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Original Research Article

Biometric Strategies and Performance of Electronic Claim Processing at National Hospital Insurance Fund in Kenya

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Abstract: Over the years, there have been concerns about the rising number of fraudsters who work with hospitals to defraud businesses of millions of shillings in fake surgeries and treatments, while health service providers overcharge those who have insurance. To address this issue, medical insurance companies and businesses have implemented biometric authentication systems in collaboration with healthcare providers. The purpose of this study was to determine the effect of biometric adoption strategies on the performance of E-claim processing at NHIF Kenya. The research was guided by four theories that include Technology Acceptance theory, Technology Diffusion theory, and Institutional theory and Performance theory. This study used a descriptive research technique and the target population comprised of 78 senior executives at the NHIF offices in Upper Hill, Nairobi County. A census of 78 respondents was used for the study. The study established that NHIF Kenya had adopted various biometric strategies that included fingerprint recognition systems, Iris recognition strategy and facial recognition. The study concludes that clients expressed high preference with biometric data as it offered high level of security and quick access. NHIF Kenya had over the years realized an increase in operations efficiency, revenue from premium payment and quality delivery of services. It was recommended that NHIF should identify pain points, security vulnerabilities and areas where biometric authentication can be beneficial. The NHIF Kenya should continually evaluate effectiveness of E-claim processing system and should implement advanced fraud detection algorithms.

Keywords: Biometric strategies, electronic claim processing and performance.

INTRODUCTION AND BACKGROUND

Biometric strategies help reduce impersonations and enhance efficiency in claims processing. According to Biometrics (2021), biometrics is the best method (compared to the manual processes of identification) for quickly and accurately identifying and authenticating people based on their distinctive biological traits. Biometrics strategies are described as the automated recognition of people in relation to their biological and behavioural characteristics. Due to the complexity of the biometrics system, both the company and its clients feel secure because the system is protected against unauthorized cyberattacks. It provides precise identification of people and provide accountability to the users. To make the system more advanced and safer, the biometric identification method has been chosen over more conventional methods like pin codes and passwords (Waterson, 2022).

According to Hamann and Smith (2019) biometric technology is used by a Chinese insurance business to determine whether its clients may pose financial risks. The largest insurance provider in China, Ping utilizes facial recognition technology to determine whether consumers are unwell or trying to defraud the business. To reduce cases of fraud, the US-based health insurer Cigna permits Chinese consumers to submit health insurance applications using a signed photo rather than using a written signature. Facial recognition technology is being investigated by the healthcare industry for several uses, such as preventing fraud throughout the insurance applications process and enhancing patient care (CB Insights, 2020). Walmart an international shopping company based in the USA employs software from Clearview AI, Inc. to compare facial scans made at its Illinois retail locations with the billions of scans stored in Clearview's enormous facial recognition database (Harwell, 2022). Similarly, Jack Ma, the CEO of Alibaba once took a selfie and stated that

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his photo itself had completely processed a live payment on its own. In addition, this platform had established smile to pay as the facial recognition technology to be used in the Alibaba platform and the Alipay wallet service (Green, 2021). In the same account, Gomes, Jin and Yang (2021) posited that facial recognition technology whenever incorporated in health care's video surveillance system; it can facilitate patient check-in process, free up the employees of the hospitals and patients from paperwork and reduce the chance of human error as possible. According to Marketing (2022) Amazon did a commendable job concerning the voice tech. it just started from nowhere to beat everyone in matters of echo smart speakers, this was considered as one of the best performing Artificial Intelligence enabled consumer electronics. Voice-enabled biometrics are now a part of organizations expanding biometric strategy. With the aid of this technology, the organizations can recognize callers based on the first few words they say. In addition, voice recognition technology has enabled to analyse individual's unique voice rather than utilizing the traditional security passwords which get commonly forgotten or lost by customers to instantly confirm their identity. This has given organizations in UK a streamlined technique of authorisation while making a robust protection to counter the fraudulent calls (Ievo, 2020). The voice biometric system is harder to hack since it requires a lot of data and much time to learn its algorithm. Because voice biometrics are simple to use, quick, and accurate, they can increase an organization's productivity level. It helps hospitals process e-claims more quickly and spend less time on conventional authentication procedures (Sengupta, 2022). According to Rogulj (2020) Croatia is introducing biometric ID cards. Following amendments to the law on identity cards and the law on foreigners, biometric ID cards will also be issued to temporary digital nomads. According to European Parliament regulations, the IDs will contain biometric facial features and fingerprints. Enhancing the security of the information being provided. According to MacDonald (2021) Wella, the Chief Executive Officer (CEO) of Wella Medical Aid Society (WEMAS), a Malawian health insurance organization that utilizes biometrics to deal with insurance processes and share coverage data, indicated that the firm has significantly achieved success after only approximately 15(fifteen) months of operations. In addition, it has introduced innovative health scheme packages and partnered with more than 150 hospitals and pharmacies in South Africa. Additionally, it was the first medical insurance firm to go and adopt biometric technology in Malawi.

