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Innovative Approaches to Prevent and Detect Medical Insurance Fraud: A Systematic Literature Review

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ABSTRACT: Health insurance fraud is a significant issue that profoundly impacts the global healthcare sector, resulting in substantial financial losses. To address this problem, previous researchers have developed various methods and techniques to detect and prevent fraud in the realm of health insurance. This study presents a systematic literature review that analyzes 21 research articles focusing on innovative methods for preventing health insurance fraud. The primary objective of this research is to gain a comprehensive overview of the methods and approaches employed to detect and prevent fraudulent claims and activities in the field of health insurance. The study utilized a systematic search and screening method to analyze relevant articles. The selected research articles demonstrated various prevention efforts, including data analytics, machine learning, empowerment initiatives, and more. Each study was analyzed for its objectives, methodology, data, innovation success, and research findings. The results of the systematic review reveal numerous approaches and techniques used to prevent and detect health insurance fraud. In this context, machine learning and data analytics-based innovations have shown promising results in detecting fraudulent activities. Conversely, for prevention, blockchain technology can be implemented to enhance security systems. The research also highlights weaknesses and challenges in previous studies. The findings from this research can aid in the development of more effective fraud detection and prevention systems, contributing to a reduction in fraud rates and losses in the health insurance sector.

KEYWORDS: medical insurance fraud, systematic literature review, detection, prevention

I. INTRODUCTION

Trend in global healthcare services shows a complex ecosystem that relies on trust, integrity, and transparency to ensure the provision of the best quality services for those in need (Krot & Rudawska, 2021). The heart of this healthcare system is health insurance, a basic mechanism that provides financial protection for patients while ensuring that healthcare providers can offer their services (BBG, 2019). However, the trust that should be built two ways is constantly being threatened by a dangerous threat, namely medical insurance fraud. Additionally, the ACFE reported that the insurance services sector experienced 69 cases of fraud, with a median loss of $190,000 (ACFE, 2024).

Medical insurance fraud has many types, which always pose a challenge to the sustainability and integrity of global healthcare services. This results in the erosion of trust, loss of money, and patients being unable to receive the services they deserve. Surveys show that the Asia-Pacific region has the highest number of medical insurance fraud cases in the world (Asia Adviser Network, 2021), including Indonesia. The results also indicate that the prevalence of this type of fraud is higher in countries that tend to be poor compared to wealthy countries, such as Indonesia, which is located in Southeast Asia (UNODC, 2013).

The number of cases makes medical fraud prevention important to investigate for various reasons. First, for economic reasons, where health insurance fraud cases result in apparent expenses from premium payments; in the long run, this can lead to an increase in the country's expenditure on healthcare services (Kelly, 1991; FBI, n.d). Therefore, understanding and mitigating fraud is essential to resolve this financial burden. Second, this fraud can also result in suboptimal healthcare handling, delays, and rejections of treatment (NHCAA, n.d). In the long run, this can affect patients' health and public health conditions as a whole. Additionally, high healthcare costs, one of which is caused by fraud, can limit access to healthcare services, especially for vulnerable populations (NASEM, 2018).

Medical insurance fraud also has an impact on the decline in public trust in the healthcare system, resulting in people being hindered from seeking healthcare services or investing in appropriate insurance (NASEM, 2018). Therefore, research on this topic is necessary.

Through in-depth research on fraud, we pave the way for a more inclusive and accessible healthcare service transformation, with a commitment to ensuring that every individual has access to essential healthcare services. Research related to fraud prevention is an important foundation for creating innovations and adaptations that are appropriate to the dynamics and challenges faced. This is not just a strategy, but the main foundation for maintaining the integrity and sustainability of the healthcare service system. The rapid development of technology brings various opportunities and challenges in efforts to prevent fraud, and that is why research is the basis for exploring approaches that integrate technology, data analysis, and artificial intelligence to comprehensively address this issue. Valid and reliable research findings also provide a basis for policymakers to design effective and equitable anti-fraud methods, which in turn support the development of inclusive policies. Due to its global nature, research in this field also strengthens best practices and global collaborations needed to effectively address fraud. No less important, financial sustainability is another key element because the sustainability of the healthcare service system and insurance market depends on handling this issue wisely.

