0.02. This demonstrates that improved knowledge sharing within organizations is closely linked to higher success rates in crisis resolution, explaining 50% of the variation in crisis resolution outcomes. Lastly, the integration

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of technology into KM practices markedly improves organizational resilience, with a coefficient of 0.48 and a p-value of 0.005. This finding indicates that technology integration in KM practices significantly boosts organizational resilience, accounting for 62% of the variance in resilience scores.

4.7. Network Analysis

Table 6 presents the network analysis of key roles and their effectiveness in crisis management. The analysis focuses on the centrality measures of different roles within the crisis management network, illustrating how the flow of information and coordination between individuals impacts overall crisis response efficiency. The Crisis Manager plays a central role in crisis management, with a degree centrality of 10, betweenness centrality of 150, and a closeness centrality of 0.85, indicating that they are highly connected, with the ability to gather and disseminate information quickly. This high centrality demonstrates the Crisis Manager's critical role in linking various teams and stakeholders, emphasizing the importance of maintaining continuous communication with key players for effective coordination. The Risk Analyst holds a degree centrality of 8 and betweenness of 120, reflecting their role in providing crucial risk assessments and ensuring smooth data flow to the Crisis Manager. Their role is pivotal in forecasting potential risks, allowing the Crisis Manager to make informed decisions swiftly.

Table 6. Network analysis

Node	Role in crisis management	Degree Centrality	Betweenness Centrality	Closeness Centrality	Efficiency	Recommendations
Crisis Manager	Central Decision Maker and coordinator	10	150	0.85	High	Ensure continuous communication with key players
Risk Analyst	Provides risk assessment and predictions	8	120	0.80	High	Improve data flow the crisis manager
IT Support	Ensure system and data integrity	7	80	0.75	Medium	Enhance access to IT support during crises
Operations Team Lead	Executes on the ground crisis operations	6	90	0.78	Medium	Increase collaboration with other departments
HR Manager	Manage staff and communication during crises	5	50	0.70	Low	Increase HR's involvement in decision making
External Partners	External stakeholders and vendors	4	60	0.72	Low	Strengthen communication pathways with external partners
Public Relations	Managers external communication	5	70	0.74	Medium	Streamline communication channels for timely updates

While IT Support has fewer connections and a lower efficiency score, their role remains critical in ensuring the accessibility of systems and data during crises. The Operations Team Lead, with six connections and moderate efficiency, is valuable for on-site operations but could benefit from increased collaboration with other departments to ensure a more cohesive crisis response. The HR Manager, though playing a key role in managing staff and internal communication, has limited involvement in decision-making, reflected in their degree centrality of 5. Expanding HR's role in the crisis management process could enhance their contribution to decision-making and improve overall crisis response.

The coordination of External Partners could be more effective with improved communication pathways, particularly if Public Relations, with five moderate connections, streamlined the communication channels. By enhancing the communication flow with external partners and vendors, organizations can improve the overall crisis response efficiency. Strengthening the crisis management network, fostering collaboration, and ensuring stronger connectivity among all roles would significantly enhance the organization's ability to respond to crises. Each role is interdependent, and increasing interdepartmental collaboration and connectivity is vital for a more effective response.

4.8. Trend Analysis

Table 7 explores the current and future adoption of emerging KM technologies in risk and crisis management. The analysis highlights how these technologies are being utilized and their potential to transform crisis response and resilience in the future. AI is currently used by 40% of businesses, with adoption expected to rise significantly to 80%. AI enhances real-time decision-making and crisis predictions, improving the speed and accuracy of crisis response. Similarly, Blockchain is used by 20% of organizations, providing secure data exchange and monitoring during crises, with the potential for growth to 60%. Blockchain's ability to ensure transparency and data integrity is increasingly valuable in crisis management.

