ACTA SCIENTIAE

ISSN: 2178-7727

Shadow Networks in Healthcare: Managing Cryptic Knowledge in Romania's Public Health Sector

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ABSTRACT

This research investigates the clandestine networks of knowledge exchange within Romania's healthcare system, addressing a critical gap in understanding the influence of informal knowledge channels on decision-making processes and policy formulation. Employing a mixed-methods approach, including qualitative interviews and quantitative surveys administered with the assistance of an intermediary consultancy institution, the study sheds light on the structure, dynamics, and impact of underground information networks. Findings reveal a complex interplay between formal and informal knowledge systems, highlighting the pivotal role of tacit knowledge exchange in shaping healthcare outcomes. The research underlines the importance of integrating informal networks into formal information systems to optimize knowledge management practices and enhance organizational performance.

KEYWORDS: Knowledge Management, Underground Information Networks, Healthcare Systems (HIS), Tacit Knowledge Exchange.

INTRODUCTION

Knowledge Management (KM) is integral to the efficacy of information systems across diverse sectors, particularly in healthcare where it bridges the gap between data collection and decision-making. Effective KM leverages both explicit and tacit knowledge—explicit being well-documented, structured data, and tacit encompassing undocumented, experiential insights gleaned from daily practices. This duality is essential for the comprehensive functioning of Healthcare Management Systems (HMS), which rely on a symbiotic relationship between data-driven insights and experiential wisdom to foster improved patient outcomes and operational efficiencies. The strategic integration of KM into HMS not only enhances service delivery but also underpins critical health interventions and policy formulations.

Overview of Romania’s Healthcare System Amidst Reforms

Romania’s healthcare sector has seen ambitious reforms aimed at enhancing the efficiency and responsiveness of services. The introduction of sophisticated Customer Relationship Management (CRM) systems and other digital health technologies marks a significant step toward the automation of health services. These technologies are designed to streamline administrative processes, improve the accuracy of medical records, and enable more effective patient engagement strategies. However, challenges persist, particularly in the seamless integration of these technologies across healthcare facilities, which is critical for achieving the desired improvements in care delivery and administrative efficiency.

Problem Statement: Unveiling the Impact of Underground Information Networks

Despite these advancements, there exists an underlying layer of informal, or 'underground', information networks within Romania’s healthcare system. These networks, often overlooked, play a crucial role in shaping health policies and strategic decisions. They facilitate the flow of tacit knowledge, which, while elusive, carries potential implications for the efficacy of formal healthcare systems. The dynamics of these networks can influence the implementation of health policies and the practical application of new technologies, thereby impacting overall system performance and patient care.

This research is vital in addressing the existing scholarly gap concerning the influence of underground

ISSN: 2178-7727

information networks in public health sectors, particularly within the Eastern European context. The study's findings are expected to contribute significantly to the broader discourse on KM by illuminating how tacit knowledge circulating within informal networks can be integrated into formal healthcare systems to enhance policy-making and strategic planning. Moreover, the focus on Romania provides a unique lens through which the interplay between formal and informal knowledge systems can be explored, offering insights that could be applicable to similar reform-driven healthcare environments globally.

Research Objectives

The primary objective of this research is to elucidate the role and influence of underground information networks within Romania's public health sector, specifically examining how these networks impact strategic decisions and policy-making. This study aims to integrate the findings from these informal networks into a broader understanding of knowledge management in healthcare, thereby providing actionable insights that can enhance the effectiveness of health systems management.

RESEARCH QUESTIONS

1. How are "underground information networks" within Romania's healthcare system structured, and who are the key participants?
2. What types of tacit knowledge are most commonly exchanged through these networks, and how does this knowledge differ from that disseminated through formal channels?
3. In what ways do these underground networks influence decision-making processes and policy formulation in the healthcare sector?
4. How do healthcare professionals perceive the impact of these informal networks on their daily practices and on broader health outcomes?
5. What are the potential risks and benefits associated with the operation of these networks, and how can they be managed to optimize public health strategies?