This research aims to explore various issues related to medical insurance fraud prevention. We delve into various types of fraud in the healthcare sector and the various methods used to commit fraud. We present an in-depth analysis of the consequences of fraud, including the financial burden borne, the decline in the quality of healthcare services, and its impact on insurance owners. This review aims to provide a comprehensive explanation of the methods and motivations for committing health insurance fraud, as well as to produce an effective and sustainable framework. By analyzing various elements that contribute to health insurance fraud, we hope to demonstrate the urgency of adopting innovative approaches to address this issue directly.

II. THEORETICAL BACKGROUND

A. Fraud Triangle Theory

The Fraud Triangle Theory is a theory that can help explain the conditions and factors that cause individuals to engage in fraudulent activities. This theory is widely used in criminology, investigation, and fraud prevention to understand the motivations and psychological aspects behind fraudulent activities. The theory states that individuals commit fraud for three reasons: pressure, opportunity, and rationalization that doing so will not conflict with the values they hold.

Pressure or motivation is financial or personal pressure that motivates individuals to do something. This pressure is usually external, such as piling up debt, financial difficulties, and personal crises; or internal, such as a desire for wealth or ownership of valuable items. This pressure is a driving factor for fraud and creates motivation for individuals to engage in fraudulent activities. When individuals are forced to solve their financial or personal problems, they are more likely to commit fraud.

Opportunity or chance refers to the creation or existence of opportunities in an individual's environment that allows them to 5commit fraud without being detected. This can refer to weaknesses in internal organizations, negligence, or vulnerabilities in financial processes. Opportunity is an important aspect because if someone is under pressure and has a motivation to commit fraud, they will not do so if the chance of being caught is considered too high. Therefore, opportunity reduces the risk of fraud.

Rationalization is something related to how individuals justify fraudulent behaviour to themselves. This often involves making justifications or reasons for their behaviour, such as that they deserve the money, or how the organization is dishonest (corrupt). Rationalization is a cognitive process that allows individuals to align fraudulent behaviour with their self-image as honest and ethical individuals. This is an important component because it makes fraudsters overcome guilt and ethical dilemmas with their behaviour.

B. Routine Activities Theory

Routine Activities Theory (RAT) is a criminology framework that can explain various types of crimes, including crimes of opportunity. This theory was developed by Cohen and Felson (1979). According to this theory, there are three components that can explain crime. The offender refers to an individual who has the motivation or drive to commit a crime. Motivation can vary, including financial goals, personal satisfaction, or problem-solving. The target refers to entities or objects that are attractive or potential for the offender. Target suitability is influenced by factors such as value, accessibility, and ease of becoming a victim. In the context of RAT, the target is considered suitable if it is less guarded.

The next component is the absence or weakness of guardianship from guardians who can protect potential targets. Guardians in this case can mean people or security systems that can make offenders change their minds. If there is no or insufficient guardianship, this makes it easier for offenders to commit crimes.

In this theory, it is stated that all three components must be present at the same time and place to cause a crime. When the three elements come together, the likelihood of crime increases significantly. If we adjust it to the context of fraud or classified as a crime of opportunity, it means that crime occurs more because of conditions that support crime, not because of strong criminal tendencies or social factors. RAT emphasizes the importance of focusing on situational aspects in crime prevention, such as making targets less suitable, increasing security, and reducing opportunities for offenders to commit crimes.

III. RESEARCH METHODS

Systematic Literature Review (SLR) is a research method that selectively reviews, evaluates, and synthesizes previous research to answer research questions (Dewey & Drahota, 2016). SLRs usually contain a synthesis of previous research on a topic presented clearly to identify, define, and evaluate research on the topic.