National Hospital Insurance Fund

National Hospital Insurance Fund in short (NHIF) is a public organization established in the year 1966 with the responsibility to provide mandatory health insurance to formal workers. In 1998, its responsibility expanded to include informal workers. NHIF membership is compulsory to formal workers, whose pay income-rated monthly contributions undergo statutory reductions, while the informal sector employees join voluntarily and pay their flat rate contributions are directly paid to the NHIF. NHIF is considered as the major health insurance provider within Kenya with 1984 staff members, 67 branches, 23 satellite officers, and employees at all Huduma centers. It covers 16% of Kenyans as compared to 32 private health insurance collectively covering merely 1% of the entire population of Kenya (National Hospital Insurance Fund, 2020). The report further indicated that percentage of Kenyans who have registered with NHIF increased from approximately 2.7 million in 2010 to 8.9 million in 2020.

Despite that more Kenyans have registered for NHIF between 2010 and 2020, its level of health insurance coverage has remained very low. And yet, Kenya has tried to make effort to meet the requirements of UHC to strengthen NHIF capability to deliver the promises that UHC has made to Kenyans (NHIF, 2020).

Statement of the Problem

The Insurance Regulatory Authority (IRA) has urged Kenyans to stop filing fictitious insurance claims because the practice is detrimental to the country's economy (IRA Report, 2022). There are also concerns about the rising number of fraudsters who work with hospitals to defraud businesses of millions of shillings in fake surgeries and treatments, while health service providers overcharge those who have insurance (AllAfrica, 2022). According to estimates, 40% of all claims in the medical insurance business were fraudulent in 2009. This resulted in revenue losses (Mbogo, 2011). To address this issue, medical insurance companies and businesses have implemented biometric authentication systems in collaboration with healthcare providers (IRA Report, 2022).

Data from the fiscal year of June 2020, as noted by Alusha (2021) NHIF raised Sh59.5 billion from its 8.9 million members and paid out Sh54.9 billion or 92.2 % as claims to hospitals. According to the NHIF Revised Strategic plan for 2018-2022 the claim/loss ratio was 80% against the revenue collected. As of June 2020, there were 8,189 healthcare providers registered with the NHIF, up from 4,281 in 2017.The Health Sector Working Group (SWG) Report 2021/22-2023/24. According to Alusha (2021) this has since become a problem since the claim's payout ratio increased from 55% to 92.05% in the year 2021. Additionally, Ngetich (2021) said that NHIF lost 20% of their collections because of fraudulent and fictitious claims in the year 2020. According to Ngetich (2021), NHIF has also been making losses through fictitious claims of up to 16.5 billion annually.

Research has been conducted on biometric adoption strategies and the performance of E-claim processing. Mwapasa *et al.*, (2020) conducted a study on the use of biometrics in the healthcare system in Malawi. They found that stakeholders believe that implementing

biometrics can have various ethical benefits and risks. There is a gap in the study as it focused solely on biometrics and overlooked the E-claim processing aspect. In a recent study by Koech and Akuku (2021), the impact of biometric registration technique on service delivery at NHIF branches in Uasin Gishu County was examined. The findings revealed that the utilization of biometric registration technique improves the efficiency of operations at NHIF. There is a gap in the study as it focused only on biometrics and did not consider E-claim processing. There is a contextual gap because the study focused on NHIF in Uasin Gishu County rather than NHIF headquarters in Kenya.

Purpose of Study

The purpose of this study was to determine the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya.

Objectives of the Study

i. To establish the types of biometric strategies adopted by NHIF Nairobi, Kenya.
ii. To assess the measures of performance of E-claim processing at NHIF Nairobi, Kenya.
iii. To examine the effect of biometric strategies on the performance of e-claim processing at NHIF Nairobi, Kenya.

LITERATURE REVIEW

Theoretical Review

Technology Acceptance Theory (TAM)

TAM was founded by Fred Davis in 1989. This model explains how customers adopt, recognize and use technology. In line with the theory, the perceived usefulness and perceived ease of use are the key factors that influence the adoption of a computer system by its potential users. Highlighting how potential users perceive things is a crucial aspect of this approach. Taherdoost (2018), Granic and Marangunic (2019) and Nadal, Sas and Doherty (2020) noted that TAM is important in biometric technologies. Biometric technologies cover a range of technologies utilized to verify the identification of people based on their unique physical or even behavioral features.

This model assumes that when an alternative innovation is presented to a customer, various factors influence the choice of methods and the timing of use. This includes the obvious simplicity and usefulness. TAM involves a well-established causal relationship between actual behavioral beliefs, purposes, and dispositions. Social medicine professionals have created this based on the notion of an intended activity. The two critical components are identified: perceived convenience and perceived utility (Ammenwerth, 2019). TAM is widely used and is instrumental in formulating a prediction about an individual's technology use (Muchran & Ahmar, 2019). Perceived utility and intent to adopt are influenced by perceived ease of use (Muchran & Ahmar, 2019).

Although TAM is an essential source of theoretical framework in the study of technology adoption and use, it has numerous limitations, including the original goal of modeling, which is parsimony and generality (Kim & Wang, 2021). It does not consider the non-organizational environment of the organization and loses the elements that regulate the adoption of ICT (Dutot, Bhatiasevi & Bellallahom, 2019). As Camilleri and Falzon (2021) indicated, perceived usefulness and perceived ease of use are crucial factors in the determination of the acceptance of a technology by potential users.

