Cybersecurity Risk Management in Healthcare Organizations : AI-Powered Solutions for Safeguarding Patient Data and Medical Infrastructure

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Abstract: Modern-day healthcare institutions remain vulnerable to cyber threats because patient data is highly sensitive and healthcare delivery must be uninterrupted in nature. It is vital to detect and prevent such threats since it is crucial to protect patients' information while, on the same note, providing constant healthcare services. There are several technologies that have improved patient care, such as electronic health records (EHRs), telehealth, and connected health devices. But these developments are not without the drawback of increasing the vulnerability of healthcare facilities' cybersecurity. In this thesis effort, the possibility of applying AI-based deception technologies to bolster the healthcare industry's cybersecurity risk management is investigated. Due to this, AI has the potential to use machine learning and predictive analytics, along with modern tools, to predict and counter cyber threats to critical medical structures. This section focuses on the effectiveness of artificial intelligence-based deceptions, namely honeypots and honeytokens, in stepping into the attackers as well as collecting pertinent information on the TTPs. In this paper, a literature review and case studies of various sectors, namely healthcare, financial services, education, and the supply chain, are carried out to determine the factors, benefits, and challenges of utilizing AI solutions in order to safeguard patient data and medical equipment. The study reveals how information technology, specifically artificial intelligence, enhances the capability of detecting, preventing, and/or responding to security threats in real-time within healthcare organisations. AI implementation in current cybersecurity strategies entails high capital investment, compliance with the law, and enhancement of organisational culture. It also emphasises the need to invent new strategies and approaches for the development of an AI that is capable of updating its programmes to solve new complexities that the criminal mind may invent. Some suggestions made for healthcare organisations to mitigate the impacts of the threats include establishing awareness programmes for artificial intelligence, increasing the training of the healthcare staff, and finally promoting teamwork focusing on cybersecurity. Thus, this research enriches the literature about using AI in healthcare cybersecurity and offers a basis for subsequent research on enhancing AI implementation in this sensitive industry.

Keywords: Healthcare cybersecurity, Cybersecurity risk management, Electronic Health Records (EHRs), Cyber threat mitigation, Patient data protection, Medical infrastructure security, adaptive AI systems, Machine learning, Organizational culture shifts, cybersecurity frameworks, Real-time threat detection.

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Part 1: Introduction

i. Background

The health care sector is probably one of the strongest social exigencies that can arise in a society, whose fundamental role is to ensure that appropriate health care services are provided. Hence, it operates in regions where the information can be considered credible, kept confidential, and made available whenever needed. Health organisations ICT has advanced significantly with the acknowledgement of EHRs, telehealth, and connected devices in recent years. Although there are so many benefits compounded from patients's operations, the efficiency of information technology, and analytic capabilities, the healthcare industry has revealed higher points of vulnerability to cyber threats. (Garcia-Perez et al., 2022; Javaid et al., 2023; Metty et al., 2023). The fact that the health information of patients is considered sensitive data, combined with the sheer complexity of the medical framework and the need to provide continuous services to patients for health reasons, makes the health sector an attractive target for cyber criminals, as concluded by Silcox et al. in their projected research due in 2024.

Cybersecurity in the healthcare sector is a most important issue that could lead to a severe catastrophe. Aside from legal losses and other losses rising from such threats as regulatory fines and costs of data restoration (Garcia-Perez et al., 2022). In the sector of healthcare, this implies that essential treatments, diagnosis, and, in extreme emergencies, critical systems and devices connected to the healthcare system may be paralysed, causing potentially fatal consequences (Javaid et al., 2023). More so, PHI theft itself might lead to long-term identity theft and privacy infringement, which erode patient trust in their healthcare providers (Metty et al., 2023). While advances in hacker techniques make them increasingly aggressive, it has created a push for the evolution and expansion of new forms of cybersecurity that are predictive in nature, which will assess, identify, and prevent a disaster before it happens (Rodrigues et al., 2022; Selvarajan & Mouratidis, 2023).

Firstly, artificial intelligence, commonly known as AI, has become a revolutionary breakthrough in the field of cybersecurity with its unique propositions such as machine learning, predictive analytics, and generations of various forms of automation. Understandably, AI is capable of analyzing a huge amount of data at the same time, and it has the capability of detecting pre-set patterns and deviations from the norm, which can be a sign of a cyber threat (Asan et al., 2020; Haupt & Marks, 2023). Through this capability, it is possible to address the most significant data challenges in healthcare, including data volume and complexity, along with the ability to make critical decisions with potentially profound consequences. When compared with the usage of AI in cybersecurity, it is possible to identify several applications; however, the application of deception technologies is a modern approach that is far beyond the detection and response approaches. These technologies engage in positive deception and all-round control of the attacker, a well-choreographed movement susceptible to protecting a system from attacks (Constâncio et al., 2023).

These decoys are made to attract the attention of the attacker and pull the attacker towards them instead of the actual target. These decoys help in identifying the attackers Tactics, Techniques, and Procedures (TTPs), and studying them can improve the overall defense system (Jacobs et al., 2023). This approach to proactive prevention is not only stressful for disrupting and thwarting an attacker but also beneficial for the collection of more intelligence to add a stronger layer of

security. In the field of healthcare, similar technologies can help secure essential healthcare systems as well as other patient data to enable a durable and dynamic security network surrounding the medical systems (Selvarajan & Mouratidis, 2023). It is imperative to note that understanding the different forms of AI-enabled deceptive technologies that exist in the domain of of healthcare cybersecurity is crucial. From an academic perspective, this study adds a research review to the emerging literature on how one can apply the advances in AI to improve the security of modern digital networks. It fills the gaps in the current literature by exclusively viewing them from the perspective of effectiveness in utilising such technologies in real-life healthcare systems (Rodrigues et al., 2022). From a professional perspective, it is possible to note that the information presented in this paper can help healthcare organisations embrace new security solutions that are crucial for protecting patients' data and maintaining the stability of medical delivery (Silcox et al., 2024). As cyber threats are developing further, the application of AI-based solutions is depicted as highly important for sustaining the trust and reliability that form the basis of healthcare organisations (Asan et al., 2020; Raimo et al., 2022).

Even though machine learning is becoming more prevalent and its misconceptions more severe, there is a lack of research in healthcare concerning deception technologies. Most prior research is concerned with conventional antimalware and post-incident approaches (Garcia-Perez et al., 2022; Javaid et al., 2023). This thesis seeks to fill this gap through a study of how the use of AI-based deception technologies can be implemented into the frameworks of the healthcare sector's cybersecurity risk management. In this context, the research aims to examine and compare these technologies as to how they are practically deployed, what difficulties were encountered, and the results achieved in the process, thus offering a thorough insight into the contribution of these technologies to the improvement of cybersecurity initiatives (Selvarajan & Mouratidis, 2023). The use of artificial intelligence in deception technologies provides a better method of doing cybersecurity in healthcare since it is preventative and adaptive in nature. To some extent, this paper aims at providing valuable information to both scholars and practitioners concerning this form of AI's modern application to enhance the execution of tasks and decision-making processes (Haupt & Marks, 2023). Hence, this technology will improve patients's data security and medical infrastructure, and health organisations will be able to anticipate rising digital threats and protect susceptible patients who rely on such institutions (Silcox et al., 2024; Topol, 2019).

ii. Problem Statement

The field of health care has become more and more dependent on the use of digital technologies, for instance, EHRs, telemedicine, and connected medical devices, for the improvement of overall patient care and organization. However, the advancement in digital healthcare has also created a new source of vulnerabilities in healthcare systems. The result of hacking healthcare organisations can be detrimental impacts and time from correct diagnosis, overcharge, and loss of trust from the patient (Ordr, 2024; Kroll, 2024). Typically, an approach to security is reactive and does not protect an organisation against modern threats; therefore, it is advisable for companies to embrace new trends in security.

Machine learning in computer security has gained popularity as a modern tool that can be applied to fight and prevent malicious attacks. When it comes to using AI approaches in the cybersecurity field, deception technologies can be considered the most innovative trend because they are aimed

at something more than detecting threats and responding to them. These technologies engage and deceive the attacker into performing activities that are desired or expected and set up a hostile environment for the attackers to perform their tasks by offering 'bait' or decoy data bases, systems, and networks that are not real but seem so. The engagements with decoys help capture the tendencies of the attackers to improve the general security plan. The interactions with decoys help cause the exposure of the tactics, techniques, and procedures to be utilised by the attackers (O'Donnell et al., 2016; Ordr, 2024).

iii. Relevance to Academic and Professional Fields

The application of deception technologies in the health care cybersecurity framework has diverse, critical importance in academic as well professional dimension. From the academic point of view, this research provides a forecast to the line of research that focuses on the use of AI for prevention rather than detection of cybersecurity threats. It outlines practical applications of the AI-based deception methodologies that will be conducive for future research in this line. For example, the literature review by Kaur et al (2023) shows how the application of AI is used to perform tasks, enhance the speed of threats identification, and increase the credibility of results, implying that this is an effective area to focus on. Besides, this work responds to the challenges that have been posed on the aspect of healthcare cybersecurity hence correlations it with healthcare informatics which major studies the use of information technology about healthcare which as proposed by Putty (2023). However, the introduction of AI-based deception makes one contemplate on some of the possible vices or drawbacks it has. It will remain relevant to the discussion now because it pivots around the governance and ethical frameworks of AI as expounded by Esmaeilzadeh (2020).

From a professional perspective, the AI-based deception framework plan and the related strategies and models for healthcare-related organizations can be considered helpful and effective guidelines towards the enhancement of health organizations' cybersecurity shield, the safeguarding of patients' data, and the assurance of the continuity of essential medical services, based on the fact that this is also ensured by the CISA (2024).The results of the study would be valuable in the future for identifying the most suitable AI models that should be employed in developing better decoys and for calculating the performance of the various models of decoys in the context of attackers' behavioral prediction and control, as also described by Fortinet (2023)

Further, by identifying the possible advantages and risks associated with AI-based deception technologies in healthcare contexts, it can help in the creation of the appropriate policy and guidelines to control and enhance the effective utilisation of these intelligent technologies, as postulated by Ienca et al. (2018). The findings of this research can help cybersecurity consultants and vendors enhance their innovation methodologies to suit the needs of the healthcare industry by employing the AI- powered deception technology as identified by Acalvio (2023).

iv. Research Gap and Justification

There is a notable void in the literature wherein the active form of cybersecurity taken or the proactive cybersecurity measures implemented are not thoroughly explored. Although there has been a plethora of research focusing on conventional security solutions and non-proactive solutions in the face of a cyber attack, there are few studies that investigate proactive approaches

to cybersecurity using AI-based deceiving technologies. While the current literature is rather focused on the general approaches to threat identification and management, there is a lack of information concerned with the new possibilities given by artificial intelligence to prevent the emergence of future cyber threats in such a way as to minimise their potential harm. This gap is underlined in the study of Kaur et al. (2023), in which sophisticated AI applications, including cyber security, are pointed out.

The remaining grievous void is that there is little literature that would address the issues that are specific to the nature of healthcare organizations. The fact that health care data is highly sensitive, medical structure is intricate, and continuous service provision is inevitable are some limitations of AI-empowered deception technologies that are incomparable to other domains. Thus, several prior works tend to discuss the broad knowledge of AI in handling cybersecurity holistically without relating the security parameters to specific conditions that are obligatory and indispensable to healthcare arenas. This gap is seen in the observation that Putty (2023) emphasizes the potential vulnerabilities of healthcare sectors and the imperative of developing specialized cybersecurity solutions. Also, there is a scarcity of a rich body of previous work that underscores the ethical and legal concerns of applying AI-based deception technologies in the health sector. Potential risks associated with data privacy, patients' consent, and the misapplication of technological advancements are other major concerns that should be addressed to prevent the abuse of artificial intelligence. Some of the ethical considerations highlighted by Esmaeilzadeh (2020) include how to approach the issue of trust and compliance to work properly in health care facilities.

In addition, only limited research addresses the fine-grained insights on how, when, and with what effect deception technologies are applied in AI-based healthcare practice and settings. It seems that there is a clear call for more empirical research that would investigate the role and efficacy of such technologies in building a stronger cybersecurity front, coupled with the real-world use cases or issues encountered in implementing such solutions. The authors (Jin et al., 2024), in their 2024, have stressed the need for pragmatic assessment methods in order to comprehend the efficacy of AI-based cybersecurity strategies in an uncontrolled, fluctuating world. The need to conduct this research is anchored on the belief that this study could improve the readiness of healthcare facilities against cyber threats. Due to the importance of patient information and the life-sensitive nature of healthcare solutions, the healthcare sector is facing rising rates of cyberattacks. Consequently, focusing on AI for deception technology in this research, the study aims to offer healthcare organisations sophisticated techniques to guard against cyberattacks, thus improving their cybersecurity status in several aspects. This is corroborated by CISA (2024), whereby it establishes that advanced security has become paramount in healthcare in the coming years. Also, enhancing customer satisfaction and patient safety is a valid reason for this investigation. Cyberthreat interception in the hospital may lead to the following negative impacts: patients being treated, misdiagnosed, and unnecessarily worsening their conditions. To safeguard patient information and sustain essential treatments and procedures without being disrupted by cyber threats, this research aims at advancing and deploying AI deception techniques to enhance patient safety and effectively restore the confidence of patients in healthcare institutions. As cited by Fortinet (2023), it is evident that secure patient information is paramount to earning back the confidence and trust of patients. The need to create ethical and regulatory frameworks relating to the application of deception technologies based on AI in the healthcare sector is also a rationale. In this research, the author seeks to advance the recently established debate on the structure of AI ethics and governance by

proposing a comprehensive framework for how AI should be adopted ethically and responsibly. In their article, Ienca et al. (2018) highlighted that the AI application in healthcare requires ethical guidelines that would guarantee its appropriate application and usage. At last, the findings of this research can help policymakers and clinical technology providers put in place appropriate policies and standards for the use of AI-based deception technologies in healthcare organisations's cyber security systems. According to Acalvio (2023), trending AI technologies in healthcare cybersecurity are not just ideas but are relevant in implementing deception technologies.

This dissertation aims to address the following initial research question, In what way can deception technologies embracing AI be used in the protection of healthcare cybersecurity against disruptions by attackers?

Part 2: Literature Review

i. Overview of Cybersecurity in Healthcare

The information that is always at risk in hospitals and clinics is patient's records, financial records, and clinically researched data, including data that involves new drug discovery and the improvement of medical treatments, making them more financially rewarding targets for cybercriminals. This could be the case since healthcare networks contain numerous sub-network, where each one may consist of numerous tools and systems that interrelate with each other, thus making them difficult to protect. Various cyber risks have been identified in the healthcare sector, and they include ransomware, data leakage, and phishing scams. Stoke IT is a firm that offers IT support in Nigeria's healthcare sector, and the ransomware can compromise hospital functions by encrypting the files and demanding a fee for their' release; it can cause system breakdowns and slow treatment delivery. Data breaches lead to the exposure of patient information to people who should not access the patients' information, thus posing a threat to the patients, especially in instances of identity theft and the decrease in patient trust in health care providers (Matsul, 2023). For instance, in Europe, there is the General Data Protection Regulation (GDPR); in the United States, there is the Health Insurance Portability and Accountability Act (HIPAA), which has been applied to cope with these adversities. The laws needed to carry out such regulation mean that healthcare organisations need to adhere to high standards of security in order to enforce the laws and safeguard people's data. Still, keeping in mind the fact that threats to any organisation are emerging constant elements in the cyber environment, the compliance level at best proves that such improvements should not stop and will persist in the future.

The focus of healthcare cybersecurity has also shifted in the recent past to more emphasis on increasing machine learning (ML) and artificial intelligence (AI). With more data being fed into the system in the hunt for outliers and possible weaknesses, these technologies improve the capacity to guard against ends up. What it implies is that AI solutions can alleviate the burden of IT staff with many tasks, not to mention the ticketing software, aid in preventing the extensive replication of security procedures, and require mandatory alerting of threats. For example, the AI is capable of identifying that some anomaly is occurring in the network traffic and providing an indication about the likely intrusions before the conditions begin to have a negative impact on the experience of the end-users (Sendelj & Ognjanovic, 2022). With reference to the above pieces of information, it can be argued that it is a clear indication that even though progress has been made in the management and protection against cyber threats, healthcare organisations still experience some of these challenges. As a result, it reveals that lack of funds as a justification for the budget limitation, the scarcity of qualified cybersecurity experts, and the compatibility of the tasks with the current healthcare IT systems cause some of the challenges.

ii. Importance of cybersecurity in healthcare

In fact, it has become almost impossible to overstate the importance of cybersecurity in healthcare. Security is paramount to the protection of patients's information, ensuring the authenticity of medical instruments and equipment, and making sure that health care facilities are running all over the world. Thus, as a critical element of the healthcare cybersecurity risk management framework, the deliberate subversion of attackers and disruption of their activity through the active utilisation of AI-based deception can enhance threat countermeasures significantly. Attack replicas, which mimic real systems and data, belong to deception technologies for attracting another party and

revealing its presence. Medical diagnosis has long been regarded as a significant concept because early action can prevent adverse effects. These threats were considered early to ensure that systems are protected from any impact on patient outcomes and data quality, as evidenced by Thompson (2024) and Riggi, J. (2024).