A. Literature Search Strategy

The literature search strategy used the PICO framework. PICO is a framework used to formulate good questions and facilitate literature searches in SLRs (Methley, et al., 2014). PICO is a structured framework used for formulating research questions and developing systematic literature reviews, particularly in healthcare and evidence-based practices. The acronym stands for Population, Intervention, Comparison, and Outcome, each representing a key element of a research question.

Population (P), refers to the specific group or demographic being studied, such as patients, healthcare providers, or institutions. The population defines the characteristics or conditions relevant to the study (Schardt, et al., 2007). In this context, the population includes healthcare providers, insurance companies, patients, or entities involved in the healthcare insurance system. Intervention (I), represents the treatment, procedure, or strategy being investigated. It includes innovations, therapies, or tools used to address a particular problem (Richardson, et al., 1995). This may include emerging technologies (e.g., blockchain, artificial intelligence), policies, or data-driven detection mechanisms (such as big data analytics or machine learning algorithms). Comparison (C), describes the alternative to the intervention, which can include a placebo, another treatment, or no intervention at all. This element allows researchers to assess the relative effectiveness of the intervention (Stone, 2002). This study considers comparing innovative methods with conventional approaches, such as manual audits, report-based investigations, or standard verification processes. Outcome (O), refers to the measurable results or effects expected from the intervention, such as improvements in health, reductions in cost, or changes in practice (Huang, et al., 2006). The outcomes may include a reduction in the incidence of medical insurance fraud, improvements in the efficiency of claims processing, or a decrease in operational costs associated with fraud. This framework facilitates precise and focused searches for evidence in academic databases, ensuring relevance and comprehensiveness in the review process.

B. Database and keywords

The data sources used in this study come from ScienceDirect, JSTOR, Emerald Insight, and Springer Link in the form of journal articles from Scopus-indexed journals found with the help of Hazard Publish and Perish software. Some of these data sources were selected because they offer journals and articles with complete text and provide many articles that can be used as research objects. The search for articles or journals needed for research is done using keywords (AND, OR NOT or AND NOT). This method will expand and make the search more specific, making it easier to find relevant articles on the research topic. The keywords used are “medical insurance fraud” OR “healthcare insurance fraud prevention” OR “fraud prevention” OR “healthcare insurance fraud” “strategy” OR “detection.”

C. Literature Criteria

There are two criteria used to sort and select articles used in this study, namely inclusion and exclusion criteria. Inclusion criteria refer to the factors selected to select articles for analysis, while exclusion criteria refer to the factors used to determine that the articles sought will not be included in the analysis sample. These criteria are used to determine the suitability of data for the purpose and scope of the research. The inclusion criteria for this study consist of: (1) Scopus-indexed journals; (2) Accessed from data sources such as ScienceDirect, Emerald Insight, and others; (3) Articles with topics on medical insurance fraud; (4) Articles written in English; (5) Articles published between 2018 and 2023; (6) Full-text and open access manuscripts; and (7) Articles using primary data.