Biometric technology (BT), such as fingerprint recognition, face recognition and iris recognition, is used in information security and personal identification. Individual and institutional acceptance and adoption of the technology is crucial for companies to successfully deploy BT (Liu, Li & Han, 2022). TAM offers valuable insights into the factors that influence the adoption of biometric strategies such as fingerprints recognition strategy, facial recognition strategy and iris Recognition Strategy, particularly in terms of perceived usefulness, ease of use, attitudes, and behavioral intentions. Therefore, TAM will be useful in the current study as it will help the NHIF to integrate electronic claims processing as a form of technology, which will improve the efficiency and accountability of claims processing as well as the performance of the NHIF.

Performance Theory

Mento, Locke and Klein (1992) made the hypothesis. This theory states that goals are viewed as goals for the future to enhance the performance of an individual or organization. It further holds that individuals or firms perform well whenever they set for themselves more challenging objectives. In contrast, if the objectives are so simple, their performance suffers. Mento et al (1992) argued that the performance theory was based on five factors namely clarity, engagement, challenge, task complexity and feedback. This implies that setting goals enables the development of action plan for guiding people and firms.

The criticism is directed against the performance theory. First, implementation was said to be time-consuming and expensive, as many elements needed to be considered for companies to achieve their goals. These include hiring the right people with the right skills and knowledge, the need for training for career growth and organizational productivity, and the incurring of costs. In addition, there is the possibility of internal competition as employees often compete. In such cases, the company's interest and goal is to ignore and focus on individual performance (Barry, 2020). These insights are important to determine how NHIF can

leverage biometrics in the form of E-Claim processing to improve NHIF's performance.

Empirical Literature Review

Ode-Martins (2021) used a qualitative exploratory case study to examine the challenges of biometric technology in Nigeria to strengthen information security. The study involved collecting and analyzing data from 10 professional IT managers on Victoria Island, Lagos, Nigeria, between the ages of 21 and 55, who had worked as supervisors, deputy managers or managers in the information technology security field. Biometrics has been found to provide individuals responsible for criminal activity with unique identity, recognition and accountability. Biometric technology can provide the person with credible proof that a transaction has been completed as all biometric data is unique and difficult to reproduce. There is a gap as the previous study was based on qualitative data and used an exploratory research style, while the current study will use quantitative data and a descriptive research design. The above study also did not specify how the qualitative data was analyzed. The study also focused on the challenges of biometric technology in Nigeria to strengthen information security, which presents a different context than the current study, which focuses on the performance of NHIF Kenya's electronic claims processing. The current study focuses on the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya so as to fill existing gap.

In a study conducted by Simiyu (2021), strategy implementation and organizational performance at NHIF Kenya were investigated. The research design was descriptive, and 110 NHIF staff members were targeted for the study. Questionnaires were utilized for gathering primary data, which was then analyzed using descriptive statistics in SPSS. In the study, Cronbach's alpha was utilized to assess the reliability of the research tool. The study used a multiple linear regression model to establish the impact of the independent variable on the dependent variable. The model demonstrated an R-squared value of 0.527, with ANOVA results indicating an F-statistic of 17.008 and a p-value of 0.000, both below the threshold of 0.05. The study's findings revealed that the organizational structure, organizational culture, and communication greatly influenced the operations of the NHIF in Kenya. The impact of organizational leadership on the performance of the NHIF was rated as negligible. There is a gap as the study variables were organizational leadership, organizational structure, organizational culture, and communication, all of which impacted performance, but the current study focuses on fingerprint technology, facial recognition, and recognition tactics by iris. The study was also limited to the implementation of the strategy and the performance of the NHIF organization; accordingly, the current study aims to fill the gap by focusing on the impact of biometric deployment methods on the performance of NHIF Kenya's electronic claims processing. The present study focuses on the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya so as to fill existing gap.

Koech and Akuku (2021) conducted a study to explore the impact of biometric registration technique and service delivery at NHIF branches in Uasin Gishu County. We utilized a straightforward random sampling method to choose the participants. The study used a structured questionnaire for data collection. Additionally, a descriptive research design was used. Descriptive and inferential statistics were analyzed using SPSS 25.0 and MS Excel. Descriptive statistics involved analysis of frequency, means, and standard deviation, while inferential statistics included correlation and regression. The study discovered that implementing biometric registration technology in NHIF has improved the accessibility of information and the accuracy of personal data identification. This has made the use of biometric registration more convenient for both customers and NHIF. There is a gap in the study as it focused solely on biometrics and overlooked E-claim processing. There is a contextual gap due to the study focusing on NHIF in Uasin Gishu County rather than NHIF headquarters in Kenya. This study emphasizes the effect of biometric strategies on E-claim processing performance at NHIF Nairobi, Kenya to address a gap in the research.

