MEDICAL TRANSLATION IN THE AGE OF NEURAL MACHINE TRANSLATION: STANDARDS, ASSESSMENT MODELS, AND ROMANIAN PERSPECTIVES

Zoltan Kovacs,
Doctoral School of Humanities, West University of Timişoara
Daniel Dejica
Politehnica University Timişoara

Abstract: *This article explores the evolving role of machine translation (MT), post-editing (PE), and translation quality assessment (TQA) in the context of medical translation, with a particular focus on the English–Romanian language pair. Methodologically, the paper offers a narrative, critical review and comparative synthesis of standards and TQA models applied to medical translation, with emphasis on the Romanian context. It examines the historical development of MT technologies, from rule-based systems to neural MT (NMT), and assesses their applicability to medical texts. The study highlights the importance of post-editing standards—especially ISO 18587—and discusses the cognitive and procedural demands of PE in high-stakes domains. A comparative analysis of key TQA models—including those proposed by House, Waddington, the American Translators Association (ATA), MQM, and DQF—reveals their strengths and limitations in evaluating medical translations. The article also identifies significant deficits in Romanian translation research and practice, particularly in doctoral inquiry, pedagogical integration, and professional standardization. In response, it proposes directions for research, teaching, and professional development that aim to consolidate the role of PE and TQA in Romanian medical translation. By bridging theoretical models with practical applications, the study contributes to the advancement of Translation Studies and advocates for a more coherent and responsive framework for ensuring the quality and reliability of medical translations.*

Keywords: *Medical translation; machine translation; post-editing; translation quality assessment; ISO 18587; neural machine translation; Romanian translation studies; translator training; MT workflows; specialized translation*

1. Introduction

In recent years, the rapid development of machine translation (MT) technologies—particularly neural machine translation (NMT)—has significantly transformed the landscape of professional translation. While these tools offer unprecedented speed and accessibility, they also introduce new challenges, especially in domains where precision and clarity are paramount, such as medical translation. The translation of medical texts from English into Romanian requires not only linguistic accuracy but also terminological consistency, cultural sensitivity, and ethical responsibility. These demands are often unmet by raw MT outputs, necessitating robust post-editing (PE) and translation quality assessment (TQA) procedures.

Despite the global momentum in translation-technology research, Romanian translation studies have yet to fully integrate post-editing and quality assessment into academic and professional frameworks. Medical translation, in particular, remains underrepresented in doctoral and applied research, and there is a noticeable gap in the development of localized standards and methodologies. As previously noted by Dejica, Pungă, Badea, and Vîlceanu (2022), medical translation has been largely neglected at doctoral level in Romania, despite its relevance to both academic inquiry and professional practice. At the same time, recent work in English for Medical Purposes (EMP) outlines a coherent pedagogical pathway for embedding medical-text translation competence in Romanian higher education (Crăineanu & Dejica, 2025). Addressing these gaps requires coordinated efforts across research, teaching, and professional practice that align international standards with the specific needs of Romanian academia and industry.

The discussion that follows unfolds through a critical engagement with current MT architectures and post-editing frameworks, followed by a comparative analysis of TQA models. Attention is given to the underexplored area of Romanian medical translation, where the lack of structured research and pedagogical integration has hindered the development of effective practices. The article also considers the broader implications for research, teaching, and professional practice, proposing directions that support the advancement of translation competence and the refinement of evaluation methodologies. By bridging theoretical insights with practical applications, the study aims to foster a more coherent and responsive framework for post-editing and quality assessment in Romanian medical translation.

A narrative, critical review approach is adopted. Academic and professional sources on MT/NMT, post-editing standards (e.g., ISO 18587), and TQA models (House, Waddington, ATA, MQM, DQF) published mainly between 2014 and 2025 were surveyed, with priority given to peer-reviewed literature and sector standards relevant to medical translation. Insights were mapped onto the Romanian context (education, research, and professional practice) to identify gaps and propose actionable directions. The scope is analytical and integrative rather than experimental; no primary empirical data are reported.