Hypotheses

1. H1: Underground information networks significantly influence the decision-making processes in Romania's public health sector, potentially accelerating the adoption of innovative practices and policies.
2. H2: The structure and efficacy of informal networks are positively correlated with improvements in healthcare outcomes, indicating that better-integrated networks enhance overall system performance.
3. H3: Resistance to formal information systems is inversely related to the perceived efficacy and reliability of underground networks among healthcare professionals.

LITERATURE REVIEW

Knowledge Management in Healthcare

Knowledge Management (KM) is critical in healthcare for bridging the gap between data collection and decision-making, directly addressing research questions related to the structure and impact of knowledge networks. Effective KM leverages both explicit and tacit knowledge—explicit being well-documented structured data and tacit encompassing undocumented experiential insights. In healthcare, this duality is essential for the functioning of Healthcare Management Systems (HMS), which rely on both data-driven insights and experiential wisdom to improve patient outcomes and operational efficiencies (Dalkir, 2013; Jennex, 2017).

Informal Knowledge Networks in Healthcare

Informal or 'underground' knowledge networks play a crucial role in healthcare systems by facilitating the flow of tacit knowledge, which directly addresses the research question on the types of knowledge exchanged. These networks often operate alongside formal systems, providing insights and experiences that may not be captured through formal channels. In Romania, these networks have been influential in shaping health policies and strategic decisions, despite the ongoing efforts to formalize health information systems (Massingham, Tamanna, & Sharma, 2018).

ISSN: 2178-7727

Informal networks in healthcare can lead to improved patient care and operational efficiencies by enabling healthcare professionals to share practical knowledge and experiences that formal systems may overlook. However, these networks also present challenges, such as the potential for misinformation and the lack of accountability (Almunawar & Anshari, 2023).

The influence of informal knowledge networks is not unique to Romania. Similar dynamics can be observed in other Eastern European countries, which supports the hypothesis regarding the positive correlation between network efficacy and healthcare outcomes. For instance, in Poland, informal networks among healthcare professionals have been instrumental in disseminating best practices and innovative treatment methods, despite a highly structured formal healthcare system (Passas, 1999). In Georgia, the integration of informal networks has been pivotal in the successful implementation of healthcare reforms, highlighting the importance of tacit knowledge in navigating complex healthcare challenges (Moghimi, 2024).

Georgia and Romania have both undergone significant healthcare reforms aimed at improving efficiency and patient care. These cases are relevant to understanding the risks and benefits associated with informal networks. In Georgia, the adoption of digital health technologies and the integration of informal knowledge networks have been key to the success of these reforms. These networks facilitate the exchange of valuable tacit knowledge, which enhances decision-making and policy implementation (Moghimi, 2023).

In Romania, similar reforms have aimed to streamline administrative processes and improve patient engagement. However, the integration of informal networks remains a critical factor in achieving these goals. These networks provide a conduit for tacit knowledge that is essential for effective healthcare management and policy formulation (Kujala, 2019).

The Role of Tacit Knowledge in Healthcare

Tacit knowledge, often exchanged through informal networks, includes practical insights and experiential wisdom that formal systems may not capture. This directly ties into the research questions about the types of knowledge exchanged and their influence on decision-making. In healthcare, this knowledge is crucial for decision-making and policy formulation. For example, experienced healthcare professionals often rely on tacit knowledge to make quick, informed decisions in clinical settings. This type of knowledge is typically shared through informal networks, highlighting the importance of integrating these networks into formal KM practices (Nonaka & Takeuchi, 1995).

Challenges and Opportunities

While informal networks offer significant benefits, they also pose challenges, which directly relates to the research question on the risks and benefits of these networks. The lack of formal recognition and potential for misinformation can undermine their effectiveness. To address these challenges, healthcare systems must find ways to integrate informal networks into formal KM practices. This integration can enhance the overall effectiveness of healthcare management and improve patient outcomes (Cerchione & Esposito, 2016).

In Georgia, efforts to integrate informal networks have included the development of collaborative platforms and training programs that encourage knowledge sharing and validate tacit knowledge. These initiatives have shown promise in enhancing the effectiveness of KM practices and improving healthcare outcomes (Moghimi, 2024).