Cloud Computing is already adopted by 70% of businesses, with a predicted increase to 90%. It facilitates rapid data sharing and collaboration during crises, enhancing accessibility and teamwork. The IoT is currently used by 50% of organizations and is expected to reach 80% adoption, enabling real-time monitoring and improving crisis response through better tracking and alerts. Big Data Analytics is utilized by 55% of organizations, with its future potential estimated to rise to 85%. This technology helps identify trends, predict risks, and assess crisis responses, making it an essential tool for data-driven decision-making. Augmented Reality (AR) and Virtual Reality (VR), which are used by 30% of organizations, have significant growth potential, with an expected adoption of 70%. These technologies can simulate crisis scenarios, enhancing training and preparedness for real-world emergencies. Robotic Process Automation (RPA) is currently used by 25% of organizations, with its future potential estimated to grow to 65%. RPA optimizes repetitive tasks, allowing organizations to focus more resources on strategic decision-making. 5G Networks, with the lowest current adoption rate of 15%, are projected to reach 85% adoption in the future, significantly improving real-time communication during crises.

Table 7. Trend analysis

KM Technology	Key Function	Impact	Current Use	Future Potential	Recommendation
AI	Data analysis and prediction	Automates risk assessment and crisis response	40%	80%	Adopt AI for better forecasts and decisions
Blockchain	Secure, transparent ledger	Ensures data integrity and traceability	20%	60%	Use for secure data sharing in crises
Cloud	Scalable storage and access	Enables fast sharing and collaboration	70%	90%	Strengthen cloud-based KM systems
IoT	Real-time data from devices	Improves monitoring and alerts	50%	80%	Apply IoT for real-time crisis tracking
Big Data	Large-scale data insights	Detects trends and risks	55%	85%	Invest in analytics for planning
AR/VR	Immersive simulations	Enhances crisis training	30%	70%	Use for realistic preparedness drills
RPA	Automates repetitive tasks	Saves time and boosts efficiency	25%	65%	Streamline tasks with RPA tools
5G	Fast mobile network	Speeds up communication and decisions	15%	85%	Prepare for faster crisis response via 5G

Figure 4 compares the current adoption rates with the future potential of several emerging technologies in KM. AI, although currently adopted by 40% of businesses, is projected to reach 80%, indicating its increasing importance for predictive analytics and decision support. Blockchain, currently at 20% adoption, is expected to grow to 60%, showing gradual but steady growth in its use for secure data management. Cloud Computing is widely used, with 70% adoption, and is expected to increase to 90%, emphasizing its pivotal role in improving collaboration and accessibility during crises. IoT, currently at 50%, is projected to grow to 80%, enhancing real-time monitoring and data collection during emergencies. Big Data Analytics is already at 55% adoption, with a future potential of 85%, reinforcing its significance in identifying crisis trends and guiding decision-making.

While AR and VR have lower current adoption rates (30%), their future potential is substantial, with expected adoption of 70%. Similarly, RPA, with 25% adoption, will see significant growth to 65%, optimizing processes for more efficient

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decision-making. Finally, 5G Networks, which currently have low adoption (15%), are expected to reach 85% adoption, greatly enhancing communication and data exchange capabilities during crises.

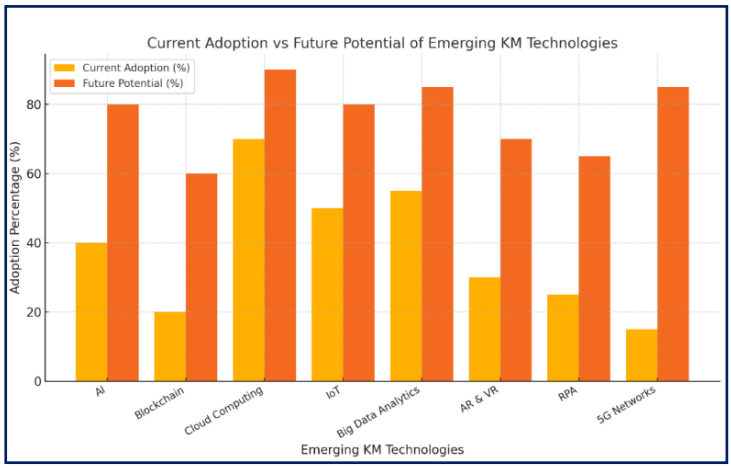

Figure 4. Comparison of current adoption and future potential of emerging km technologies in risk and crisis management

The trend analysis clearly indicates that while some technologies, such as Cloud Computing and Big Data Analytics, are already widely adopted, many emerging technologies, including AI, IoT, AR/VR, and 5G, have significant growth potential. These technologies will play an increasingly important role in improving crisis management and organizational resilience, with data-driven, immersive, and communication-enhancing technologies set to dominate the future landscape of KM.

