Natural Language Chatbots in Biomedical Translations in Nigeria

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Abstract

In recent years, technology integration into the healthcare sector has witnessed significant advancements, with natural language chatbots emerging as a promising tool for improving communication and accessibility in various domains. This article explores the evolving role of natural language chatbots in the context of biomedical translation in Nigeria. Three objectives were formulated to guide the study. The design methodology use for the study is Natural language chatbots for medical diagnosis. The method employs a literature review approach to synthesize relevant literature on the impacts of Natural Language Chatbots in Biomedical Translations in Nigeria. This methodology is suitable for the research objectives as enables the identification and analysis of extant knowledge and best practices in the field. The challenges of Biomedical, translational practice in Nigeria were discussed. The historical development of Natural language chatbots globally was traced. Finally, the role of natural language chatbots in biomedical translation in Nigeria was examined. The study concludes that by addressing language barriers and improving patient-provider interactions, chatbots can enhance healthcare delivery and accessibility. Finding indicates that a successful implementation requires a comprehensive understanding of Nigeria's linguistic, cultural, and technological landscape. The recommendations include implementing ethical guidelines and best practices to mitigate potential risks and ensure responsible use of the Natural Language Chatbots. The study also recommended human involvement in Natural language chatbots for medical diagnosis to ensure human judgment invest in training and reskilling programs for workers whose jobs may be impacted by the adoption of Natural Language Chatbots in Biomedical Translations in Nigeria.

Keywords: Natural, Language, Chatbots, Biomedical Translation

Introduction

A functional national healthcare system stands as a cornerstone of a thriving society, profoundly influencing every facet of a nation's progress. Its significance is inextricably woven into the fabric of public health, economic stability, and societal well-being. At its core, a working healthcare system safeguards the health of a nation's citizens. It serves as a bulwark against diseases, shielding the population from preventable illnesses and reducing mortality rates. By providing timely medical interventions, vaccinations, and routine screenings, it curbs the spread of contagious diseases, ensuring a healthier populace.

Economically, a well-functioning healthcare system is an investment in human capital. The vitality of a nation hinges on the wellness of its people. A healthy workforce is more productive, contributing meaningfully to economic growth. Reduced absenteeism due to illness and increased productivity amplify industrial output and innovation, fostering a dynamic economy. Mortality reduction is another crucial aspect. Maternal and child health services within a national healthcare system is paramount. Accessible prenatal care, safe childbirth practices, and paediatric care ensure fewer maternal and infant deaths. This reduction directly impacts population growth and the nation's future.

The system's role in disease prevention and control cannot be overstated. Rapid responses to outbreaks, comprehensive vaccination campaigns, and health education initiatives prevent epidemics from spiraling out of control. This proactive approach safeguards both individual health and public health infrastructures. Investment in healthcare infrastructure underscores a nation's commitment to its people. Hospitals, clinics, and medical facilities signify a nation's readiness to respond to health crises, offering vital care during emergencies. This infrastructure enhances the capacity to address routine health needs and critical situations alike.

Healthcare systems also extend their influence to education. Healthy children are more likely to attend school regularly, actively participating in their own intellectual growth. By ensuring their physical well-being, a national healthcare system fosters a future generation equipped for societal progress. Equity is paramount. A well-designed healthcare system ensures that even vulnerable populations access quality care. This inclusion promotes social cohesion, upholding the principles of justice and equal opportunity. Moreover, healthcare systems foster innovation. Research and advancements in medical technology emerge from the nurturing environment of a functional healthcare infrastructure. These innovations not only enhance the well-being of the nation but also contribute to global medical progress.

Essentially, a working national healthcare system transcends medical boundaries, shaping the contours of a nation's success. It protects lives, fuels economic prosperity, and empowers citizens to lead fulfilling lives. Its reach extends beyond hospitals and clinics, shaping the destiny of a nation.

