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Leveraging AI-Driven Telemedicine for Efficient Healthcare Delivery in Anambra State

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Abstract:- The study, Leveraging AI-Driven Telemedicine for Efficient Healthcare Delivery in Anambra State, explored the impact of AI-Driven Telemedicine on accessibility, challenges faced during implementation, strategies for successful adoption, and the development of a tailored decision support interface. The objectives sought to; predict the impacts of AI-driven telemedicine solutions on healthcare outcomes and patient satisfaction, evaluate the possible challenges in the implementation of the AI-based telemedicine solutions, develop strategies for easy implementation and sustenance of the AI-based telemedicine, and provide the features and functionalities that would be incorporated into the AI-driven decision support interface that would optimize healthcare accessibility and efficiency in the state. The study employed a mixed-methods research approach, including surveys, interviews, and a comprehensive review of existing literature. The findings showed that AI-driven telemedicine solutions will have positive and significant impact on healthcare outcomes and patient satisfaction ($t_{statistic}$, 3.535 > $t_{critical}$, 2.571). With the result, $t_{statistic}$, 8.875 > $t_{critical}$, 2.306, the study indicated that the implementation of AI-based telemedicine solutions in Anambra State would be faced with some challenges such as funds, limited internet connectivity, ethical concerns, regulatory compliance, etc. However, it highlighted some strategies that need to be developed to facilitate a seamless implementation and sustenance of the AI-based telemedicine ($t_{statistic}$, 3.646 > $t_{critical}$, 3.182). The study also identified some features and functionalities that would be incorporated into an AI-driven decision support interface to optimize healthcare accessibility and efficiency in Anambra State ($t_{statistic}$, 14.909 > $t_{critical}$, 2.262). The study concluded that addressing the identified challenges and leveraging the potentials presented by AI-based telemedicine will require a concerted effort from the government, healthcare providers, policymakers, telecoms providers, and the academic community. Therefore, it was recommended that the government and relevant stakeholders should prioritize infrastructure development, particularly in the areas of power supply and internet connectivity, while the policymakers should collaborate with medical experts to develop and implement regulations, policies, and strategies that promote the adoption of AI-based telemedicine.

I. INTRODUCTION

The use of telemedicine has increased recently, and when artificial intelligence (AI) is integrated, telemedicine's capabilities can be further enhanced, unlocking countless possibilities for creating solutions that satisfy specific healthcare requirements. Four emerging trends can be used to identify the potential influence of AI in telemedicine: information technology in healthcare, intelligent diagnosis and aid, patient monitoring, and information analysis collaboration. It has the potential to improve healthcare delivery by supporting decision-making and helping with activities. Additionally, it is extremely beneficial since it frees up time that could be devoted directly caring for patients by automating administrative activities.

However, there are constraints related to safety, ethics, efficacy, efficiency, regulations, and cost when using them in the healthcare industry. If doctors lead the process and provide informed, encouraging guidance, their adoption would rise. For patients and the medical community to embrace AI, there must be sufficient proof of the technology's advantages. AI-enabled telemedicine ought to integrate well with current healthcare procedures. It needs a framework that may be based on costs, accessibility, repeatability, usability, dependability, and clinical and technical factors.

The healthcare industry is essential to the social and economic development of any region. Artificial Intelligence (AI) has revolutionised several industries in recent years, and the healthcare industry is no exception.

With a population of over 13 million, Anambra State is one of the most populous states in Nigeria. AI-based telemedicine solutions can improve the efficiency and accessibility of healthcare in the state. The healthcare system in Anambra State still faces a number of difficulties despite the notable advancements in the field in recent years, including a lack of professionals, inadequate infrastructure, and restricted access to healthcare services, particularly in underserved and remote areas. These challenges have led to high rates of morbidity and mortality and poor healthcare results.

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Optimising basic healthcare services using AI-based telemedicine technologies offers a promising way to guarantee proper diagnosis, effective treatment, and better patient outcomes for the state. This thesis aimed to investigate how Anambra State's healthcare system could be made more accessible and efficient using AI-based telemedicine solutions.

This study aimed to investigate how AI-based telemedicine solutions can improve the efficiency and accessibility of the healthcare system in Anambra State.

The specific objectives were:

- To predict how the overall accessibility and efficiency of healthcare services in Anambra sate would be affected by AI-driven telemedicine solutions.
- To evaluate possible challenges that the implementation of AI-based telemedicine solutions may face in Anambra State
- To develop strategies for easy implementation and sustenance of the AI-based telemedicine solutions.
- To provide a framework and a decision support interface for AI-based telemedicine solution that can be adapted to the unique medical requirements of the state of Anambra.

II. LITERATURE REVIEW

➢ *Telemedicine Overview*

The World Health Organization (1997) defines telemedicine as "the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research, and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities". For Liji (2023), telemedicine is the provision of remote clinical services, via real-time two-way communication between the patient and the healthcare provider, using electronic audio and visual means. The term "telemedicine" denotes the practice of providing medical services remotely via technology. It is the process of providing health treatment remotely by utilising technology. It guarantees that someone gets medical attention when they need it, particularly for people who have difficulties accessing care.

From the foregoing, telemedicine entails using electronic and telecommunication technology to provide medical information and clinical services remotely. It encompasses various forms of service delivery such as phone calls or video chats with healthcare providers, secure messaging through email or other forms of secured systems, remote monitoring of vital signs without leaving home, etc. Implementing telemedicine entails many things, ranging from the use of ICT for information exchange in real-time for service provision, to the training of healthcare providers of telemedicine solutions.

Rachel (2022) opined that telemedicine allows a person to seek a doctor's advice about nonemergency situations that do not require an in-office visit. It ranges from basic medical text messaging to sophisticated procedures like remotely operated surgery. In primary care, telemedicine typically takes the form of phone discussions between the patient and the doctor regarding non-emergency medical issues that do not need to be seen in person. When in-person consultation is required, telemedicine enhances rather than replaces it. Right now, the true value of telemedicine is in the convenience it provides to both patients and providers by eliminating the need for in-person visits in order to receive medical advice or treatment. Additionally, it is less expensive than waiting to see a physician or other healthcare professional. Because technology is developing so quickly, medical care is depending more and more on creative ideas to improve healthcare services, increase productivity, and ultimately save lives. Information and communication technology (ICT)-driven telemedicine provides substantial social and economic advantages by bringing medical care to underserved and remote locations. Optimising healthcare delivery is the goal of the convergence of artificial intelligence (AI) and telemedicine.

➢ *Telemedicine Types*

Telemedicine services can be delivered in different forms. Some authors classify telemedicine into two, three or four types.

Mahar *et al.* (2024) identified two (2) types of telemedicine programmes, viz: Synchronous programmes and asynchronous programmes. Synchronous programmes take place in real time and are a live 2-way interaction between the patient and healthcare provider. This includes virtual appointments that are conducted using the patient's smartphone, tablet, or computer with a camera. When using a smartphone or tablet, patients must first download an app that connects them with a provider. The U.S. Department of Veterans Affairs (VA) states that synchronous telemedicine requires the presence of both parties at the same time and a communication link between them that allows a real-time interaction to take place (Richard R., 2020). Again, the definition of synchronous telemedicine by The American Telemedicine Association (ATA) was referred to by Richard R. (2020) as interactive video connections that transmit information in both directions during the same time period.

The second type is asynchronous programmes, also known as "store and forward" applications, which are not live and involve the transfer of images, videos, and other clinical information that a healthcare provider views and responds to later (Mahar *et al.*, 2024). In this case, patients may wear medical devices to monitor and track health information (e.g., blood pressure) in a personal health application that they forward to their healthcare. Richard R. (2020) referred to asynchronous telemedicine as defined by VA as acquiring medical data, then transmitting this data to a doctor or medical specialist at a convenient time for assessment offline. The ATA defines asynchronous telemedicine as a term describing store-and-forward transmission of medical images and/or data because the data

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transfer takes place over a period of time, and typically in separate time frames (Richard R., 2020). Unlike synchronous telemedicine, which happens simultaneously, asynchronous telemedicine does not take place at the same time.

Yolanda (2023) identified three types of telemedicine to include store-and-forward, remote monitoring, and real-time interactive services, stating that each of these has a beneficial role to play in overall health care, offer tangible benefits for both healthcare workers and patients. With store-and-forward type of telemedicine, patient information such as medical images or biosignals can be sent to the specialist as needed when it has been acquired from the patient (Yolanda, 2023). She referred to remote monitoring (also known as self-monitoring or self-testing) as a type of telemedicine that uses a range of technological devices to monitor the health and clinical signs of a patient remotely, mostly used in management of chronic diseases such as cardiovascular disease, diabetes mellitus, and asthma. The third type, which is Real-time interactive services, can provide immediate advice to patients who require medical attention through different mediums such as phone, online, etc. A medical history and consultation about presenting symptoms can be undertaken, followed by an assessment similar to that which is usually conducted during face-to-face appointments (Yolanda, 2023).