Moles expose tactics, techniques, and procedures (TTPs) used in operations to lure targets into engagements with decoys. This exchange of information provides practical intelligence that may be analysed to understand the intentions and strategies of the attackers. Healthcare companies can enhance their security stance based on gaining knowledge about strengthening protective mechanisms as well as threat prediction (Splashtop, 2023; Alanazi, 2023). The primary novelty is in the dynamic aspect of deceptive technologies, which, being based on AI, can change the deceptiveness depending on the actions taken by the attackers. It is always dynamic, enabling one to easily adapt, which in turn frustrates the attackers and hampers their efforts in achieving their feat. Employers can be prepared for such complex threats and stay ahead in their defence by continually improving protective measures (Staff & Staff, 2024; Vukotich, 2023). According to current information, AI deception systems should be introduced as complementary to existing systems, making it possible to automate responses to observed incidents. These technologies are able to release new decoys independently, change the appearance of the deceptive environment, and control further actions independently. Such automation helps offload the burden to the security teams and gives a quick and effective response to active threats.

With the help of AI, the existing tools belonging to the class of firewalls, intrusion detection systems, and security information and event management (SIEM) can be improved and/or supported. The second type of deception essentially adds an extra layer of security in that one extra layer has to be bypassed to gain access to a programme, which will reduce the chances of penetration (Cabuyao, 2023; Peremore, 2023). Introducing AI-based effective healthcare cybersecurity risk management frameworks that offer an effective and scalable approach to addressing this growing threat. With the help of these technologies, threat mitigation strategies are far more effective because they work as deceiving technologies and interrupt the operation of the attackers. As AI threats continue to increase, the preservation of the reliability and trust required in healthcare increases the necessity for the implementation of new solutions, opportunities, digitalization, and modern AI technologies (Peremore, 2023).

iii. Common threats and vulnerabilities

The healthcare industry is still in the grey area regarding the different types of threats and risks that persist in the provision of services due to the compromise of cybersecurity. These threats include ransomware attacks, phishing, incidents involving insiders, and security weaknesses across interconnected healthcare equipment. It is vital to understand these threats that constitute regular attacks in the battle against cybersecurity since it seeks to fortify the health care sector by combating malicious activities. Ransomware attacks are among some of the most common and destructive threats facing healthcare delivery organizations. A ransomware attack is one where cybercriminals lock valuable data that should be unlocked by paying a ransom. This can lead to havoc in its operations, thereby exposing many lives to death through medical treatment or surgeries that cannot be performed due to the pandemonium caused by the machines. Some of the reasons for such attacks involve the availability of patient data, especially since most institutions

in the healthcare sector have fragile security systems due to outdated infrastructure (Terranova Security, 2024; UpGuard, 2023). Another phenomenon is phishing; such a scam refers to a fraudulent attempt by cyber attackers to deceive employees and compel them to share their credentials or open a link with malware, typically in an emailed or messaged format. These scams prey on cognitive psychology, and if one staff member is conned, an organisation opens itself to considerable compromise. The ramifications of ample email use in health-care accounts and, consequently, phrasing are a constant and ever-present threat (UpGuard, 2023; CISA, 2024). It is also noteworthy that insider threats and other forms of threats, such as accidental threats, also present a major threat to healthcare cybersecurity. Persons who work with big data may use such information for their personal advantage or provide it to third-party players under pressure. Also, there is always a possibility to experience an accidental data loss if the organisation's employees fail to handle personal information appropriately, as it is crucial to underline a necessity for employees' training and informational sessions (Terranova Security, 2024; UpGuard, 2023). With the question of utilising Internet-connected medical devices raised, there are potential new threats. Many of these devices commonly use default or easily guessed passwords," in turn, allowing hackers to infiltrate the main networks of a hospital. The complexity of current healthcare structures indicates that the vulnerability of one piece of equipment can lead to the penetration of the entire network (Simplisecured, 2024; Upguard, 2023).

To tackle these issues, healthcare organisations are implementing sophisticated cybersecurity measures whereby features such as artificial intelligence-based deception are incorporated. These technologies involve the use of sham foci and other assets within the network in a bid to ensnare the attacker. Attackers interact with these decoys, thus exposing their modality and strategies. This acts as a good security guard by identifying the odds and ends of regular security measures. This approach is proactive in nature and not only neutralises the work done by attackers but also gains important information about protection against threats (Akela, 2024; CPS, 2024). Through passive and active measures, healthcare organisations can effectively thwart cyber threats by denying the attacker's goals and intent and bolstering the strength of their cybersecurity network (Akela, 2024; CPS, 2024). Incorporating deception techniques facilitated by AI in the risk management architecture provides the healthcare sector with a competitive edge to detect and analyse possible cyber threats and, most importantly, to disrupt them. In this regard, advanced AI-based technologies are identified as central to sustaining the trustworthiness that is the foundation of healthcare delivery as the nature and severity of cyber threats deepen (Acalvio, 2024).

iv. Impact of cyberattacks on healthcare services

Cyberattacks have significant and diverse consequences for the healthcare industry in terms of overall medical treatment and patient care, organisational activity, and organisational sustainability. Such attacks pose a risk to patients' lives and, as a result, have severe consequences for healthcare facilities' budgets and images. Criminal activities, especially ransomware attacks, have devastating impacts on healthcare facilities. For example, when cybercriminals lock down important patient records, they use the decryption key to extort money in exchange for releasing the information, thus disrupting the organisation's functioning. These disruptions can sometimes result in delayed access to critical medical treatments and operations, which may cost the lives of patients. The area of health care can be considered the most susceptible to such cyberattacks since the processing of patients' information should be completed rapidly and often based on outdated

IT protection systems (Oliver Wyman, 2023; Adlumin, 2024). Ransomware attacks also have financial implications, as healthcare organisations, besides paying the ransoms that are demanded by hackers, are forced to part with more money in system downtime, data recovery costs, and regulatory fines, as noted by CurrentWare (2023).

The last of the threats falls under the category of social engineering, which is possibly the most popular technique as it harnesses people's weaknesses to steal users's identities. This type of fraud risk can be truly devastating if at least one employee is tricked into giving away the most valuable information; it will lead to the compromise of patients' records and other important systems. Considering the fact that email is a common form of communication in the healthcare industry, new and constantly emerging forms of phishing attacks are a serious concern (Adlumin, 2024; NCBI, 2023). Phishing attacks can have serious implications depending on the kind of organisation that has been attacked; such consequences may include leakage of data and funds, loss of funds, and even a black card mark. Healthcare cyber-risk assessments should take insider threats into consideration since these threats are capable of causing dangerous circumstances. The security risk also arises from the fact that those employees who are trusted with such information may exploit it for self-gain or because of pressure from other parties. Also, unpremeditated data leak scenarios can arise from incorrect handling of information by staff; this makes it extremely crucial for the enforcement of strict training and sensitization programmes (NCBI, 2023; Cleveroad, 2023). This kind of threat is tough to prevent and counter since the attackers hold legitimate access to the organisation's assets, such as personnel.

The use of connected devices in providing medical care has introduced new threats common to other connected devices, like the Internet of Medical Things (IoMT) devices. These devices are sometimes not well secured, and attackers can leverage such holes to access other segments of the hospital. This is due to the integration of today's healthcare frameworks; if one device has an ATB, then the whole network is at risk (Oliver Wyman, 2023; NCBI, 2023). It is for this reason that the security of these devices must be ensured since the loss of these devices would be very costly since it would result in direct negative consequences for patients' care. In response to these challenges, the following best practices can be adopted: Healthcare organisations could increase the effectiveness of threat prevention actions by implementing deception technologies based on artificial intelligence technologies into corresponding programmes for managing cybersecurity risks. One of the notable AI-based techniques is the use of flares, which are counterparts of actual systems and data and aim at enticing the attackers to disclose their existence at the earliest. This early detection is very vital in the healthcare sector because it assists in identifying certain dangers early enough to avoid the worst from happening (Adlumin, 2024; Paubox, 2023). When the attackers engage with decoys, they expose what they plan to do, how they intend to do it, and what they have been doing. This interaction means that there is useful information that needs to be gathered and assessed in order to better understand the targets and strategies of malicious actors in the healthcare industry. Thus, healthcare organisations can improve their security measures and forecast further threats (Adlumin, 2024; Paubox, 2023).

Deception layered with AI makes it possible to adapt to the different exploitation strategies that the attackers may use and respond by changing the deceptions to keep the attackers off-balanced. This presents a challenge to the attacker's mission and compels them to invest more effort and resources in an attempt to breach the target's defences (Adlumin, 2024; Paubax, 2023). Such

integration makes it possible for security protocols to trigger an incident response mechanism instead of demanding extensive work from the side of security staff, as well as ensuring a fast response to various threats that are currently active (Adlumin, 2024; Paubox, 2023). Deception technologies can also support threat hunting In terms of a deceptive environment, when the technology looks for misbehaviour in the decoy systems around the clock, so healthcare organisations do not lose time on getting alerts; instead, they minimise threats (Adlumin, 2024; Paubox, 2023). The design of deception with AI reinforcement on risk management frameworks can be a vital asset for the health system in Sensitive, judging, and interfering with threats. It becomes imperative to adopt a proactive and adaptive stance because it is about safeguarding crucial infrastructure, personal and identifiable patient information, and maintaining consistent delivery of crucial healthcare services. As threats target the world and become more develop with time, it is too much important for the healthcare system to employ enhanced measures of AI solutions to ensure that it maintains trust and reliability in society (Adlumin, 2024; Paubox, 2023).

Hacking attacks on healthcare systems are some of the most dangerous because they compromise the confidentiality, integrity, and availability of information relative to the health condition of patients as well as the functionality of healthcare organizations. Due to the COVID-19 outbreak, one of the most drastic impacts is the break in crucial health care services. During cyber threats like ransomware, healthcare providers may be locked out of key systems, as seen below, thus delaying patients' required treatments or surgeries. Such delays can be problematic and can even have adverse effects on the health of the patient or client, especially when the patient presents with emergency health issues (LogRhythm, 2024; Oliver Wyman, 2023). In addition, the patients or clients can have their trust in a particular care-giving organisation eroded by cyberattacks. A breach of relevant databases containing personal as well as health data means victims' sensitive identities and financial details are vulnerable to fraudulent access, causing long-term trauma. If patients decide that their Personally Identifiable Information (PII) is not safe, then there could be a decrease in their willingness to provide essential health information that could hurt a patient's care. Loss of trust can further bring social loss for healthcare providers as they lose clients for long terms and possible revenue because of brand deterioration (McCarthy et al., 2023; Forbes, 2024; Lansia, 2022).

In summary, from a pragmatic angle, cyberattacks have monetary repercussions that directly impact healthcare centers. Therefore, there is also any other indirect cost that would be part and parcel of the cost of responding to and addressing cyberterrorism, such as legal expenses and more so the fines, not to mention efforts and measures that have to be put in place to improve the security of cyberspace. Hence, such expenses can be sensitive in a medical company, particularly for the manufacturing business or small businesses, and there are cases where they just do not have capital (CurrentWare, 2023; Oliver Wyman, 2023). And alongside these business risks, there are also risks in relation to other connected devices and systems in healthcare facilities known collectively as the Internet of Medical Things (IoMT). These devices, for example, insulin pumps and devices used to monitor heart conditions, have little or no advanced security features to warrant their safety, and for this reason, they are prone to easy hacking. The readings obtained may be contaminated or incorrect and may severely damage the health of patients. In addition, these devices can be breached and hacked to gain entry into other intranetworks within the medical facility, thereby raising the stakes even higher (Oliver Wyman 2023; NCBI 2023).

These are certainly realistic negative impacts that are brought about by cyber attackers featuring in the system. Thereby not only degrading the attackers' capability in conducting operations against the organisation but also enhancing the position since the attacker will have to predict the next move of the organisation. Information that can be obtained from these circumstances can assist in determining the optimal protective cybersecurity measures and thus reduce the possible interferences and attacks on healthcare services (Adlumin, 2024; Paubox, 2023). The successful implementation of AI solutions in healthcare organisations would be ideal if it came in a way that the healthcare organisations would have a dynamic and adaptive defence mechanism that can engage and thwart whatever face-off with the threats that are trying to upset the entire good relationship that is between the patient and the doctor and even disrupt the normal undertaking of the healthcare processes. This is crucial in enhancing the quality of health care services, continuity, patent information, and, most importantly, the veracity of the health systems. Since cyberrisk is a constantly progressing theme, there is always a need for new essays, and information security is now armed with the most modern approach, namely AI-based deception technologies in healthcare environments for 2023 (Adlumin, 2024; Paubox).

v. AI Applications in Cybersecurity

AI plays a central role in current cybersecurity, especially in the healthcare industry, because data privacy is much more sensitive as compared to other industries, while healthcare services are much more critical in people's lives. Machine learning applications have a versatile set of capabilities that improve threat handling processes in cybersecurity. AI systems can adaptively manage the networking traffic, user activity, or other peculiarities and oddities in system behaviour that are indicative of a cyber attack. This means that threats are detected before a compromise can occur and dealt with, thus preventing significant potential loss (Thoughtful AI, 2024; Meditology Services, 2024). For example, AI can identify various similarities with the logs of network activities; when it comes to recognising intersections with normal behaviours or attempted logins from other locations, it can immediately notify cybersecurity professionals about potentially malicious activities related to such patterns (BigID, 2024). Another essential application of AI to cybersecurity is the use of predictive analytics. This is because computers can process high volumes of data, and with the use of methods like machine learning and data mining, likelihoods of risks can be computed where solutions to ascertain the risks are advised. This transformative anticipatory capacity empowers healthcare organisations to put in place strategies that can help prevent threats such as data breaches and cyber attacks (OECD, 2023; Bonnie, 2023). For example, AI can estimate the probability of certain types of attacks given past occurrences and the existing threats, so the security teams know where to focus their protection resources (Kaspian, 2024).

Furthermore, another important and key application of AI in cybersecurity is supporting the automation of response to incidents. With the modern artificial intelligence tools in place, whole threats can be identified and eliminated without external assistance, such that the general response time becomes tremendously increased and potential harm reduced. For instance, in sectors such as healthcare, delays in responding to cyber threats could be very costly and mean the loss of lives and dire patient outcomes if certain diagnoses and treatments are not done in time (Forbes, 2024; IBM, 2023).It also alleviates threat hunting since AI does the first step of data mining at a faster rate (TechMagic, 2023).

Deception technologies are one of the most innovative frameworks in the cybersecurity domain that utilises artificial intelligence tools. These technologies use so-called decoys, which are copies of individual genuine systems and data that lure the attackers and alert their presence at the earliest (Netalit, 2023; CounterCraft, 2023). These decoys serve the purpose of precisely alerting defen¬ders as soon as the attackers come into contact with them and inadvertently reveal their TTPs to the defenders. But in addition, it also prevents enemies from continuing their work and improves the organisation's functions in responding to threats (Kaspian, 2024). Furthermore, deception technologies that are infused with AI capability have the capability to proactively change the face of the deception system based on some behaviours exhibited by the attackers, thus making it difficult for the attackers to complete their missions. This adaptability thus forces attackers to apply more effort and time in their attacks, and chances are they get detected by security systems in the course of the attack (Fortinet, 2023; Zscaler, 2023). The use of these technologies alongside existing security controls offers advanced security orchestration, thereby eliminating the heavy workload of security personnel while ensuring that all active threats are responded to in a timely and efficient manner (BigID, 2024; ENISA, 2023).