Despite the universally accepted importance of a functional healthcare sector, Nigeria's healthcare delivery sector faces various challenges, including inadequate infrastructure, workforce shortages, funding gaps, and unequal access to quality healthcare services. A lot of actions have been directed on the inadequate infrastructural decay and funding gaps in Nigeria. Teibowei (2023) submitted that one of the foremost among these challenges is unequal access to healthcare services. Disparities between urban and rural areas, as well as between different socioeconomic strata, lead to uneven distribution of healthcare services. The result is that marginalized communities often face barriers to accessing essential medical care, perpetuating health inequalities. Inadequate health information systems must be improved in disease surveillance and health planning. The lack of comprehensive data collection and analysis

impedes timely responses to disease outbreaks and limits the capacity for evidence-based decision-making.

Teibowei and Etebu (2022) reported that Nigeria is a country with over 500 ethnic groups and languages, which in turn poses linguistic diversity and a significant challenge in disseminating medical information and research findings to healthcare professionals and patients across the nation. Biomedical translation involves translating medical news, research papers, and patient records, is crucial in disseminating knowledge and improving patient care. Natural language chatbots, powered by AI and NLP technologies, offer a promising solution to overcome these barriers and revolutionize biomedical translation in Nigeria. Natural language chatbots can serve as intermediaries, enabling seamless translation of medical content from one language to another. These chatbots can process complex medical terminology and ensure accurate translation, reducing the risk of misinterpretation and improving the quality of healthcare delivery. This article explores the role of natural language chatbots in biomedical translation in Nigeria. Specifically, the study will achieve the following:

i. Clarify the concepts of natural language chatbots and Biomedical translations.
ii. Summarise the historical development of natural language chatbots.
iii. Identify the factors affecting biomedical translational practice in Nigeria.
iv. Examine the role of natural language chatbots in biomedical translations in Nigeria.

Design Methodology

The study employs a literature review approach to synthesize relevant literature on the impacts of Natural Language Chatbots in Biomedical Translations in Nigeria. This methodology is suitable for the research objectives, as it will enable the identification and analysis of extant knowledge and best practices in the field (Creswell, 2014). In line with Peters et al. (2020), this approach will allow us to systematically search for and screen relevant studies, particularly both quantitative and qualitative research designs, grey literature, and expert opinions. The inclusion criteria will focus on studies that explore the impacts of Natural Language Chatbots in Biomedical Translations in Nigeria, published in English language journals from 2019 to 2023. The initial step in this study involves the conduct of a comprehensive review of academic and professional literature related to the Natural Language Chatbots. The review includes journal articles, books, reports, and other relevant sources, guided by research objectives; the sources are selected based on their relevance to research objectives (Creswell, 2014). The literature review is conducted via databases such as Google Scholar. We follow the guidelines proposed by Snyder (2019) and Paul and Criado (2020) for writing a comprehensive literature review. This includes the synthesis of key findings from included studies, critical evaluation of quality and limitations of research, and identification of future research directions. These rigorous methodology guidelines provide a comprehensive overview of the current state of research on the impacts of Natural Language Chatbots in Biomedical Translations in Nigeria and help identify knowledge gaps and future research directions. According to Grant and Booth (2009), an appropriate sample size for a literature review will depend on the research questions, scope of review, and available resources. For this study, the appropriate sample size for the literature is determined by a preliminary search to identify the number of relevant studies or articles. 20 articles are identified through a database search and by review of reference lists of key articles on the topic. This sample size is justified because the studies identified are of high quality and provide rich and relevant data that address research questions (Bettany-Saltikov, 2010). This study adopts purposive sampling because it involves the selection of studies based on their relevance to research objectives, as determined by researchers' expertise and knowledge of the field (Fink, 2014). In this study, purposive

sampling is accomplished through various methods, for example, the use of specific keywords to search for relevant studies in databases (e.g., Google Scholar). The researchers then screen the studies based on their relevance to the research objectives.

The study assesses the natural language chatbots in clinical data need and requirement in diagnosing diseases in Bayelsa state, Nigeria. Natural language chatbots are advanced computer programs designed to interact with and assesses the patients' clinical data found in EHRs or manual records as depicted in Figure 2. However, figure 1 provides the linkage of biomedical translation in Nigeria with natural language chatbots.

