Article

Artificial Intelligence-Driven Translation Tool in Intensive Care Unit (AITIC) for Enhancing Communication and Research

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Abstract: There is a need to improve communication for patients and family members who belong to cultural minority communities in the Intensive Care units (ICU). As a matter of fact, language barriers negatively impact patient safety, family participation in the care of the critically ill patients as well as recruitment in clinical trial. Recent studies indicate that Google translate and ChatGPT are not accurate enough for advanced medical terminology. Therefore, developing and implementing an Artificial Intelligence-driven language translation tool is essential for bridging language barriers. This tool will enable language minority communities to access advanced healthcare facilities and innovative research in a timely and effective manner, ensuring they receive the comprehensive care and information they need. Method: Key factors that facilitate access to advanced health services, in particular ICUs for language minority communities are reviewed. Results: The existing digital communication tools in emergency and the ICU are reviewed. To the best of our knowledge, no AI translation app has been developed for deployment in ICUs. Patient privacy and data confidentiality are other important issues that should be addressed. Conclusions: Developing AITC which uses language models trained with medical/ICU terminology dataset could offer fast and accurate real-time translation. AITIC could support communication, consolidate and expand original research involving language minority communities.

Keywords: AI; communication; emergencies; research

Background

Language barriers are associated with the risk of misdiagnosis, delayed medical treatment, increased hospital length of stay, poor mental health outcomes among survivors, low patients' satisfaction, increased anxiety and depression (as proven by the HADS inventory), and a higher mortality rate [1–3]. Recent studies demonstrate that diversity in the intensive care unit (ICU) facilitates communication and results in overall better patient care [4–8]. Although professional interpreter services are effective, there is limited availability in hospitals, especially in time-critical situations in the ICU and out of hours [1,3]. Family members who assist with translation, when available, may not be able to convey complex medical terminology. Moreover, the stress generated by the critical condition of their loved one might influence their ability to translate. [6] With the rapid development of mobile technology, digital language translation apps can fill this gap. However, recent studies indicate that Google Translate has limited benefit in emergencies and is not accurate enough for advanced medical terminology [1,9]. Moreover, the literature evaluating Google Translate for medical terminology has found that the translation accuracy varies based on the target language [10]

Rationale

Effective communication between patients, their family members and medical professionals is essential in the context of complex medical care.[1] This is paramount for treating critically ill patients in the ICU that require sedation and invasive mechanical ventilation. [2.3] As an example, anglophones living in Quebec and Francophone patients outside of Quebec face challenges to have access to care in their languages and are at higher risk of poor health [1,11–13]. In critical and stressful situations patients and their family members, who belong to cultural minority communities, provided that their care givers do not speak their primary language, could lose their ability to convey to their desired extent. Similarly, health care providers and researchers have significant barriers in explaining innovative care or in promoting advanced high technology research. Complex, critical and stressful situations are common in the ICU setting.

Methods

A thorough search was conducted across relevant databases, including PubMed, Google Scholar, and Scopus, utilizing keywords such as "language minority communities," "advanced healthcare access," "ICU," "digital communication tools", "AI translation" and "natural language processing in healthcare". Studies published in the last ten years were prioritized to ensure the inclusion of the most current advancements in technology and methodologies. Authors included articles that discussed the impact of language barriers on healthcare access, the role of digital tools in enhancing communication, and any existing AI-driven solutions relevant to healthcare translation. Studies focused exclusively on non-emergency healthcare settings or lacking empirical data were excluded from this review. Key themes and findings from the selected articles were extracted and organized to identify critical factors influencing access to ICU services for language minority communities. The data were synthesized to highlight trends concerning the efficacy of digital communication tools in overcoming language barriers and to evaluate the current state of AI applications in healthcare translation. Additionally, authors assessed prevailing concerns related to patient privacy and data confidentiality in the context of deploying AI translation tools in healthcare, ensuring ethical considerations were part of our analysis.