2. The Evolution of Machine Translation and Its Impact on Medical Texts

The evolution of machine translation (MT) technologies has profoundly reshaped the landscape of professional translation, particularly in specialized domains such as medicine. From early rule-based systems to contemporary neural architectures, MT has transitioned from linguistically deterministic models to data-driven approaches capable of producing fluent and

contextually appropriate translations. However, despite these advancements, the application of MT in medical translation remains fraught with challenges, especially concerning terminological precision, contextual sensitivity, and ethical accountability. As Karakus et al. (2025) demonstrate in their systematic review of NMT in clinical settings, while MT tools offer broad language coverage and potential efficiency gains, their performance varies significantly across languages and contexts, often requiring human oversight to ensure safety and accuracy. Similarly, Rojas Plata and Castro Sánchez (2024) emphasize that although NMT systems outperform earlier models in fluency, they continue to struggle with domain-specific terminology and semantic fidelity—issues that are particularly critical in medical communication.

Historically, MT began with rule-based machine translation (RBMT), which relied on manually crafted linguistic rules and bilingual dictionaries. These systems attempted to model the grammatical structures of source and target languages, but their rigidity and inability to handle exceptions limited their scalability and adaptability. The emergence of statistical machine translation (SMT) in the late 20th century marked a significant shift. SMT systems, particularly phrase-based models (PBSMT), leveraged large parallel corpora to derive probabilistic equivalences between language pairs. While SMT improved fluency and reduced reliance on handcrafted rules, it struggled with idiomatic expressions, word order in morphologically rich languages, and domain-specific terminology (Rojas Plata & Castro Sánchez, 2024).

The advent of neural machine translation (NMT) introduced a paradigm shift in MT research and practice. NMT systems employ deep learning techniques, typically using encoder-decoder architectures, to generate translations based on vector representations of meaning (Yip, 2024). These models are trained on vast datasets and are capable of capturing long-range dependencies and contextual nuances. Unlike SMT, which treats translation as a sequence of probabilistic mappings, NMT generates output word-by-word, allowing for more coherent and fluent translations. However, NMT is not without limitations. It often sacrifices accuracy for fluency, performs poorly with low-resource languages, and struggles with rare or domain-specific terms (Rojas Plata & Castro Sánchez, 2024).

In medical translation, these limitations are particularly consequential. Medical texts demand high levels of terminological accuracy, syntactic clarity, and contextual appropriateness. Errors in translation can lead to misdiagnoses, inappropriate treatments, and breaches of patient confidentiality. A systematic review conducted by Karakus et al. (2025) highlights the risks associated with deploying NMT tools in clinical settings. While tools such as Google Translate and ChatGPT offer broad language coverage and potential cost savings, their accuracy varies significantly across languages and contexts. The review found that NMT systems performed inconsistently when translating discharge

materials and interpreting clinical interactions, especially in low-resource languages. The authors conclude that, despite technological progress, NMT tools are not yet ready for widespread clinical use without human oversight.

Comparative studies between SMT and NMT further underscore the complexity of MT in medical contexts. Experiments using medical corpora reveal that NMT generally outperforms SMT in terms of fluency and syntactic coherence, but SMT may offer better accuracy in certain terminological domains. For example, in translating phrases such as "acute myocardial infarction," NMT systems consistently produced the correct equivalent in Spanish ("infarto agudo de miocardio"), while SMT occasionally rendered less idiomatic or fragmented translations. However, NMT systems also exhibited issues such as over-translation, under-translation, and hallucinated outputs—errors that are particularly problematic in medical communication (Rojas Plata & Castro Sánchez, 2024).

The integration of MT into medical translation workflows must therefore be approached with caution. While NMT offers promising capabilities, its deployment in high-stakes environments requires robust post-editing and quality assurance mechanisms. Moreover, the effectiveness of MT systems is contingent upon the quality and domain relevance of the training data. Specialized medical corpora, annotated datasets, and terminological databases are essential for improving MT performance in this field. Recent developments in domain-specific MT models suggest that smaller, specialized systems may outperform general-purpose models in medical translation tasks, offering greater precision and reliability (Karakus et al., 2025).

In the Romanian context, the adoption of MT technologies in medical translation remains limited. The absence of Romanian-language medical corpora, standardized terminological resources, and structured research initiatives has hindered progress. As noted by Dejica et al. (2022), medical translation is underrepresented in Romanian doctoral research, and there is a pressing need for interdisciplinary studies that bridge computational linguistics, translation theory, and medical communication. Addressing these gaps requires coordinated efforts across academia, industry, and healthcare institutions to develop localized MT solutions and integrate them into professional practice.