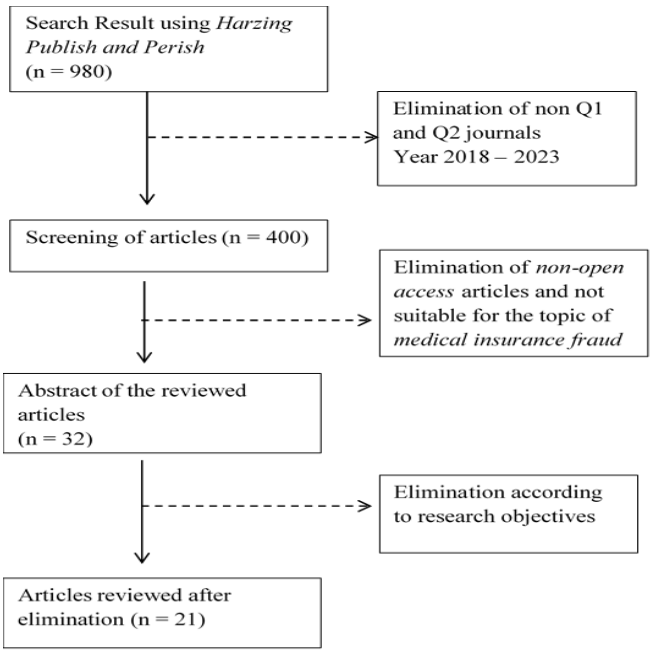

Diagram 1. Article Selection Mechanism Chart

IV. RESULT

Systematic Literature Review (SLR) is used to determine fraud prevention based on various alternatives through technology, policies, personality inventories, and other innovations. This research approach involves collecting articles from various data sources and conducting matrix analysis to see comparisons between studies, including methods, participants, types of innovation, results, and recommendations for future research.

A. Prevention Types Finding

Table 1. Overview of Innovation Types

Type of Innovation	Researcher	Amount	Percentage
Data analysis	Massi, et al. (2020	9	42,86%
	Kapadiya, et al. (2022)		
	Zhou, et al. (2020)		
	Matloob, et al. (2020)		
	Timofeyev & Jakovljevic (2022)		
	Ekin, et al. (2021)		
	Xihua, et al. (2019)		
	Gao, et al. (2018)		
	Baesens, et al. (2021)		
Machine learning	Herland, et al. (2019)	5	23,81%
	Sun, et al. (2018)		
	Amponsah, et al. (2022)		
	Arockiam & Pushpanathan, (2023)		
	Gong, et al. (2020)		
Combination of Data analysis dan Machine learning	Haque & Tozal (2023)	2	9,525%
	Johnson & Khoshgoftaar (2023)		
Security Technology	Ismail	1	4,76%
Legislative / policy	Clemente, et al. (2018)	1	4,76%
Empowerment	Drew & Farrell (2018)	1	4,76%
Framework	Abdullahi & Mansor (2018)	2	9,525%
	Haruddin, et al. (2021)		
Total		**21**	**100%**

B. Prevention Strategy Focus Findings

Table 2. Overview of the Fraud Management Strategy Focus

Strategy	Amount	Percentage
Prevention	5	23,81%
Detection	13	61,90%
Combined	3	14,29%
Total	**21**	**100%**

V. DISCUSSION

The Systematic Literature Review (SLR) used in this study provides insights into research on health insurance fraud, its types, and the methods used for detection and prevention. Especially without ignoring the many types of fraud, including fraud by healthcare workers, fraud by patients, and fraud in payments (Timofeyev & Jakovljevic, 2022; Zhou, et al., 2020; Baesens, et al., 2021). Fraudulent behaviour in health insurance can also be seen in the form of upcoding, unbundling, identity theft, and others. This complexity underlies the urgent need to develop comprehensive and adaptive strategies to address health insurance fraud behaviour. The discussion section will discuss the main findings and explanations of these phenomena.

Through the literature review conducted, it was found that there is substantial evidence supporting the role of technological advancements in addressing insurance fraud problems (Al-Quayed et al., 2023). These advancements have primarily been utilized in detection strategies that target fraudulent behaviour, showcasing significant improvements in both efficiency and accuracy. As highlighted in the results section, technologies such as machine learning, data analytics, and artificial intelligence are pivotal in fraud prevention efforts. Machine learning algorithms, for instance, have the capability to learn and adapt over time, improving their accuracy in detecting fraud patterns with minimal human intervention (Johnson & Khoshgoftaar, 2023). Data analytics complements this by enabling the processing and visualization of complex datasets, uncovering hidden correlations that may indicate fraudulent activities (Matloob et al., 2020).