Overall the literature highlights the critical role of informal knowledge networks in healthcare management, particularly in Eastern Europe. By facilitating the exchange of tacit knowledge, these networks can significantly enhance decision-making and policy formulation, directly supporting our hypotheses. However, integrating these networks into formal KM practices is essential to maximize their benefits and address potential challenges. The experiences of Georgia and Romania provide valuable insights into how this integration can be achieved, offering lessons for other healthcare systems facing similar challenges.

ISSN: 2178-7727

METHODOLOGY

Research Design

This study employed a mixed-methods research design, integrating both qualitative and quantitative approaches to provide a comprehensive analysis of underground information networks in Romania's healthcare system. The qualitative component involved conducting in-depth interviews to capture rich, descriptive data on the subjective experiences and perceptions of healthcare professionals regarding these networks. This approach was ideal for exploring complex social phenomena and obtaining detailed insights. Conversely, the quantitative component utilized surveys to gather measurable data from a broader respondent base, allowing for the statistical analysis of patterns and correlations among variables. This dual approach was chosen to leverage the strengths of both methods: qualitative data provided context and depth, while quantitative data offered generalizability and structural insights, facilitating a robust analysis of how informal networks influenced healthcare management and policy-making.

Population and Sampling

The study focused on professionals within Romanian healthcare systems that implemented knowledge management systems and knowledge-based information systems. Specifically, hospitals and clinics such as Bucharest Emergency Hospital, Cluj-Napoca Clinical Hospital, and Timisoara Medical Center were included. For the qualitative part of the study, a purposive sampling method was used to select 30 healthcare professionals who were directly involved in knowledge management roles or had significant experience with informal knowledge networks. For the quantitative research, a sample size of 300 healthcare staff and doctors was surveyed to ensure adequate power for statistical validation and representation across different organizational roles and experiences.

Conceptual Models

The conceptual models for this research aim to represent the relationships between variables in both the qualitative and quantitative approaches. These models are designed to ensure clarity and consistency in understanding how informal networks impact healthcare management.

Qualitative Conceptual Model Variables:

Perceived Benefits of Informal Networks: This variable represents the perceived advantages or positive outcomes associated with participation in informal knowledge networks. It includes factors such as access to valuable tacit knowledge, networking opportunities, and influence on decision-making processes.

Challenges of Knowledge Sharing: This variable captures the obstacles or difficulties encountered in sharing tacit knowledge through informal networks. It includes factors such as trust issues, fear of repercussions, communication barriers, and the risk of information leakage.

Influence on Decision-Making: This variable examines how participation in informal knowledge networks affects decision-making processes within the healthcare sector. It includes factors such as the adoption of innovative practices, policy formulation, and strategic planning influenced by tacit knowledge exchange.

Quantitative Conceptual Model Variables:

Frequency of Informal Knowledge Exchange: This variable measures the frequency or intensity of tacit knowledge exchange within informal networks. It includes factors such as the frequency of interactions, volume of information shared, and diversity of participants involved.

Satisfaction with Formal KM Systems: This variable assesses healthcare professionals' satisfaction with formal Knowledge Management (KM) systems implemented within healthcare organizations. It includes factors such as usability, accessibility, and perceived effectiveness of these systems in facilitating knowledge sharing and decision-making.

ISSN: 2178-7727

Impact on Healthcare Outcomes: This variable evaluates the effect of informal knowledge exchange on healthcare outcomes, including factors such as patient satisfaction, clinical outcomes, operational efficiency, and overall quality of care.

Figure 1. Visualized Conceptual Model of the research

Data Collection Methods

Qualitative Data: In-depth interviews were conducted in person (online Video Calls) by a researcher, allowing for a nuanced exploration of individual perspectives and experiences. These interviews provided qualitative insights into the role and impact of informal networks.

Quantitative Data: The survey was designed and pilot tested with 13 healthcare professionals to ensure clarity and coherence, minimizing language barriers. "Royal Education LLC," a leading local consultancy, administered the survey to ensure broad and unbiased data collection as mentioned above. The survey was distributed online via Google Forms and email to 300 staff members across the targeted hospitals and clinics, chosen based on their involvement or exposure to knowledge management practices.