In conclusion, while MT technologies have made significant strides, their application in medical translation demands careful consideration of linguistic, contextual, and ethical factors. The evolution from RBMT to SMT and NMT reflects a broader trend toward data-driven translation, but the challenges of domain specificity, accuracy, and reliability persist. Future research must focus on optimizing MT systems for medical contexts, developing specialized resources, and ensuring that human expertise remains central to the translation process.

3. Post-Editing Standards and Practices in Medical Translation

Post-editing (PE) has become an indispensable component of contemporary translation workflows, particularly in domains where precision, clarity, and terminological consistency are critical. In medical translation, the stakes are exceptionally high: errors in translated texts can lead to misdiagnoses, inappropriate treatments, and legal liabilities. As machine translation (MT) technologies—especially neural machine translation (NMT)—continue to evolve, the role of post-editing in ensuring the quality and reliability of medical translations has gained increasing prominence. Recent research confirms that PE is a significant human–machine interaction process, essential for refining MT outputs and ensuring translation quality in high-stakes domains such as healthcare (Peng, Wang & Li, 2024).

The concept of post-editing has evolved alongside the development of MT systems. While early references to PE date back to the 1950s (Bar-Hillel, 1951), contemporary definitions have been formalized through international standards. The international standard ISO 18587:2017 provides a structured framework for post-editing MT output, establishing clear requirements for process quality, editor competence, and final deliverables. The standard distinguishes between two levels of post-editing: light post-editing, which aims to produce a comprehensible text without stylistic refinement, and full post-editing, which seeks to achieve a result comparable to human translation. In regulated domains such as healthcare, full post-editing is generally required, as it ensures terminological accuracy, syntactic correctness, and contextual appropriateness (ISO 18587:2017; Nitzke & Hansen-Schirra, 2021). In addition, familiarity with genre conventions of specialized texts (Dejica, 2020) may also be useful for effective post-editing.

Recent industry applications of ISO 18587 in medical translation have demonstrated its value in balancing technological efficiency with human oversight. For example, medical language service providers have adopted workflows that begin with a pre-assessment of the source text's suitability for MT, followed by machine translation using domain-specific translation memories and glossaries. Post-editors then apply either light or full post-editing, depending on the client's requirements, and conduct final verification to ensure compliance with ISO standards. This structured approach not only improves translation quality but also reduces turnaround time and cost, making it a viable solution for high-volume medical content (Medical Language Service, 2025; Translation Standards, 2024).

However, the implementation of ISO 18587 is not without challenges. As highlighted by Laghari (2025), many organizations underestimate the complexity of post-editing, assuming that light post-editing is sufficient for all contexts. This misconception can lead to quality issues, especially in medical translation, where even minor inaccuracies can have serious consequences.

Moreover, the lack of qualified post-editors—professionals with both linguistic expertise and domain-specific knowledge—remains a barrier to effective implementation. Training programs must therefore focus on developing competencies in medical terminology, translation technologies, and quality assurance procedures.

The cognitive effort involved in post-editing medical texts has also been the subject of recent empirical studies. Deng and Fan (2025) conducted a comparative analysis of post-editing efficiency using Google Translate and DeepL, focusing on medical and legal texts. Their findings revealed that DeepL consistently outperformed Google Translate in terms of fluency and contextual accuracy, resulting in shorter editing times and fewer syntactic errors. However, both systems required substantial human intervention to correct terminological inconsistencies and ensure semantic fidelity. The study underscores the importance of selecting appropriate MT tools and tailoring post-editing workflows to the specific demands of medical translation.

In addition to ISO 18587, other frameworks such as the TAUS Dynamic Quality Framework (DQF) and the Multidimensional Quality Metrics (MQM) have contributed to the standardization of post-editing practices. The TAUS DQF, developed and maintained by the Translation Automation User Society, provides a comprehensive set of tools and metrics for evaluating translation quality across workflows, and is widely adopted in the language industry (TAUS, n.d.). Similarly, MQM offers a flexible, hierarchical error typology and customizable evaluation criteria, supporting nuanced assessments of MT output and facilitating quality control and translator training (MQM Council, n.d.; Lommel, Burchardt & Uszkoreit, 2014). While neither framework is specific to medical translation, their integration into post-editing workflows can enhance quality control and facilitate translator training.