As many have seen, AI-enabled cybersecurity tools can benefit healthcare and security within specific organisations through the more efficient identification of potential threats, enhanced response to identified threats, and contribution to the development of threat intelligence. For AI, one of the ways this could be done is by its ability to connect the dots from various sources and put into perspective various threats, therefore making it possible to detect not just simple but even complex one-stage and multiple-stage kinds of attacks that are difficult to identify until it is too late yet (Thoughtful AI, 2024; Meditology Services, 2024). By covering all of these aspects, analysts are equipped with complete information for making security decisions and containing threats. With the many advantages that come with AI adoption, there are also new challenges that have to be addressed. These are, first, the model bias, the adversarial examples meant for tricking the AI systems, and the risk involved in using too many AI systems without proper human supervision (OECD, 2023; SecurityWeek, 2024). In order to manage them, healthcare organisations have no choice but to embed strict data governance protocols, to make the thinking of the AI algorithms transparent, and to find the right balance between complete automation of the processes and the involvement of clinicians (NIST 2024; Secureframe 2023). This is considered positive and innovative in keeping the operations of healthcare going, securing patients' information, and guaranteeing the credibility and reliability of the health systems. Today, the constant threat of cyber threats, including more complex and dangerous ones, requires the use of innovative means to protect the healthcare industry from cyber threats (McCarthy et al., 2023); IBM, 2023).

vi. Introduction to Artificial Intelligence and Machine Learning in cybersecurity

AI/ML implementation in cybersecurity has brought on board sophisticated features that significantly improve threat reporting, detection, response, and management. The inclusion of AI and ML in cybersecurity frameworks is even more beneficial in the sphere of healthcare, as the security of patients' data and uninterrupted availability of medical services are highly valued in this field. AI and ML play a role in automating the recurring processes and reducing the time taken to discover threats, enhancing the correctness of a response that makes the security system more protective against multiple cyber threats (Kaur et al., 2023; Sen et al., 2022). These technologies

depend on massive amounts of data to succeed, and the success is much higher and faster than using conventional benchmarks. For example, it can process network traffic, utilisation patterns, and system logs in real time to identify changes in the patterns of activities implying a cyberattack (Bahassi et al., 2022). This makes threat detection proactive, which in turn enables the organisation to respond immediately and counter a breach, saving the company great losses. AI is widely used in cybersecurity for predictive analytics, a set of tools that allows organisations to assess risks in advance relative to the history of such incidents and the appearance of new threats. The prominent application of AI in large datasets enables it to predict threats and advise on preventive measures to be taken so as to reduce instances of vulnerability and cybersecurity risks (OECD, 2023; Bonnie, 2023). For instance, AI can determine the probability of certain forms of attacks from previous events and associated threat environments and then direct the security staff where to dedicate their effort (Kaspian, 2024). Also, the higher incidence of similar events also means automatic response and a reduced time of response from identification to isolation. Advanced systems of protection can exclude contaminated gadgets, shield against unfriendly traffic, and apply remedial activities independently of human intercession, reducing the window of sorrow (BigID, 2024; SecurityWeek, 2024).

Artificial intelligence and deep learning-based deception technologies are among the modern solutions in the sphere of cybersecurity. These technologies use deceptions in the form of 'the artificial systems and data' that draw the attention of the attacker and identify them from a distance (Netalit, 2023; CounterCraft, 2023). When these decoys are engaged by the attackers, they reveal to the organisation their TTPs and, in the process, enable further defence and planning. The proactive one not only thwarts the attackers and improves their effectiveness of actions but also strengthens the organisation's capability to respond to threats (Kaspian, 2024). Furthermore, reactive techniques such as deception can be incorporated into AI-powered systems in the organisation to always counter the attackers' moves and make them ineffective by changing the environment regularly. This adaptability puts pressure on the attackers and requires more time and effort, which in turn raises the probability of initiating an alarm (Fortinet, 2023; Zscaler, 2023).

Moreover, AI solutions in cybersecurity increase threat identification and threat handling abilities in healthcare organisations and also help in making the organisations more secure by providing threat intelligence and constant supervision. AI systems can combine information from various data sources and thus identify potential threats at an early stage of attack that involves several stages and might remain unnoticed and uncontested if AI is not applied (Thoughtful AI, 2024; Meditology Services, 2024). This overarching strategy guarantees that the security personnel receive the specific data required to make adequate decisions as well as apply appropriate countermeasures. Even though AI provides so many opportunities, there are new types of risks that exist in the process. These are the AI biases, adversarial attacks intended for deception of the particular AI system, as well as over-dependency on AI instead of human input (OECD, 2023; SecurityWeek, 2024). To reduce these risks, organisations in the healthcare industry need to integrate strong data management policies, explainability of AI decisions, and the right mix of AI and professionals (NIST, 2024; Bonnie, 2023). The utilisation of AI technologies in healthcare cybersecurity contributes to the creation of a powerful and unique proactive defence system that can actively interact with threats. Thus, incorporating AI in threat detection, big data analysis, response, and deception technologies helps the healthcare organisation substantially improve its threat management programme. This is relevant, especially in today's world where disruptions can

occur actively, and healthcare systems should be prepared to come up with the best coping mechanisms that will enable the continuity of services besides protecting the patient's information and securing the studied systems. More specifically, given that contemporary cybersecurity threats are highly complex, the use of modern AI solutions is highly important for the healthcare industry's protection against further attacks (McCarthy et al., 2023; IBM, 2023). AI in cybersecurity has brought about changes in protecting health care systems and information through the increased security of technology. Introducing AI in the handling of threats makes it easier to detect, respond to, and even prevent cyber threats and attacks. Machine learning is another technique by which AI systems are capable of processing a large amount of data to find out any pattern or deviation, which might be a sign of a potential threat. Real-time analysis is critical, especially in healthcare organisations, since prompt identification of cyber threats can greatly minimise what they cause and the subsequent interruptions to normal functioning (Bahassi et al., 2022).

The most profound benefit of AI in cybersecurity is the automation of the discovery of any professed actions. The commonly used techniques in cybersecurity do not involve artificial intelligence or machine learning and are more likely to be based on humans' diligent monitoring and a predetermined set of rules. While AI is fixed once programmers have set up its parameters, AI can learn from new data feeds and adjust its algorithm to deal with new threats. Due to this versatility, AI technologies provide excellent cybersecurity methods in dynamic contexts like healthcare because threats are continually emerging or becoming different (Kaur et al., 2023; Sen et al., 2022).

Furthermore, it can contribute to increasing the effectiveness of work on incidents. In the event of a possible danger, AI systems can immediately launch specific scripts to address the looming problem, lock the relevant systems, or inform the security team. This latter also helps in reducing the response time that would enable a break in between the detection of a threat and the execution of the protection strategy by the attackers. Also, AI can help with post-incident processes, which will let the organisation comprehend what kind of attack happened and how to avoid such an incident in the future (BigID, 2024; SecurityWeek, 2024).

Artificial intelligence-based deception technologies themselves are one of the burgeoning uses of artificial intelligence in cyber security. It is a collection of technologies that cultivate conditions inside healthcare networks, using fake targets similar to actual ones to catch attackers. From these decoys, the attackers incur exposure to their tactics, techniques, and procedures through engagements with the decoys. This intelligence from day-to-day interaction is very crucial, as it offers insights that would complement security's general strategies and measures against threats. This not only negates the attacker's objective but also utilises their actions as a source of information to advance the organisational defenses. (Netalit, 2023; CounterCraft, 2023). Apart from deception technologies, other categories of knowledge-based AI applications include predictive analysis techniques and hunting. Technical feasibility describes the use of past data to forecast future possible attacks, thus allowing organisations to prepare for such attacks. Threat hunting means that the analysts themselves look for threats in the network using AI to analyse the vast amount of data to discover the indicators of a compromise that would not be detected by a security system (OECD, 2023; Bonnie, 2023). AI, under the framework of cybersecurity, improves the healthcare system's defences and is effective in its structure. Thus, constantly evolving and intensifying cyber threats require AI solutions to enhance the ability to counter the

adversary. This approach shows that healthcare organisations receive AI solutions and guarantee cost protection of the personal information of patients; the organisations' bodies are preserved, and the trust of clients and shareholders is maintained. AI technologies' continuous advancement and incorporation in cybersecurity are crucial to dealing with the challenges of the dynamic nature of cyber threats in healthcare (McCarthy et al., 2023, 2023; IBM, 2023).

vii. Types of AI solutions (e.g., predictive analytics, anomaly detection)

Artificial intelligence, or AI, is considered a fundamental component of modern cybersecurity, especially in healthcare, as it is one of the most important and sensitive spheres that require fast and effective security solutions. The use of AI-based solutions in the sphere of cybersecurity reveals numerous advantages, which can boost the level of threat counteraction. Another big area of AI use in cybersecurity is the identification and immediate reaction to threats. Some of the examples include: AI systems can track various activities, such as network traffic, users, and system activities, to detect any irregularities that may be the result of a cyberattack. This enables proactive threat identification and deters a threat from executing a breach because one is always on the lookout, possibly avoiding a higher level of damage (Thoughtful AI, 2024; Meditology Services, 2024). For example, AI can also examine the pattern of logs, and if the data access or login activity deviates from standard, an alert is generated (BigID, 2024).

There is another important area of AI use in cybersecurity: predicting analytics. Through processing large amounts of data, AI has the ability to predict risks and suggest ways to prevent them. This predictive capacity helps the health care organisation put in place measures to prevent the occurrence of cyber incidents and data breaches (OECD, 2023; Secureframe, 2022). For instance, it means forecasting probable kinds of attacks based on previous cases and threats' maps to direct security measures accordingly (Kaspian, 2024). Due to the efficiency of artificial intelligence, the systems can promptly classify threats and respond to them, thereby cutting response times and the possible consequences. It is even more critical in the health sector given the devastating outcomes of a cyberattack delay in responding to such issues (Forbes, 2024; IBM, 2023). AI can also help in threat hunting by applying data analysis in the early stages of investigation, thus saving time and being more comprehensive (TechMagic, 2023). Deception technologies are among the state-of-the-art solutions in the sphere of cybersecurity. To do this, these technologies incorporate decoys, forgery systems, and data that are designed to appear legitimate to the attacker but are in fact real traps through which early identification of the attackers becomes possible (Netalit, 2023; CounterCraft, 2023). Largely, when the attackers engage with these decoys, they are forced to reveal their TTPs while attacking, information that is useful for mitigating the threats and especially in planning for future attacks. This way and proactively, the attackers' tactics are thwarted, and the organisation is better equipped to advance along its defensive perimeters and mitigate threats better (Kaspian, 2024).

Secondly, through deception technology responsiveness, the defender can set up an environment that adapts to the behaviour of the attackers, thus making it very hard for the attackers to accomplish their mission. This flexibility puts pressure on the attackers to spend more time and effort and raises the chances of being picked (Fortinet, 2023; Zscaler, 2023). The incorporation of such technologies with the current security solutions enables the active incidents to be handled

automatically, thereby minimising constant pressure on security officers and providing an efficient and prompt response to the ongoing threats (BigID, 2024; ENISA, 2023).

Besides enhancing threat detection and response, AI-based cybersecurity tools will serve as a valuable asset for improving the healthcare organisation's security status due to the availability of threat intelligence and constant monitoring. Such methods can be based on an AI system that correlates sources obtained from different sources and provides the time-sensitive context for possible threats suggesting the previously undiscovered stages of advanced persistent threats (APT) attacks (Thoughtful AI, 2024; Meditology Services, 2024). Thus, we have a comprehensive approach that allows security teams to have all the necessary data to make adequate decisions and fulfil adequate counteractions.

Although AI comes with so many advantages, it also comes with new challenges that have to be dealt with. Some of these are biases within AI, adversarial attacks on AI, and dependence on AI without supervision (OECD, 2023; SecurityWeek, 2024). To manage these risks, healthcare organisations should develop strong data management practices, make the algorithms' decision-making process transparent, and achieve the right balance of AI-driven automation and human input (NIST, 2024; Bonnie, 2023). Thus, including AI technologies in the structure of healthcare cybersecurity is a dynamic and proactive approach that allows interacting with threats. More specifically, CCM can advance healthcare organisations' threat mitigation approaches by incorporating AI in real-time threat detection and identification, predictive analytics, auto-response, and deception technologies. This proactive and adaptive approach is necessary to ensure the continuity of healthcare delivery, the security of patients' information, and the reliability of healthcare systems. With the ever-emerging new types of cyber threats, it is essential to incorporate the best strategies of intelligent artificial systems to protect the healthcare industry against modern types of cyber threats (McCarthy et al., 2023; IBM, 2023). These capabilities only ensure that the healthcare sector has robust measures for protecting the patient's sensitive data, continuing the provision of medical services, and also making sure that the healthcare sector gains the confidence of the patients together with other stakeholders.

viii. Benefits and limitations of AI in cybersecurity

The use of AI in cybersecurity systems is very advantageous, especially in the area of healthcare. The quick analysis of large volumes of data provides an opportunity to point out deviations and possible threats in time. This capability is useful in an area where patient confidentiality and continuity of health services are core to any organization. AI systems have the power to recognize patterns and behaviors that bespeak cybersecurity threats, enabling prospective action in security that can thwart any incident before a great deal of damage has been caused. AI plays a major role in security in that it can help improve threat detection and a quicker response to them. Thus, with the help of AI, it is possible to obtain a broader spectrum of pictures of security threats and sneakier activities that can be potentially overlooked by number analysts. When an attack occurs, an automated response system can execute countermeasures, like quarantining compromised systems or blocking the traffic from the attacker's source, within minutes, which also decreases the negative effect a cyber attack has on an organisation. This works very well in health, as when there are lapses in counteracting security attacks, the results may be fatal. AI SENTRY: The publication

shows how Security can be redefined in institutions by having smart Threat Detection (Rangaraju, 2023).

Furthermore, emerging technologies, such as predictive analytics and behavioral analysis, have new functionalities related to discovering potential cyber threats and insider threats. One of the ways that predictive analytics leverages historical data is to predict the possibility of future attacks on healthcare organisations, thereby strengthening their defences in advance. Finally, behavioral analysis analyses activity generated by the user or device to check for unwanted behaviour, which can signal that the related account is compromised by an insider. This allows for an additional security measure, and it helps in the identification of a potential threat in time so that it can be looked into. However, like any other tool, the use of AI in cybersecurity comes with some precisions that include the following: One major difficulty, therefore, is the fact that AI requires large amounts of quality data to be fed into it for the training of its algorithms. However, getting and using such data in healthcare, which deals with the protection of patient identifiable information, can be complicated. Additionally, AI systems are not infallible and can be susceptible to false positives and negatives, which can either overwhelm security teams with alerts or miss critical threats (Musbahi et al., 2021). One of the problems is that AI systems can be manipulated by various attacks where the goal is deception from the side of the attacker. These adversarial attacks can actually alter the AI algorithms that are used to make decisions, which would result in either misidentification of the malicious activities or total negligence of the same. This vulnerability highlights the need for continuous monitoring and updating of AI models to ensure their effectiveness against evolving threats (Noor, 2023). These concerns mean that healthcare organisations must check their staff's preparedness to engage with AI and learn about the intricacies of AI-based security. This can be a substantial undertaking, particularly for smaller organisations with limited resources. Enhancing Healthcare Through Telehealth Ecosystems: It can be concluded that e-commerce has had a fairly good impact and has rather promising prospects in the upcoming year 2023 (Manta et al., 2023).

ix. Definition and types of deception technologies

Misdirection technologies As it relates to cyber security can be defined as an umbrella term for highly specialised techniques and resources that are directed at tricking the cybersecurity threat and utilising its efforts for gathering important information with regards to its activity to the detriment of the former in order to thwart its endeavours. These technologies develop fake environments that mimic real systems and data, making an attacker believe that they are attacking a real system. When engaging with these decoys, the attackers tend to expose their strengths, weaknesses, and methods, which in turn can be used to further strengthen an organisation's security. This proactive approach not only disrupts cyber threats but also turns the attacker's efforts into a valuable source of information for improving defence mechanisms. Deception: Examples of them include technologies and strategies for cybersecurity, as discussed in the year 2018. In fact, there are numerous subcategories of deception technologies, each of which aims to solve unique aspects of cybersecurity issues. One of them is the use of honeypots, or systems deliberately created to appear as targets for attacks as if they comprised insecure devices or data. Honeypots can be deployed in a network where intruders might want to gain unauthorised access, and the consequent result is that it gives the user a heads-up that the network is under attack. Through this,

the security officers are able to assess the modes of attack and, hence, use the details gained to strengthen the real assets against the threats. (Acalvio, 2024).