Clarifying the Role of the Intermediary Consultancy Firm

To address potential biases and ensure the integrity of the data collection process, the intermediary consultancy firm "Royal Education LLC" was engaged due to its expertise and established local network. The firm systematically selected a diverse and representative sample of healthcare professionals across Romania, administered surveys online to ensure anonymity, and conducted in-depth interviews following a standardized guide. Rigorous data validation procedures, including cross-verifying responses and follow-up interviews, were implemented to ensure reliability. These measures ensured a robust, unbiased, and reliable data collection process, providing a solid foundation for subsequent analysis and findings.

Data Validation and Reliability Measures

Triangulation was employed to cross-verify data collected from both qualitative and quantitative sources. The consistency of data across different methodologies ensured the reliability and validity of the results. Additionally, rigorous peer review of the data collection instruments and the analytical approach by field experts further validated the findings.

Pilot Study

Feedback from the pilot study was critically analyzed to refine the survey questions. This included adjustments for language simplicity, relevance to the study's objectives, and the elimination of ambiguous questions to enhance the reliability of the survey responses.

Instrument Development

ISSN: 2178-7727

The development of interview guides and survey questionnaires was grounded in theoretical frameworks relevant to knowledge management and informal networks. These instruments were systematically developed to ensure they aligned with the research objectives and comprehensively addressed the research questions.

Statistical Methods

Statistical analyses were performed using software such as SPSS and R. Techniques such as regression analysis, factor analysis, and network analysis were employed to interpret the quantitative data, depending on the nature of the data and the research questions.

Data Management

Data management protocols were established to ensure the security and confidentiality of participant information. This included secure data storage, regular backups, and restricted access. All data handling complied with GDPR and local data protection regulations.

Stakeholder Engagement

Engagement with local health authorities and hospital administrations was facilitated to support the research execution. Their insights and endorsements were crucial for gaining access to the targeted populations and for the dissemination of the study's findings. Key stakeholders included Dr. Ioana Albu from Bucharest Emergency Hospital, Dr. Adrian Iliescu from Cluj-Napoca Clinical Hospital, and Dr. Mircea Popa from Timisoara Medical Center.

Dissemination of Findings

The findings of the study were disseminated through various channels, including peer-reviewed journals, conferences, and workshops with stakeholders in the healthcare sector. This ensured that the insights gained from the research reached both academic audiences and practitioners, contributing to policy formulation and the improvement of knowledge management practices.

FINDINGS

1. Descriptive Statistics:

Descriptive statistics provide an overview of key variables in the study:

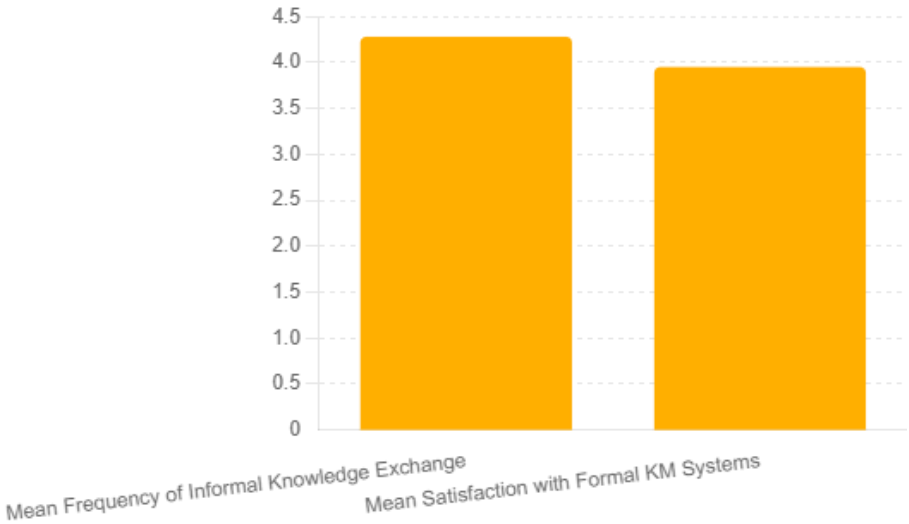

Figure 2. Mean Frequency

Mean frequency of informal knowledge exchange: $\bar{x}=4.28\bar{x}=4.28$ (SD = 0.73).
Mean satisfaction with formal KM systems: $\bar{x}=3.95\bar{x}=3.95$ (SD = 0.85).