Results

To the best of our knowledge, there is currently no AI-driven translation application specifically designed and deployed within ICU settings. This gap significantly impedes timely and effective communication between healthcare providers and patients who speak languages other than the dominant languages of the local healthcare system. Various digital communication tools have been implemented in healthcare environments to facilitate communication between healthcare providers and patients. However, most of these tools lack tailored features for addressing the specific needs of language minority communities. The review identified common barriers such as limited access to qualified interpreters and inadequate multilingual resources within existing systems.

The review also highlighted critical concerns regarding patient privacy and data confidentiality associated with the integration of AI translation tools in healthcare environments. Ensuring that patient information remains secure while utilizing such technologies is paramount to their successful implementation.

Despite existing challenges, the positive trajectory of AI technologies presents a vital opportunity. Developing an AI-Translation Communication (AITC) tool that utilizes language models trained with a medical/ICU terminology dataset could offer swift and accurate real-time translations.

Discussion

Machine learning is a powerful and versatile digital tool that enhances healthcare communication by improving patient care and education, allowing for faster decision-making, and optimizing resource use, reducing health care costs. As examples, Natural language processing (NLP)

and deep neural network (DNN) are two field of machine learning which have been researched and implemented across different aspects of healthcare. NLP is a branch of AI that enables computers to understand human languages. AI-based chatbot is a virtual assistant or conversational agent which can communicate with patients via text or voice [14–17]. The chatbot can be developed with combination of Natural Language Processing, Computer Vision, and Machine Learning and are able to automatically create and retrieve medical histories and manage scheduling appointments and patient registration [18]. In this study, the application of AI models as translation tools to assist provider to communicate with patients/family members who speaks a different language or have limited health education will be investigated.

Machine Translation (MT) focuses on the automated process of converting text from one language to another. MT can either deliver more precise translations or to reduce the time and costs required compared to human translation [19,20].

Anita Panayiotou et al [10] evaluated 15 iPad-compatible translation apps for the top 10 languages spoken in Australia to see if they are suitable for health care settings. The results show the low suitability of google translate and Microsoft and MediBabble translator, Universal Doctor speaker, Canopy speak, SayHi and never Papago translate and TripLingo. Among the apps assessed, only two, CALD Assist and Talk To Me, were deemed highly suitable for use in the healthcare setting. Translation technology cannot fully replace a professional interpreter; However, it is neither practical nor financially feasible to provide professional interpreters for every interaction. This highlights an urgent to further study and need to develop tools that enable safe and effective communication [10] Pavithra Rao et al [21] compared ChatGPT and Google Translate (GT) in their effectiveness at accurately translating instructional and educational medical documents into multiple languages (English into Spanish, Vietnamese, and Russian). While Google Translate remains the most widely used translation tool, ChatGPT has the potential to achieve comparable results. The study indicates that ChatGPT may reliably translate medical information into Spanish but was less effective when translating into other languages. ChatGPT should not be used as a substitute for a professional translator and must be approached with caution due to the high error rate observed in this study. This is particularly crucial for less commonly used languages, where limited data availability may result in lower-quality translations [21]. Moreover, GT proved to be of limited value in making medical record content more understandable for patients [22].

It is essential for the scientific community to comprehend ChatGPT's capabilities and limitations. This involves identifying the specific tasks and domains where ChatGPT is most effective, as well as recognizing potential challenges and constraints [23]. Lundmark, A., & Boglind, F. [24] examine ChatGPT's performance as a tool for translating a medical terminology dictionary. The study involves translating a Danish medical events dictionary into Swedish using various methods. The findings highlight ChatGPT's in-context learning capabilities, demonstrating that it can surpass Google Translate when provided with appropriate reference examples [24].