Moreover, artificial intelligence is integral to automating fraud detection, leveraging neural networks and predictive models to identify anomalies in real-time, often before the fraud fully occurs (Arockiam & Pushpanathan, 2023). However, while these technologies have shown great promise, there are challenges in implementation. These include data privacy concerns, the need for standardized regulations, and ensuring the adaptability of systems as fraud techniques evolve. Therefore, it is crucial to foster continuous innovation and investment in these technologies, while also integrating them with robust governance frameworks to maximize their effectiveness and sustainability in combating fraud.

The use of technology in detecting fraud problems must be accompanied by careful attention to ethical issues, particularly concerning privacy and data security. While advanced technologies like artificial intelligence and machine learning provide robust tools for fraud detection, they also involve processing large amounts of sensitive personal data, which can expose vulnerabilities if not managed properly. Innovations such as blockchain, as highlighted in Kapadiya's research et al. (2022), offer a promising solution to reinforce security systems by ensuring data immutability and transparency. Blockchain can prevent unauthorized access and misuse of consumer data, reducing the risks of insurance fraud and enhancing trust between stakeholders.

However, safeguarding privacy requires more than technological fixes. Ethical frameworks must guide how data is collected, shared, and utilized to prevent exploitation and maintain public trust. For instance, Margam (2023) emphasizes that ethical practices in healthcare data usage are foundational to fostering trustworthy systems. Additionally, Chiruvella and Guddati (2021) stress that data privacy should be a cornerstone of fraud prevention strategies, ensuring that innovations do not inadvertently jeopardize patient confidentiality. Balancing effective fraud prevention with stringent data protection measures is vital, calling for the integration of robust policies and compliance mechanisms alongside technological advancements.

In addition to technology that focuses on detecting fraudulent activities, significant attention must be directed toward preventive measures and policy implications. Prevention is inherently proactive, aiming to minimize the likelihood of fraudulent behaviour before it occurs. Drew and Farrell's (2018) research on self-protection programs demonstrates the utility of educating individuals and organizations to recognize and mitigate potential risks. Similarly, Clemente et al. (2018) underscore the value of clear, enforceable policies to establish a framework that discourages fraudulent actions while fostering accountability.

Prevention strategies are also widely acknowledged as more cost-effective compared to reactive approaches, which often incur significant financial and reputational damage (Dyck et al., 2010). Effective prevention measures include identifying and addressing vulnerabilities within systems or specific population groups. For instance, Haruddin et al. (2021) and Abdullahi & Mansor (2018) highlight the critical role of identifying risk factors such as opportunity, a key element of the Fraud Triangle Theory (TFT).

To mitigate these risks, it is essential to adopt a multi-layered approach. This includes implementing robust security systems, conducting regular audits, offering comprehensive data security training, and fostering collaboration among stakeholders. Policies

promoting transparency and standardization across the insurance industry are equally important to ensure sustainable fraud prevention strategies. Ultimately, a balanced combination of technology, education, and policy interventions can create a robust defense against fraud.

Through this literature review, it was found that systematic collaboration between various fields such as law, technology, and health is crucial to developing comprehensive and structured preventive measures against fraud. In the legal domain, establishing robust regulatory frameworks and enforcing stricter penalties for fraudulent activities can act as significant deterrents. Meanwhile, advancements in technology, particularly in artificial intelligence (AI) and data analytics, provide powerful tools for detecting fraud early and predicting fraudulent behaviours through behavioural analysis and predictive modelling (Sarkar, 2023; Dhirani, 2023). The healthcare sector contributes by ensuring secure handling of sensitive patient data and adopting ethical practices to maintain public trust (Dhirani, 2023).

In addition to inter-disciplinary collaboration, public awareness campaigns play a pivotal role in fraud prevention. These campaigns educate individuals and organizations about the different forms of fraud, common tactics used by fraudsters, and actionable steps to safeguard against exploitation. For instance, research indicates that tailored awareness programs targeting vulnerable populations and industries have proven effective in reducing fraud risk (ResearchGate, 2024). Such campaigns should leverage multiple platforms, including digital media, community outreach, and workplace training, to maximize their impact. Together, these collaborative and educational strategies create a robust, multi-faceted approach to combating fraud.