Four types of telehealth were identified by Marlene (2020) to include synchronous telehealth, remote patient monitoring (RPM). Store-and-forward telemedicine and mobile health (mHealth). Marlene described mobile health, otherwise known as mHealth, as using smart devices for many specialised aspects of healthcare that benefit from continuous collection of data about a person's behaviour or condition. Smartphones, tablets and smart wearables can monitor various factors such as pulse rate, heart rate, blood sugar levels, etc.

Summarily, there are basically two types of telemedicine. These include synchronous and asynchronous telemedicine.

- Synchronous telemedicine: This is the most common type of telemedicine. Synchronous telemedicine involves real-time interaction between patients and medical providers through phone calls, video consultations and live chats.
- Asynchronous telemedicine: Another name for this is store-and-forward telemedicine. It is a non-real-time communication, enabling the patient and the provider to exchange messages, medical reports, test result and other information at different times. The two do not need to be online at the same time as it allows for flexibility without simultaneous interaction.

However, there are two subcategories within asynchronous telemedicine; viz: remote patient monitoring (RPM) and mobile health (mHealth). RPM provides continuous insights into the patient's health status. It enables healthcare providers to track the patient's health data remotely. It is beneficial for managing chronic conditions like high blood pressure, diabetes, weight, heart problems, breathing issues, and sleep disorders. mhealth involves using a device, like smart phone or wearable, to support a patient's health and transmit data between a patient and their provider. Mobile apps and devices like blood glucose meters, pulse oximeters, and blood pressure monitors make remote patient monitoring possible.

➢ *Benefits of Telemedicine*

Telemedicine is revolutionising the medical landscape in different ways such as remote consultations, geographical accessibility, reduced travel expenses, emergency response, etc. With telemedicine, patients can consult with medical specialists from the comfort of their individual homes. They can communicate virtually for periodic check-ups, follow-up visits, or expert consultations. In terms of geographical accessibility, Gajarawala and Pelkowski (2020) noted that initially, telehealth was limited only to rural communities but recently, it has expanded to the geographic reach of health care services and improve access to care. Telemedicine removes obstacles based on location. Patients who live in underserved or rural locations can receive medical expertise that they might not otherwise have access to. By reaching patients in different areas, specialists can enhance healthcare equity. Citing Rutledge *et al.* (2017), Gajarawala and Pelkowski (2020), noted that "increasingly, telehealth technologies are being adopted and implemented as an efficient and cost-effective means for delivering and accessing quality health care services and outcomes." One of the potentials of telemedicine is that it offers improved efficiency with less net costs. Long-distance travel for medical appointments is no longer necessary for patients. This lowers the expense, duration, and inconvenience of transportation. Telemedicine guarantees prompt care without putting a strain on the body for the elderly or those with limited mobility. Emergency response is another key component of telemedicine. In emergency response, telemedicine is essential as decision-making can be improved by paramedics and first responders consulting with professionals virtually.

In summary, telemedicine is changing the medical landscape in the following ways:

- Remote consultations and monitoring: Telemedicine enables patients to consult with medical specialists from the comfort of their homes. The services can include communicate virtually for periodic check-ups, follow-up visits, or expert consultations. It is now possible to monitor vital signs, chronic illnesses, and post-operative recovery in real time via telemedicine platforms.
- Geographical accessibility: Telemedicine can overcome geographical barriers as every patient has access to healthcare services no matter his or her location. Particularly, the challenges faced by patients in rural communities in accessing healthcare facilities due to long distances, limited transportation options, and shortages of medical professionals are addressed by telemedicine. By reaching patients in different areas, specialists can enhance healthcare equity.
- Reduced travel expenses**:** Telemedicine eliminates travel expenses for patients by reducing the need to travel the

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hospital especially for those who live in rural areas or require frequent care. This saves time and money. This is particularly beneficial for the elderly or those with limited mobility who may find it challenging to travel for medical appointments.

- Tele triage: Telemedicine is used by triage systems to rank situations and ensures effective allocation of resources. It provides a safe and efficient alternative to in-person screening of patients. It decreases rates of patients leaving without being attended to.

➢ *AI in Healthcare*

Artificial Intelligence (AI) is technology that enables computers and machines to simulate human intelligence and problem-solving capabilities (IBM, 2024). On its own or n, robotics) AI can perform tasks that would otherwise require human intelligence or intervention. Digital assistants, GPS guidance, autonomous vehicles, and generative AI tools (like Open AI's Chat GPT) are just a few examples of AI in daily lives.

While Encyclopaedia Britannica (2024) defined Artificial Intelligence (AI) as the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings, Bajwa *et al.* (2021) postulated that Artificial Intelligence (AI) is a powerful and disruptive area of computer science, with the potential to fundamentally transform the practice of medicine and the delivery of healthcare. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from experience.

In the field of healthcare, artificial intelligence (AI) is revolutionary. AI-based medical technologies, such as computer vision, natural language processing, and machine learning, have shown to have revolutionary promise. The health sector is undergoing transformation, thanks to the successful AI implementations in various healthcare contexts. Sharma *et al.* (2023) posited that "AI has the potential to enhance the capabilities of healthcare professionals and improve the efficiency and safety of telemedicine. AI is anticipated to tackle the issue of avoidable medical errors and enhance workflow efficiencies, which are currently at a high rate in healthcare provision.

Stephanie (2021) highlighted ways that AI could impact medicine in the near future. AI enables you to have more face time with your doctor. AI could relieve some paperwork from the doctor. For instance, a doctor could use AI to record and transcribe office visits instead of typing notes while talking to the patient. AI-powered technology could then figure out where the information fits into the patient's medical record. AI enhances data, using special sensors and other devices that can gather health records and share it with the doctor. It is also capable of reading imaging test results. AI can also check EKG (electrocardiogram) recordings of the heart, screen chest X-rays, read mammograms to look out for early signs of breast cancer, and check moles for signs of skin cancer.

AI could offer precise care in the following ways: triage, diagnosis, personalised treatment, hospital bed management, predicting future health condition, manage conditions like diabetes and hypertension, and keep tabs on when to take medication (Stephanie, 2021). AI could also be quite helpful in surgery.

Artificial Intelligence in telemedicine holds a transformative power that can enhance experiences within the healthcare system for both medical professionals and patients (Oleksandra and Dmytro, 2023). The researchers stated that the existing traditional healthcare systems were getting increasingly hectic due to the collision between growing healthcare demands, a lack of skilled workers, and insufficient resources. They painted a scenario of the relief of a burnt-out physician in an understaffed, highly stressful environment getting empowered by an AI-driven assistant that can take care of appointment scheduling, administrative support, and other repetitive tasks, which allows them to focus on patient care. In another scenario, an AI-enhanced telemedicine platform can help an older person living with a chronic condition stick to a consistent medication intake schedule, learn about health tips tailored to his needs, and get emergency assistance when needed. Basically, such tools can make a patient feel like having an additional digital caretaker by his side.

According to Kuziemsky *et al.* (2019), examples of the role of Artificial Intelligence in delivery of healthcare include use of tele-assessment, tele-diagnosis, tele-interactions, and tele-monitoring. Mary (2023) posited that by using individual patient data and larger sets of historical data, AI can aid clinicians to deliver accurate diagnoses and accurately interpret the results of medical imaging. This is tele-diagnostics. One of the most compelling powers of AI algorithms is their ability to quickly analyze vast datasets, including medical images, patient histories, and clinical notes, to provide accurate insights; and while the final decisions must be left to human professionals, especially in complex cases, using artificial intelligence in telehealth data processing and analysis speeds up the diagnostic process, increases its accuracy, and enables timely interventions (Oleksandra & Dmytro, 2023). Kuziemsky *et al.* (2019), postulated that a well-known existing area for tele-diagnosis is tele-dermatology, which lends itself well to automation through AI. Similar promise is offered in other areas of automated diagnosis such as breast cancer or cervical cancer screening.

AI in telemedicine is becoming more widespread because it excels at cracombined with other technologies (e.g., sensors, geolocatiofting personalized treatment plans based on a user's unique medical journey, genetics, lifestyle, and other data. Such treatment recommendations are often not only more effective but also more mindful of the patient's comfort, leading to fewer side effects (Oleksandra & Dmytro, 2023). Universal approaches to treatment are becoming obsolete and are being replaced by other forms of treatment that provide high quality care, such as AI-based telemedicine.