4.9. Risk Assessment and Scenario Analysis

Table 8 illustrates the impact of KM strategies on mitigating various crisis scenarios. The analysis compares the severity of risks with and without KM implementation, demonstrating the measurable benefits of KM in reducing both operational and reputational threats. For instance, in the case of a Data Breach, the implementation of secure knowledge-sharing platforms and encryption technologies reduces the severity of impact from 4.5 to 2.0, a 55% reduction. Similarly, during a Natural Disaster, the use of cloud computing enables swift data restoration and operational recovery, lowering the impact by 37.5%.

Table 8. Risk assessment and scenario analysis

Scenario	Type of Risk	Impact without KM	Impact with KM	Risk Reduction	KM Strategies
Data Breach	Operational and Reputational	4.5	2.0	55%	Secure knowledge-sharing platforms and encryption technology.
Natural Disaster	Operational	4.0	2.5	37.5%	Get your data back in the blink of an eye using cloud computing.
Product Recall	Reputational and Financial	4.2	2.8	33.3%	Strengthen teamwork and information exchange.
Cyber Attack	Operational and Reputational	5.0	2.0	60%	Adopt technologies that identify and respond to threats using artificial intelligence.
Regulatory Non-Compliance	Financial and Legal	3.8	2.4	36.8%	Make use of analytics on large data to track compliance status in real-time.
Supply Chain Disruption	Operational	4.5	3.0	33.3%	Use the Internet of Things to track and predict the supply chain in real time.
Pandemic Outbreak	Operational and Reputational	4.7	2.9	38.3%	To coordinate responses and exchange health protocols, use KM systems.
Negative Publicity	Reputational	4.0	2.7	32.5%	Simplify public relations and centralize media handling with KM.

KM significantly improves interdepartmental collaboration and information sharing, which contributes to a 33.3% reduction in the impact of Product Recalls. In the context of Cyber Attacks, AI-driven threat detection and response mechanisms lead to the highest reduction in impact 60%, underscoring the value of advanced technologies in mitigating digital threats. Through the use of big data analytics, KM also supports regulatory compliance by providing real-time tracking and reporting capabilities, resulting in a 36.8% reduction in risk. IoT technologies assist in forecasting and addressing Supply Chain Disruptions, reducing their severity by 33.3% through continuous monitoring. During Pandemic Outbreaks, KM frameworks facilitate coordinated responses and knowledge exchange regarding health protocols, decreasing the impact by 38.3%. Additionally, integrated public relations and communication strategies within KM systems reduce the damage caused by Negative Publicity by 32.5%, highlighting the role of centralized messaging in reputational management.

Collectively, the application of KM strategies especially those involving AI, cloud computing, and IoT significantly enhances organizational resilience. These tools facilitate faster communication, improved data accessibility, and more informed decision-making, thereby reducing the severity and operational impact of diverse crisis events.

4.10. Findings

The findings of this study underscore the pivotal role of KM in strengthening crisis management across multiple industries. KM enables organizations to proactively mitigate risks, share critical information in real time, and integrate advanced technologies to support rapid and informed decision-making during crises. Technologies such as cloud computing, the IoT, and AI significantly enhance KM frameworks by improving data accessibility, facilitating seamless communication, and accelerating decision-making processes. KM also supports organizational learning by capturing insights from past crises, thereby helping institutions better anticipate and prepare for future disruptions.