Mason *et al*., (2020) examined biometric authentication in the UK healthcare system through a primary data collection questionnaire. Analyzed data from a survey of 324 adult respondents, which included 167 healthcare consumers and 157 individuals in the healthcare field. Biometrics enables the identification of individuals through their physical and behavioral traits. The integration of biometrics and information technology in healthcare has led to a novel technique for determining patient identity. Biometric technology has been shown to be more acceptable to healthcare providers than consumers. It was found that vendors' attitudes towards the potential uses and limitations of biometrics differed more from those of customers. There is a gap because the previous study did not conduct a pilot study to verify the reliability and validity of the instruments. The study also only performed descriptive data analysis, ignoring inferential statistics such as regression and correlation. The study also looked at biometric authentication in the healthcare sector in the UK, which is different from Kenya. The present study focuses on the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya so as to fill existing gap.

Mwapasa *et al*., (2020) conducted a study on the implementation of biometrics in the healthcare system of Malawi. A study was carried out to investigate biometric clients (n=14), implementers (n=12), policy makers, and bioethicists (n=4). The research utilized qualitative data

collection and analytical techniques. Thematic guidelines were developed based on a thorough review of the existing literature. The study identified key employees with various specialized areas and expertise in biometrics through targeted random sampling. Experts argue that integrating biometrics into a healthcare system in low- and middle-income countries such as Malawi presents numerous potential advantages and ethical challenges. It is important to gather input from various stakeholders to affect policy creation and execution, as well as to assess the advantages and disadvantages of using biometrics for identification. Only qualitative data was used in the previous study, while quantitative data is included in the current study. The study also only pointed to the use of biometric data in the Malawian health system. Therefore, the current study is relevant to fill the gap regarding the impact of biometric introductory techniques on the performance of NHIF Kenya's electronic claims processing.

Singh, Srivastava, and Singh (2019) conducted an empirical review of previous work to focus on payment card fraud prevention using biometrics in India. It was found that the proposed wording to prevent credit card fraud through biometric user verification provides an additional level of protection. The standard biometric system has shown a good compromise between the true acceptance rate and the false acceptance rate; however, implementation depends on cost, speed, and applications. While biometrics such as fingerprints can be used to verify users, environmental factors such as workers and extremely cold locations can prevent users from completing the verification process due to missing fingerprints. Clear fingerprints or a shift in detail due to poor rub line compliance. There is a gap as the previous study was qualitative in nature and used secondary data from a literature review, while the current study is quantitative in nature. The study also focused on the use of biometrics to prevent payment card fraud, so the context was not in the insurance industry, specifically NHIF. The current study focuses on the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya so as to fill existing gap.

In a study conducted by Tangai, Kaguta, and Yi (2019), a census was utilized to examine the effects of user-friendliness and fallibility of biometric fingerprint technology on criminal identification in Kenya. Primary data was collected using a self-administered semi-structured questionnaire. We analyzed the data using the SPSS version 22 software. Descriptive and regression analyses were utilized. We analyzed how the variables impacted offender identification through multiple linear regressions. The research revealed that the user-friendly nature of biometric fingerprint technology results in improved fingerprint capture quality and efficiency. Enhancing the quality of a fingerprint has important implications for identifying criminals. Moreover, the research revealed that the limitations of biometric fingerprinting technology positively and significantly affect criminal identification. There is a gap in the research as the previous study examined the effects of biometric fingerprinting technology on criminal identification, while the current study looked at how biometric insertion methods affect electronic claims processing at NHIF Kenya. This study is centered on investigating how biometric strategies affect the efficiency of E-claim processing at NHIF Nairobi, Kenya to address a specific gap in the research.

Mirenga (2018) examined the performance factors of NHIF-labelled healthcare providers in Kenya. 75 employees from five hospitals in the areas of management, administration and wards took part in the study. The study used a stratified random sample, and the data were analyzed using descriptive and inferential statistical methods. According to the results of the study, the better an employee's understanding of a particular healthcare service provided by NHIF Healthcare Provider, the more likely it is to be practiced. Based on market research and service performance, there was a significant correlation between the two variables. The study suggests that staff should be trained more on this variable to improve bi-directional optimization, productive capacity management and workflow management for better service performance. There is a gap as the study does not explain how the questionnaire was tested before collecting data from 75 employees to verify that the instruments are correct and valid. The study also focused on the performance determinants of NHIF-designated healthcare providers but excluded the concept of biometric methods of introduction. The present study focuses on the effect of biometric strategies on the performance of E-claim processing at NHIF Nairobi, Kenya so as to fill existing gap.

RESEARCH METHODOLOGY

This study used a descriptive research technique as it facilitates the investigator to gather huge amounts of information from a huge population in a very efficient, simple and inexpensive method through structured questionnaires as noted by Saunders, Lewis and Thornhill (2019). Therefore, this study population's included all 4,652 NHIF employees at the headquarter and the various branches in Kenya (NHIF Human Resources, 2023). The study targeted 78 senior executives at the NHIF offices in Upper Hill County, Nairobi. This study adopted a census sampling technique. This study adopted a semi-structured type of questionnaire while collecting the primary section of data. The study handed out the questionnaire to chosen employees with the assistance of a research assistant. Data analysis involves using analytical and logical reasoning to assess each data component, enabling the finding of valuable information and the formulation of conclusions. The data was collected in both quantitative and qualitative forms, and the analysis was conducted using descriptive statistics. SPSS was utilized to generate

frequency distributions, tables, percentages, means, and standard deviations for quantitative data analysis.

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

Effect of Biometric Adoption Strategies on Performance of E-Claim Processing.