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Another important role of AI in healthcare delivery is telemonitoring. Remote monitoring (or tele-monitoring) involves data acquisition using an appropriate sensor, transmission of data from patient to clinician, integration of data with other data describing the state of the patient (e.g. sourced from the electronic health record), synthesis of an appropriate action or response or escalation in the care of the patient with associated decision support, and storage of data (Nangalia *et al.*, 2010). For Oleksandra and Dmytro (2023), AI could become a true lifesaver in telemonitoring as one of the primary missions of telemedicine is to make healthcare accessible to all kinds of patients, including those facing mobility challenges or living in remote areas, stating that AI-powered devices and apps help healthcare professionals (HCPs) maintain access to crucial patient data and receive notifications when anything looks out of the ordinary. One example is wearable device which is equipped with AI algorithms and can track vital signs, detect anomalies, and alerts healthcare providers when intervention is necessary. To this extent, patients and medical workers can engage in more proactive care, preventing unnecessary hospital visits and ensuring continued well-being. Mary (2023) asserts that AI analyzes a patient's vital signs, data from blood pressure cuffs, heart monitors and other medical devices to watch for anomalies and then alerts relevant parties to any abnormal readings. AI-driven tools are used to monitor patients, both inside medical facilities and outside hospital walls.

In the area of management of chronic diseases, AI in telemedicine has shown great potentials. Living with chronic conditions such as diabetes, heart disease, and asthma is a daily challenge, demanding constant monitoring; fortunately, the adoption of AI in healthcare makes this task more manageable (Oleksandra & Dmytro, 2023). With AI-powered telehealth platforms, patients have access to tools for self-care, tailored recommendations, medication reminders, and practical lifestyle tips. This results to enhanced disease management and access to healthcare providers when human intervention is required.

Patient engagement in telehealth empowers the patients to participate actively in their health and wellness. Gajarawala and Pelkowski (2020) opined that patient satisfaction is increased from the use of telehealth, which offers increased access to care, convenience, and reduced stress. Mary (2023) believed that AI-driven technologies, such as chatbots, streamline services like providing information, scheduling appointments, and handling intake prior to clinical visits. Automated conversational interactions offer many other opportunities across the care spectrum to augment and in some cases replace human carer tasks (Nangalia *et al*., 2010). These automated conversational interactions may include reminders and motivational messages e.g., for medication, nutrition, and exercise; routine condition checks and health maintenance, based on personal monitoring data; answering of health queries and provision of targeted health information and education; providing a personalised means to address social isolation and community involvement; and acting as an intermediary or broker entity between multiple carers or service agencies.

Fostering patient engagement on telemedicine platforms empowers users to actively participate in their healthcare journey and share vital information with healthcare providers; this naturally leads to better adherence to treatment plans and recommendations, thus improving health outcomes and patient-provider relationships (Oleksandra & Dmytro, 2023). By providing instant responses to patient queries, offering health tips, and monitoring medication adherence, AI-driven chatbots and virtual assistants help patients to interact with their healthcare providers more effectively. These AI technologies encourage frequent communication and support, encouraging patients to take an active role in their care.

Another essential feature of AI-powered healthcare is Triage. Tele-triage is a system used to rank situations and make sure resources are allocated as effectively as possible. It helps to determine the urgency needs and provides care appropriately.

In conclusion, there is a great deal of promise in the intersection of telemedicine and AI. It opens the door for a more accessible, effective, and patient-centred future while also empowering patients and improving healthcare delivery.

- *Technological Infrastructure*

Indeed (2023) defined technology infrastructure as the components that make the operation and management of enterprise IT services and IT environments possible. The components include hardware, software, networks, and facilities companies use to create, test, deliver, control, and support IT services. According to Wikipedia (2024), “Information technology infrastructure is defined broadly as a set of information technology (IT) components that are the foundation of an IT service; typically, physical components (computer and networking hardware and facilities), but also various software and network components”. Technological infrastructure can, therefore, be referred to as the underlying structures, resources and tools that facilitate the performance of technology within an organisation. Data centers, servers, cables, routers, etc make up the physical infrastructure components, while software platforms, cloud services, databases, and communication protocols make up the digital infrastructure components.

As an enabler for various services and applications, technological infrastructure facilitates communication and data exchange, provides repositories for information, executes tasks, and safeguards data. Centre for Care Innovation (2021) opined that the “provision of high-volume telemedicine requires appropriate infrastructure including high-speed internet connectivity and camera and microphone enabled devices.” It highlighted the primary components of an IT Infrastructure to include ‘the physical systems such as hardware, storage, any kind of routers/switches and the building itself hut also network and software”. Abhineet *et al.* (2022) noted that recently, communication has become increasingly vital in the delivery of healthcare services, just as most healthcare providers are

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currently experimenting with and integrating the fifth generation (5G) of network and other cutting-edge technologies for communication and on-demand service delivery. They highlighted that the Internet of Things (IoT) plays a major role in remote health monitoring, which is effective for patients and service providers. "Patients' health can be monitored regularly, and the doctor can supervise their patients remotely on the basis of previous medical records".

Having a robust technological infrastructure is key to economic prosperity as it enhances productivity, innovation, and competitiveness. According to the U.S. Department of Health and Human Services (2024), infrastructure-related issues, such as lack of access to the internet or the appropriate technology (smartphone or computer) as well as limited mobile phone data plans, may prevent participation in telemedicine. Ftouni *et al.* (2022) noted that from the twenty-one studies reviewed, technical issues were the most reported barrier of telemedicine use during the Covid-19 pandemic. "Telemedicine adoption was sluggish and the main obstacles that hindered its rapid implementation were technological prerequisites". The studies highlighted lack of universal access to technology, poor internet connection, and low expansion of rapid internet networks, especially in developing countries, as important barriers that impeded communication and interaction through video consultations. Other technical issues that were identified for hindering meaningful communication were scarcity of high-resolution cameras, high-quality signals, poor audiovisual quality, latency in the conversation, and time lag.

Christine (2024), while emphasizing the importance of having proper equipment and robust Wi-Fi, and avoiding common videoconferencing mistakes, noted that "in the early days of COVID-19, most patients forgave less-than-perfect aesthetics in order to get expedited care. Now, users want high-quality audio, video and personal connections that mirror a typical face-to-face appointment." A robust technological infrastructure is therefore, critical to address these challenges.

From the forgoing, it is pertinent to note that a successful implementation of AI-based telemedicine system in Anambra State requires a robust system that is scalable and can handle big data. Therefore, a robust technological infrastructure must be put in place for efficient communication and data management. High-speed internet is essential to allows seamless transmission of audio, video, and patient data, and for video consultations, remote monitoring, and telehealth platforms. Cameras, microphones, and other peripherals facilitate visual examinations and real-time interactions. Dedicated technical support ensures smooth telehealth operations by troubleshooting, addressing user queries, and maintaining equipment. Proper training in the areas of platform usage, patient privacy, and communication protocols ensures efficient use of telehealth tools. Telemedicine infrastructure plays a pivotal role in expanding access to healthcare services.

- *Healthcare Provider Training*

Healthcare provider training is critical to ensure quality of care, adaptation to change, patient safety, team collaboration, ethical considerations, and legal and regulatory compliance. According to Christine (2024), "A massive shift to telehealth during the COVID-19 pandemic left many healthcare organizations scrambling to ramp up — not only to acquire the technology and added connectivity but also to get hundreds of providers and staff trained to handle the deluge. To be able to convince patients to adapt to and trust the service, both now and in the future, preparation is critical to ensure that proper care is delivered and to provide a safe and seamless experience that is comparable to an in-person visit". With respect to training for telehealth, 5 ways to prepare the providers, were highlighted thus: understand and meet the evolving expectations of the patients, educate all staff member, regardless of their role, offer easy access to IT support throughout the care journey, educate providers (and patients) on security best practices, and expand your perceptions on what virtual care can be. The five steps can be simplified thus: survey patients to identify common pain points and opportunities, thoroughly educate providers about the workflows and capacities of the chosen platform, provide a designated help desk, IT staffer or managed services partnership to step in when an unexpected hiccup arises, communicate the presence of privacy risks as well as best practices for safe remote work and use of mobile communications devices.

Health Resources & Services Administration (2022) identified three types of training for telehealth to include introductory training, digital communication skills, and cultural humility. Introductory training is appropriate for staff members with little to no experience using telehealth. The training may include basics of telehealth technology and equipment, compliance and regulations, reimbursement and how to establish a telehealth workflow. To effectively interview and examine patients virtually, digital communication trainings for providers and other staff is essential. Cultural humility training will help the healthcare providers appreciate the unique elements of every patient's identity and acknowledge the complexity of their daily lives in order to give them personalised care.