Fig. 1 – Linkage of Natural Language Chatbots to Biomedical Translations in Nigeria
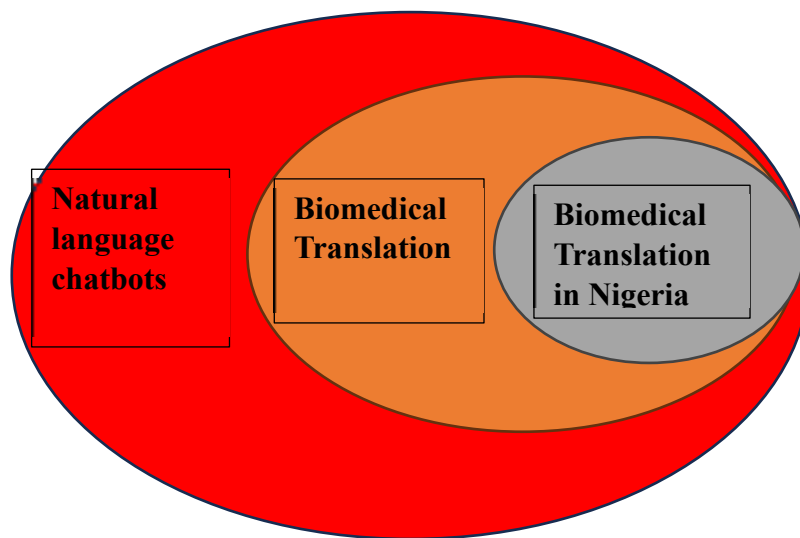
The biomedical translation in Nigeria are subset of biomedical translation which a subset of the Natural Language Chatbots. Fig. 1 provides a diagrammatic representation of the linkage that exist among the three areas.

Figure 2 - Bayelsa Medical University Chatbot for medical Diagnosis System
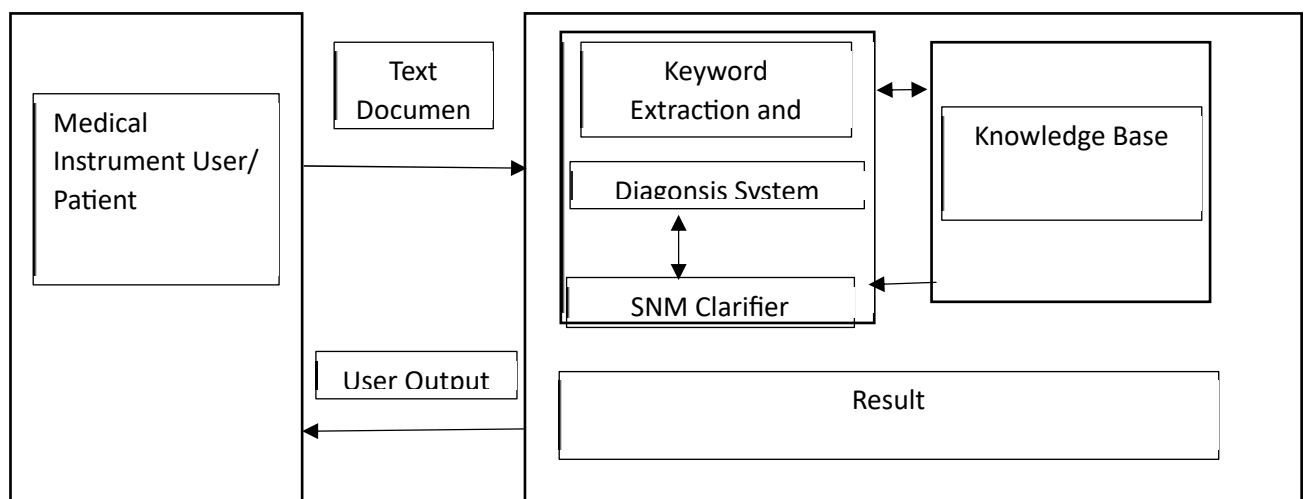
Source – Bayelsa Medical University Biomedical Translation Department

The steps depicted in fig.2 involved in the Bayelsa Medical University chatbot of medical diagnosis system are as follows: The patient or medical instrument user provides key word using text document to extract words that are used for diagnosis or analysis. Depending on the route, the analysis or diagnosis uses support vector machines (SVM) clarifier or the knowledge base of the data to generate similar results or create new results. The results are read out through the output loop to the medical instrument user or patient. Key components of the chatbot include description of the knowledge base, preprocessing of text-based documents, tagging of document, extraction of answer; and ranking of user answers.