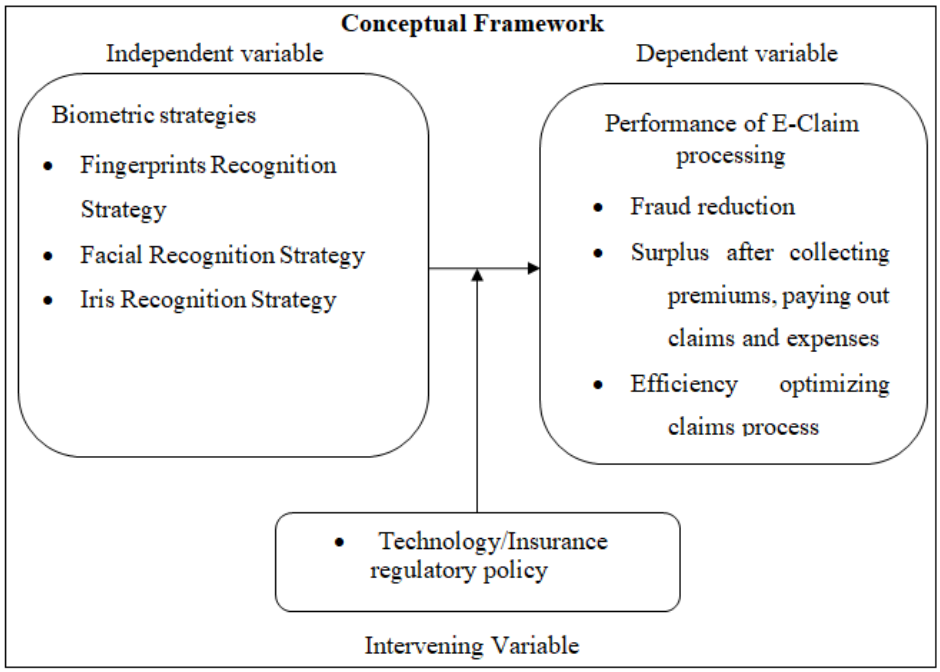

Figure 2.1: Conceptual framework

Table 4.1: Effect of Biometric Adoption Strategies on the Performance of E-Claim Processing

Statement	Strongly Disagree		Disagree		Neutral		agree		Strongly agree		Mean	Std dev
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent		
Fingerprints biometrics strategy has contributed greatly in terms of enhanced efficiency thus increasing NHIF premium	0	0	0	0	0	0	40	55.6	32	44.4	4.44	0.50
Facial recognition strategy has contributed greatly in terms of enhanced efficiency thus increasing NHIF premium	0	0	0	0	24	33.3	40	55.6	8	11.1	3.78	0.63
Iris recognition strategy has contributed greatly in terms of enhanced efficiency thus increasing NHIF premium	10	13.9	40	55.6	19	26.4	3	4.2	0	0	2.25	0.85
Fingerprints biometrics strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance	0	0	0	0	0	0	37	51.4	35	48.6	4.49	0.50
Facial recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance	0	0	0	0	0	0	27	37.5	45	62.5	4.63	0.49
Iris recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance	0	0	1	1.4	22	30.6	33	45.8	16	22.2	3.89	0.76

Source: Author (2023)

Table 4.7 displays the perspectives of the participants in regard with various statement regarding biometric adoption strategies on the performance of e-claim processing. The findings show that 40 (55.6%) of the participants agreed that fingerprints biometrics strategy has contributed greatly in terms of enhanced efficiency thus increasing NHIF premium while 32 (44.4%) of the participants strongly agreed with the statement. Overall, the statement had a mean of 4.44 the standard deviation of 0.50, which translates to "Agree". This therefore implies that fingerprints biometrics strategy has contributed greatly in terms of enhanced efficiency thus increasing NHIF premium. These findings support those of Haraksim and Beslay (2018) that fingerprint recognition provides a highly accurate method of verifying the identity of policyholders and claimants, this accuracy reduces the risk of identity fraud and ensures that claims are paid to the rightful beneficiaries.

According to the results, 40 (55.6%) of the participants indicated that the facial recognition strategy significantly improved efficiency and led to an increase in NHIF premium. 24 (33.3%) had a moderate opinion, and 8 (11.1%) strongly agreed. The statement had a mean of 3.78 and a standard deviation of 0.63. The data shows that majority of respondents agreed that the facial recognition strategy has significantly improved efficiency and boosted NHIF premium. These findings go hand in hand with those of Yang *et al*., (2019) that fingerprint biometrics add an extra layer of security to insurance transactions thus reducing the risk of unauthorized access and fraudulent activities, enhancing overall security.

The results indicated that 40 (55.6%) of the respondents disagreed indicate that the Iris recognition strategy significantly improved efficiency and increased NHIF premium. 19 (26.4%) had a moderate opinion on the matter, and 10 (13.9%) strongly disagreed. Additionally, 3 (4.2%) of the participants supported the statement. The data had a mean of 2.25 and a standard deviation 0.85, which translates to agree. On the whole, the data shows that the majority of respondents agreed that the Iris recognition strategy has not significantly improved efficiency or increased NHIF premium. These findings agree with the findings by Yang *et al*., (2019) that the public may have concerns about the collection of biometric data, including iris scans, by government agencies and that addressing privacy concerns and gaining public acceptance can be challenging and require extensive communication and education efforts.