In the Romanian context, the adoption of post-editing standards remains limited. As noted in previous sections, the absence of structured training programs, domain-specific resources, and institutional support has hindered the development of consistent post-editing practices. Romanian translation studies must therefore prioritize the integration of ISO 18587 and related frameworks into academic curricula and professional certification schemes. This includes the creation of Romanian-language medical corpora, the development of terminological databases, and the establishment of collaborative networks between universities, healthcare institutions, and language service providers.

Ultimately, post-editing in medical translation is not merely a technical task but a complex cognitive and ethical process. It requires a deep understanding of both source and target languages, familiarity with medical discourse, and the ability to critically evaluate machine-generated content. As

MT technologies continue to evolve, the role of the post-editor will become increasingly central to ensuring the quality, safety, and usability of medical translations. By aligning with international standards and investing in translator education, Romanian translation studies can contribute meaningfully to this global endeavor.

4. Translation Quality Assessment Models: Comparative Perspectives

Translation Quality Assessment (TQA) remains a central concern in both academic and professional translation contexts, particularly in specialized domains such as medical translation. The complexity of medical discourse, the ethical implications of translation errors, and the increasing reliance on machine translation (MT) systems necessitate robust and adaptable frameworks for evaluating translation quality. Over the past decades, a variety of models have been proposed, each reflecting different theoretical orientations, methodological priorities, and practical applications. This section offers a comparative analysis of key TQA models and discusses their relevance to medical translation and post-editing workflows.

One of the earliest and most influential models is Juliane House's functional-pragmatic approach, which emphasizes the preservation of meaning across semantic, pragmatic, and textual dimensions. House's model is grounded in systemic-functional linguistics and distinguishes between overt and covert errors, offering a structured method for comparing source and target texts based on register variables (field, tenor, mode) and genre conventions (House, 1997; House, 2014). While comprehensive, the model is often considered too elaborate for routine professional use, particularly in time-sensitive environments such as medical translation. Nevertheless, its emphasis on communicative function and textual equivalence remains valuable for evaluating translations in contexts where accuracy and appropriateness are paramount.

Christopher Waddington's model provides a more operational alternative, particularly suited to educational settings. It includes four methods: Method A focuses on error analysis with weighted penalties; Method B introduces a severity-based scoring system; Method C adopts a holistic scale; and Method D combines quantitative and qualitative elements. Waddington's framework has been widely used in translation training, allowing instructors to provide structured feedback and students to develop awareness of translation strategies (Manipuspika, 2021). In medical translation, where terminological precision and syntactic clarity are essential, Waddington's model can be adapted to prioritize domain-specific error categories and functional adequacy.

The American Translators Association (ATA) framework, originally developed for certification purposes, has also been adapted for pedagogical

and professional use. It categorizes errors into two broad domains: target language mechanics and meaning transfer. The framework includes a flowchart for error weighting and a matrix for scoring, ensuring consistency and transparency in evaluation. Its pragmatic orientation and alignment with industry standards make it particularly suitable for high-stakes domains such as healthcare, where translation errors can have serious consequences (Rivera-Trigueros, 2022).

More recently, the Multidimensional Quality Metrics (MQM) and the Dynamic Quality Framework (DQF) have emerged as comprehensive and customizable models for translation quality assessment. Developed through EU-funded projects and industry collaborations, MQM and DQF offer hierarchical error typologies that cover dimensions such as accuracy, fluency, terminology, style, locale conventions, and audience appropriateness. These frameworks allow for fine-grained error annotation and can be tailored to specific domains and workflows. In medical translation, MQM and DQF have been used to evaluate MT output and post-edited texts, providing insights into error patterns and informing quality assurance protocols (Lommel, 2018; Zhu, 2023).

Despite their strengths, these models face challenges in terms of standardization, interoperability, and practical implementation. As noted by Zhu (2023), many existing TQA models suffer from limited applicability, underutilization of technology, and excessive theoretical abstraction. To address these issues, recent research advocates for the integration of artificial intelligence and machine learning technologies into TQA workflows, enabling automated error detection, predictive analytics, and adaptive evaluation criteria. Such innovations hold promise for enhancing the accuracy and efficiency of translation quality assessment, particularly in domains like medicine, where large volumes of content must be processed under strict regulatory constraints.