To maximise the benefits of AI-based telemedicine, training of the healthcare workforce must not be neglected. This must be prioritised. This is why Rutledge *et al.* (2021) noted that neglect to provider training on telehealth is a major concern as telehealth requires an understanding of the nuances of patient privacy, consent, telehealth etiquette, billing, and more. As health systems are transforming from traditional in-person encounters to telehealth visits, several health care professional organizations have called for telehealth competency-based trainings. Providing education using competencies based on the Four P's framework will provide learners with the necessary tools to assume a leadership role in all phases of telehealth implementation, delivery, and refinement (Rutledge *et al.*, 2021). The categories of the telehealth competencies based on the Four Ps of telehealth framework are planning, preparing,

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providing and performance evaluation. For Sharma *et al*. (2023), education and training are crucial for the appropriate use of new healthcare technologies such as AI-enabled telemedicine.

Therefore, healthcare providers must invest in training and upskilling their workforce to ensure they are proficient in utilizing AI technologies. This is quite important as training of the healthcare providers directly impacts patient's well-being, safety, and the effectiveness of the overall healthcare system.

- *Regulatory Policies*

AI-based telemedicine has been a revolutionary trend in health sector, as it has come with numerous benefits that enhance the accessibility and efficiency of healthcare with the resultant patient outcomes. However, one of the critical concerns that has been a topic of discussion is if there is presence of strong regulatory framework to guide its implementation. Townsend *et al.* (2023) noted that although the growth of Artificial intelligence (AI)-enhanced technology brings great opportunities for the positive transformation of the economy, business, healthcare, and society, there are also concerns about the way in which AI is designed, developed, and deployed. Are there regulatory measures and mechanisms with respect to issues concerning data quality and privacy, explainability and transparency of the algorithms, and issues of social and distributive justice? Notwithstanding the prevalence of ethical instruments–many of which find application in Africa–a critical question is whether AI in Africa is regulated. Regulatory frameworks associated with the management of digital health data and health research are a foundational element for further development of AI technologies in healthcare (Townsend *et al.*, 2023).

On this premise, Sharma *et al.* (2023) posited that to ensure optimal effectiveness, AI-powered telemedicine should comply with existing clinical practices and adhere to a framework adaptable to various technologies. It should also consider technical and scientific factors, including trustworthiness, reproducibility, usability, availability, and cost. It noted that AI integration into everyday practice is limited due safety and regulatory challenges among other factors. Safety is a primary concern as AI algorithms may not always be accurate and can make errors that could be harmful to patients. Since AI-based telemedicine platforms must adhere to strict regulations to ensure patient privacy and data security, regulatory compliance is another major concern. Establishing clear guidelines and regulations around the use of AI in telemedicine is critical to overcoming these challenges.

It is crucial therefore, to develop regulatory policies that create a supportive framework for AI-based telemedicine, which would be beneficial to patients, healthcare providers, and the overall healthcare system. No doubt, a strong policy would ensure patient safety and quality assurance, ethical use of AI, interoperability and compatibility, and innovation with accountability.

- *Healthcare Accessibility*

In offering healthcare services, the ease with which individuals can obtain needed medical services is one of the key factors that determines the efficiency of the system. Is it available? Is it acceptable? Is it affordable? These questions and more are the factors that influence the accessibility of healthcare.

According to the publication from School of Medicine, MU (2023), health care access is the ability to obtain healthcare services such as prevention, diagnosis, treatment, and management of diseases, illness, disorders, and other health-impacting conditions. For healthcare to be accessible it must be affordable and convenient. Mostly in third-world countries, most people do not have access to adequate healthcare. Three key areas of debate in healthcare access are the problem of poverty, the many barriers to healthcare access, and the question of healthcare resource allocation. Often these generate controversies about the role and alleviation of poverty, how to overcome access barriers, and how to fairly allocate limited resources. Overcoming these challenges translates to access to adequate healthcare. In developed countries the cost of healthcare has been rising, fuelled by the cost of new technology, better and more extensive care for patients and treatment of diseases, sedentary lifestyles and poor nutrition, and aging populations. In most countries healthcare is not an unlimited resource. Trade-offs and compromises must be made. Either some people do not get adequate healthcare, the cost of healthcare is high, there is a long wait to receive certain healthcare services, healthcare workers are relatively poorly compensated, or some combination of these occurs.

The Institute of Medicine, Committee on Monitoring Access to Personal Health Care Services (2009), defines healthcare accessibility as "the timely use of personal health services to achieve the best health outcomes. In other words, it emphasizes the importance of timely access to healthcare services to promote optimal health outcomes for individuals. Access to healthcare is critical as it helps to prevent and manage disease, reduce premature deaths, and cut down on the amount of unnecessary disability.

There are three steps that coincide with access to health services: access to the healthcare system (mostly through insurance coverage), locating a place where healthcare services are provided, and finding a provider that the patient can trust and communicate with (James, 2019). James identified the "Five 'A's of Access" as the primary foundation of all the three steps; viz: affordability, availability, accessibility, accommodation and acceptability. These steps and the 5 As underscore the importance of recognising the multifaceted interplay of dimensions of healthcare accessibility.

The many dimensions to access to healthcare, if manged properly will transcend from access to healthcare to access to quality healthcare. Therefore, it is pertinent to note that access to quality healthcare is essential for reducing mortality and mobility, preventing complications, rapid access to medical care during emergencies, enhancing quality of life and ensuring equal access to health services.

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➢ *Efficiency in Healthcare Delivery*

Wikipedia (2023) defines healthcare efficiency as a comparison of delivery system outputs, such as physician visits, relative value units, or health outcomes, with inputs like cost, time, or material. It then describes efficiency as a ratio of outputs to inputs or a comparison to optimal productivity using stochastic frontier analysis or data envelopment analysis. The Bloomberg index calculates an efficiency score based on a nation's life expectancy along with relative and absolute health expenditures.

Efficiency in health can be technical or allocative. Technical efficiency is using the least possible amounts of inputs (such as health workers, medical equipment, and supplies) to produce a given amount of output, e.g., health services or treatments (WHO, 2021). Allocative efficiency focuses on allocating health inputs in a way that produces the optimal mix of health outputs to maximize overall societal health. Palmer and Torgerson (1999) described the concept of efficiency in health care as Technical, Productive, and Allocative.

Guinness *et al.* (2011) posited that efficiency in healthcare delivery systems (HCDs) means providing the most cost-efficient healthcare to those in need. As equity is a pillar of the HCDS, efficiency and equity are opposing forces. Therefore, it is critical to have the broader determinants of health into consideration on HCDS. Thus, Metaspire Business Consulting (2010) identified three essential keys to improving efficiency and effectiveness in healthcare delivery as defining and examining core, supporting and driving processes, leveraging tools and technology, and understanding the appetite of the current culture for change. Given the number and diversity of participants as well as the complexity of healthcare delivery process, implementing these keys uncovers the need for an objective party to initiate, facilitate, and integrate a sustainable efficient and effective healthcare delivery process.

In healthcare delivery, efficiency is crucial for making sure that patients receive timely, effective, and cost-effective care. Healthcare efficiency entails doing things both the right way (technical efficiency) and the right thing (allocative efficiency). By optimizing resource use, streamlining processes, and minimizing errors, we can enhance healthcare delivery for the benefit of the patients and the communities.

➢ *Challenges and Considerations*

Implementation of AI-based telemedicine must come with its challenges, and some considerations must be made to address these. How these are handled will determine the success of the implementation. The challenges ranges from technical, non-technical to policy-related issues.

Vendor selection is a challenging component of any health IT project, and it can be even more difficult in a marketplace full of hype, hope, and big ideas (Jennifer, 2018). Petersson *et al.* (2022) emphasized the need to see the implementation of AI system in healthcare as a changing learning process at all organizational levels, necessitating a healthcare system that applies more nuanced systems thinking. Ganesh (2023) identified the solution design as the main challenge and consideration in this evolving scenario of AI telemedicine. While noting that AI can improve the healthcare processes, critical concerns were raised. What role will AI play in making the final decision? Will it independently make the decisions for the doctors, or will it offer assistance to them? Sharma *et al.* (2023) highlighted safety as one of the primary concerns that poses several challenges and limitations to integrating AI into telemedicine, because "AI algorithms may not always be accurate and can make errors that could harm patients."

Considering these challenges therefore, it is critical to have, in place, a clear strategy to define the role of AI in the system because AI-generated results will not be always 100% reliable. Thus, while designing the system, the position of in the AI final decision-making must be well stipulated.