Conceptual clarification

Natural language chatbots - Natural Language Chatbots are advanced computer programs designed to interact with humans in a way that resembles natural language communication. These chatbots utilize complex algorithms and artificial intelligence (AI) technologies to understand, interpret, and respond to human language in a way that feels conversational and intuitive (Kalla and Smith, 2023). Unlike traditional computer interfaces that require users to use specific commands or follow rigid structures, natural language chatbots allow users to communicate with them using the same kind of language they would use when talking to another person. This includes written or spoken language, and chatbots are often used in text-based messaging platforms or voice assistants.

Natural language chatbots use a combination of techniques such as machine learning, natural language processing (NLP), and pattern recognition to analyze the input provided by the user. They try to understand the context, intent, and meaning behind the words and phrases used by the user (Katnaklar, 2022). Based on this analysis, they generate relevant and coherent responses that simulate human-like conversation. These chatbots can perform a wide range of tasks, from answering questions and providing information to assisting with customer support, making recommendations, and even facilitating transactions (King, 2022). The more advanced ones can learn and improve over time through interactions, adapting to user preferences and refining their responses. Overall, natural language chatbots bridge the gap between humans and computers, making technology more accessible and user-friendly. They find applications in various industries, including customer service, healthcare, finance, e-commerce, education, and more, offering efficient and personalized interactions while automating tasks that once required direct human involvement.

Biomedical Translation - Biomedical translation is the intricate process of transforming complex scientific knowledge and discoveries from the realm of research and laboratory findings into practical applications that directly benefit human health and medical care. It acts as a bridge, linking the often-intricate findings of biomedical research to real-world solutions that improve diagnosis, treatment, and overall patient well-being (Teibowei, 2023). At its core, biomedical translation involves the conversion of theoretical insights and experimental data from various fields of biology, genetics, molecular biology, and medicine into actionable solutions. This process encompasses several stages, including identifying promising research findings, validating their clinical relevance, and translating them into tangible medical interventions, therapies, diagnostic tools, or procedures.

Biomedical translation is not just about transferring knowledge but also about adapting and refining it to work effectively in clinical settings. This involves addressing the challenges posed by human biology's complexity, potential side effects, regulatory approvals, and ethical considerations (Teibowei, 2022). The goal of biomedical translation is to positively impact healthcare outcomes. It takes scientific breakthroughs that may start in a laboratory setting and guides them through the intricate steps necessary to turn them into therapies that can prevent,

treat, or cure diseases. This multidisciplinary effort involves collaboration among researchers, medical professionals, engineers, regulatory bodies, and sometimes industry partners. In essence, biomedical translation is a pivotal link in the chain that connects cutting-edge research to tangible advancements in medical practice. It can transform groundbreaking discoveries into innovations that change lives, reduce suffering, and extend the frontiers of medical possibility.

Biomedical Translation in Nigeria

Biomedical translation in Nigeria involves the critical process of converting scientific advancements and discoveries in the field of biomedicine into practical applications that directly impact healthcare outcomes and improve the well-being of the Nigerian population. In this context, biomedical translation encompasses the journey from laboratory research and experimentation to developing innovative medical solutions that address pressing health challenges in the country. It starts with identifying promising biomedical research findings, often in areas such as genetics, molecular biology, epidemiology, and medical technology, that have the potential to bring about positive changes in healthcare (Teibowei, 2023).

Nigeria faces unique health concerns, including infectious diseases, non-communicable diseases, maternal and child health issues, and more. Biomedical translation in Nigeria aims to address these challenges by translating research insights into tangible interventions. This might involve the creation of new diagnostic tools, therapies, medical devices, or treatments tailored to the Nigerian population's specific health needs. The translation process also involves adapting these solutions to suit the Nigerian healthcare landscape, which can include considerations such as cultural sensitivities, resource limitations, and infrastructure constraints. Collaboration between researchers, medical practitioners, policymakers, and industry partners is vital to ensure that these solutions are not only scientifically sound but also practical and feasible within the Nigerian context.