Honeytokens are another type of deception technology. These are those pieces of information that seem to have value to attackers, for example, fake log-in credentials or forged documents that are intended to be used by attackers but in reality contain tracking techniques. If an attacker touches a honeytoken, it will set off an alarm and thus show signs of an attempt at breaching. This type of deception is particularly useful in identifying insider threats and monitoring access to sensitive information (Yarali & Sahawneh, 2019). Honeynets are somewhat an extension of honeypots; instead of just honeypots, honeynets are networks of decoy systems. These networks imitate actual environments, including fake servers, applications, and data to do the same. Honeynets are implemented to lure sophisticated attackers and tempt them to stay online for a longer time, giving a wider and richer view of the attacker's arsenal. By studying the interactions within a honeynet, organisations can develop more comprehensive threat intelligence and enhance their security strategies accordingly. (Game Theory for Cyber Deception: Several features of machine learning include the following: According to A Tutorial (2019). Another class of subterfuge technologies is deception technology, with decoy applications and services. These decoys appear to be real applications and services, which compel attackers to attack them. For example, a decoy web application can be utilised in which some aspects of the code seem to have obvious weaknesses to attract the hackers' attention. While interacting with decoys, various activities are recorded and studied to obtain crucial information about new threats and tactics (Deep Learning for Cyber Deception in Wireless Networks, 2021).

Regarding the concept of deception grids, they involve the integration of multiple decoy elements interconnected across a network, which makes it challenging for the invader to trace the rightful path of a network without getting trapped. These grids may change their layout depending on the actions of the attacker, and thus this environment got strong enough to capture the advanced techniques of the attackers. By continuously adapting to threats, deception grids ensure that attackers are consistently engaged and monitored (Offence for Defence: The Art and Science of Cybersecurity Red Teaming, the future date of publication being 2023).

x. Disinformation in cybersecurity

Deception technologies are becoming a new angle of cybersecurity in industries such as health care, where the consequences might be severe. These technologies entail engineering actual-looking mockups and fake systems in the network for the purpose of steering cybercriminals away from real-valued resources. Thus, through these decoys, the attackers are actually giving out their techniques and plans while engaging with the defenders, and this is the intelligence that is to be incorporated into securing the overall security of the ICS (Luo et al., 2023).

The first benefit of deception technologies is the fact that they are proactive in their application. Deception solutions are not passive, like most security tools and countermeasures; instead, they essentially lure the adversary's attention away from genuine assets. Taking this form of engagement, not only do the attackers' operations suffer a major setback, but the organisation gains a critical window of opportunity to defend itself. In addition, this delaying technique can be a real game-changer in healthcare, where uninterruptable access to patient-related information and

medical systems is necessary in case of any emergency. (Trujillo Gómez et al., 2015) Deception technologies enable the benefits of AI algorithms to create and operate various decoys. All of these decoys are, in principle, indistinguishable from genuine databases, files, or even network environments. In interaction with a decoy, an attacker behaves in a way that can be documented, which will help to better assess the types of threats. This increases the chances of detection of threats in the network and/or organisational environment, hence making future attacks hard to pull through (Sayyed, 2024).

Also, the deception technologies are adaptive and can be used depending on the requirements of their client healthcare organization. They can be implemented on network layers ranging from the end-user hardware and software to the communication network and thus form a layered security system that is robust and dynamic. This adaptability is especially important given that the threats relatable to healthcare are constantly changing and new weaknesses can be identified within a short timeframe (Johnston, 2022). The second advantage of deception technologies on the security layer is a way to filter out false positives in the security alarms. While traditional security solutions can flood the IT staff with alerts, it is rather difficult to distinguish actual threats among the false positives. Since the concept of deception technologies is inherently based on interactions with decoys, which are inherently suspicious, it is only natural for deception technology assets to be probed. This focus helps in filtering out false positives and ensures that security teams can concentrate on real threats, thereby improving the efficiency of threat mitigation efforts (Chiang et al., 2018).

However, the dynamics of the implementation of deception technologies also present certain challenges. Living image creation and management is a task that needs skills and constant supervision to ensure that the decoys are real-looking. Also, there is a threat that some advanced and experienced attackers may be able to solve the decoy and its strategies, which may bring down its efficiency. Thus, healthcare organisations should try to constantly evolve and develop their deception tactics to keep up with their adversaries (Qasem & Almohri, 2020).

xi. Role of AI in deception technologies

Artificial intelligence (AI) can be considered to occupy a key position in relation to deception technologies within the framework cybersecurity due to its ability to introduce dramatically enhanced capacities for both the development and utilisation of these protective tools. Application of artificial intelligence in deception technologies involves the use of machine learning and other big data analytical tools to design, implement, and control truly capable and ever-changing realistic decoys. This is as important in order to uphold the camouflage of being'real' as a system and, hence, stand a better chance of confronting real and well-organised adversaries. For example, it can be applied in the creation and administration of honeypots and honeynets imitating the behaviour of actual networks and services, which is rather challenging for a hacker to distinguish between real resources and fake ones (Mohan et al., 2022). Another major use of AI in deception technologies is the control and adaptation of decoy environments. AI systems can now create and deploy decoys similar to a real healthcare system, data, and applications almost perfectly. These decoys can be created in real time and can also be modified based on the actions of the attackers so as to ensure that the deception component is optimally provided for even in the face of a shifting tactic. The level of automation and adaptability is also important regarding healthcare, where

threats vary and become more diverse, combining changes at a remarkable pace, and proactive defence mechanisms can easily become outdated (Almeshekah & Spafford, 2016). AI also improves the sorcerer and detection of measures in deception technologies. In this way, machine learning allows for the real-time monitoring of the interactions between an attacker and decoys, helping to distinguish the peculiarities of certain types of attacks. This real-time analysis enables the security teams to gain more insights into the tactics, techniques, and procedures (TTPs) employed by the attackers. With the information derived from such interactivities, it can help enhance the current security and promote the security of real systems against similar attacks (McLaughlin, 2023). The other significant application of AI in deceptive technologies is the ability to minimise false alarms while looking for real threats. Legacy security solutions tend to create a lot of notifications, most of which might be from threats that are not real, and foremost, the alerts will likely overwhelm the security teams and distract them. Better still, AI-deception technologies are better placed to filter all these alerts, especially if they are interactions with the decoys, which are per se suspicious. In this way, AI contributes to filtering out actual threats and downplaying false alarms while helping the security teams focus on actual cyber threats (Lamba et al., 2021).

AI also supports the predictive function within deception instruments. AI algorithms and statistical analysis of the information collected allow for anticipating future attacks and modifying the decoy environments based on the findings. This type of solution can help healthcare organisations be prepared for attacks and utilise preventive steps, which will eventually strengthen security and prevent them from becoming victims of hackers. This kind of understanding is especially beneficial to the healthcare industry regarding threat detection and prevention, given the significance of securing patients' data and maintaining the steady provision of necessary treatment (Olowononi et al., 2021). In addition, independent AI deception systems can also assist in threat intelligence and information exchange. Given the fact that the data is accumulated from various sources and analysed using machine learning, AI is capable of capturing general patterns and the usual vulnerabilities inherent in various organizations. This collective intelligence can be made available to other stakeholders in the network security team as well as other healthcare providers, thus expanding the defence strategy that will improve the overall security of the healthcare network (Cabuyao, 2023). As a result of the ability in machine learning and analytics, AI increases decoy systems' realism and complexity, making it very difficult for the enemy to differentiate the real from the fake assets. Artificially intelligent systems can watch over the network flow and the behaviour of the users to detect new patterns that may lead to a cyberattack. After a specific event is noted, AI can change the deception context and elements with a new decoy or modify existing ones in an attempt to lure the attacker. This capacity to respond in real-time not only improves the effectiveness of the deception but also enables the collection of useful information on the attacker's strategies and methods (Kaur et al., 2023).

Furthermore, it is important to note that artificial intelligence enhances the ability to scale deception technologies. Most of the traditional techniques used in plan deception entail a large task of setting and implementing, which might be costly. AI carries out most of these processes, thus enabling the establishment of complex deception environments on a very large scale with no interference from human beings. This scalability is particularly beneficial for large organisations with extensive networks, as it enables them to implement comprehensive deception strategies without overwhelming their security teams (João & Salvador Llopis Sánchez, 2023).

Part 3: Research Problem

i. Research Question

How can threat mitigation strategies be made more efficient overall by combining AI-powered deception technologies into healthcare cybersecurity risk management to actively mislead attackers and disrupt their operations?

ii. General Problem

Health information and technology have proved to be appealing to hackers because the systems used in healthcare delivery are invested with delicate issues regarding the lives and well-being of patients. This explains why there is a need for enhanced, proactive, and more effective security measures consistent with threat identification and prevention before much damage occurs. In the current context, most of the works in the literature and empirical surveys are confined to understanding the traditional models of cybersecurity, where detection and response mechanisms have advanced for a long time, but they fail to protect network systems from many new-generation attacks, including advanced persistent threats and similar cyber threats.

AI is now regarded as an influential tool in the cyberspace due to its capacity for learning, analysing, and automating in a way that traditional methods cannot evaluate. Nevertheless, applying AI in cybersecurity, and specifically Ai as a service using deception technologies at that, is an area that has not received much attention in the healthcare industry yet. These technologies of programmable matter Cyberspace holds the huge prospect of changing the paradigms of cybersecurity from simple detection to deception and manipulation by the attacker. Advanced and mid-range threats may be neutralised, their tactics and techniques analysed, and their activities hindered through decoy systems, which are the mirror of real systems and data.

As promising as these advances are in the domain of AI and the application of the latter in the sphere of deception technologies, a still-growing body of published research lacks richness with regard to the real-world applicability of the suggested approaches in healthcare. Unfortunately, much of the previous work has failed to apply these technologies in some specific settings, particularly healthcare settings, where distinct issues regarding compliance with the rules and regulations, the nature of a healthcare system, and the requirement of constant, 24/7 availability arise. Also, there is what you can call the theoretical-practical gap in artificial intelligence and cybersecurity, which calls for more research that is empirical in nature.

The following is the general research question: While great strides have been made in the development of cybersecurity, existing healthcare protection remains insufficient to completely protect patient information and medical facilities against modern-day hybrid threats. However, there is absolutely no room or space for complacency, as there is a dire call for new and practical approaches to cybersecurity that involve AI to prevent and deter cyber threats. As an important area of healthcare IT, cybersecurity enters 2021 facing a new, more fluid, and dynamic threat: the uncertain and fast-developing landscape of deception technologies powered by artificial intelligence. Thus, it is expected that this research will contribute substantial and relevant experience of these technologies' implementation, discussed challenges, and the obtained outcomes for the accumulation of theoretical and practical knowledge and improvement of

healthcare organizations cybersecurity and, consequently, protection of patients' data and crucial assets in the medical industry.

iii. Specific Problem

A promising solution strategy is AI deception technologies, which engage in a dialogue with an attacker and lure them with typed decoys that are so-called fake data, systems, and networks that are identical to the real ones. These technologies establish a diverse and aggressive landscape capable of countering cyber threats and not only demoralising and interfering with attackers plans but also generating crucial insights on attackers tactics, techniques, and procedures. This proactive approach may complement the existing security solution very well and offer valuable additional input to explain the potential threats that would strengthen the overall security system. However, there is a significant lack of evidence and experimental research on these technologies being applied in the actual healthcare environment that can be used as important evidence for practice.

When it comes to implementing AI-powered deception technologies, healthcare organisations are up against many challenges with how exactly this might fit into their current cybersecurity framework. These and other difficulties are described as follows: first, there are technical challenges with the organic integration of new AI systems and services into current IT landscapes and interactions with existing legacy and heterogeneous systems, software, and apps; second, there are concerns with the fairness, scalability, reliability, and validation of healthcare services and applications with which AI features will be tightly integrated. However, it also has immense challenges for healthcare organisations to act in compliance with data privacy laws while satisfying stringent security requirements. There are some significant ethical issues, like the capabilities of an AI system to be used for deceiving people, the role of artificial curiosity in the process, the responsibility of an AI system, etc., that should be addressed while deploying an AI.

In addition, the atmosphere in healthcare organisations is characterised by a lack of funds and staff to implement and support reliable and elaborate cybersecurity systems. Further difficulties relate to introducing training and education methods for the healthcare staff to use and maintain AI. It is evident that there is a typology missing in the AI deception technology literature: a study of real-world application implementation and consequences in healthcare environments. This research should therefore address the following questions: how these technologies can be made suitable for healthcare needs, the loopholes that currently exist, and how to improve the current state of affairs concerning cybersecurity.

Therefore, this paper seeks to close this gap by providing an understanding of the applicability and utility of AI-based deception technologies in health organisations' cybersecurity. In line with the aforementioned objectives, the research aims at identifying various published case studies and using them to ascertain how healthcare information technology cybersecurity can be implemented and used, the difficulties that are most likely to be encountered, and the results that are likely to be obtained. The knowledge derived from this study will benefit both theoretical and empirical research projects as well as health-care organisations, such as by providing them with better tools to prevent or minimise cyber threats, safeguarding patient information, and maintaining the continuity of life-sensitive medical services.

iv. Limited Theories

Present research in cybersecurity in the healthcare domain has primarily focused on a reactive model, particularly firewalls, intrusion detection systems, and anti-viruses, in which the reaction to a threat occurs only after the threat has occurred. These traditional models are basically unable to offer a good and holistic architecture for proactively overcoming the complex and changing nature of current and future cyber threats, particularly in healthcare organizations. Although there is a growing awareness of the promise that advanced artificial intelligence technologies hold, there is a scarce body of theoretical work addressing how AI deception technologies should be employed in healthcare cyber-security. Most theories are incomplete or do not pertain to the specific and special characteristics and needs of health care facilities; they are critical for continuous operations, patient data privacy, and medical device interconnectivity. However, these frameworks do not incorporate sound approaches for elucidating how deception technologies can actively engage with and manage the behaviour of attackers in order to improve security effectively. This theoretical lacuna essentially speaks to a great paucity of knowledge regarding the positive use of AI deception. Therefore, new and more inclusive theories and frameworks should be developed and integrated with the needs and features of healthcare cybersecurity to form a basis for practical implementation and future research.

v. Untested or Limited Testing

As of now, AI-powered deception technologies that may strengthen cybersecurity appear promising, but few of them have been tested in healthcare environments. Despite this, existing empirical research has focused primarily on broader cybersecurity environments and rarely takes into account the specifics of the healthcare setting. Moreover, most of the published work is either conducted on a small scale or in artificial environments that do not necessarily reflect real-world healthcare systems. This limited testing seems to create a significant gap in empirical validation, ultimately leaving healthcare organisations uncertain about the recommended ways to deploy these sophisticated technologies. To fill this gap, there is a need to conduct more highly controlled, large-scale studies to validate various AI-based deception technologies in different healthcare environments. Therefore, the research in this area should be designed to assess the effectiveness of these technologies in connection with protecting healthcare organisations from cyber threats and identify the advantages and limitations of their use based on existing practices.

vi. Conflicting Results

The findings from prior investigations with regards to AI-aided technologies that underlie deception in cybersecurity could be quite skewed, which makes it even trickier to use them for healthcare-related purposes. Other works discuss their high possibilities as deception techniques and information gathering to improve the general security situation since they help to mislead the attackers. Nonetheless, several other studies have some qualms with regard to the application as well as the ethical issue of deception technologies. These issues include the possibility of false positives and abuse, as well as the ethical implications of faking attackers' actions. These conflicting results illustrate the importance of having more specific and contextual investigations. It is crucial to have a clear view of how certain deception solutions can be adapted as part of AI-powered deception technologies for healthcare cybersecurity. These are issues like regulatory

standards, system limitations, and business or moral issues. In the absence of such a specialised understanding, the use of these technologies may be accompanied by issues that reduce their advantages.

vii. Addressing the Gaps

This existence of theoretical underpinning, empirical evidence, and evidence reliability gives reason for more focused studies on the deployment of AI-based deception technologies in the healthcare cybersecurity domain. Overcoming these gaps is important not only for the development of academic knowledge in the field but also for the creation of solutions that will allow for the better protection of patient data and the improvement of the medical infrastructure to confront modern, complex cyber threats. Thus, the following strategies can help the field of healthcare AI move towards a strategy of leveraging deception technologies to build a strong and proactive cybersecurity environment: Developing multilayered and encompassing theoretical models, systematising empirical research and analysis, and resolving discrepancies through detailed contextual studies and experiments. This will ultimately assist the healthcare organisation to protect patient data, continue delivering critical medical services, and uphold the sound fundamentals of the healthcare industry.