In the Romanian context, the adoption of TQA models remains fragmented. While some academic programs introduce basic error analysis and evaluation techniques, there is limited exposure to comprehensive frameworks such as MQM or DQF. Moreover, the lack of Romanian-language corpora and annotated datasets hampers the development of localized evaluation tools. Addressing this gap requires interdisciplinary collaboration, investment in resource development, and the integration of TQA models into translator training and professional certification schemes.

In conclusion, translation quality assessment is a multifaceted endeavor that requires a balance between theoretical rigor and practical applicability. Models such as House's, Waddington's, ATA's, MQM, and DQF offer valuable perspectives and tools for evaluating translation quality, each with its own strengths and limitations. In medical translation, where the

stakes are high and the demands are complex, the choice of TQA model must be guided by considerations of domain specificity, workflow integration, and user competence. By adopting and adapting these models to local contexts, Romanian translation studies can contribute to the global discourse on translation quality and enhance the reliability and professionalism of medical translation practices.

5. Deficit Analysis in Romanian Translation Research and Practice

The integration of post-editing and translation quality assessment into Romanian translation studies remains limited, despite the growing relevance of these practices in global academic and professional contexts. While international research has produced a wide range of models, standards, and technological solutions, Romanian scholarship has yet to develop a coherent and localized framework that addresses the specific challenges posed by machine translation (MT) and its application in specialized domains such as medical translation.

One of the most pressing issues is the underrepresentation of medical translation in doctoral research. As highlighted by Dejica, Pungă, Badea, and Vîlceanu (2022), medical translation has not received sufficient attention in Romanian academic programs, particularly at the doctoral level. This neglect has resulted in a lack of structured inquiry into the linguistic, terminological, and ethical dimensions of medical texts, as well as the absence of pedagogical models that prepare students for the complexities of translating in this field. The consequences are visible in both academic and professional settings, where translators often rely on ad hoc strategies and informal practices rather than standardized procedures.

Moreover, the adoption of MT and post-editing technologies in Romania has been uneven and largely unregulated. While some translation service providers have begun to experiment with MT tools, the lack of training, institutional support, and quality control mechanisms has limited their effectiveness. Translators are frequently left to navigate the challenges of post-editing without clear guidelines or access to domain-specific resources. This situation is exacerbated by the absence of Romanian-language corpora and terminological databases, which are essential for training MT systems and supporting post-editing workflows.

The deficit also extends to the pedagogical dimension. Romanian translation programs have yet to systematically incorporate post-editing and quality assessment into their curricula. As a result, students are often unfamiliar with the cognitive and procedural demands of post-editing, and lack exposure to the tools and standards that define professional practice in this area. The gap between academic training and industry expectations continues to widen, raising concerns about the preparedness of future

translators to engage with evolving technologies and specialized domains. In addition to translation programs, English for Medical Purposes (EMP) curricula in Romanian medical faculties remain underutilized as structured entry points for developing medical-text translation competence—particularly through genre-based tasks, terminology management, and guided MT/PE activities (Crăineanu & Dejica, 2025).

Addressing these deficits requires a coordinated effort across research, education, and professional practice. Romanian translation studies must prioritize the development of localized frameworks for post-editing and quality assessment, informed by both international standards and the specific needs of the Romanian linguistic and cultural context. This includes the creation of training modules, the development of terminological resources, and the establishment of collaborative networks between academia and industry. Only through such initiatives can Romanian translation studies respond effectively to the challenges and opportunities presented by MT and post-editing technologies.

6. Directions for Research, Teaching, and Professional Practice

The consolidation of Romanian translation studies in the medical domain necessitates not only an acknowledgment of existing limitations but also the articulation of a strategic vision responsive to the needs of academia and professional practice. This section delineates pathways for embedding post-editing and translation quality assessment more firmly within Romanian medical translation, thereby contributing to the development of Translation Studies as an interdisciplinary and practice-driven discipline.

From a research perspective, the study of post-editing and quality assessment in medical translation offers fertile ground for both theoretical inquiry and empirical investigation. The complexity of medical discourse, the ethical implications of translation errors, and the evolving nature of MT technologies demand a nuanced and context-sensitive approach. Romanian translation studies would benefit from targeted research projects that examine the cognitive processes involved in post-editing, the effectiveness of various TQA models in specialized domains, and the interaction between human and machine translation in real-world workflows. Such research should be interdisciplinary, drawing on insights from linguistics, computational linguistics, medical communication, and translation pedagogy. Moreover, as Dejica et al. (2022) argue, doctoral research in Romania must move beyond descriptive studies and embrace methodological innovation, corpus-based analysis, and technology-enhanced inquiry. The development of Romanian-language corpora, annotated datasets, and domain-specific glossaries would significantly enhance the capacity for empirical research and model testing.