Developing a successful AI-powered telehealth model will require data preparation and data integration in the system (Ganesh, 2023). It is pertinent to test the model comprehensively before rolling out. Careful gathering, cleansing and annotation of the data is a prerequisite in the telemedicine app development. Ganesh (2023) noted that "As different healthcare facilities use different systems, data exchange and usage becomes challenging, resulting in further complications." Therefore, there should be consideration for data interoperability to ensure result accuracy and enhanced patient safety. Sharma *et al.*, while highlighting regulatory compliance as another major challenge to integrating AI into telemedicine, noted that "AI-powered telemedicine platforms must adhere to strict regulations to ensure patient privacy and data security." Ganesh (2023) emphasised that AI-backed telehealth software must comply with relevant laws like HIPAA (Health Insurance Portability and Accountability Act), GDPR (General Data Protection and Regulation), and HL7 (Health Level 7). As AI is heavily dependent on data, integrating it with telemedicine will call for patient care and data regulatory requirement. It is pertinent to ensure the encryption and secure storage of the patient data. Developing a telehealth and AI model that meets HIPAA compliance is not only important for patient health data safety but also for easy data access and transmission across various systems (Ganesh, 2023). Therefore, Sharma *et al.* (2023) posited that establishing clear guidelines and regulations for the implementation of AI-based telemedicine is essential.

Ganesh (2023) noted that "it is important for the AI-models to keep patients engaged and give them a better experience", citing that lack of human interaction during the consultations can affect patient satisfaction. Considering patients' reservation with respect to relying on AI for their health, it is crucial to ensure that they accept and trust these AI-based tele-apps. Therefore, to enhance patient engagement and experience, we should be deliberate about

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building a platform that can help build patients' trust while using AI in telemedicine.

Telehealth artificial intelligence models can streamline a lot of healthcare processes. However, its integration with telehealth systems can be difficult for healthcare providers to adapt and use properly (Ganesh, 2023). Testing of the models and training of the healthcare providers on the use of the models must be conducted before its implementation. Thus, Sharma *et al*. (2023) posited that "healthcare providers must also invest in training and upskilling their workforce to ensure they are proficient in utilizing AI technologies".

In summary, to ensure a successful implementation of AI-based telemedicine, technical, non-technical and policy-related challenges must be addressed. Physician-guided adoption, adherence to clinical practice and provider education are critical for a successful implementation.

III. METHODOLOGY

This study adopted a combination of descriptive and quantitative research design. The study focused on Anambra State, Nigeria, as a context for developing and implementing AI-based telemedicine solutions. The population of the study comprised an estimated population of 5,527,809 (2016 population forecast) residents of the 21 local government areas of Anambra state. Using a 95% confidence level, a 50% standard of deviation (population proportion), and a 5% margin of error, the sample size of 384 was used for the study. Out of the 384 questionnaires that were administered, 346 were returned for analysis. Thus, a response rate of 90.1% was ascertained. The hypotheses formulated in this study were tested using two-tailed, one sample t-test at 5% significance level, α.

IV. DATA ANALYSIS

Data analysis was conducted using Microsoft Office Excel, version 2404 (Build 17531.20152 Click-to-Run), and IBM SPSS Statistics version 29.0.2.0 (20).

- *Data Analysis of Research Question One*

Table 1: Percentage, mean score, and standard deviation of responses on the advantages that AI-based telemedicine would offer in Anambra State

S/N	ITEM	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
1	AI-based telemedicine will improve access to healthcare in Anambra state	239 *69.1%*	89 *25.7%*	1 *0.3%*	17 *4.9%*	0 *0.0%*	346 *100%*	4.59	0.97
2	The implementation of AI-based telemedicine in Anambra State will reduce travel time for patients who need healthcare services	229 *66.2%*	87 *25.1%*	0 *0.0%*	30 *8.7%*	0 *0.0%*	346 *100%*	4.49	0.97
3	The implementation will lead to enhanced collaboration among healthcare providers	201 *58.1%*	100 *28.9%*	1 *0.3%*	40 *11.6%*	4 *1.2%*	346 *100%*	4.31	0.97
4	It will lead to better management of chronic health conditions via remote monitoring, personalised care, predictive analytics, etc	194 *56.1%*	107 *30.9%*	6 *1.7%*	39 *11.3%*	0 *0.0%*	346 *100%*	4.32	0.97
5	The healthcare system in Anambra state would experience patients' satisfaction if AI-based	178 *51.4%*	123 *35.5%*	0 *0.0%*	45 *13.0%*	0 *0.0%*	346 *100%*	4.25	0.97

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S/N	ITEM	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
	telemedicine is implemented in the state.								
6	AI-based telemedicine has great potential to save lives via early detection, remote monitoring, reduced response time, access to specialists, etc	215 *62.1%*	99 *28.6%*	0 *0.0%*	32 *9.2%*	0 *0.0%*	346 *100%*	4.44	0.97
AVERAGE MEAN/ STANDARD DEVIATION								4.40	0.97

Legend: $\bar{x}$ = Mean Score, σ = Standard deviation

Table 1 presents the summary of the results from the statistical analysis of the responses from research question two, which outlined the potential of AI-based telemedicine that would offer tremendous benefits to Anambra State. The results showed how the participants perceived telemedicine, highlighting some great advantages that would transform the healthcare system in Anambra state and enhance patients' outcome.

Conclusively, Table 1shows that the average mean score and the average standard deviation are 4.40 and 0.97 respectively. It presents a statistical summary of views of the respondents on the advantages that AI-based telemedicine would offer in Anambra State if implemented. The average standard deviation of 0.97 accounts for 22.0% of the average mean value of 4.40. It underscores the varying views of the advantages that AI-based telemedicine would offer in Anambra State, leaning towards high level of consensus with the emphasized variables.

- *Data Analysis of Research Question Two*

Table 2: Percentage, mean score, and standard deviation of responses on the challenges that would be faced in the implementation of AI-based telemedicine in Anambra State

S/N	ITEMS	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
1	Availability of funds for investment in infrastructure and technology that would drive the implementation of AI-based telemedicine in Anambra state will be a challenge	200 *57.8%*	106 *30.6%*	1 *0.3%*	30 *8.7%*	9 *2.6%*	346 *100%*	4.32	0.61
2	Limited internet connectivity will hinder the seamless implementation of this project	301 *87.0%*	23 *6.6%*	0 *0.0%*	18 *5.2%*	4 *1.2%*	346 *100%*	4.73	0.24
3	Lack of awareness among patients will lead to low adoption of this innovation	219 *63.3%*	98 *28.3%*	1 *0.3%*	22 *6.4%*	6 *1.7%*	346 *100%*	4.45	0.56
4	Regulatory Compliance – non-adherence to regulations that will ensure patient privacy and data security will limit the adoption rate and sustenance of the solution.	203 *58.7%*	88 *25.4%*	11 *3.2%*	44 *12.7%*	0 *0.0%*	346 *100%*	4.30	0.60
5	Data integration and interoperability – i.e. gathering data from different sources and storing them as a single unified system, and then formatting them to work effectively across different systems- will challenge the implementation of the AI-based telemedicine.	226 *65.3%*	68 *19.7%*	0 *0.0%*	52 *15.0%*	0 *0.0%*	346 *100%*	4.35	0.54
6	Inadequate support from the stakeholders – govt, healthcare workers, technology companies, etc- will hinder the implementation	250 *72.3%*	57 *16.5%*	1 *0.3%*	33 *9.5%*	5 *1.4%*	346 *100%*	4.49	0.47

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S/N	ITEMS	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
7	Resistance from the medical personnel and the patients will hinder the implementation and will affect the adoption rate.	216 *62.4%*	63 *18.2%*	2 *0.6%*	41 *11.8%*	24 *6.9%*	346 *100%*	4.17	0.57
8	Training and education for healthcare providers on the use of AI models will be a great concern for successful implementation.	304 *87.7%*	15 *4.3%*	0 *0.0%*	27 *7.8%*	0 *0.0%*	346 *100%*	4.72	0.22
9	Ethical concerns surrounding the use of AI in health care (such as issues of bias and transparency as AI algorithms may not always be accurate and can make errors that could harm patients) will pose a challenge to the implementation of AI-based telemedicine in Anambra state.	200 *57.8%*	99 *28.6%*	0 *0.0%*	37 *10.7%*	10 *2.9%*	346 *100%*	4.28	0.61
AVERAGE MEAN/ STANDARD DEVIATION								4.42	0.49

Table 2 demonstrates the statistical analysis and the summary of the results of the responses from research question three, which bordered on the challenges that would be faced in the implementation of AI-based telemedicine in Anambra State. The results depict varying responses from the participants, outlining some possible challenges that implementation of AI-based telemedicine in Anambra State would face.

In conclusion, Table 2 presents a statistical summary of views of the respondents on the challenges or concerns that will be encountered while implementing of AI-based in Anambra state. The table has an average mean score of 4.42 and average standard deviation of 0.49. The average standard deviation of 0.49 accounts for 11.1% of the average mean value of 4.42. It underscores the varying views on the challenges or concerns that might arise while implementing AI-based telemedicine in Anambra State, indicating agreement with the outlined variables.

- *Data Analysis of Research Question Three*

Table 3: Percentage, mean score, and standard deviation of responses on the strategies that could be developed for easy implementation and sustenance of AI-based telemedicine in Anambra State.