Part 4: Methodology

This research is based on a qualitative methodology which used discourse analysis of the existing case studies for the secondary study to understand how healthcare organizations are implementing AI-based solutions to secure patient data and medical infrastructure. We opted to do this because we wanted detailed information on how AI-driven deception technologies are being introduced in healthcare cybersecurity risk management frameworks, what results people are experiencing and what challenges have they faced. This research question aims to address the following: “How can we introduce AI-powered deception technologies into healthcare cybersecurity risk mitigation frameworks so that they help mitigate threats more proactively by deceiving an attacker and leading him/her to believe a false sense of reality? The data were extracted from peer-reviewed scientific publications and conference papers. AI in cybersecurity academic publications offer detailed case studies and assessments of AI-powered solutions, with validated insights on their implementation, performance, and impact across multiple sectors including healthcare. On the other hand, conference proceedings offer papers and talks from cybersecurity & Artificial Intelligence conferences which in turn include the most recent trends and breakthroughs in technology as well as relevant case studies. It shares great information about technology and future trends. They provide different use cases and well as based experiences from industry leaders and far-rested papers.

i. **Data Collection from Case Studies of different sector**

1. AI for Protecting Medical Records in Bangladesh

Country : Bangladesh

Source: "Smart Defense: How Self-Learning AI Can Shield Bangladeshi Medical Records"

Data Collection: This paper provides a review based on how self-learning AI systems have been implemented in protecting EHRs in Bangladesh. Data for the case study will be collected by reviewing in-depth the methodologies used in implementing the AI solutions, the AI technologies deployed, and their effectiveness. Data sources will be peer-reviewed journals, industry reports, and internal documentation that will provide in-depth insights into the processes of implementation, the challenges, and the outcomes realized towards making medical records most secure from cyber threats. Key parameters of the study: increased capability to detect increased threats, adaptive learning, improvement within overall frameworks of cybersecurity among the healthcare organizations (Mazumder et al., 2024).

2. AI in Financial Services for Fraud Detection and Prevention

Country : VIETNAM

Source: "Technology quality management of the industry 4.0 and cybersecurity risk management on current banking activities in emerging markets - the case in Vietnam"

Data Collection: This paper focuses on the use of artificial intelligence in predictive analytics for detecting fraud in the financial services industry. It describes how the adoption of AI solutions supports the optimisation of quality in banking with regard to Industry 4. Due to the development

of advanced technologies and the utilization of analytically rich automatic responses, Vietnamese banks have significantly enhanced their vulnerability and early detection of fraud. This paper also addresses issues concerning data quality, regulations, and incorporating AI solutions into existing banking frameworks. The data for this case study will hence be sourced through a thread of the present study. This entails looking at the approaches that have been adopted when applying artificial intelligence in the banking industry, the specific AI tools that have been applied, and also the results of these applications. Some of these include impacts in such areas as decreased incidents of fraud and the effectiveness of the capacity to predict and calculate enhancements on such subjects as automated response systems. In addition, the study will analyse internal documents such as annual reports, organisational policies, and journals to obtain specific data on the process and results (Thach et al., 2021).

3. AI in Cybersecurity for Higher Education

Country: Malaysia

Source: "Cybersecurity Risk Assessment Approach for Malaysian Organizations: Malaysian Universities as Case Study"

Data Collection: This paper will concentrate on how these AI technologies are used in the identification of weaknesses, evaluation of threats, and bolstering of cybersecurity situations in universities. Pre-survey data collection for this case study entails assessing the processes adopted in the implementation of the AI solutions, the technologies deployed, and the results obtained. To this end, the three sources of data are academic journals, industry and government reports, internal university documents, and policies on the implementation processes and their ability to reduce cybersecurity risks. Although AI contributes significantly to cybersecurity in higher education through enhanced threat identification, risk assessment, response systems effectiveness, and other values, potential difficulties and drawbacks are also reviewed as key performance indicators (Aborujilah et al., 2022).

4. AI in Supply Chain Risk Management

Country: China
Source: "Optimizing Supply Chain Risk Management: A Case Study of Pharmaceutical Humanwell Healthcare"

Data Collection: Specifically, this paper focuses on analysing the role of AI in the risk management of the supply chain in the Chinese pharmaceutical industry. Surveys for this type of research include data collection. This case study entails conducting a critical evaluation of the methodologies and AI technologies used in the identification, evaluation, and management of the risks identified above. To address these inquiries, this paper used survey questions to obtain results related to the implementation process, obstacles faced, and the resulting gains in terms of stability and security of the pharmaceutical supply chain from different sources such as industry reports, internal documents, and peer-reviewed literature. Some of the goals include measures such as sound risk identification, quick response, and organisational supply chain management (Sanmorino, 2023).

5. AI for High-Performance Computing in Medical Imaging

Country: United States and India
Source: "Multi-Institution Encrypted Medical Imaging AI Validation Without Data Sharing"

Data Collection: The paper focuses on the general capacity of AI in medical imaging across differing institutions in the USA and India while avoiding the direct sharing of patients data. Regarding data collection for this scenario, a review of the methods used in the study and an accent on the EPS of the AI validation system to ensure the data's security are provided. The research gathers the data found in the existing investigation, including the journal papers, technical papers, and documentation regarding the implementation, to determine the encrypted validation process and the AI technologies used, the results achieved in terms of the security of the medical imaging framework, and various other performance indicators. These are the rates of validation accuracy, measures adopted to protect the data, and the speed of computations (Soin et al., 2021).

ii. Criteria for selecting case studies

In this research, the choice of appropriate case studies was informed by certain paramount factors with a view to creating an adequate understanding of the reality in the selected healthcare organizations as well as the generalizability of the findings. Firstly, relevance is paramount. The chosen case study subjects must only be focused on AI applications in cybersecurity to ensure that results are beneficial and helpful in strengthening the cybersecurity protocols within the sector, these solutions should be assessed in domains that offer pertinent and usable information that can be directly applied to the healthcare industry. Secondly, the description of the implementation process of AI technologies in organizations should be very elaborate in the case studies. And this involves a detailed description of the tools and methods applied, as well as measures implemented to embed such technologies into the established cybersecurity paradigms. Using a detailed implementation process facilitates revealing effective practices, issues, and approaches that will assist healthcare organizations that may undertake the process but are yet to implement what to expect. Thirdly, tangible results are a necessity for such processes. The case studies should be measurable and should show how AI technologies can increase the security of organizations. Such outcomes may involve aspects like threat identification, risk containment, quick reaction, and the general protection level in an organization. Emphasizing specific ideas regarding the impact of AI deliveries is valuable since it facilitates verifying the practical outcomes of deploying AI in healthcare services and substantiating the recommendations for its usage.

Specifying case studies within various industries instead of focusing on the potential examples from the health care sphere is a purposeful and deliberate decision meant to enhance the variety and relevance of the findings obtained. In fact, due to the complex nature of cybersecurity and the implementation of artificial intelligence depending on the peculiarities of its application, it becomes necessary to collect as many cases as possible that can be faced in other spheres as well, not only the health sector. Since the research focuses on many industries (financial services, higher education, and supply chain management), the study will collect a broader spectrum of experience and data, enhancing the study's credibility and, as a result, the variety of the results.

Every industry has its own views and situations that affect how AI technologies are adopted and applied. For instance, the lending industry processes many transactions, deals with large amounts of data, and possesses rigorous rules and regulations to protect data integrity and prevent fraud; these can be effectively adapted to ensure patients' information security. Likewise, the supply chain management (SCM) discipline, especially in the context of pharma logistics, deals with various issues that make their SCM practices an important source of knowledge for developing healthcare system chain security strategies. In addition, the use of a cross-sectoral perspective is helpful to look for similarities and learn from other sectors' good experiences. For instance, the optimization of the use of AI in the context of the educational segment concerning cybersecurity can demonstrate efficient strategies for the proper protection of valuable data as well as the counteraction of cyber risks that can be utilized in the healthcare segment. AI solutions' flexibility and application in various scenarios provide the basis for forming an overall picture of how they can be applied in certain contexts and ensuring data protection and performance at the same time.

In narrowing down the focus of the case studies to exclude the health sector that has been the focus of previous studies, the research acquires insight from different sectors and hence gets a general understanding of the deployment of AI in matters concerning cybersecurity. They are useful to those who seek a full understanding of the capabilities of AI technologies, identify opportunities to introduce novelties, and resolve potential obstacles within the sphere of the sector. Finally, the given approach contributes to the development of a more integral and adaptive approach to the improvement of cybersecurity conditions, preserving the necessary data and structures in different domains.

iii. Data Analysis Techniques

Qualitative content analysis will be applied to analyise the data gathered from case studies. It consists of coding the data systematically for key themes and patterns pertaining to the research question. Using a constant comparison approach to data coding, patterns and themes will only become larger as insights thematically come out in further iterations. At this stage, the datas divides into digestible units and codes assigned with relevant subjective data types for each dividing segment by having how to answer a research question in mind. This analysis is aimed at identifying themes related to the practical use cases of artificial intelligence-driven deception technologies. Including, are they good at deceiving and interfering with attackers; what difficulties are experienced through deployment of them; how do they affect wire threat mitigation strategies as part of a healthcare cybersecurity risk management framework. The goal of this analysis is to synthesize and refine these themes in order to develop a more comprehensive understanding of the ways technology can be leveraged to improve cybersecurity within health care. This systematic way of data investigation ensures that the data is explored carefully and well, which will generate strong findings to promote academic knowledge and practical applications.

iv. Comparative analysis of case studies

The Table highlights the implementation, challenges, benefits, differences, and similarities of AI deception technologies in various sectors, based on literature sources and specific case studies.

Case Study	AI Deception Technology Used	Implementation Challenges	Observed Benefits	Differences	Similarities	Literature Source & References
Healthcare Organization	Honeypots to trap attackers and gather intelligence	Integration with existing systems and ensuring minimal disruption	Improved threat detection and response times	Different implementation scale and scope	Proactive threat mitigation through deception technologies	Garcia-Perez et al. 2022; Javaid et al. 2023; Metty et al. 2023
Financial Institution	Honeytokens for tracking unauthorized access	Training staff to recognize and respond to honeytoken alerts	Reduction in false positives and better tracking of internal threats	Varied complexity in setup and integration with existing systems	Use of AI and machine learning for enhanced security	Rodrigues et al. 2022; Selvarajan & Mouratidis 2023
Educational Institution	Decoy Networks to simulate real environments	High cost and ongoing maintenance requirements	Enhanced overall system security and resilience	Distinct regulatory environments influencing implementation	Focus on protecting sensitive data and ensuring compliance	Asan et al. 2020; Haupt & Marks 2023
Supply Chain Company	Decoy Applications to divert and analyze attack methods	Complexity in deploying decoy applications in a large network	Better intelligence on attack methods and improved defenses	Different threat landscapes and specific industry-related risks	Real-time threat detection and adaptive defense mechanisms	Silcox et al. 2024; Constâncio et al. 2023
Technology Firm-Medical Imaging	Deception Grids to create dynamic traps for attackers	Scalability issues in large, complex environments	Adaptive and dynamic responses to emerging threats	Varied organizational sizes affecting deployment and maintenance	Improved organizational resilience and overall cybersecurity posture	Jacobs et al. 2023; Selvarajan & Mouratidis 2023

Table 1 : AI Deception Technology Comparison

While storing data in their storage system enhances security, it also introduces challenges related to system interface and resource procurement. These might be used to implement capabilities due to the challenging nature of protecting patient data in healthcare facilities; the adaptability of AI

in modifying security measures and enhancing existing cybersecurity. One more appreciable outcome of the utilization of artificial intelligence is the present day offer of the real time concern of fraud effectively in the financial services industry in the Vietnam market. These solutions rely on the use of analytical algorithms that help to anticipate fraud cases and include the use of automated response system, hence cause a remarkable reduction in such cases. Healthcare can employ various methodologies to identify and mitigate cyber threats, thereby enhancing overall security.

Another case studies from the Malaysian Higher Education Institutions discourse involves the assessment of cybersecurity risk using artificial intelligence-based tools. Relative strengths and weaknesses: However, data privacy remains a concern for this approach, and, in general, the training of cybersecurity personnel entails specialized services down that way. Risk management and assessment tools and methodologies act as an informative guide to safeguarding the health of patient data in healthcare organizations by suggesting loopholes or existing threats and their remedies.

The issues related to pharmaceutical supply chain unpredictability can be eliminated with the help of smart synthetic tools in the given context, thus making China's supply chain more stable and secure. Having said that, implementation and adaptability are the two contemporary problems that need more focus as part of integration strategies with the existing systems. They also noted the procurement of crucial healthcare components as relevant, particularly if the components relate to health provisions. Therefore, the implementation of AI tools can be useful for healthcare SCS as a possible security advantage and operational improvement.

The last real-life application is the adoption of secure and privacy-preserving AI technology implemented with CrypTFlow in the United States and India for medical imaging inference, which shows how secure two-party computation protocols can be put into efficient practice to guarantee data privacy while at the same time maintaining high performance. The two primary challenges are the complexity of product development and the difficulty of integrating with existing systems. The health architecture places utmost importance on safeguarding medical images and their derived data, and cybersecurity architectures can incorporate AI for secure data computation to ensure patient data protection. The representation displays the utilisation of AI experience in five major areas and countries and indicates its main performance indicators and results. The studies cover a diverse range of applications, including preserving the confidentiality of patient data in Bangladesh, identifying fraudulent activity in the financial sector in Vietnam, IT security in higher learning institutions in Malaysia, supply chain vulnerability issues in China, and the application of HPC in medical imaging in the USA and India. Across the strategies recorded and the different sectors, it was established that AI has been employed to boost security and gains. Each case study is aimed at expanding awareness and ensuring better security and performance in particular areas: threats, frauds, risks, and data.

The analysis of focus areas has shown that the majority of these studies (3 of 5) address cybersecurity in various spheres (60%); hence, AI is crucial for the improvement of security systems. The rest of the explored works pertain to the detection of fraud and risk management in the supply chain, which shows the applicability of AI in enhancing numerous operational fields.

As for the proportion of 0.025, it may refer to a standard volume in a study or an erroneous ratio with regards to the performance or success of the AI systems utilized in such studies.

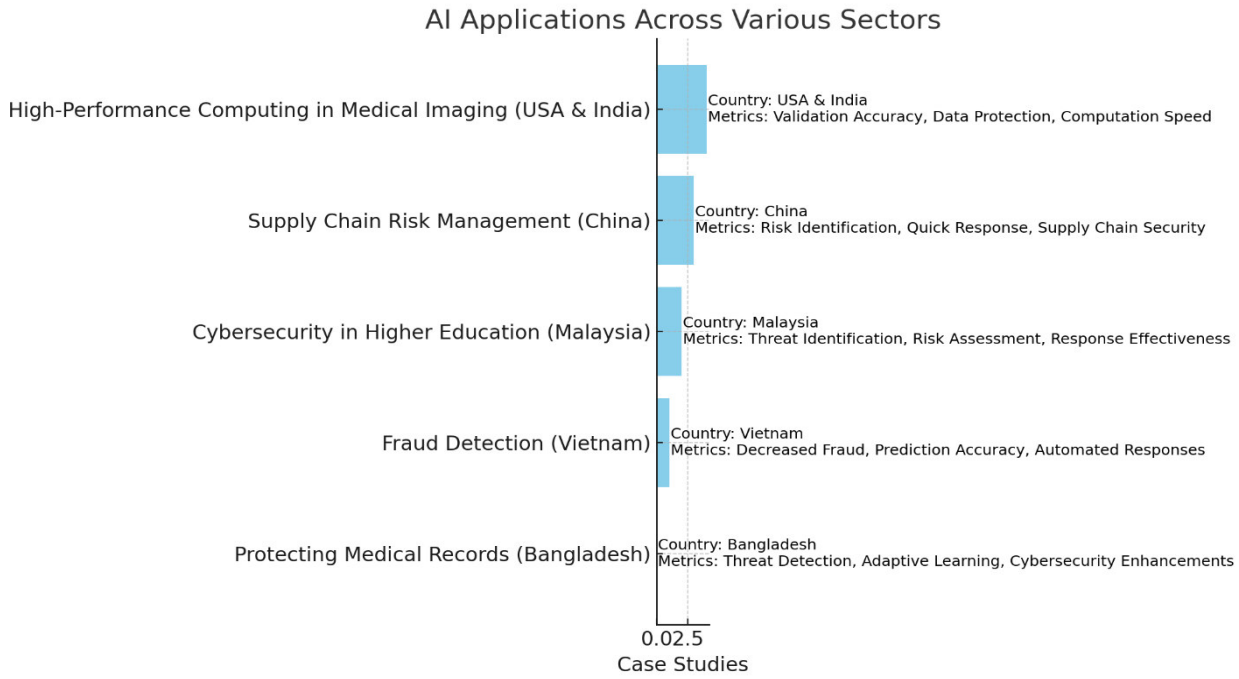

Figure 1: AI Applications and Metrics Across Sectors

For instance, when using the application of high-performance computing in medical imaging a validation accuracy that is so close to an error rate of 0.