Furthermore, regulatory approval, ethical considerations, and patient safety play pivotal roles in biomedical translation in Nigeria. Ensuring that these innovations adhere to ethical standards, are safe for use, and have been rigorously tested is crucial to their successful implementation (Teibowei, 2022). Biomedical translation in Nigeria ultimately seeks to bridge the gap between scientific discovery and tangible improvements in healthcare delivery. By harnessing the potential of advanced research and technology, this process can revolutionize disease prevention, diagnosis, treatment, and overall healthcare quality in the country, leading to a healthier and more prosperous future for the Nigerian people.

Historical development of Natural Language Chatbots
The history of natural language chatbots spans several decades, with milestones in artificial intelligence and natural language processing contributing to their development.
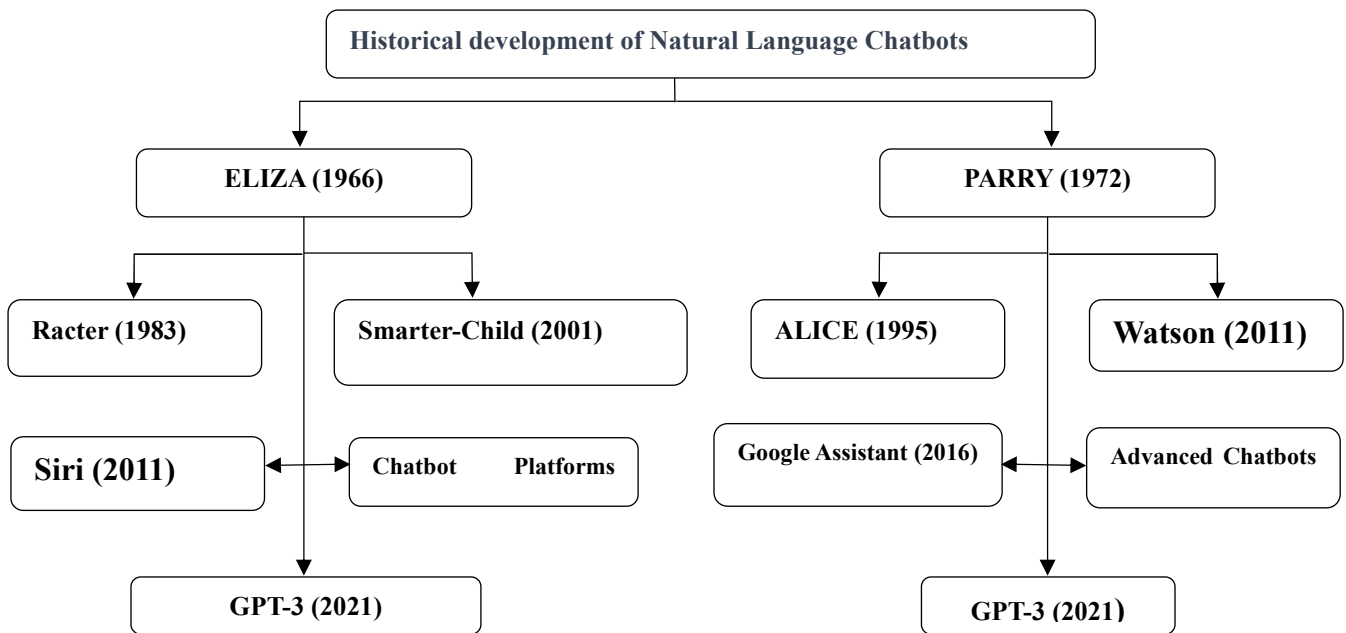Fig 3 - **Historical development of Natural Language Chatbots**

Fig. 3 presents a pictorial representation of the timeline in a two-branch chronological order that provide an outlook for the period of natural language chatbots. . Lund (2023), Kirmani (2022), Lund and Wang (2023) presented an overview of key events and advancements in the history of natural language chatbots as:

1. ELIZA (1966): ELIZA, created by Joseph Weizenbaum at the MIT Artificial Intelligence Laboratory, is often considered one of the earliest examples of a natural language processing program. ELIZA emulated a Rogerian psychotherapist, conversing with users by rephrasing their statements as questions. It demonstrated how simple patterns and scripts could create the illusion of understanding and communication.