S/N	ITEM	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
1	Public awareness campaigns will address the envisaged challenges to the AI-based telemedicine implementation in Anambra state and increase adoption rate	299 *86.4%*	39 *11.3%*	1 *0.3%*	7 *2.0%*	0 *0.0%*	346 *100%*	4.82	0.96
2	Training for healthcare workforce – upskilling and reskilling- will ensure that they are proficient in the use AI technologies	279 *80.6%*	49 *14.2%*	1 *0.3%*	17 *4.9%*	0 *0.0%*	346 *100%*	4.71	0.96
3	Collaboration among healthcare providers, policymakers, and technology companies will create a robust foundation for a successful telemedicine implementation in Anambra state	300 *86.7%*	21 *6.1%*	0 *0.0%*	25 *7.2%*	0 *0.0%*	346 *100%*	4.72	0.96

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S/N	ITEM	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
4	Establishment of clear guidelines and regulations around the use of AI in telemedicine will foster responsible AI adoption, as it will ensure trust and safety, address ethical concerns, and provide quality assurance.	311 *89.9%*	10 *2.9%*	1 *0.3%*	24 *6.8%*	0 *0.0%*	346 *100%*	4.76	0.96
AVERAGE MEAN/ STANDARD DEVIATION								4.75	0.96

Table 3 demonstrates the statistical analysis and the summary of the results of the responses from research question four, which bordered on the strategies that could be developed for easy implementation and sustenance of AI-based telemedicine in Anambra State. The results show varying responses from the participants, outlining wonderful strategies that will ensure seamless implementation and sustenance of AI-based telemedicine in the state.

In summary, Table 3 shows the average mean score and the average standard deviation as 4.75 and 0.96 respectively. It presents a statistical summary of views of the respondents on the strategies that could be developed for easy implementation and sustenance of AI-based telemedicine in Anambra State. The average standard deviation of 0.96 accounts for 20.2% of the average mean, showing high level of consensus with the outlined strategies.

- *Data Analysis of Research Question Four*

Section 5 of the research instrument focused on the ways to enhance the AI decision support interface to optimise healthcare accessibility and efficiency in Anambra. Table 4 below presents the analysis of the responses on the features that could be integrated in the telemedicine app to enhance healthcare outcomes in the state. The analysis shows the Percentage, mean score, and standard deviation of the responses.

Table 4: Percentage, mean score, and standard deviation of responses on the features that could be incorporated in telemedicine app to enhance healthcare outcomes in Anambra state.

S/N	ITEMS	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
1	User authentication	281 *81.2%*	28 *8.1%*	0 *0.0%*	37 *10.7%*	0 *0.0%*	346 *100%*	4.60	0.35
2	Virtual consultations with doctors	301 *87.0%*	25 7.2%	0 *0.0%*	20 *5.8%*	0 *0.0%*	346 *100%*	4.75	0.24
3	Prescription requests and delivery	294 *85.0%*	19 *5.5%*	0 *0.0%*	30 *8.7%*	3 *0.9%*	346 *100%*	4.65	0.29
4	Appointment scheduling	300 *86.7%*	14 *4.0%*	0 *0.0%*	32 *9.2%*	0 *0.0%*	346 *100%*	4.68	0.25
5	Health record access	284 *82.1%*	33 *9.5%*	1 *0.3%*	28 *8.1%*	0 *0.0%*	346 *100%*	4.66	0.33
6	Medication reminders	302 *87.3%*	16 *4.6%*	0 *0.0%*	28 *8.1%*	0 *0.0%*	346 *100%*	4.71	0.24
7	Medication recommendations	297 *85.8%*	16 *4.6%*	1 *0.3%*	29 *8.4%*	3 *0.9%*	346 *100%*	4.66	0.27

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S/N	ITEMS	SA	A	UD	D	SD	TOTAL	$\bar{x}$	σ
8	Triage (response to patients in emergency based on severity of their conditions to allocate limited resources)	193 *55.8%*	111 *32.1%*	1 *0.3%*	41 *11.8%*	0 *0.0%*	346 *100%*	4.32	0.62
9	Encryption protocols and access controls to protect patient records	295 *85.3%*	14 *4.0%*	0 *0.0%*	37 *10.7%*	0 *0.0%*	346 *100%*	4.64	0.28
10	Diagnostics support	309 *89.3%*	8 *2.3%*	0 *0.0%*	29 *8.4%*	0 *0.0%*	346 *100%*	4.73	0.19
AVERAGE MEAN/ STANDARD DEVIATION								4.64	0.35

The statistical analysis and the summary of the results of the responses from research question five are demonstrated on Table 4. Research question five centred on the features that could be incorporated in telemedicine app to enhance healthcare outcomes in Anambra state. The results show varying responses from the participants, indicating preferences to different features that would boost healthcare outcomes and ensure patients satisfaction.

Conclusively, Table 4 shows the average mean score and the average standard deviation as 4.64 and 0.35 respectively. It presents a statistical summary of views of the respondents on the proposed features of AI-based telemedicine app development in Anambra state. The average standard deviation of 0.35 accounts for 7.5% of the average mean. It outlined varying views on the proposed features of the app, leaning towards high level of consensus with the emphasized variables.

➢ *Test of Hypotheses*

The hypotheses formulated in this study were tested using two-tailed, one sample t-test at 5% significance level, α. A two-tailed one-sample t-test is a statistical test used to compare the mean of a sample to a hypothesized value. The t-test always uses the following null hypothesis:

H_0: $\mu = \mu_0$ (population mean is equal to a hypothesized value, denoted as μ_0)

H_1: $\mu \neq \mu_0$ (population mean is not equal to a hypothesized value, μ_0)

The t-statistic, t is calculated using the following formula:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} - William\ Sealy\ Gosset$$

Where:

$\bar{x}$ = sample mean

μ_0 = hypothesized population mean

s = sample standard deviation

n = sample size

The decision rule is as that if $|t| > t_{critical}$, reject the null hypothesis (H_0).

➢ *Test of First Hypothesis*

H_{02}: AI-driven telemedicine solutions will not have positive impact on healthcare outcomes and patient satisfaction in Anambra State (μ=3.00).

H_{12}: AI-driven telemedicine solutions will have positive impact on healthcare outcomes and patient satisfaction in Anambra State ($\mu \neq 3.00$).

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Table 5: One sample t-test for Second hypothesis

Parameters	Description
Hypotheses	H_{02}: AI-driven telemedicine solutions will not have positive impact on healthcare outcomes and patient satisfaction in Anambra State (μ=3.00).
	H_{12}: AI-driven telemedicine solutions will have positive impact on healthcare outcomes and patient satisfaction in Anambra State (μ≠3.00).
Sample mean (x̄)	4.40
Test value (μ_0)	3.00
Standard deviation (s)	0.97
Sample size (n)	6
t-statistic	$\frac{\bar{x}-\mu_0}{s/\sqrt{n}} = 3.535$
Critical t-value (Two-tailed), $\alpha = 0.05$, df = 5	±2.571
Comparison	Calculated t-statistic (3.535) > critical t-value (2.571)
Conclusion	Reject H_{02}: There is sufficient evidence to conclude that AI-driven telemedicine solutions will have positive impact on healthcare outcomes and patient satisfaction in Anambra State

H_2 assess whether AI-driven telemedicine solutions will have positive impact on healthcare outcomes and patient satisfaction in Anambra State. The following are observable from Table 4.14: x̄ = 4.40, σ = 0.97, t = 3.535 and df = 5. The calculated t-statistic, 3.535 is greater than the critical t-value, 2.571 at 0.05 significance level and 5 degrees of freedom. Thus, the null hypothesis (H_{02}), which states that AI-driven telemedicine solutions will not have positive impact on healthcare outcomes and patient satisfaction in Anambra State, is rejected. This result, together with the high mean score (x̄ = 4.40), indicates that the six survey items presented sufficient evidence to conclude that AI-driven telemedicine solutions will have positive impact on healthcare outcomes and patient satisfaction in Anambra State.

Test of Second Hypothesis

H_{03}: Anambra State would not face challenges in the implementation of AI-based telemedicine solutions.
H_{13}: Anambra State would face challenges in the implementation of AI-based telemedicine solutions.