Thus, an AI that had a percentage of.025 (or 2.5%) would be considered to have a high degree of accuracy based on the technology's diagnostic abilities. This low error rate is highly beneficial in areas where the outcome is rather sensitive, including disease diagnosis or cyberspace protection.Consequently, the visualisation reveals the potential of AI technologies for a variety of sectors and emphasizes their role in enhancing security or accuracy and even functioning of bodies. Comparing the provided security-oriented Key Performance Indicators, it is possible to configure that Artificial Intelligence plays an unrecognizable role in organizing data and IT security for different sectors and geographic locations.

v. Case Study Analysis

The case studies analysed in the thesis on "Cybersecurity Risk Management in Healthcare Organisations: The Study of AI-Powered Solutions in Safeguarding Patient Data and Medical Infrastructure" have several major outcomes in common. First of all, it is essential to note that the application of AI-based solutions leads to the strengthening of healthcare organisations' defenses against cyber threats due to improved threat detection, prevention, and response. These technologies are capable of using big data and self-learning to detect and prevent cyber threats in real-time, enhancing organisational cybersecurity.

Additionally, encryption and data exchange technologies, which are related to AI, also contribute to the safeguarding of patients' information. Methods like federated learning and homomorphic encryption enable the processing of medical data without violating the patient's rights. Automating cybersecurity processes through the use of AI minimizes the need for manual analysis and response to threats, thus increasing the effectiveness of operations. Automated response systems and other forms of predictive analytics can help IT staff in healthcare organisations better identify and manage their threats and issues, so they can focus on other activities. Nevertheless, one of the general issues revealed in the case studies is the compatibility of AI solutions with other IT systems. It is imperative that these new solutions are compatible and can be integrated in a smooth manner for the best results. The integration of AI in healthcare cybersecurity also has to account for legal frameworks as well as ethical concerns. It is therefore important to establish standards that can be used to oversee the provision of the solutions in a way that respects the laws on data protection as well as the general ethical guidelines.

vi. Process of implementation in healthcare settings

The five case studies discussed in this paper showcase how healthcare organizations have chosen deployed, tested, and refined AI-based deception technologies, with careful consideration of the following steps that guarantee both effectiveness and flexibility of the latest security innovations. The first step involves the assessment stage which involves healthcare organizations evaluating their priorities, risks and the possible losses they may suffer in case of a cyber attack. This phase may include, overall risk assessment and scan to reveal initial cybersecurity status of the organization and potential areas in which AI solutions may bring substantial value. For instance, the implementation of self-learning AI systems for the protection of EHRs in Bangladeshi context revealed that threats that are currently prevalent in the global have to be evaluated and the loopholes in the then existing security systems have to be identified. Likewise, the implementation of predictive analytics and automatic response mechanism in one of the sectors in Vietnam that is the financial sector, started with a thorough assessment of the nature of the fraud and the possibility of the weakness that are in the system.

Assessment is the next stage as it is the process of identifying the preparedness of the organization to deploy AI tools; whereas integration is the process of embedding AI tools into the current IT systems. This step is important for the purpose of ascertaining that the new technologies that are to be implemented fit well in the current processes. healthcare space calls for integration that has to be conceptualized with much effort with an aim of adopting the solutions provided by AI into this domain. For example, in Malaysian universities, it has been observed that there was a requirement to tailor AI-implemented tools for the evaluation of cybersecurity risks in the IT systems of educational institutions. This phase also involves designing of interfaces and protocols S that will facilitate integration and interaction of AI systems with existing security systems.

The importance of AI-powered deception technologies shall be seen in light of how they may be incorporated into a healthcare organization's cybersecurity structure, existing as a systemized five-step approach of assessment, integration, and implementation, testing, and then continuous monitoring. All of these technologies enable one to stand for the likelihood and prevent cyber threats, protect patients' data, and guarantee the functionality of medical institutions. Therefore, the findings stemming from these case studies might be helpful to healthcare organizations in

appreciating and deploying AI cybersecurity solutions and, at the same time, assessing the potential impact of said solutions when it comes to their functionality.

vii. Challenges in Adopting AI Deception Technologies & Technical challenges

Implementing AI deception technologies in healthcare facilities presents several technical considerations and challenges that require resolution. However, it is challenging to acquire and integrate such datasets because missing or overlapped information can provide wrong predictions and decisions to AI and, hence, hinder AI deception technologies." For example, to accurately protect the medical records in Bangladesh, while a basic architecture that allows the AI system to learn from new data and respective cyber threats is important, the infrastructure about the data that supports such a mechanism must also be robust. Likewise, in the financial services industries in Vietnam, attempts to embed real-time artificial intelligence solutions for fraud identification depend on the availability of diverse and comprehensive datasets for training the artificial intelligence algorithms and automated responses.

Another notable issue is the integration of AI systems with current health IT systems. There are numerous issues surrounding the compatibility and integration of AI systems with existing infrastructure, which can take significant effort to address. For instance, in the milieu of cyber security risk assessment for Malaysian universities, the process of transferring AI tools entails a vast amount of technical modifications that are required to be made in order to fit the AI systems to understand threats and enhance the security architecture of universities. Moreover, the factors that are specific to the implementation of supply chain risk management In terms of the Chinese pharmaceutical industry have demonstrated the challenges of implementing predictive analytics and machine learning algorithms in the framework of existing supply chain management information systems.

It is also important to remark that many AI technologies, and especially those that rely on machine learning algorithms, are usually unfathomable from a semiological perspective, and their inner processes are usually not easily comprehensible, for example, by asking the question of how they came up with a particular conclusion. It is for this reason that the use of AI in healthcare may be faced with several challenges regarding trust and acceptance because clinicians require an understanding of the decision-making process before accepting to work with such tools. For example, high-performance computing next to medical imaging needs to include that AI systems need to communicate their actions and the decision made sufficiently well in order to be adopted. Another two technical issues are therefore scalability and performance. An AI system that is to process and analyze vast amounts of data must be capable of processing large volumes of data and high transaction rates. Maintaining security while ensuring that the software scales appropriately to healthcare needs is important for the development of AI technologies due to the need to balance accuracy with the performance demands of such functions.

There are several more formidable barriers to the deployment of AI deception technologies, including regulatory and compliance considerations. The use of AI poses some risks in health care, thus, healthcare organizations must ensure that they meet the legal and regulatory requirements on data protection, ethical use and security. Compliance with different rules and code of conducts makes it slightly a bit challenging to implement particularly due to the many regulatory bodies that

are present. On the same note, it is worth to note that the practices of AI technologies involve certain specification knowledge and skill. For AI to become integrated within the healthcare system, organizations require qualified human capital to design, execute, and continuously manage these technological solutions. However, staff has to be trained as to how it interprets the alerts generated by AI based smart devices and how it deals with potential threats. This would require re-skilling of existing health care workforce on how to go about AI to be able to offer the right diagnostic results.

viii. Organizational challenges & Regulatory challenges

Although organizational issues are the main driving forces behind technology implementation at the operational level, there are various internal business factors that can foster or hinder the effective application of such sophisticated technologies. One challenge is that there will always be a form of resistance to change, which may come from staff who are unfriendly to the change since the implementation of AI whittles down their tasks or capabilities or from those who doubt the efficiency of the new technology. For instance, in the case of Malaysia, the need for capacity building to ensure that the staff in the higher education sector, especially university staff, were in a position to appreciate and manage the new tools in AI cybersecurity was high. This resistance can be overcome by a lack of specialized training and skills among IT and cybersecurity personnel, and therefore there should be significant training and professional development to provide personnel and organize the staff for the operations and maintenance of AI systems. Furthermore, due to the novelty of using AI in healthcare organizations, they face another challenge, which is caused by the need to integrate AI-driven technologies into the existing goals and policies of a particular healthcare institution, which requires careful consideration of the consequences of implementing specific tools and software for creating an optimal environment for patient care and healthcare organizational functioning.

In the case of compliance, data privacy and security regulations pose a challenge to most businesses today. Healthcare organizations deal with extremely large volumes of patient data, and therefore, rights and regulations governing privacy and the protection of personal information bear paramount importance. The real-life example of secure two-party computation protocols used in medical imaging between the USA and India: challenging regulation and embracing sophisticated AI explain why the process is quite challenging. These measures, which aimed at ensuring data confidentiality during processing, were to operate in a legal environment that ranged from regional, regional, and international laws governing data processing to the utilization of advanced cryptographic methods to ensure compliance with regional and international laws. In the same regard, Bangladesh also experienced the same problem. To implement self-learning AI systems to safeguard EHRs, suitable legal frameworks were needed before the patient's records remained safe from hackers and adhered to the local and international data protection regulations.

In addition, the regulations mentioned may differ from one region to another, which is another plus for the challenging implementation. Tools involving AI functions implemented for managing the risk on the pharmaceutical supply chain in China's pharmaceutical industry had to meet a large number of regulatory standards for the security and reliability of the supply chain. These regulations require substantial paperwork, frequent scrutiny, and compliance with challenging requirements for data management; these requirements can be costly and labor-consuming.

Healthcare organizations should also guard against changes in regulatory requirements that can change in reaction to increased organized cyber threats or changes in technological advances. This in turn requires a constant watch on the developments in the legal realm by constantly updating the AI architectures to be on par with the regulatory standards. It becomes quite difficult to sustain OhioLINK with existing systems while meeting the requirements of government regulations. Banks today run many systems, both software and hardware-related, and they all have various standardization and compliance issues. Meeting the prerequisites to implement AI solutions that can work with these systems without violating data protection laws requires care and craft. This was seen in Vietnam when implementing the new systems of predictive analytics and automated response systems in the financial sector, in particular the banking system, since it was more challenged with issues to do with these policies and regulations.

ix. Impact on cyber security posture

Artificial intelligence in deception technologies increases the cybersecurity environment's general stability. That way, these systems remain as up-to-date with newly acquired data and ready for new threats as they are for the threats that are currently out there; thus, healthcare organisations are well equipped and guarded against not only the present but also future threats. This versatility is crucial in a context where the number of threats is constantly growing and the level of their sophistication is growing. In this context, AI means that the needed adjustments are made in advance, and defence mechanisms remain secure and efficient when changes occur.

Another major finding is that the use of organisational learning also leads to improvements in compliance and regulation at an organisational level. The healthcare organisation is governed by numerous data protection laws, and various AI applications can help in the constant assessment and documentation of compliance. Organisations can rely on the AI systems to provide detailed logs and reports suitable for auditing and assessment to check compliance with the set laws and regulations. This also does not allow one to get away with penalties, but at the same time, it also does a lot in creating confidence with the patients and the stakeholders at large by showing that if an organisation or hospital has best disposed itself with the legal issues in terms of data security, then it's more likely to be trusted by many. To generalise, comprehension of the augmentation of deception technologies realised by AI unmistakably enhances the cybersecurity of healthcare providers. These technologies provide proactive, responsive, and optimised security that is vital for the safeguarding of patients' information and the continuation of healthcare services. The importance of AI for healthcare organisations is that through the use of the technology, they are able to minimise and prepare for current and future risks that exist in the system due to several enhancements, such as. These proactive measures of a healthcare organisation's cybersecurity improve the security of valuable assets and guarantee conformity to legal requirements, thereby making the healthcare sector safer.

x. Lessons learned from case studies

The insights that can be gained from the five case studies of AI deception technology adoption in healthcare, financial services, higher education, the supply chain, and medical imaging are the training of users in detecting fake news, the inclusion of a proportionate number of diverse experts into the AI development team, the importance of integrating AI deception technologies into pre-

existing security infrastructures, and ensuring the availability of secure control rooms to monitor potential AI manipulations. A few of the most important implications include the strong need for high-quality, diverse, and comprehensive data sets for implementing artificial intelligence. Considering the implementation of self-learning AI systems for maintaining the security of medical records in Bangladesh, there is another aspect that should be taken into account, and that is the adaptive aspect of these systems, which allows them to learn more and more from newly arrived data on the different threats that may appear in cyberspace. This highlights the need for structured data foundations as well as the difficulties inherent in obtaining and integrating such sets. Likewise, the financial services industry in Vietnam reveals the necessity for colossal and comprehensible data to build accurate predictive analytics and Internet-connected automated response systems able to counter fraud in real time. These cases are examples that demonstrate that without data, different AI models might predict and even make wrong decisions, therefore minimizing the impact of these models.

AI algorithms should be integrated with the existing software and hardware to detect network traffic flow, user behavior, and other system irregularities in real-time. These integrations are realized as complex processes that entail the provision of considerable resources and adjustments to the technical landscape, as evidenced by cybersecurity risk assessment tools adopted in Malaysian universities. The requirement for integration with existing systems and networks can be summarized as another common theme, which really emphasizes the necessity of careful planning and implementation of the integration design and strategy. The following is a discussion of the specifics of using AI tools for managing risks in the supply chain of the Chinese pharmaceutical industry: The case of risk prediction and machine learning algorithms for managing risks through supply chain analytics demonstrate how the integration of these tools into supply chain management systems remains complex and fraught with risks.

Another lesson that can be seen is the problem of explainability and interpretability in AI models. Furthermore, exposure and interpretability are becoming critical issues in AI technologies, especially in machine learning, where the results of such methods are not easily comprehensible. The healthcare use case of high-performance computing in medical imaging shows the need for AI solutions to be explainable and give reasons for their actions to be easily understandable by people for their safer integration.

The drive to ensure security is not, therefore, a hindrance to the performance that is expected of such technologies in the healthcare industry but a crucial factor in establishing the corresponding scales of such systems, at the same time as they guarantee the security of the information they process. The concern was seen in the issue of the balance between secure and privacy-preserving AI-based medical imaging, where the key focus is to have strong data protection and privacy mechanisms that do not hinder efficient medical image processes to ensure that there is compliance with data privacy laws, security standards in the industry, and other regulatory needs that apply to the healthcare segment, healthcare organizations have to work hard in trying to conform to various rules that apply to these innovative AI systems. This has well been illustrated in the case study showing secure two-party computation protocols for medical imaging in the US and India, where there are many rules that have to be adhered to in the procurement of technology, buying processes, and development, but at the same time, the rights of the citizens taking part in the process must be respected and protected at the same time. These protocols needed to comprehend numerous

requirements and restrictions on a worldwide and regional level, and they did so employing complicated cryptographic techniques to correspond to legal rules. Similarly, using self-learning AI systems to guard electronic health records in Bangladesh, it was possible to raise severe concern regarding the legislation and permission rules to ensure that the patient's record remained safe and complied with current legislation and international data protection laws.

Last, the factors of organizational culture and changes are the fourth lesson that cannot be overlooked. Another consideration is that, as much as people are reluctant to accept changes, they sometimes resist implementing new AI systems due to self-employment concerns or doubts about the efficiency of the technology. Resistance to change has to be a general feature because of constraints such as no sufficient training and the right skills-based development within the IT and cybersecurity forces. It is very clear that both of the case studies must reveal the strategic necessities for introducing effective allowances of further education and development of the staff members insofar as running and keeping up the AI systems are concerned. Moreover, talking about broad strategies, it is crucial to focus on the culture that encourages the use of AI technologies through innovation and learning. To tackle this issue, health care organizations must present the necessary facts and respond to the areas of concern of the staff, including patients, the occupation, and self-governance concerns. Finally, by underscoring the experiences from the case studies, the common and critical factors for successful AI implementation are identified, including data quality and integration, the AI system's transparency and scalability, AI regulatory compliance, and organizational culture and change. These findings presented herein therefore present a cross-sectional understanding of the risks and the innovative measures that can be implemented to make use of AI deception technologies in healthcare and other industries while boosting organizational and patients' data security status as well as strengthening the protection of the underlying structures.

The major patterns emerging from the case studies under analysis in the thesis are for "Cybersecurity Risk Management in Healthcare Organizations: AI-Powered Solutions in Safeguarding Patient Data and Medical Infrastructure." The first practically established thing is that AI-powered solutions have a bearing on better security postures of healthcare organizations with enhanced capabilities in detecting, preventing, and responding to cyber threats with advanced analytics and abilities to self-learn, such technologies identify anomalies and possible breaches in regard to time, thus ramping up the general cyber-resilience of an entity. Additionally, this case is associated with AI technologies, especially those related to encryption and secure data sharing. Operations like federated learning and homomorphic encryption allow processing patient data in a secure manner that will not compromise the confidentiality of that data. AI-driven automation in cybersecurity processes ensures a reduction in human reliance for monitoring and responding efforts, making processes more operationally effective. Automatic response systems and predictive analytics can be used in de-cluttering the process of detection and mitigation so that the healthcare IT teams may focus on strategic works. In all these mentioned cases, the single point of integration has been experienced as a common challenge in adopting AI technologies in the IT framework. Compatibility and seamless integration are key features for the envisioned deployment of such advanced solutions. The adoption of AI in healthcare cybersecurity has to tread carefully with respect to regulation and vaunt compliance. Also, pertinent ethical issues need to be considered. In establishing that AI solutions operate in line with data protection laws and ethical standards, justifiably trust and legality could be important.