In the field of education, the integration of post-editing and quality assessment into translation curricula is both necessary and urgent. Curriculum updates that reflect the realities of technical translation and post-editing are crucial for preparing future professionals (Grigoraș & Dejica, 2025). Current programs often focus on traditional translation skills, with limited attention to the technological and evaluative dimensions of contemporary practice. To address this gap, translation training should include dedicated modules on MT systems, post-editing workflows, and TQA methodologies. These modules should combine theoretical instruction with hands-on practice, allowing students to engage with real-world medical texts, perform post-editing tasks, and apply quality assessment frameworks. The use of authentic materials, collaborative projects, and reflective assignments can foster critical thinking and professional awareness. Furthermore, the inclusion of post-editing and TQA in assessment criteria would align academic evaluation with industry standards, preparing students for the demands of the professional market. As Romanian translation education evolves, it must also consider the development of micro-credentials, continuing education programs, and online resources that support lifelong learning and specialization in medical translation.

For professional practice, the adoption of post-editing and quality assessment must be supported by clear guidelines, institutional frameworks, and collaborative networks. Translators working in medical domains require access to standardized procedures, validated tools, and domain-specific resources. Professional associations, translation service providers, and academic institutions should collaborate to develop and disseminate best practices for post-editing and TQA. This includes the creation of Romanian-language style guides, terminological databases, and annotated examples of post-edited medical texts. In addition, the implementation of mentoring programs, peer review mechanisms, and quality assurance protocols can enhance the consistency and reliability of medical translations. The role of technology must also be critically examined: while MT systems offer efficiency, their outputs must be rigorously evaluated and adapted to meet the communicative and ethical standards of medical discourse. Translators should be trained not only in the use of MT tools but also in the critical assessment of their limitations and the strategic application of post-editing techniques.

These directions reflect a broader vision for the development of Translation Studies in Romania—one that is interdisciplinary, technology-aware, and responsive to the needs of society (Dejica et al., 2022; Dejica and Grigoraș, 2025; Dejica and Toma, 2025; Grigoraș and Dejica, 2025; Kovacs and Dejica, 2025; Dejica Mali and Dejica, 2025a; Mali and Dejica, 2025b; Toma and Dejica, 2023). By prioritizing research, education, and professional practice in post-editing and quality assessment, Romanian translation studies

can contribute to the global discourse on translation technologies while also addressing local challenges. The medical domain, with its high stakes and specialized demands, offers a compelling context for innovation and collaboration. Through sustained efforts across academic and professional communities, the integration of post-editing and TQA can become a cornerstone of Romanian translation competence and a model for other specialized fields.

7. Conclusion

The translation of medical texts from English into Romanian presents a set of challenges that are both linguistic and technological in nature. As machine translation systems become increasingly integrated into professional workflows, the need for effective post-editing and reliable quality assessment frameworks becomes more urgent. This article has examined the evolution of MT technologies, the standards and practices of post-editing, and the comparative strengths of various TQA models, with a particular focus on their applicability to medical translation. It has also identified significant deficits in Romanian translation research and practice, especially in the areas of doctoral inquiry, pedagogical integration, and professional standardization.

In response to these gaps, the article has proposed a set of directions for research, teaching, and professional practice that reflect the specific needs of Romanian translation studies. These include the development of interdisciplinary research projects, the integration of post-editing and TQA into academic curricula, and the establishment of collaborative frameworks that support translators working in specialized domains. The medical field, with its high stakes and terminological complexity, offers a compelling context for such innovation.

By bridging theoretical models with practical applications, this study contributes to the advancement of Translation Studies in Romania. It advocates for a more coherent and responsive approach to post-editing and quality assessment—one that aligns with international standards while remaining sensitive to local linguistic and institutional realities. The integration of these practices into Romanian academic and professional contexts is not merely a technical adjustment but a strategic imperative for ensuring the quality, reliability, and ethical integrity of medical translations.

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