The findings showed that 37 (51.4%) of the respondents agreed that fingerprints biometrics strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance while 35 (48.6%) of the respondents had a strongly agreement. In overall the statement had a mean of 4.49 and standard deviation of 0.50 which translates to strongly agree as per the measurement scale. This therefore implies that most of the respondents strongly agreed that fingerprints biometrics strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. These findings support those of Moriuchi (2021) that face biometrics provide a convenient and user-friendly way for individuals to authenticate themselves, in that users can simply look at a camera or device, eliminating the need to remember and enter passwords or PINs.

The study found that a majority of the respondents, specifically 45 (62.5%) expressed strong agreement with statement that facial recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. Furthermore, a significant proportion of the respondents, specifically 27 (37.5%) agreed with this statement. The statement exhibited a mean value of 4.63 and as standard deviation of 0.49 indicating a classification of "strongly agree". This therefore implies that most of the respondents strongly agreed that facial recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. These findings support those of Kubes and Rancak, (2018) facial recognition technology ensures that the person initiating a claim is the same individual associated with the policy. This biometric authentication method makes it difficult for fraudsters to impersonate policyholders or beneficiaries.

The research findings indicate that a majority of the participants, specifically 33 (45.8%), expressed agreement with the notion that Iris recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. Further, 22 (30.6%) of the participants held a more moderate perspective while 16 (22.2%) of the participants strongly agreed and 1 (1.4%) of the respondents strongly disagreed with the statement. The statement's overall mean was found to be 3.89 and a standard deviation of 0.76. This indicates that the response falls into the "Agree" category. This means the majority agree that Iris recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. These findings concur with those of Fernandes and Moreira (2019) that iris recognition has a high level of accuracy and precision in verifying the identity of individuals. The low false acceptance rate (FAR) and false rejection rate (FRR) ensure that authorized individuals are accurately identified while minimizing the risk of false positives and fraudulent access.

On the challenges in biometric recognition strategies that have affected performance of NHIF claims processing, the respondents indicated that inaccurate biometric data can lead to authentication failures, causing delays in claims processing. Concerns about data security and potential breaches can impact the

implementation and trust in biometric strategies. Network outages, power failures, or hardware issues can disrupt the biometric verification process. They also indicated that system downtime can disrupt the claims processing workflow and lead to delays.

Karl Pearson Correlation Analysis

Table 4.2: Karl Pearson Correlation Analysis

		Organizational performance	Fingerprints Recognition	Facial Recognition Strategy	Iris Recognition Strategy
Organizational performance	Pearson Correlation	1	.338**	.360**	.304**
	Sig. (2-tailed)		.004	.002	.009
	N	72	72	72	72
Fingerprints Recognition	Pearson Correlation	.338**	1	.115	-.118
	Sig. (2-tailed)	.004		.334	.323
	N	72	72	72	72
Facial Recognition Strategy	Pearson Correlation	.360**	.115	1	.128
	Sig. (2-tailed)	.002	.334		.286
	N	72	72	72	72
Iris Recognition Strategy	Pearson Correlation	.304**	-.118	.128	1
	Sig. (2-tailed)	.009	.323	.286	
	N	72	72	72	72
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Author (2023)

In Table 4.8 presents the findings regarding the relationship between independent and dependent variables. The study conducted a Pearson correlational analysis to explore the connection between the study variables. This analysis was conducted to demonstrate three key points. Initially, the focus was on determining if a connection existed between the variables. Following this, the emphasis shifted to assessing the intensity of the established relationship. Lastly, determining the direction of the relationship between these variables.

In the same point of thinking, Mutua and Kibe (2023) posited that the relationship was indicated by a value ranging from -1 to +1, at the same time, the results nearing one demonstrated a strong correlation, whereas values closer to 0 indicate a weak correlation. When two variables have a positive correlation, an increase in one variable leads to a movement in the same direction for the other variable.

The correlation factor of 0.338 indicated a weak positive link between fingerprints recognition and performance of NHIF Kenya, as shown in Table 4.9. The p value of 0.004 was less than 0.05, indicating that there was a statistically significant relationship between the two variables. The aforementioned data lend credibility to the propositions put forth by Beslay (2018) that implementing fingerprint-based access control systems, organizations can better protect their physical premises, sensitive data, and assets from unauthorized access, theft, or breaches.

The research findings indicated a strong correlation between the use of facial recognition strategy and the performance of NHIF Kenya. The weak positive correlation coefficient of 0.360 and a p-value of 0.002 were both below the significance level of 0.05. The significance level of 0.002 suggests a very low p-value. Without specific hypotheses, the small p-value indicates strong evidence that using facial recognition significantly improved NHIF Kenya's performance. These findings corroborate the conclusions of Naik (2020) that facial recognition systems streamline access control by allowing authorized personnel to gain access quickly and conveniently.

The study found a positive relationship between the iris recognition approach and the performance of NHIF Kenya. The correlation coefficient of 0.304 showed a weak positive association, and the significance value of 0.009, below the threshold of 0.05, further confirmed this result. The research conducted by Hanson and Kalyanam (2020) validates that iris recognition technology is efficient and precise, enabling swift identity verification. This may enhance patient check-in procedures, minimize wait times, and enhance the overall patient satisfaction in healthcare facilities.