2. PARRY (1972): PARRY, developed by Kenneth Colby, was another early chatbot that simulated a person with paranoid schizophrenia. PARRY engaged in text-based conversations, demonstrating an early attempt to model human thought processes and behavior through dialogue.

3. Racter (1983): Racter, short for "RAILway to English Response," was a chatbot developed by William Chamberlain and Thomas Etter. It generated surreal and poetic text, blurring the lines between meaningful conversation and abstract expression.

4. ALICE (1995): A.L.I.C.E. (Artificial Linguistic Internet Computer Entity), created by Richard Wallace, was designed to engage in natural language conversations. ALICE utilized a pattern-matching approach and was trained on large text datasets to produce more coherent responses.

5. Smarter-Child (2001): Smarter-Child was an instant messaging-based chatbot that gained popularity on platforms like AOL Instant Messenger (AIM) and MSN Messenger. It provided information, weather updates, and even played games with users.

6. Watson (2011): IBM's Watson made headlines by winning the quiz show "Jeopardy!" against human contestants. Watson's natural language processing capabilities allowed it to understand and answer questions posed in natural language. While Watson's primary focus was not on chatbot interactions, it demonstrated advancements in natural language understanding and reasoning.

7. Siri (2011): Apple's Siri marked a significant step in bringing natural language interaction to mainstream users. Introduced with the iPhone 4S, Siri responded to voice commands and queries, performing tasks like setting reminders, sending messages, and providing information. In subsequent years, major tech companies like Google, Amazon, and Microsoft introduced their own voice-enabled assistants, each building upon advances in speech recognition and natural language understanding. These virtual assistants could not only perform tasks but also engage in more natural, human-like conversations.

8. Google Assistant (2016): Google's Assistant integrated natural language processing with the company's vast knowledge graph to provide users with personalized assistance. It expanded beyond smartphones to smart speakers and other devices, showcasing the potential of chatbots in various contexts.

9. Chatbot Platforms (2010s): The 2010s witnessed the rise of various chatbot platforms, allowing developers to create their own chatbots with varying degrees of complexity. Platforms like Microsoft Bot Framework, Facebook Messenger Platform, and Dialogflow (formerly API.ai) facilitated the development of chatbots for different industries and use cases.

10. GPT-3 and Advanced Chatbots (2020s): OpenAI's GPT-3, released in 2020, marked a significant advancement in natural language processing. It enabled the creation of highly sophisticated chatbots capable of generating human-like responses across a wide range of topics and contexts. GPT-3-powered chatbots demonstrated the potential for AI to engage in more meaningful and contextually relevant conversations. The advent of deep learning, a subset of machine learning, further accelerated chatbot development. Deep learning techniques enabled chatbots to learn from large amounts of data, improving their ability to understand context, nuances, and varying language patterns.

OpenAI's GPT (Generative Pre-trained Transformer) models, including GPT-3, brought about a significant leap in natural language chatbot capabilities (Lund, 2023). These models can generate coherent, contextually relevant responses, opening the door to chatbots that can hold more advanced and meaningful conversations.

The development of natural language chatbots continues to progress rapidly. They are now integrated into various applications, platforms, and industries, from customer service and healthcare to education and entertainment. The journey from early rule-based systems to the current era of AI-driven chatbots demonstrates the ongoing commitment to creating machines that can interact with humans in a genuinely conversational and useful way(Mehta, 2023).

The history of natural language chatbots spans from early experiments in language simulation to the development of advanced AI models capable of engaging in complex and contextually rich conversations. These advancements have paved the way for the integration of chatbots in various industries, including healthcare, customer service, education, and more.