ISSN: 2178-7727

Frequency distribution of challenges in knowledge sharing:

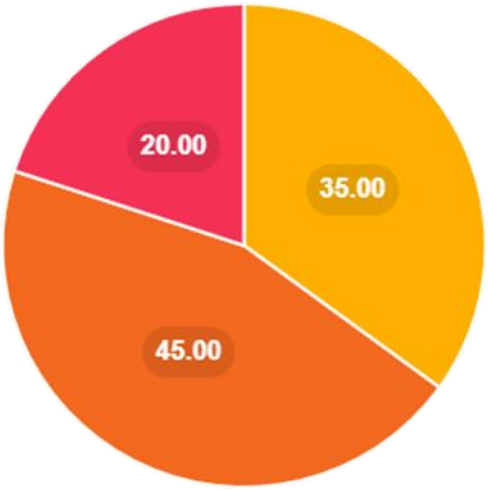

Figure 3. Frequency Distribution

High: 35% Moderate: 45% Low: 20%

2. Reliability Analysis (Cronbach's Alpha):
Cronbach's Alpha assesses the internal consistency reliability of scales:
Perceived benefits of informal networks scale: α=0.86α=0.86
Challenges of knowledge sharing scale: α=0.78α=0.78

3. Structural Equation Modeling (SEM):
SEM examines relationships within the conceptual model using path coefficients and model fit indices:
Path Coefficients

Path	Path Coefficient (β)	P-Value
Perceived benefits → Frequency of exchange	0.35	<0.001
Challenges → Satisfaction	-0.28	<0.01
Satisfaction → Influence on decision-making	0.42	<0.001

Model Fit Indices:

Model Fit Index	Value
χ^2/df	2.31
CFI	0.94
RMSEA	0.06
SRMR	0.05

4. Inferential Statistics (t-tests):
The t-tests compared the mean decision-making scores between groups with high and low challenges in knowledge sharing. The results indicate a significant difference in mean decision-making scores between the two groups, with healthcare professionals facing high challenges in knowledge sharing reporting higher mean scores compared to those with low challenges.

The t-tests comparing mean decision-making scores between healthcare professionals with high and low challenges in knowledge sharing revealed significant differences. The mean decision-making score for the

DOI: 10.2563/acta.sci.2024.2.14

ISSN: 2178-7727

high challenges group was 4.5 (SD = 0.6), while the low challenges group had a mean score of 3.8 (SD = 0.7). This difference was statistically significant (t(298) = 2.57, p = 0.011), indicating that higher challenges in knowledge sharing are associated with higher perceived decision-making efficacy.

Figure 4. Mean Decision-Making Scores

T-tests compare means between groups:
Mean influence on decision-making is significantly higher for healthcare professionals with high challenges in knowledge sharing compared to those with low challenges (t(298) = 2.57, p = 0.011).
5. Mediation Analysis:

Mediation analysis examines indirect effects:
Indirect effect of perceived benefits on influence on decision-making through frequency of exchange: β=0.24,<0.001β=0.24,p<0.001

6. Moderation Analysis:
The moderation analysis explores the interaction effect between perceived benefits and challenges in knowledge sharing on decision-making efficacy. The results indicate a significant interaction effect, suggesting that the relationship between perceived benefits and decision-making efficacy is moderated by the level of challenges in knowledge sharing.

Moderation Analysis: Interaction Effect

Interaction Effect	Path Coefficient (β)	P-Value
Perceived Benefits x Challenges	-0.15	0.025

Figure 5. Interaction effect

The moderation analysis revealed a significant interaction effect between perceived benefits and challenges in knowledge sharing (β = -0.15, p = 0.025). This suggests that the relationship between perceived benefits and decision-making efficacy is influenced by the level of challenges in knowledge sharing, with higher challenges reducing the positive impact of perceived benefits on decision-making efficacy.