Government Policy

Table 4.3: Moderating Effect of Government Policy

Statement	Strongly Disagree		Disagree		Neutral		Agree		Strongly agree		Mean	Std dev
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent		
There has been provision adequate resources in terms of technology to enhance adoption of biometrics in NHIF to facilitate E-claim processing	32	44.4	27	37.5	7	9.7	6	8.3	0	0	1.82	0.92
There has been provision adequate resources in terms of finance to enhance adoption of biometrics in NHIF to facilitate E-claim processing	42	58.3	18	25.0	10	13.9	2	2.8	0	0	1.61	0.83
There has been provision adequate resources in terms of IT personnel to enhance adoption of biometrics in NHIF to facilitate E-claim processing	34	47.2	26	36.1	5	6.9	7	9.7	0	0	1.79	0.95
The government through various investigative authorities have been supportive in terms of reduction of E-claim payment frauds at NHIF	37	51.4	13	18.1	17	23.6	5	6.9	0	0	1.86	1.01
The government Has supported NHIF through various revenue pooling systems to bridge the gap that exists in claim payment to clients	16	22.2	19	26.4	9	12.5	19	26.4	9	12.5	2.81	1.38

Source: Author (2023)

Table 4.9 displays the perspectives of the participants about their degree of concurrence with various statements regarding the moderating effect of government policy on the relationship between automation innovation and organizational performance. It was established that 32 (44.4%) of the respondents strongly disagreed that there has been provision adequate resources in terms of technology to enhance adoption of biometrics in NHIF to facilitate E-claim processing while 27 (37.5%) of the respondents disagreed with the statement. Further, 7 (9.7%) of the respondents were of moderate opinion while 6 (8.3%) agreed with the statement. In overall the statement had a mean of 1.82 and the standard deviation of 0.92 which translates to "disagree" as per the measurements scale. This therefore implies that there is a lack of adequate provision of resources in terms of technology to enhance adoption of biometrics in NHIF to facilitate E-claim processing. These findings correspond with those of Ode-Martins (2021) Organizations with outdated or incompatible IT infrastructure may face challenges when integrating biometric technology into their existing systems.

The findings revealed that 42 (58.3%) of the respondents strongly disagreed that there has been provision adequate resources in terms of finance to enhance adoption of biometrics in NHIF to facilitate E-claim processing while 18 (25.0%) of the respondents disagreed with the statement. Further, 10 (13.9%) of the participants were of moderate opinion while 2 (2.8%) of the respondents strongly agreed. Overall, the statement had a mean of 1.61 and the standard deviation of 0.83 which translates to "disagree" as per the measurement scale. This therefore implies that the majority of the respondents disagreed that there have been provision adequate resources in terms of finance to enhance adoption of biometrics in NHIF to facilitate E-claim processing. Results are consistent with those found by Koech and Akuku (2021) that implementing biometric systems, including hardware such as biometric scanners and software for data management and analysis, can be expensive. Organizations with limited budgets may struggle to allocate funds for these investments. Further biometric systems require ongoing maintenance and upgrades to ensure they remain effective and secure, in this light the cost of maintaining biometric databases can strain limited financial resources.

The results revealed that 34 (47.2%) of the respondents strongly disagreed that there has been provision adequate resources in terms of IT personnel to enhance adoption of biometrics in NHIF to facilitate E-claim processing while 26 (36.1%) strongly disagreed with the statement. Further, 7 (9.7%) strongly agreed with the statement while 5 (6.9%) of respondents held a moderate opinion. The mean score was 1.79 and a standard deviation of 0.95 (equivalent to disagree). This therefore implies that the majority of the respondents disagreed that has been provision adequate resources in terms of IT personnel to enhance adoption of biometrics in NHIF to facilitate E-claim processing. These findings concur with those of Mason et al. (2020) that implementing and managing biometric systems requires specialized technical expertise in fields such as biometrics, data security, and database management. If an organization lacks personnel with the necessary skills and knowledge, it can hinder the successful deployment of biometric technology.

It was noted that 37 (51.4%) of the respondents disagreed that the government through various investigative authorities have been supportive in terms of reduction of E-claim payment frauds at NHIF while 17 (23.6%) of the participants had a moderate judgment. Further, 13 (18.1%) of the respondents disagreed, while 5 (6.9%) of the respondents agreed with the statement. Overall, the statement had a mean of 1.86 and the standard deviation of 1.01 which translates to “disagree” as per the measurement scale. This therefore implies that most of the respondents agreed that the government through various investigative authorities have been supportive in terms of reduction of E-claim payment frauds at NHIF. These findings harmonize with those of Tangai, Kaguta and Yi (2019) that unresolved e-claim payment frauds can lead to inefficiencies in government programs and services, in that resources that should be allocated to those in need are diverted to fraudulent activities, diminishing the effectiveness of government initiatives.