The role of natural language chatbots in biomedical translations in Nigeria

It is evident that natural language chatbots hold significant potential to play a transformative role in advancing biomedical translation efforts in Nigeria. These advanced AI-driven chatbots have the capacity to bridge communication gaps, enhance collaboration, and facilitate the dissemination of biomedical information within the country's complex healthcare landscape. In the context of biomedical translation, natural language chatbots can serve as valuable tools for disseminating research findings and medical knowledge to a wide range of stakeholders, including healthcare professionals, researchers, policymakers, and even the general public (Kirnmani, 2022). By simulating human-like conversation, these chatbots can effectively convey complex scientific concepts in a manner that is more easily understandable, breaking down barriers between experts and non-experts.

One of the challenges in biomedical translation is the efficient communication of research outcomes and findings. Natural language chatbots can assist in summarizing research papers, explaining medical breakthroughs, and answering questions about the implications of these findings (Lund & Wang, 2023). This can facilitate better understanding among healthcare practitioners, enabling them to integrate new knowledge into their clinical practice more effectively. Furthermore, these chatbots can play a role in medical education and training. They can provide instant access to up-to-date medical information, support the learning process for healthcare professionals, and ensure that practitioners remain informed about the latest advancements in the field (Lund, 2023). This can contribute to enhancing the overall quality of healthcare delivery in Nigeria.

In patient care, natural language chatbots can empower patients to make informed decisions about their health. These chatbots can provide information about medical conditions, treatment options, and preventive measures, promoting health literacy and encouraging proactive healthcare-seeking behaviour. Chatbots can assist in connecting researchers from different institutions, facilitating the exchange of ideas, and fostering cross-disciplinary discussions (Mehta, 2023). They can also aid in coordinating clinical trials, patient recruitment, and data collection, streamlining the research process.

While chatbots are not a replacement for human expertise, they can undoubtedly complement human efforts by providing quick access to relevant information, promoting ongoing learning, and simplifying complex concepts. As Nigeria strives to advance its biomedical translation efforts, integrating natural language chatbots into the healthcare and research ecosystem can accelerate the translation of scientific discoveries into practical applications that benefit the health and well-being of its population.

Conclusion and Recommendations

In conclusion, the integration of natural language chatbots into biomedical translation has the potential to revolutionize healthcare communication in Nigeria. By addressing language barriers and improving patient-provider interactions, chatbots can enhance healthcare delivery and accessibility, ultimately contributing to better health outcomes. However, successful implementation requires a comprehensive understanding of Nigeria's linguistic, cultural, and technological landscape. Collaborative efforts between technologists, healthcare professionals, linguists, and policymakers are crucial to harnessing the full potential of natural language chatbots in biomedical translation and transforming healthcare delivery in the country.

Recommendations

Based on the literature reviewed, the following policy recommendations can be made to ensure the responsible use of Natural Language Chatbots in Biomedical Translations in Nigeria. First, ethical guidelines and best practices must be implemented to mitigate potential risks and ensure responsible use of the Natural Language Chatbots. Policymakers within the medical field could collaborate with experts to develop comprehensive guidelines that address concerns around privacy, bias, and control over data. These guidelines should be regularly reviewed and updated to reflect the evolving landscape of Natural Language Chatbots in Biomedical Translations in Nigeria. Second, human involvement should be maintained in the use of Natural Language Chatbots in Biomedical Translations in Nigeria. While technology has the potential to enhance efficiency and productivity, it should not replace human judgment entirely. Medical and educational institutions can invest in training and reskilling programs for workers whose jobs may be impacted by the adoption of Natural Language Chatbots in Biomedical Translations in Nigeria. This will help ensure a smooth transition to the new technology and reduce the risk of job displacement.

Finally, educational institutions like the Bayelsa Medical University must balance human judgment and machine learning to effectively incorporate Natural Language Chatbots in Biomedical Translations in Nigeria education. This includes addressing concerns around accuracy, reliability, security, privacy, and ethical implications. This will help ensure that the technology is effectively integrated into existing educational practices and does not compromise the quality of education. However, as Natural Language Chatbots in Biomedical Translations in Nigeria become more widely used, it is important to ensure that ethical considerations are considered, and that the technology is used responsibly. Overall, future research can help to maximize the potential benefits of Natural Language Chatbots in Biomedical Translations in Nigeria while mitigating potential risks and ethical concerns.

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