Table 6: One sample t-test for Third hypothesis

Parameters	Description
Hypotheses	H_{03}: Anambra State would not face challenges in the implementation of AI-based telemedicine solutions (μ=3.00).
	H_{13}: Anambra State would face challenges in the implementation of AI-based telemedicine solutions (μ≠3.00).
Sample mean (x̄)	4.42
Test value (μ_0)	3.00
Standard deviation (s)	0.49
Sample size (n)	9
t-statistic	$\frac{\bar{x}-\mu_0}{s/\sqrt{n}} = 8.875$
Critical t-value (Two-tailed), $\alpha = 0.05$, df = 8	±2.306

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Parameters	Description
Comparison	Calculated t-statistic (8.875) > critical t-value (2.306)
Conclusion	Reject H_{03}: There is strong evidence to conclude that Anambra State would face challenges in the implementation of AI-based telemedicine solutions

H_3 investigates whether Anambra State would face challenges in the implementation of AI-based telemedicine solutions. In Table 6 above, $\bar{x}$ = 4.42, σ = 0.49, t = 8.875 and df = 8. The critical t-value at 5% significance level and 8 degrees of freedom is 2.306. Clearly, the calculated t-statistic is greater than the critical t-value, i.e. $t_{statistic}$ (8.875) > $t_{critical}$ (2.306). Therefore, the null hypothesis (H_{03}), which states that Anambra State would not face challenges in the implementation of AI-based telemedicine solutions, is rejected. This supports the high mean score ($\bar{x}$ = 4.42), indicating that the nine items in the survey questionnaire presented strong evidence to conclude that Anambra State would face challenges in the implementation of AI-based telemedicine solutions.

➢ *Test of Third Hypothesis*

H_{04}: The developed strategies will not have significant impact on the implementation and sustenance of the AI-based telemedicine.

H_{14}: The developed strategies will have significant impact on the implementation and sustenance of the AI-based telemedicine.

Table 7: One sample t-test for Fourth hypothesis

Parameters	Description
Hypotheses	H_{04}: The developed strategies will not have significant impact on the implementation and sustenance of the AI-based telemedicine (μ=3.00).
	H_{14}: The developed strategies will have significant impact on the implementation and sustenance of the AI-based telemedicine (μ≠3.00).
Sample mean ($\bar{x}$)	4.75
Test value (μ_0)	3.00
Standard deviation (s)	0.96
Sample size (n)	4
t-statistic	$\frac{\bar{x}-\mu_0}{s/\sqrt{n}} = 3.646$
Critical t-value (Two-tailed), $\alpha = 0.05$, df = 3	±3.182
Comparison	Calculated t-statistic (3.646) > critical t-value (3.182)
Conclusion	Reject H_{04}: There is ample evidence to conclude that the developed strategies will have significant impact on the implementation and sustenance of the AI-based telemedicine

H_4 assess whether the developed strategies will have significant impact on the implementation and sustenance of the AI-based telemedicine by addressing the challenges. Table 7 above presents the following scores: $\bar{x}$ = 4.75, σ = 0.96, $t_{statistic}$ = 3.646 and df = 3. The critical t-value at 5% significance level and 8 degrees of freedom is 3.182. These figures from the table shows that the calculated t-statistic is greater than the critical t-value, i.e. $t_{statistic}$ (3.646) > $t_{critical}$ t-value (3.182). Considering this result, the null hypothesis (H_{04}), which states that the developed strategies will not have significant impact on the implementation and sustenance of the AI-based telemedicine, is rejected. This supports the high value of the mean score ($\bar{x}$ = 4.75), indicating that the four items in the survey questionnaire presented ample evidence to conclude that the developed strategies will have significant impact on the implementation and sustenance of the AI-based telemedicine.

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➢ *Test of Fourth Hypothesis*

H_{05}: The features and functionalities that would be incorporated into an AI-driven decision support interface will not optimize healthcare accessibility and efficiency in Anam bra State.

H_{15}: The features and functionalities that would be incorporated into an AI-driven decision support interface will optimize healthcare accessibility and efficiency in Anambra State.

Table 8: One sample t-test for Fifth hypothesis

Parameters	Description
Hypotheses	H_{05}: The features and functionalities that would be incorporated into an AI-driven decision support interface will not optimize healthcare accessibility and efficiency in Anambra State (μ=3.00).
	H_{15}: The features and functionalities that would be incorporated into an AI-driven decision support interface will optimize healthcare accessibility and efficiency in Anambra State (μ≠3.00).
Sample mean (x̄)	4.64
Test value (μ_0)	3.00
Standard deviation (s)	0.35
Sample size (n)	10
t-statistic	$\frac{\bar{x}-\mu_0}{s/\sqrt{n}} = 14.909$
Critical t-value (Two-tailed), $\alpha = 0.05$, df = 9	±2.262
Comparison	Calculated t-statistic (14.909) > critical t-value (2.262)
Conclusion	Reject H_{05}: There is powerful evidence to conclude that features and functionalities that would be incorporated into an AI-driven decision support interface will optimize healthcare accessibility and efficiency in Anambra State

H_5 evaluates the features and functionalities of an AI-driven decision support interface that will help to optimize healthcare accessibility and efficiency in Anam bra State. Table 8 presents the following scores: $\bar{x}$ = 4.64, σ = 0.35, $t_{statistic}$ = 14.909 and df = 9. The critical t-value at 5% significance level and 8 degrees of freedom is 3.262. Clearly, the figures from the table show that the calculated t-statistic is greater than the critical t-value, i.e. $t_{statistic}$ (14.909) > $t_{critical}$ t-value (2.262). Consequently, the null hypothesis (H_{05}), which states that the features and functionalities that would be incorporated into an AI-driven decision support interface will not optimize healthcare accessibility and efficiency in Anambra state, is rejected. This supports the high value of the mean score ($\bar{x}$ = 4.64), indicating that the ten items in the survey questionnaire presented powerful evidence to conclude that the features and functionalities that would be incorporated into an AI-driven decision support interface will optimize healthcare accessibility and efficiency in Anambra State.

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V. FINDINGS

The importance of an efficient healthcare system can never be overemphasized because health is wealth. To have a robust economy, a nation must ensure an efficient and effective health sector that will guarantee a healthy workforce. A healthy nation is a wealthy nation. AI-based telemedicine has great potentials that could revolutionise healthcare system for enhanced outcomes.

The findings demonstrate that:

AI-driven telemedicine solutions will have positive impacts on healthcare outcomes and patient satisfaction in Anambra State ($t_{statistic}$, 3.535 > $t_{critical}$, 2.571) viz, improved access to healthcare, reduced travel time for patients, enhanced collaboration among healthcare providers, better management of chronic conditions, satisfied patients and life-saving in emergency situations. The average mean score of 4.40, as shown in Table 4.9, gives credence to this. This result further confirms the study conducted by Sharma *et al.* (2023), which highlighted some benefits of telemedicine in various medical specialties, including managing type 2 diabetes, remote monitoring in cardiovascular patients, effective interventions in tele-oncology, intelligent diagnosis, patient monitoring, and healthcare IT. It also agrees with the study carried out by Omaghomi *et al.* (2024) which demonstrated that telemedicine could overcome geographic barriers, bringing access to healthcare services for people in the most remote regions of Africa, the potential to mitigate the incidence of avoidable illnesses and enhance public health by providing individuals with information and enabling prompt actions.

Anambra State would face challenges in the implementation of AI-based telemedicine solutions ($t_{statistic}$, 8.875 > $t_{critical}$, 2.306). These challenges include availability of funds for investment in infrastructure and technology, limited internet connectivity, lack of awareness among patients, regulatory compliance (adherence to regulations to ensure patient privacy and data security), data integration and interoperability, inadequate support from the stakeholders, resistance from the medical personnel and the patients, training and education for healthcare providers on the use of AI models and ethical concerns surrounding the use of AI in health care (such as issues of bias and transparency as AI algorithms may not always be accurate and can make errors that could harm patients). The average mean score of 4.42, as shown in Table 2, indicates substantial agreement with the finding.

This result further confirms the study carried out by Jiang *et al.* (2021), which stated that though AI has shown promise in clinical tasks, some challenges exist, including the lack of standardized processes, ethical and legal supervision, and scalability for real clinical practice. Also, it collaborates with the study by Omaghomi *et al.* (2024), which revealed that the implementation of telemedicine in rural Africa has been beset with several challenges, including inadequate infrastructure, the digital divide, cultural and linguistic diversity, barriers to health literacy, and regulatory obstacles.

The developed strategies will have statistically significant impact on the implementation and sustenance of the AI-based telemedicine in Anambra State ($t_{statistic}$, 3.646 > $t_{critical}$, 3.182). These strategies include public awareness campaigns, training for healthcare workforce (upskilling and reskilling to ensure they are proficient in the use AI technologies), collaboration among healthcare providers, policymakers, and technology companies, and establishment of clear guidelines and regulations around the use of AI in telemedicine. This is supported by the high value of the average mean score ($\bar{x}$ = 4.75) from Table 4.11. This result further agrees with the study carried by Jiang *et al.* (2021), which proposed a process framework to ensure safe and orderly AI development in the medical industry, emphasizing regulatory oversight, interdisciplinary collaboration, clinical validation, education and training, and patient-centric approach. The result also confirms the study by Petersson *et al.* (2022), which emphasized the need to develop implementation strategies across healthcare organisations to address challenges to AI-specific capacity building, stressing that laws and policies are needed to regulate the design and execution of effective AI implementation strategies.