Sarella, P. N. K., & Mangam, V. T. [25] reviewed the benefits and obstacles of integrating AI into healthcare. it becomes evident that AI-NLP is more than a technological tool; it is a transformative force with the potential to revolutionize healthcare communication. By empowering patients with accessible, personalized information, reducing administrative burdens, and supporting diagnosis and treatment planning, AI-NLP is poised to redefine the patient experience and elevate care quality. However, this transformation comes with ethical complexities, including concerns about patient privacy, data security, and algorithmic bias. Addressing these challenges requires a commitment to responsible innovation. Collaboration among healthcare professionals, technology developers, policymakers, and society at large are essential to fully harness AI's potential while adhering to the highest ethical standards. With thoughtful oversight, transparency, and a focus on equitable, patient-centered care, AI-driven healthcare communication can achieve meaningful and lasting improvements for all [25]. Névéol, A. et al [26] provides a comprehensive overview of clinical NLP for languages other than English including Indo-European languages such as French, Swedish, and Dutch, as well as Sino-Tibetan (e.g., Chinese), Semitic (e.g., Hebrew), and Altaic (e.g., Japanese, Korean) languages, summarizing recent studies and highlighting opportunities in this growing field.

Recent studies indicate that (1) the field is maturing, (2) researchers now have access to datasets enabling the development of robust methods for tasks such as electronic health record (EHR) de-identification, clinical entity recognition, normalization, and contextualization. However, there is a need for shared tasks and datasets to allow comparative analysis across languages and approaches. Challenges in systematically identifying relevant literature also underscore the importance of adopting more structured publication guidelines that detail language and task specifics. Analyzing language-specific and task-specific nuances could foster methodological innovations in adaptive approaches for clinical NLP [26]

Noack et al [9] designed a digital communication tool to run on a smartphone to help paramedics to overcome language barriers when delivering services in the ambulance or in the emergency department. However, no AI methods such as machine learning (ML) or natural language processing (NLP) algorithms were used by these authors. [9]

To the best of our knowledge, no AI translation app has been developed for deployment in ICUs. Patient privacy and data confidentiality are other important issues that the AITIC app project could address. In summary, the proposal of developing an AI machine learning app has the rationale of enabling real time AI French/English translation for the intensive care setting in Quebec, this can be extended to support additional languages beyond French and English to meet the need of diverse user bases. AITIC required to be trained with specialized datasets that include comprehensive medical terminology and context-specific dialogues used in the ICU settings. Unlike general translation tools, AITIC must accurately interpret complex terms, diagnoses, treatment protocols and symptoms, and culturally specific language while maintaining patient safety and confidentially. Misinterpretations can lead to misunderstandings of symptoms, inaccurate diagnoses, or improper treatment plans, posing serious risks to patient safety. AITIC must capture the nuances of conversations between providers and patients to ensure effective communication and safe care delivery. Therefore, developing AITIC, requires collaboration between AI-developers and medical professionals to validate datasets and to assess whether AITIC interprets complex terminology, clinal instructions and nuance patient descriptions ensuring the technology is effective and safe for real-world communication in critical medical settings.

The findings underscore the critical importance of integrating advanced technological solutions, such as AI-driven language translation tools, to bridge communication gaps for language minority communities in accessing advanced health services. By overcoming language barriers, AITC can facilitate timely access to critical information and healthcare resources, thus enhancing the quality of care and outcomes for these communities.

Furthermore, the development of AITC could significantly contribute to original research that focuses on the experiences and needs of language minority populations in healthcare settings. By ensuring effective communication, AITC could support more inclusive health services and empower healthcare providers to deliver culturally competent care tailored to the diverse needs of their patients.

Addressing ethical considerations around patient privacy and data confidentiality is essential to the successful adoption of AI translation tools in ICUs. Stakeholders must prioritize robust data protection measures and engage in ongoing dialogue with language minority communities to establish trust and transparency in the use of these technologies.

In conclusion, as healthcare continues to evolve, embracing AI-driven solutions tailored to the linguistic and cultural needs of language minority communities will be vital in promoting equitable access to advanced healthcare services. Future research should focus on the practical implementation of AITC in ICUs and its efficacy in improving outcomes for patients with language barriers.

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