It was observed that 19 (26.4%) of the respondents either agreed or disagreed that the government has supported NHIF through various revenue pooling systems to bridge the gap that exists in claim payment to clients while 16 (22.2%) of the participants strongly disagreed with the statement. Further, 9 (12.5%) of the respondents either held a moderate viewpoint or and strongly agreed with the statement. In general, the statement had a mean score of 2.81 and standard deviation of 1.38, indicating that it falls into the "moderate" category on the measurement scale. This therefore suggests that respondents were of moderate viewpoint that the government has supported NHIF through various revenue pooling systems to bridge the gap that exists in claim payment to clients. These findings concur with those of Mirenga (2018) that in insurance-based systems, governments can use revenue pooling to stabilize premium rates this promotes equity and ensures that vulnerable populations receive necessary support.

Summary of the Key Findings

1. It was agreed that the biometric strategies that had been adopted at NHIF included fingerprint recognition strategy, facial recognition strategy and Iris recognition strategy. Fingerprint recognition strategy was adopted at NHIF due to its acceptability by clients as indicated by a mean of 3.82 and due to its accuracy in terms of verification as indicated by a mean of 3.61. Facial recognition strategy was adopted at NHIF organization due to its accuracy in terms of verification as indicated by a mean of 3.79 and due to its acceptability by clients as indicated by a mean of 3.81. Iris recognition strategy was adopted due to its acceptability by clients as indicated by a mean of 2.17.
2. It was revealed that there has been an increase in revenue in terms of NHIF premium payment over the years indicated by a mean of 4.08, a reduction in terms of fraud reduction regarding claims paid by NHIF indicated by a mean of 4.06 and NHIF has been able to improve its services in terms of its reliability to claims paid as indicated by a mean of 4.11. It was agreed that NHIF has been able to improve its services in terms of its responsiveness to customers claim payment over the years as indicated by a mean of 4.13 and processing time of claim payment by NHIF has reduced over the years as indicated by a mean of 4.13. it was agreed that there has been elimination of error and data redundancies in claim payment over the years as indicated by a mean of 3.86.
3. The research revealed a statistically significant positive association (r = 0.338) between fingerprints recognition and performance of NHIF Kenya. The research findings also revealed a significant positive correlation (r = 0.360) between facial recognition strategy and performance of NHIF Kenya. Similarly, a positive relationship (r = 0.304) was observed between the iris recognition strategy and performance of NHIF Kenya.
4. The research revealed that the government through various investigative authorities have not been supportive in terms of reduction of E-claim payment frauds at NHIF (37 (51.4%), there lacks adequate provision of resources 34 (47.2%) in terms of IT personnel to enhance adoption of biometrics in NHIF to facilitate and that The Kenyan government has not supported NHIF through various revenue pooling systems to bridge the gap that exists in claim payment to clients (19 (26.4%).

CONCLUSIONS AND RECOMMENDATIONS

Discussions of Key Findings

Based on the study findings this research concludes that NHIF Kenya had adopted various biometric strategies in view of promoting efficiency in process operationalization. Examples of biometric

strategies adopted by NHIF include fingerprint recognition systems, Iris recognition strategy and facial recognition. The study concludes that clients expressed a high preference with biometric data as it offered high level of security and quick access. The study concludes that the NHIF would likely invest in training programs to ensure that staff is familiar with the new biometric system. Training is crucial for efficient system usage and to mitigate potential resistance to change. The study finds the need to for Upgrading or ensuring a robust technological infrastructure is in place to support the biometric system. NHIF would likely consider the scalability of the biometric system to accommodate future growth and changes in technology. Biometric strategies can thus play a significant role in achieving Sustainable Development Goals (SDGs) and national development objectives, such as Vision 2030 by enhancing healthcare services, improving efficiency and ensuring better health outcomes.

The study concludes that with adoption of biometric systems, NHIF Kenya had over the years realized an increase in operations efficiency, an increase in revenue from premium payment, quality delivery of services in terms of reliability to claims paid over the years and improvement in claim processing time and payment. Further, there has been a reduction of internal fraud by staffs, increased accuracy in verifying identities of policyholders and claimants. The study also concludes biometric systems at NHIF had low false acceptance rate (FAR) and false rejection rate (FRR) ensure that authorized individuals are accurately identified while minimizing the risk of false positives and fraudulent access.

The study concludes that fingerprints biometrics strategy has contributed greatly in terms of enhanced operations efficiency thus increasing NHIF premium. The strategy has also contributed greatly on fraud reduction in claims paid by NHIF thus enhancing E-claim performance. Facial recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance. Iris recognition strategy has contributed greatly regarding fraud reduction in claims paid by NHIF thus enhancing E-claim performance.

RECOMMENDATIONS

Biometric Adoption Strategies adopted at NHIF Kenya

NHIF Kenya should constantly adopt biometric data identification systems strategies, however this process should be anchored on comprehensive assessment of the current e-claim processing system, identifying pain points, security vulnerabilities and areas where biometric authentication can be beneficial. NHIF Kenya should ensure that the chosen biometric system is user-friendly, meets stringent security standards and complies with data protection regulations. Further NHIF Kenya should provide support and train employees and users on the proper use of biometric authentication. This will thus streamline patient management processes, such as registration and check-in, leading to reduced waiting times and improved overall healthcare service efficiency. This aligns with the SDG goal of ensuring access to quality healthcare for all.

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