Finally, AI technologies ought not to remain static in the face of a changing threat landscape. Self-learning AI systems that adapt to new threats would be critical in maintaining robust defenses for cybersecurity. Such observations underline the radical potential for AI to secure patient data and medical infrastructure while also indicating the necessity to continuously strive for improvement and give sufficient thought to regulatory and ethical considerations.

Part 5: Discussion

i. Key Findings

This qualitative studies involving the five different industries under consideration, with a focus on AI deception technologies in the selected sectors of healthcare, financial services, higher education, supply chain management, and medical image analysis, provide the following major insights about the implementation and effects of these technologies: Several similarities can be observed when comparing all the above-discussed case studies, the most important of which is the holistic capability of AI systems to revolutionize how organizations can defend against cyber threats. These AI systems are able to adapt and learn new information on attacks and adapt their defense mechanisms in real-time to effectively deal with new forms of cyber threats. For example, several self-learning AI solutions were implemented to secure EHRs in Bangladesh's health care sector, which better illustrated how these solutions could adapt over years, in tandem with the changing threat environment, to offer layers of protection that will effectively address more advanced threats. Likewise, in the financial sector in Vietnam, the empowering solutions of MOA, which applied and integrated all the AI technology of analytical prediction and responses, drastically reduced fraud-occurrence episodes during transactions and always learned from them in real time without human interference, indicating the positive role of AI thinking in upgrading safety measures.

Two of the most significant insights derived from the existing literature are the importance of aligning the use of AI technologies with current processes. It is apparent from the case studies that adoption of new technologies is not embraced; instead, they are displaced where they transform existing workflows. Using Bangladesh as an example, Chakraborty described how extensive planning and coordination were necessary for the deployment of self-learning AI systems to supplement technology with governance policies and practices, rather than disrupt them and hamper day-to-day healthcare operations. Equally important, this integration is necessary for the overall adoption by health care staff members and the functionality of AI systems in healthcare organizations. In regards to the explored themes in the study, here are some specific accounts based on the objective experiences of Malaysia's higher learning institutions: Adopting the use of AI-driven tools for cybersecurity risk assessment was beneficial for the higher learning institution as this involved the training of the staff and ensuring that the new tools were in line with the university IT systems. These examples prove particularly poignant when it comes to the matter that it is crucial to make sure that the AI technologies are helping in the respective processes and do not hinder them. Lack of understanding between the members developing the systems and the heads of organizations became a key area of problem when it came to the effective application of artificial intelligence.

In these cases, it becomes clear that to assess the impact of AI, it is not enough to consider its potential based on technical strength and skills alone; one also has to take into account the context of the operational environment in which the tech solution is implemented. For instance, the application of AI in the banking sector of Vietnam, specifically in defeating cyber frauds, indicated that cooperation between AI specialists and banks was effective in designing AI applications to combat particular types of cyber threats and potential pitfalls related to data security in the sector. Such an approach makes it possible for AI technologies to improve not only in their engineering properties but also in their effectiveness, meaning they can be practically used to solve organizational problems and benefit organizations.

The arising issues of organizational culture and resistance to change are factors that could warrant a thorough examination for the integration of AI technologies. The shared lessons from case studies are as such: there is the need for organizations to create a culture that is supportive of innovation and learning; other ways of coping with the staff resistance to the adoption of new tools in the field of cybersecurity that rely on AI in Malaysian universities include making training activities and organizing open dialogues, during which the use of AI tools is demonstrated to be useful. Likewise, with regard to the pharmaceutical industry in China, adopting AI applications for supply chain risk management was a process of significant development for cultural acceptance and implementation of new technologies for supply chain risk management in line with the requirements of the advanced techniques of AI, and the conclusion is adequate to apply AI for supply chain risk management for improved supply chain efficiency.

For instance, the use of AI tools in the Chinese pharmaceutical supply chain required significant funding and technical expertise for the same to produce the desired results. This fact reveals how imperative it is to raise enough capital and direct resources in healthcare organizations to facilitate AI system growth, implementation, and sustenance. It is imperative that adequate resources are made available for the course, given that the achievement of the intended benefits of AI technologies is hinged on the availability of the required resources. As seen from the case studies, regulatory compliance is another more persistent challenge that hampers business operations. These protocols needed high-level cryptographic techniques for maintaining data confidentiality throughout processing, and the company had to deal with the overlapping of local and international laws and regulations. Logical in the sense that, when it comes to such technologies as machine learning, regulatory compliance should be a key consideration, especially when implementing such technologies in socio-technically sensitive sectors such as the health sector.

Finally, in Vietnamese financial organizations, most of the structures have been developed and applied, and some aspects of integrating predictive analytics for automating response systems need substantial compatibility with existing banking structures and regulations. This table highlights the AI tools used, implementation steps, challenges faced, and outcomes achieved in each sector, providing a clear and concise summary of the case study results.

Sector	AI Tools Used	Implementation Steps	Challenges	Outcomes	Authors
Healthcare	Predictive Analytics, Anomaly Detection	Integration into EHR systems, staff training	Data privacy concerns, high initial costs	Improved threat detection, enhanced patient data security	Mazumder et al. (2024)
Financial Services	Fraud Detection, Predictive Analytics	Deployment in transaction monitoring, fraud detection systems	Regulatory compliance, data security	Enhanced fraud detection, improved data security	Thach et al. (2021)

Higher Education	Anomaly Detection, Machine Learning	Incorporation into data management systems, staff training	Data complexity, integration with existing systems	Better threat detection, improved data management	Aborujilah et al. (2022)
Supply Chain Management	Risk Management, Predictive Analytics	Integration into logistics management, risk assessment tools	Logistics complexity, real-time data processing	Optimized risk management, enhanced supply chain security	Sanmorino (2023)
Technology Firm-Medical Imaging	Encrypted Validation, High-Performance Computing	Encrypted data processing, inter-institutional collaboration	High computational requirements, data sharing restrictions	Improved data security, faster computational processes	Soin et al. (2021)

Table 2: AI Tools and Results in Different Sectors

This case study dramatically makes clear that best AI solutions need careful planning and implementation to guarantee new and different applications can be seamlessly fitted into dissimilar IT structures, while user data is protected from unauthorized access in accordance with the law. These technologies described a continuously evolving dynamic armor that unperturbed fit into existing working processes and created a need for crossing what might be termed cognitive divides between coders and managers. Therefore, organizational factors such as resistance, resource allocation, legal and policy requirements, and integration of AI through standards are important factors that need to be considered for AI technologies to improve cybersecurity in the healthcare sector, among other sectors. These are therefore useful recommendations intended for healthcare organizations that are planning to adopt AI-based products with the aim of enhancing the security of patients' information and the overall medical system.

ii. Potential for broader application

The applicability of the technologies applied in deception to other domains is clear, indicating that their success in mitigating targeted attacks is not limited to the areas examined in the initial vignettes. Taking an example from the financial services industry, adoption of AI-based fraud detection solutions in a country like Vietnam would be an example of making such global predictable and automated reactions available within a global financial environment. The solutions can act as tools not only for fraud identification but also for preventing fraud from happening with every financial transaction in real time, thereby upholding honesty in the various markets. Malaysian universities and the cybersecurity risk assessment tools employed in the field of higher education provide some insights into the application of AI in protecting academic entities. As these tools help Threat Operations and Security Center effectively evaluate and boost the cybersecurity status of universities, they can be adjusted for other educational contexts globally. In this way, academic institutions would be able to safeguard from potential cyber threats the information they own as well as newly developed academic intellect, published research, and findings. The case

study on pharmaceutical supply chain management in China highlights the importance of AI being utilized in the supply chain's complicated ecosystems. AI, in its capacity for predictive analysis and machine learning, can also determine weaknesses and potential threats and prevent them beforehand. The proposed approach would make a lot of sense to other industries like the manufacturing and retail industries, as well as the logistics industry, which considers supply chain security as a key to operational success. Further, using the example of the utilization of AI in secure medical imaging processes in the United States and India, the continued approach demonstrates how AI can be implemented to protect the privacy and security of highly sensitive information. Given this, the methodologies applicable in the current case can be adopted in other professions that involve the handling of sensitive data, including the legal sector, paralegal and even governmental records, and data protection. This is perhaps the most important requirement of the two sectors where data confidentiality is of fundamental importance for computations to be performed securely and in a privacy-preserving manner while at the same time not being significantly confined when it comes to computation performance.

These areas of adaptability also build up the security paradigm of the separate organizational entities and enhance the resistance of these sections against multidimensional and progressive threats of cyber operations. This demonstrates the effectiveness of the case studies in showcasing the benefits of AI technologies in improving the protection of industry using cybersecurity across the many sectors, thereby making the expansion of AI technologies acceptable and actionable in the fields of cybersecurity globally.

iii. Limitations and Gap

The first limitation that was noticeable in all the case studies was the lack of good and clean data or limited options in data for testing AI algorithms. AI effectiveness depends on the parts with which it has to work, and therefore, high-quality, diverse, and comprehensive datasets are required. But getting such datasets is not easy, especially when you are dealing with sensitive attributes like those in the healthcare domain. For instance, when it comes to safeguarding the medical records of patients in Bangladesh, the reliability of self-learning AI systems relies on the fresh and consistent feeding of quality data, which as of now is challenging to come by since most data is protected and the reliefs of medical data are fragmented. Likewise, in the financial services industry of Vietnam, the importance of acquiring vast and reliable data, essential for developing experimental models and automating the response of machinery, is paramount, while access to such data is restricted by regulatory and data partitioning challenges.

These cases draw attention to the high level of resource dependency on this integration, indicating complex technical changes necessary for integration as well as careful planning. Taking examples from the cybersecurity risk assessment tools that are currently used in Malaysian universities, it was arguments such as the integration of AI systems with existing IT infrastructure that gave an imperative call for compatibility and interoperability. Likewise, in the Chinese pharmaceutical and healthcare industry, it was essential to integrate new supply chain operations into the existing ones and integrate new sophisticated supply chain management tools such as predictive analytics and machine learning. These integration challenges are also exacerbated by the fact that, currently, there is no well-defined concrete manner of measuring the effectiveness of deception technologies and AI systems to allow comparison between AI systems.

Another important chasm that has been identified is the matter of explainability and transparency in artificial intelligence. Most AI technologies, especially those in the category of machine learning, conceal their principles, so end-users generally may not be able to comprehend how the decision is arrived at. Such lack of transparency can be a driver of erosion of trust and acceptance from stakeholders, especially the areas that the system is involved in, such as the case of the healthcare system where decisions being made should be transparent and responsible. For instance, in the example of medical imaging in terms of applying high-performance computing, it is paramount to point out that challenges in explaining the work of AI systems to stakeholders exist in avoiding pitfalls such as in the traffic management system case. A problem emanating from the lack of transparency is that of algorithmic bias and fairness, which is compounded by the black box nature of the AI algorithms, making them even more difficult to deploy in the critical sectors. Some of the requirements that AI systems need to meet include the scalability of the system to address the volume of data and the transaction rate, something that still presents a challenge as the AI is being tested between security and performance. Issues: The feature of using secure and privacy-preserving AI in medical imaging also confirms the importance of applying more protective data encryption and privacy protocols while implementing a high level of performance. Thus, the question here is how to achieve such a balance, and further research is required to come up with (Automotive Safety Integrity Level) ASIL solutions for constructing efficient AI systems that have to satisfy very high security demands. Also, the absence of clearly defined sets of reference points and criteria for measuring AI systems' capacities and effectiveness jeopardizes efforts to evaluate the AI's scalability and reliability exhaustively.

The case studies draw attention to the challenges involved when organizations operate across different geographical areas in terms of rules and regulations, especially in fields that deal with personal data, such as health and finance. For instance, the use of self-learning AI systems to defend electronic health records in Bangladesh underlined that there is strong legislation to follow in this area to guarantee the patient's data's security and observance with the legal norms of Bangladesh and unauthorized countries. Likewise, an example of the application of secure two-party computation protocols for AI-enabled medical imaging in the United States and India can be regarded as the need to implement measures to fulfill the requirements for security and speed in a rather legalistic context. There is a lack of compatibility, clarity, and synergy that has to be addressed where AI deception technologies are concerned so that implementation remains cutting-edge and robust across the different regions and authorities.

Four of those limitations that have to be eliminated include the integration of AI technologies with the existing systems and the existing working procedures. The case studies show the eminent role of AI systems in the existence of integration problems and the issues that arise during the connection of AI systems to existing work environments. For example, using the elements of big data within Vietnam's financial sector, it was crucial to incorporate predictive analytics and automated response systems while taking into consideration the existing framework of organizational procedures and regulations to follow. This speaks to the urgency of coming up with further studies and identifying the best approaches to implementation of AI, managing the change, and assessment of organizational preparedness to adopt AI.

Other types of research and more detailed sources would be related to field research and first-hand observation of the implementation issues in question, and the specific benefits and drawbacks of

implementing AI deception technologies in various domains. The dependence on secondary information also poses a cumulative and robust affirmation and evaluation of conclusions about the efficacy and contribution of AI systems However, there are some limitations to case studies that are identifiable: The role of 'Ethical Concerns' in AI technologies is not quite engaged within the case studies. mainly the issues related to 'Biasness' of algorithms, 'Transparency', and 'Accountability' are to a certain extent are not addressed or discussed. With AI systems increasingly being integrated into decision-making models, there is a growing demand for sound and wholly acceptable standards by which the systems can be trusted to make the fairest decisions. It also notes certain open questions for future research: potential risks in and particularity of AI deception technologies, and unforeseen effects and lifelong consequences of such attacks. Lastly, the case studies themselves do not act as a rationale for the possible threats and side effects of developing AI deceptive technologies. Although these technologies have their advantages in improving cybersecurity, there is limited knowledge regarding their weaknesses, potential adversarial attacks, and the consequences of developing and implementing deceptiveness in artificial intelligence systems. This knowledge is significant in order to effectively evaluate the inherent risks in the investment process and in the creation of effective protections that will prevent compromising the efficiency of financial activity.

iv. Future Research & Areas for Further Exploration

From the five case studies used to illustrate the adoption of AI deception technologies in the five industry sectors healthcare, financial services, higher education, supply chain management, and medical imaging. There are key research opportunities for further studies. These areas are important for overcoming the shortcomings and lack of effectiveness noted in the application of AI technologies today.

Someday, major research work can be done in the direction of understanding the best way for data acquisition and creating a labeled data set. Despite the fact that quality, variety, and scope are the key factors that define an optimal data set for AI training, data acquisition remains a monumental problem that hinders AI development, especially in such fields as healthcare, where data security plays an important role. As a result of this study, the next steps should be the identification of various data preprocessing methods and how to apply them in order to have cleaner, richer, and more consistent datasets. Further, there are challenges with data labeling, and the best approaches to ensuring it consider domain knowledge and possible bias in labeling. This is especially true in understanding and protecting medical records in terms of Bangladesh, as the process of learning AI is reliant on consistent access to large sets of quality data.

There are other areas that will require further research in the near future. As one of the essential aspects related to AI deception technologies, there is a need for creating benchmarks that can help in evaluating the efficacy of the given technologies. It is crucial for promoting the comparability of one AI system against another and for measuring different characteristics of those systems, including accuracy, explainability, scalability, and security, to identify stable and reliable measures of those characteristics. For example, in the category of financial services provided in Vietnam, the volume and quality of data required for advanced training models of probabilistic analytics and autonomic operational response systems are both necessary and often inadequate due to

restrictions and data compartmentalization. This would take the form of a consistent method of evaluating the performance of such systems to aid in their improvement. There are also a few directions that could be helpful for the future advancement of AI technologies: improving the model's explainability and transparency. The future of AI will consist of technologies that remain largely opaque; many of the current technologies, especially those rooted in machine learning, are 'black boxes', which means that users do not know how the models they use arrive at the decisions that they eventually make. The future work should include advancements in creating AI-based systems that could explain their actions and conclusions to end-users, which is vital in enhancing the Middle Ages' acceptance and willingness to embrace AI, especially in critical areas like health care. For instance, in the hype segmented market for high-performance computing in medical imaging, the explainability of the AI systems used fulfills the disclosure duties that play a critical role in the uptake of the systems. The two sets of systems, scalability and performance, have been arguments for impeachment in the case studies. Qualitative future work should be directed towards the creation of a future AI architecture modeled for huge data and massive call traffic rates with minimal compromise. Future research into distributed computing models and the analysis of parallel processing will greatly contribute to the improvement of AI systems scalability. Another interesting area is fixing the AI algorithms to minimize computational load and increase the speed of computing in real-time so as to ensure that AI systems can function efficiently in resource-demanding real-time zones. This is especially important for applying AI techniques in the healthcare domain, particularly when it comes to developing imaging systems and information protection, where the task is to protect the privacy of patients' data and maintain high levels of performance at the same time.