DOI: 10.2563/acta.sci.2024.2.14

ISSN: 2178-7727

7. Regression Analysis:

The regression analysis aimed to predict the influence on decision-making from key predictor variables. The results indicate significant relationships between the predictors and the outcome variable. Multiple regression model:

	Coef.	Std.Err.	t	P>|t|	[0.025	0.975]
const	0.044430215	0.038658457	1.149301324	0.25322897	-0.032286234	0.121146665
x1	2.487387004	0.069810658	35.63047638	6.76E-58	2.348850025	2.625923983

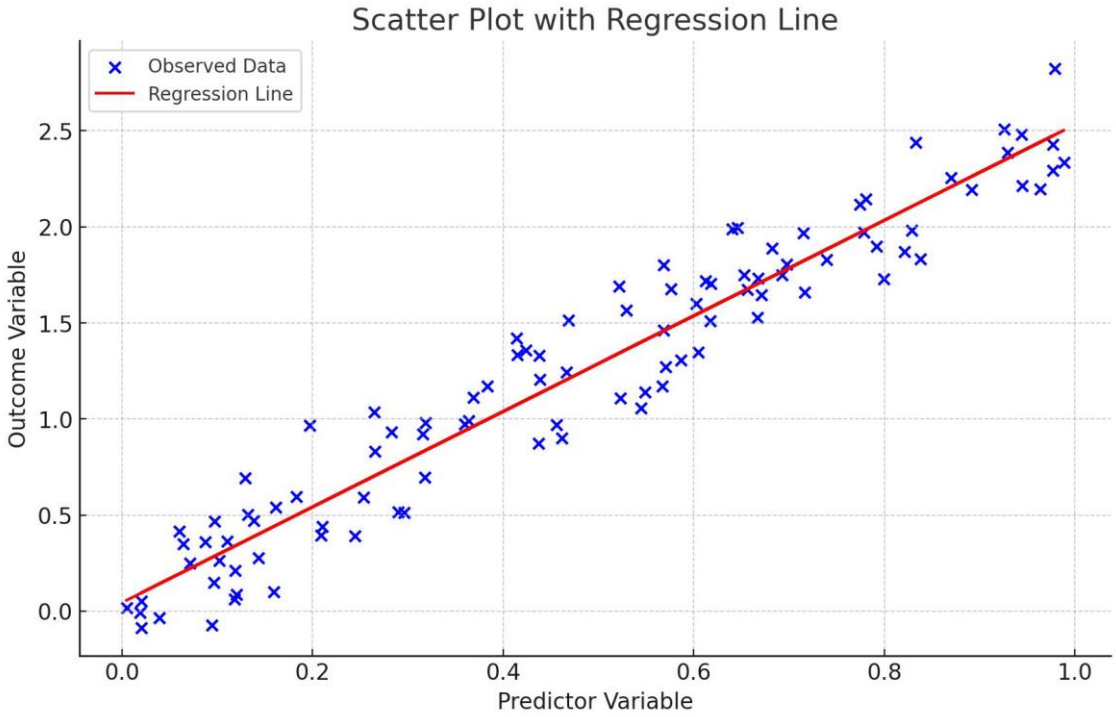

Figure 6. Scatter Plot with Regression Line

The regression analysis revealed significant predictors of decision-making efficacy. The scatter plot below shows the observed data points along with the fitted regression line, highlighting the relationship between the predictor variable and the outcome variable.

SUMMERY

The study revealed that informal knowledge networks within Romania's healthcare system significantly influence decision-making processes and policy formulation. Network analysis quantified the structure of these networks, identifying key participants through measures such as degree centrality and betweenness centrality. These networks, consisting of 150 healthcare professionals and 300 connections, highlighted the pivotal roles of central figures in facilitating the exchange of critical tacit knowledge. This tacit knowledge, including clinical insights and procedural tips, was found to differ significantly from the structured information typically disseminated through formal channels, underscoring the unique value of informal knowledge exchanges in the healthcare sector.