VI. CONCLUSIONS

Health insurance fraud poses significant challenges to the healthcare system, including misallocation of resources, compromised treatment quality, and substantial financial losses. These losses impact not only individuals but also insurance companies and national economies, highlighting the necessity of prioritizing fraud prevention as a critical aspect of system integrity. To combat health insurance fraud effectively, technological innovations such as artificial intelligence (AI), machine learning (ML), and blockchain have emerged as promising solutions. AI and ML enable the detection of complex patterns and anomalies in real-time, facilitating early identification of fraudulent activities. Blockchain enhances transparency, security, and accountability in data management, reducing vulnerabilities in claim processing.

Fraud prevention requires a holistic strategy that integrates various approaches. Technological tools like data analytics must be complemented by well-designed policies, strict legal frameworks, and public awareness campaigns. Education and training initiatives also play a critical role in empowering stakeholders to identify and mitigate fraud risks effectively. Collaborative efforts among policymakers, technology developers, and healthcare providers are essential to achieving comprehensive fraud prevention. By integrating innovative technologies with policy-driven and educational initiatives, a robust and sustainable solution to health insurance fraud can be realized. This combination ensures a proactive and adaptive response to evolving fraud tactics while maintaining the integrity and efficiency of healthcare systems.

VII. LIMITATION AND FUTURE RESEARCH

This literature review has several limitations that should be addressed in future studies. First, it exclusively focuses on research published in indexed journals, excluding studies published in lower-ranked or non-indexed journals, as well as grey literature such as theses, conference proceedings, and unpublished research. As a result, certain valuable insights, especially those from emerging fields or underrepresented regions, may have been overlooked. Second, the scope is limited to peer-reviewed articles, omitting government publications, organizational reports, and data from anti-fraud agencies that could provide practical insights or real-world applications. Third, the timeframe of the reviewed research is restricted to 2018–2023, potentially missing out on the latest advancements or historical perspectives that might enhance the understanding of evolving trends.

Additionally, the review synthesizes research employing diverse methodologies and population groups, which presents challenges in integrating and comparing findings coherently. Greater standardization or a meta-analytic approach might provide a more unified perspective. Finally, the review adopts a global scope and does not delve into country-specific issues or contextual nuances. As fraud and its detection mechanisms can vary significantly by jurisdiction, future research should consider focusing on region-specific studies to provide more targeted insights. Addressing these limitations in future work can enhance the comprehensiveness and applicability of findings in combating fraud effectively.

Future research should foster systematic collaboration between diverse experts in fields such as health, technology, data science, law, and behavioural sciences. Such interdisciplinary approaches can provide a holistic framework for creating robust strategies to prevent and detect fraud. Specifically, the integration of advanced technologies like big data analytics and AI with legal and ethical insights can significantly enhance fraud mitigation efforts by tailoring interventions to specific contexts.

Longitudinal studies are essential to track the evolution of health insurance fraud over time. By identifying shifting trends and emerging vulnerabilities, these studies can inform proactive strategies and provide insights into population-specific risks. Additionally, future research should include impact analyses of health insurance fraud on healthcare quality, accessibility, and financial sustainability. Such analyses must employ both qualitative methods, such as stakeholder interviews, and quantitative methods, including statistical modelling, to capture the multifaceted nature of fraud's consequences.

Moreover, effectiveness studies of anti-fraud policies, regulations, and interventions are critical to evaluating their real-world applicability. Comparative research examining different policy frameworks and interventions across countries can highlight best practices and areas for improvement. Finally, research exploring ethical dilemmas in data sharing and fraud prevention could provide guidance on balancing security with privacy and inclusivity in anti-fraud initiatives. By addressing these areas, future research can lay the groundwork for a more resilient and fraud-resistant healthcare system. heading of the Acknowledgment section and the References section must not be numbered.

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