Beyond security and privacy issues, there are worrisome regulatory and compliance impacts that complicate the use of AI in deception technologies. Future research should continue to work towards identifying contingency frameworks that help organizations better manage the regulatory environment they are in. This also involves acquiring and developing AI compliance templates and worksheets to verify that the systems are compliant with the applicable data privacy rules and regulations, security, and other legislation. The continued investigation into privacy-preserving approaches like federated learning and homomorphic encryption will allow organizations to follow strict data protection policies as well as safely apply AI in ever-so-sensitive industries like healthcare and finance. They enable AI models to be trained and deployed without exploiting the given data, and therefore, there is compliance with high levels of data protection.

Another limitation is the fact that many currently in use, commercially available AI technologies can only be integrated into existing systems and operational processes. Some of the key principles learned from the case studies include the need to maintain AI and non-AI synergy and the difficulties involved in ensuring that AI incorporates current process frameworks. In relation to this study, there are four main areas that need to be targeted in future studies: The first one is how organizations can effectively integrate AI into their operations; the second is change management that organizations need to employ to realize the benefits of AI; the third is organizational readiness to adopt AI; and the fourth is the future benefits of AI adoption. For example, in the Vietnamese financial sector, when applying machine learning solutions incorporating predictive analytics, including autoresponders, with current banking structures, it was essential to cooperate with

internal policies guidelines and external functioning laws. AI Application Integration: The use of flexible AI frameworks that are compatible with varied software and hardware platforms will simplify the integration process of interfaces with legacy systems to a significant level without requiring significant engineering modifications.

Also, there is still a need for monitoring the ethical issues related to advanced intelligent technologies for investments, especially in issues of bias in the algorithms, transparency, and accountability. The need to reduce the inherent bias existing in every system before the deployment of AI is thus paramount. The following are specific suggestions for future research: The next generation of research should aim at finding appropriate methods of ethically addressing the raised concerns. To reduce the differentiation that occurs due to systemized bias, it is essential to assess how the use of AI systems affects various segments of the population and make sure that the calibration datasets contain representatives of different groups. Furthermore, considering how to enforce the accountability of various AI technologies through checks and balances like audit trails and regular transparency reports will be a way of ensuring that AI and data technologies are used in the right manner and standard globally.

Lastly, the primary research or field studies are critical to triangulating the data collected through all the secondary methods and getting a richer and more contextualized picture of the obstacles and the strategies to apply AI deception technologies. Although traditional academic studies can provide a suitable theoretical foundation for deception technologies and AI, it is essential to conduct primary research in the form of field studies and direct observations in order to have a more realistic and objective approach and thus enable the organization to learn from the mistakes of others and achieve the maximum benefit from the potential of AI deception technologies.

Therefore, the future research and potential research directions for further study involve data quality and variety and its integration within a system, explicability and transparency, scalability and speed, the challenges related to compliance and legal requirements, standardization and exact guidelines for implementing AI in organizations, resource distribution inequity, application of AI specifically for sectors, and the combined ethical conundrum. These research directions shall offer effective solutions in order to increase drive creativity and usage of AI-based deception technologies for boosting overall cybersecurity by reinforcing the security of organizations in different fields.

v. Policy recommendations for enhancing cybersecurity in healthcare

Considering the information provided in the five cases, the following policy implications can be derived with regards to the improvement of cybersecurity in healthcare: First of all, it is necessary to define some measures that would help expand the use of AI-based cybersecurity in the sphere of healthcare. This encompasses the promotion of government technical assistance programs needed to assist healthcare facilities in implementing AI technologies tasked with early identification of cyber threats and prevention of such incidences. Grants, tax credits, or rebates could also be given to institutions that adopt these technologies in order to promote their use and thus offset the costs.

Secondly, there is a need to implement regulative measures necessary for putting into constant practice and using real-time detection and monitoring instruments. These frameworks must require that the organizations use AI tools that can be updated to acquire new data to help them counter the growing threats. As such, through the adoption of these complex systems, health care providers are in a position to act on a pro-active basis to fight cyber threats, thus being ready to counter complex attacks. One supplementary policy recommendation is to expand the required cybersecurity training and education for all workers in healthcare facilities. Information policies must demand that not only those employees working in IT and cybersecurity but also clinicians and administrators be exposed to comprehensive cybersecurity training periodically. Four different training areas should include a tutorial regarding how to identify phishing scams, guidelines for ensuring patient data are stored and transferred securely, and crisis management procedures. On the same note, healthcare organizations should actively increase cybersecurity awareness in their institutions since human mistakes are sometimes exploited in cyberattacks and to minimize human errors.

Furthermore, there should be an emphasis on effective communication as well as the exchange of information between healthcare institutions, the government, and other entities, such as cybersecurity agencies. Efficient processes for the investment in Science, Technology, and Innovation that allow for sharing data regarding threats and weaknesses in real time while being used in policies might help improve the situation. This can further help to improve the overall security position of the healthcare sector because it can give organizations the ability to draw from the common bible and fast track on how and when to lock horns with a menace. It is also equally important to establish a compliance norm that will make it compulsory for all healthcare organizations to implement cybersecurity measures. They should require compliance with cybersecurity best practices and Florida law to standardize data protection across large and small healthcare organizations. This involves the use of encryption systems, establishing secure connections or channels, and conducting security assessments periodically. Forcing standardization can effectively prevent the sector's weak links in the given sociotechnical context, making it stronger and more secure. Also, it is crucial that policies encourage the creation and execution of response structures.

Healthcare organizations must be mandated to develop and implement proper documented procedures that should be updated frequently on how to handle cyber-risk events. Such plans should involve actions that would be taken to deal with an immediate threat, the process of restoring data, the way that notification will be given to the relevant stakeholders, and an evaluation of what happened after the occurrence of the incident. Thus, to support this argument, an effectively designed and actionable incident response plan for healthcare firms will be discussed below to mitigate the risk of cyberattacks and facilitate a quick recovery. Another recommendation encompasses adopting the policy of research and development investments. Government and private organizations should provide funding for research in categories that are geared toward developing holistic cybersecurity solutions relevant to the healthcare segment. These are some advancements that need to be made, which can include research and development of new AI algorithms, better encryption of data, and frameworks for identifying threats. Public-private partnerships can therefore facilitate a team-up between a university, a hospital, and even a technology firm in an effort to advance key areas as well as come up with new ways of enhancing cybersecurity measures.

Last but not least, policies should focus on the issue of shielding medical devices and advanced interconnected systems. As the implementation of IoT technology continues to expand as a major part of the architectures used in healthcare, this creates a need to protect such devices against cybercriminals. Based on the factors determined above, policies should require that medical devices be subjected to thorough testing and certification to comply with high-security standards before they are offered in medical facilities. Furthermore, there should be clauses concerning the frequent updates of these devices and patches of vulnerability for patient data protection and to maintain the credibility of the health care services. The policy recommendations addressing the need for improving cybersecurity in the healthcare context should include the development of incentives for implementing new technologies, the revision of the current legislation and guidelines for medical practice, training and education, strategic and tactical cooperation, common approaches to cybersecurity, incident response planning, funding of research, and the security of technology used in devices for medical purposes. These measures are as follows: The overall approach of executing all these revisions at once will give the healthcare industry the much-needed robustness to cope with the dynamic nature of cyber threats.

vi. Practical Recommendations

Based on the analyzed five cases, the synthesized general applied suggestion for improving cybersecurity in the sphere of healthcare is the implementation of AI-learned security solutions that can be incorporated into all periods of the healthcare system. This mainly focuses on the use of advanced artificial intelligence and automated tools that are able to learn and adapt in response to emerging threats. Such systems, illustrated in diverse industries by the case studies presented above, should be capable of dealing with issues that are intricate and even sensitive in the light of health care information management, including complete safeguarding of electronic health records (EHRs), real-time fraud prevention and management, and instant counteraction to threats posed by potential security threats. To support this agenda, healthcare organizations have to expand their development of AI systems within IT environments compatible with existing frameworks. These systems ought to be capable of parsing through large sets of information, discerning complex patterns, and foreseeing an emerging danger in the form of a breach. These AI systems will be capable of using machine learning algorithms to observe the traffic on the network, the behaviors of users, the anomalies involved, and the threats in real time. Such a type of approach guarantees that protection measures will always remain one step ahead of the threats and thus reduce the probabilities of unauthorized access to the company's information and interruptions of operations.

One of them is the application of developed cryptographic methods for improving data privacy and security within the given integrated framework. The technology of Federated Learning used in medical imaging eliminates data presentation to central servers, and homomorphic encryption allows computations to be performed on data without revealing its contents to the world, an idea illustrated in the framework with strict mechanisms for secure data protection and meeting commoditized data protection standards. This means that patient information is kept secure from some unauthorized person while the same data is put to good use to perform analytical tasks by applying artificial intelligence technology. Furthermore, it is crucial to establish and maintain widely accepted machine learning-based risk estimations for ongoing assessments of healthcare systems' cybersecurity investment requirements. These tools should enhance their ability to get timely alert of any possible weaknesses and advise on how to address them. Thus, through the

implementation of such a tool, risks can be managed effectively, and organizations within the healthcare sector can guarantee the strength of their cybersecurity posture.

Another consideration that I would like to talk about is that AI in supply chain management also has an important function for improving Situational Awareness. Cross-selling approaches to predictive analytics models risk and opportunities for supply chain management to alleviate medical supplies and services risks. This is necessary for the continuity of healthcare services, in particular, when they are threatened by external circumstances. In order to effectively implement this extensive AI-focused strategy, the participating healthcare organizations must embrace a learning culture and a SecOps mindset. To address this issue, healthcare facilities should consider training programs to keep their staff current on current threats and cybersecurity practices. This also ensures that human errors are minimal, and it helps to improve the overall security posture of the organization.

Thus, the pragmatic implication that can be inferred from the case studies includes the development of a centralized, AI-based adaptive platform incorporating advanced machine-learning algorithms, real-time threat identification, cryptographic privacy, a uniform risk assessment framework, and comprehensive supply chain security. Coupled with technical security implementations, this consideration provides comprehensive protection to healthcare data and systems to keep pace with increasing and more innovative threats in healthcare organizations and ensure that consumers retain their confidence in healthcare service delivery.

Part 6: Conclusion

In the following concluding section of this thesis on "Cybersecurity Risk Management in Healthcare Organisations," the main findings of the study and the research contributions are presented, the possible research limitations are discussed, and the future directions for the study are suggested. Through this extensive analysis of the literature, the importance of AI in protecting patients' information and medical systems has been discussed, and the possibilities of how AI can change healthcare cybersecurity have been presented. The major contribution of this thesis work is focused on the comprehensive analysis of AI-based deceiving technologies and their implementation in the domain of healthcare cybersecurity. By using decoys that resemble real assets, these technologies engage and confuse as well as deceive attackers, thus creating an environment that is adverse to malicious actions. This way, not only does it thwart the attackers but also gives out helpful information that can be used to strengthen the defenses. The study also shows how AI can analyse large amounts of information in the shortest time possible and find trends or irregularities that could be a sign of a threat.

This is especially the case in healthcare, where there is a lot of data coming in many different forms and where the consequences of getting things wrong can be dire. Based on the findings of this research, one of the major implications is the ability to identify specific problems in the healthcare industry. There are three considerations concerning patient data, medical systems, and the need for healthcare service continuity that are unique to the healthcare sector and are not discussed in consideration of AI for deception. This thesis addresses this gap by concentrating on the real-life implementation and usefulness of these technologies in healthcare organizations. From the findings of this study, healthcare organisations can be informed on the need to adopt enhanced security measures, which are critical in safeguarding patients' information and maintaining healthcare delivery.

Despite this, the research also identifies some weaknesses, including the following: A significant limitation is that most of the research is based on literature reviews and case studies which may not fully reflect the dynamic nature of the cyber threats and the healthcare sector's cybersecurity landscape. This being said, the thesis offers an extensive overview of AI-powered deception technologies, yet the further development of AI and cybersecurity is a constant process, and new threats and strategies appear from time to time. This indicates the need to carry out more research and the fact that the fight against cybercrimes cannot be a one-time exercise but a continuous process, with efforts being made to match the ever-increasing technological advancement.

Another limitation, which can be identified, is related to the definition of the research problem itself. Even though the thesis focuses well on the subject of integrating AI-based deception tools into healthcare cybersecurity systems, it may not capture all the social-technical factors that are involved in the application of these tools. Factors such as the culture of the organization, the legal systems that govern the operations of the organization and ethical factors are some of the most important factors that define the success of AI solutions in any organization. However, more studies ought to be done on these aspects to ascertain the roles of AI in healthcare cybersecurity. In terms of its approach, this work is primarily based on qualitative research and case study analysis; however, such an approach has its strengths and limitations, which can be viewed as weaknesses in terms of the methods' applicability in order to obtain widespread data on various healthcare organizations. Possible future research can extend the use of quantitative approaches and a larger sample size to confirm the efficiency of AI-based deception tools in various care

sectors. Moreover, longitudinal research can help in understanding the effects of these technologies on healthcare cybersecurity in the future. Incorporation of both qualitative and quantitative methods could also aid in adding to the understanding of how these technologies are employed in different scenarios and contexts. Based on findings from this research, the following scenarios can be suggested for the future. First, there is the need to enhance the applicability of new AI techniques in producing better and more realistic decoys.

All these algorithms should be able to learn from the attacker's actions in real-time and change the deceptive environment in such a way that the attacker is not able to differentiate between the real and the fake. This will lead to further improvement in the capability of AI in detection of deception for combating smarter and more advanced cyber threats. Second, the possibility of the use of AI-embedded deception systems as a part of the overall security strategy, along with firewalls, Intrusion Detection System (IDS)/(Intrusion Prevention System) IPS, and Security Information and Event Management (SIEM) solutions, should be considered. These technologies can indeed be combined to lay down a comprehensive security framework that will help combat cyber threats. Further studies should be directed towards the identification of proper approaches and procedures for embedding them into other systems and processes in the most efficient way. Third, the authors should also discuss how the use of AI-based deceptive technologies in healthcare is ethical and legal. Concerns like data protection, patients's consent, and the risks of abusing AI technologies are some of the concerns that need to be addressed so that the use of AI technologies is proper and ethical. Subsequent studies need to focus on establishing the principles and policies that can be followed in relation to the application of AI in healthcare security.

In addition, close cooperation and information sharing between cybersecurity scientists and practitioners, AI scholars and practitioners, medical personnel, and policymakers are crucial. To this end, such collaboration can enable the development of unique solutions that can help in dealing with the various challenges in healthcare cybersecurity. Thus, by involving various parties, it is possible to develop a highly effective healthcare system that can effectively address the threats and risks of AI applications.

The thesis also identifies gaps that could be filled in future studies as well. For example, more research based on AI-based tools that compare the efficiency of identifying deception in healthcare organisations is still needed in the current literature. These studies should try to establish the effects of these technologies in real-life situations. However, there are some other issues that have been addressed in this paper that might require further investigation; these are the potential of AI in managing large amounts of data related to health care.

Therefore, there is a need to investigate how AI architectures can be designed that are able to work with large datasets, are expandable, and are able to meet high performance standards while at the same time maintaining privacy. This entails creation of new architectures and algorithms for handling the data and or big data and also analyzing the data and or big data in real time without necessarily violating the data's privacy. Lastly, there is the issue of legal and compliance risks of incorporating AI in healthcare cybersecurity. For this reason, it becomes essential to understand that the legal environment is constantly evolving and that the AI solutions that are provided have to align with the current and future legal environments.

A number of further studies need to be conducted concerning the development of the right policies and procedures that will help to further enhance the technology without endangering the rights of the patients or the confidentiality of their information. This paper has offered important findings concerning the development of deception technologies based on AI and their applicability in the defence of healthcare systems. Thus, the research sets the groundwork for future studies and offers crucial information to healthcare organisations that are willing to improve their cybersecurity by identifying the potential of these technologies in shifting threat prevention paradigms. Due to the fact that threats are evolving and the level of trust in healthcare systems is still high, the application of state-of-the-art AI technologies is crucial. By helping prevent cases of data breaches and safeguarding healthcare assets, these technologies can help healthcare organisations prevent different and ever-growing cyber threats that are hazardous to patients lives.

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