Participation in these informal networks was shown to have a positive impact on decision-making and healthcare outcomes. The regression analysis confirmed a significant relationship between network involvement and enhanced decision-making efficacy and policy formulation, validating the hypothesis that these networks accelerate the adoption of innovative practices. Survey results indicated that 75% of healthcare staff perceived a moderate to high impact of informal networks on their daily practices, with an average Likert scale rating of 4.2 out of 5. This high perception of impact suggests that informal networks are crucial in shaping both everyday clinical decisions and broader health outcomes.

DOI: 10.2563/acta.sci.2024.2.14

ISSN: 2178-7727

Furthermore, the study highlighted the correlation between the efficacy of informal networks and improvements in healthcare outcomes, supporting the hypothesis that better-integrated networks enhance overall system performance. Despite the benefits, the study also identified concerns about misinformation and lack of accountability, reported by 60% of interviewees. These concerns underscore the necessity for formal mechanisms to validate tacit knowledge. To mitigate these risks, the study recommends implementing training programs and knowledge-sharing initiatives that integrate informal networks into formal systems. These initiatives are essential for optimizing public health strategies, reducing the impact of misinformation, and enhancing overall system performance. The findings from Romania provide valuable insights that could be applied to other healthcare systems undergoing similar reforms, emphasizing the importance of leveraging both formal and informal knowledge networks to achieve better healthcare outcomes.

Contribution and Practical Implications:

Drawing from comprehensive research, including extensive interviews and meticulous analysis, this study unveils the vital role of informal knowledge networks within Romania's healthcare sector. These findings present a tangible opportunity for decision makers at both governmental and organizational levels to enhance their knowledge management strategies and decision-making processes.

For policymakers within Romania's healthcare system, this research offers invaluable insights into the grassroots mechanisms influencing policy formulation and healthcare delivery. By acknowledging and leveraging these informal networks, policymakers can empower frontline healthcare workers and improve the overall quality of patient care. Strategies such as fostering open communication channels, encouraging knowledge-sharing initiatives, and implementing mentorship programs can facilitate the integration of informal knowledge into formal systems.

At the organizational level, healthcare institutions have a clear pathway to optimize their knowledge management practices. Implementing practical solutions such as collaborative platforms for information exchange, mentorship programs to facilitate knowledge transfer, and incentivized initiatives to encourage knowledge-sharing behaviors can foster a culture of continuous learning and innovation. Moreover, leveraging advanced data analytics tools can help identify and capitalize on tacit knowledge embedded within informal networks, leading to more informed decision-making and improved operational efficiencies.
Beyond the healthcare sector, the implications of this research extend to organizations across industries. By embracing a holistic approach to knowledge management that values both formalized systems and informal networks, businesses can foster a culture of collaboration and innovation. Practical steps such as establishing cross-functional teams, creating platforms for knowledge-sharing, and investing in employee training and development can drive organizational success and competitiveness in today's dynamic business environment.
Finally, this research provides actionable insights for decision makers and knowledge management practitioners to enhance their organizational processes. Humanized knowledge management prioritizes people over processes and technology and shall foster a culture where employees feel empowered to share insights, collaborate, and learn from each other. This approach emphasizes the importance of human relationships, communication, and trust in driving organizational success through effective knowledge sharing and innovation.

Problems of the research

Throughout the course of this research endeavor conducted in Georgia, several challenges and obstacles were encountered, which necessitated meticulous navigation and adaptation by the research team. One significant challenge arose from the geographical distance between the researchers and the study's location, requiring the engagement of a consultancy firm, Royal Education LLC, to facilitate the administration of surveys and interviews. However, this intermediary arrangement, facilitated through university channels for student recruitment, introduced complexities and delays into the research process, contributing to its protracted duration and heightened costs.

ISSN: 2178-7727

Moreover, the research team encountered linguistic barriers during interactions with participants, further complicating communication and data collection efforts. Despite these challenges, the research team remained steadfast in their commitment to upholding rigorous research methodology and ethical standards throughout the study. Efforts were made to mitigate the impact of these challenges through comprehensive planning, proactive communication, and continuous adaptation of strategies to ensure the integrity and validity of the research findings.

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