The features and functionalities that would be incorporated into an AI-driven decision support interface will optimize healthcare accessibility and efficiency in Anambra State ($t_{statistic,}$ 14.909 > $t_{critical}$, 2.262). These features include user authentication, virtual consultations with doctors, prescription requests and delivery, appointment scheduling, health record access, medication reminders, medication recommendations, triage (response to patients in emergency based on severity of their conditions in order to allocate limited resources), encryption protocols and access controls to protect patient records, and diagnostics support.

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The average mean score of 4.64, as shown in Table 4, indicates high level of consensus with this finding. This result further corroborates the study carried out Procoders (2024), which highlighted some must-have features of a telemedicine app to include medical history management, secure authentication and encryption, appointment booking and reminders, prescription management, video and audio communication, search, payment feature, and analytics. The result also collaborates with the study by Vinati (2024), which listed some features in telehealth app development to include registration, patient profile, search, calendar and appointments, communication, payment, notification, medication tracking, secure chats, in-app calls, navigation, cloud data storage, patient's insurance plan, scheduling and calendar, communication and EHR review, digital prescriptions, video or audio session recording, dashboard or analytics, pharmacy databases, specialist consultations, referrals etc. It also agrees with the study by Han and Lee (2018), which showed that those who use health apps are statistically significantly more satisfied with using mobile health applications to manage their health in comparison to the users of conventional care.

- *Framework for Seamless Implementation of AI-based Telemedicine in Anambra*

Based on the findings of the study and the reviewed literatures, the following framework, represented in Fig 4.7, was developed to help Anambra state to effectively implement AI-based telemedicine. Key players, including healthcare providers, community leaders, policy makers, etc, should be identified. Understanding the unique healthcare challenges in Anambra state, considering existing healthcare infrastructure, patient demographics and health needs, underserved areas and vulnerable populations is critical. Next is to assess the existing infrastructure requirements, such as electricity, Internet connectivity, hardware, software, data centres, and then plan for necessary upgrades.

Another critical consideration is the platform design. The features and functionalities of the app should be user-friendly, accommodating local languages, cultural preferences and ease of use for both the patients and the healthcare professionals. It should include features like video consultations, appointment scheduling, medication reminders, prescription management, etc.

Training and capacity building is critical to sustaining the system. Healthcare providers should be trained on the use of the telemedicine platform, and culturally sensitive communication. Awareness campaigns should be conducted to educate patients about telemedicine benefits and usage. Every perceived digital literacy gap should be addressed.

Furthermore, legal and regulatory considerations are very important. Therefore, effort should be made to understand local and national regulations related to telemedicine. Necessary licenses and approvals must be obtained, while liability, privacy, and consent issues must be properly addressed.

Finally, data security and privacy should be prioritized to ensure patient data privacy compliance. To achieve this, robust security measures to protect patient data during transmission and storage must be implemented. Privacy laws, such as Nigeria Data Protection Act 2023 (NDPA), should be complied with, while security protocols should be regularly audited and updated.

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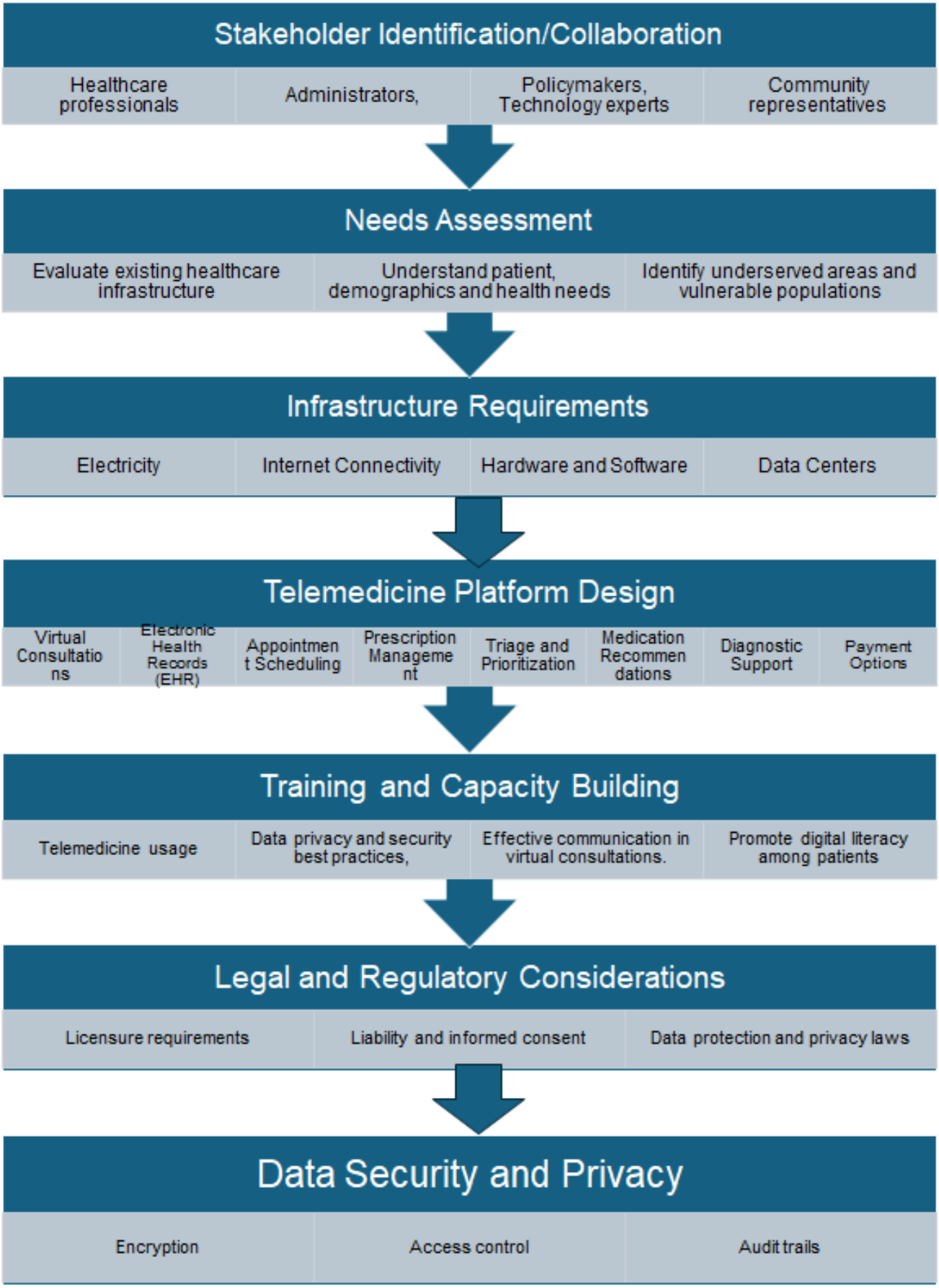

Fig 1 Implementation Flowchart

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VI. CONCLUSION

AI-based telemedicine has great potential to transform the health sector in Anambra state to improve accessibility and efficiency. The findings from the study have shown that the overall efficiency and accessibility of healthcare services in Anambra state is suboptimal. Therefore, the system needs to be enhanced for effective health services delivery. Thus, it becomes pertinent to leverage the AI-based telemedicine to enhance the system. As indicated from the findings, it has several advantages that will have positive impacts on healthcare outcomes and patient satisfaction in Anambra state. However, the findings identified some challenges that Anambra state will face in the implementation of the solution. Addressing these challenges is critical to utilizing the great advantages that AI-based telemedicine offers. Thus, the study identified some strategies that will be developed to address these challenges in order to ensure seamless implementation and sustenance of the AI-based telemedicine. It emphasized the importance of public awareness campaigns, workforce training, collaboration and clear guidelines and regulations to mitigate the envisaged challenges. Furthermore, AI-based telemedicine will not be complete without app development. Thus, the study identified some critical features that will be integrated in the telemedicine app to better utilize all the potentials of the system. These features and functionalities will optimize healthcare accessibility and efficiency in Anambra state. Evidently, implementation of AI-based telemedicine in Anambra state will revolutionize the health sector to improve accessibility and overall efficiency.

RECOMMENDATIONS

- To effectively harness the potentials of AI-based telemedicine, the government and relevant stakeholders should prioritize infrastructure development, particularly in the areas of power supply and internet connectivity.
- Policymakers should collaborate with medical experts to develop and implement regulations, policies and strategies that promote the adoption of AI-based telemedicine while addressing ethical concerns and data security.
- Employ the services of reputable app developer to build an AI-based telemedicine solution, taking cognisance of the features and functionalities highlighted in this study.
- Training programmes and initiatives should be prioritized to reskill and upskill the medical workforce on the effective use of AI-Based telemedicine.

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