Despite these benefits, the study reveals sector-specific challenges. In manufacturing, key obstacles include weak knowledge transmission, limited data security measures, and gaps in workforce training. In contrast, the financial services sector demonstrates leadership in KM adoption, particularly in leveraging AI and predictive analytics for risk assessment and crisis response. The healthcare sector benefits from EHRs for real-time patient data access during emergencies, while ERP systems in manufacturing support supply chain continuity and operational coordination.

Sentiment analysis results indicate a generally positive perception of KM in sectors like technology and healthcare, where stakeholders acknowledge KM's effectiveness in managing crises. In contrast, the manufacturing sector expresses more neutral or negative sentiment, reflecting ongoing difficulties in knowledge retention and practical application. Quantitative analysis shows that KM practices significantly contribute to reducing the impact of major threats. For example, KM systems can reduce the severity of cyberattacks by up to 60% and data breaches by 55%, demonstrating their capacity to alleviate some of the most critical crisis risks. Integration with technologies such as AI, big data analytics, and cloud platforms leads to faster crisis resolution times and enhanced organizational agility.

Regression analysis reinforces these insights, confirming that KM practices especially when supported by technological integration have a statistically significant effect on risk reduction, cost savings, crisis resolution success, and organizational resilience. The combination of qualitative and quantitative evidence in this study highlights that, while implementation challenges remain in some sectors, KM remains an essential enabler of effective crisis management and long-term resilience"

5. Conclusion

This study reaffirms the vital role of KM in enhancing organizational capacity to manage crises proactively and effectively. By integrating KM frameworks with emerging technologies such as AI, IoT, blockchain, and cloud computing, organizations can strengthen resilience, improve decision-making, and respond more swiftly in high-pressure situations. These technologies enable real-time data access, predictive insights, and collaborative information sharing, all of which are essential for timely and informed crisis response.

The financial sector exemplifies advanced KM adoption, utilizing AI, big data, and cloud computing to anticipate and mitigate risks. Predictive analytics support proactive crisis detection, while big data analytics identify trends and assess vulnerabilities. Cloud computing enables seamless information flow, supporting faster, more coordinated decision-

making. Together, these tools demonstrate how technology-integrated KM systems can significantly reduce response times and enhance overall crisis management effectiveness.

However, persistent challenges exist, particularly in sectors like healthcare and manufacturing. In healthcare, while EHRs improve data access, issues related to cross-department collaboration and data security hinder efficient knowledge sharing. In manufacturing, organizations struggle with knowledge retention and secure sharing of sensitive operational data. These challenges highlight the need for sector-specific adaptations of KM strategies and better integration of technologies across diverse operational contexts.

An important finding of this study is the value of sentiment analysis in KM practices. By capturing stakeholder perceptions and public sentiment in real time, organizations can refine crisis communication strategies and tailor interventions to meet evolving expectations. This emotional intelligence aspect of KM enables more adaptive, responsive, and socially attuned crisis management. While the benefits of KM in crisis management are evident, further empirical research is needed to validate these findings across sectors and regions. Future studies should focus on overcoming barriers to technology adoption, improving KM training and literacy among staff, and developing flexible KM models tailored to different industries and crisis scenarios.

KM frameworks when effectively integrated with digital technologies serve as critical enablers of organizational resilience. They enhance decision-making, streamline communication, and support rapid responses, ultimately reducing the impact of crises. To unlock the full potential of KM, organizations must address existing implementation challenges and continue investing in innovative, collaborative, and adaptive knowledge strategies.

6. Declarations

6.1. Author Contributions

Conceptualization: E.M.A.Q.; Methodology: E.M.A.Q.; Software: E.M.A.Q.; Validation: E.M.A.Q.; Formal Analysis: E.M.A.Q.; Investigation: E.M.A.Q.; Resources: E.M.A.Q.; Data Curation: E.M.A.Q.; Writing Original Draft Preparation: E.M.A.Q.; Writing Review and Editing: E.M.A.Q.; Visualization: E.M.A.Q.; All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Institutional Review Board Statement

Not applicable.

6.5. Informed Consent Statement

Not applicable.

6.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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