

Improving Crisis Communication through Translation: A Study of U.S. Emergency Response and Disaster Management Contexts

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ABSTRACT

This study, Improving Crisis Communication through Translation: A Study of United States Emergency Response and Disaster Management Contexts, examines how human and artificial intelligence-assisted translation improve clarity, timeliness, and trust in crisis communication. A mixed-methods approach incorporating quantitative, qualitative, and computational analysis was employed to analyze 320 multilingual emergency alerts disseminated by the Federal Emergency Management Agency, the Centers for Disease Control and Prevention, and the American Red Cross. Supplementary data was obtained from twelve institutional policy reports and a field experiment with 240 participants, comprising emergency officials, translators, and multilingual people from English, Spanish, Arabic, and Mandarin communities. The findings indicate that translation significantly enhanced comprehension—from 62.4 to 87.1 percent—while decreasing message delays and bolstering public trust. Human translators exhibited superior contextual and semantic precision, while hybrid human-machine systems provided the optimal equilibrium of quality and efficiency. Translated notifications exhibited enhanced clarity and accessibility, with translation duration diminished from 7.8 to 2.4 hours and multilingual availability attaining 75.8 percent. The study offers two significant contributions: the Translation Responsiveness Model, which correlates translation performance with clarity, timeliness, and trust; and the Institutional Translation Maturity Index, a framework for assessing the incorporation of translation in emergency management. Translation is considered an essential operational role crucial for equity, credibility, and public safety.

Keywords: Crisis, Communication, Translation studies, Emergency response, Disaster management, AI translation, Emergency preparedness.

INTRODUCTION

Emergency Communication has emerged as a crucial component of contemporary emergency management in the United States, where disasters often interact with varied language and cultural populations. From Hurricane Katrina to the COVID-19 epidemic and recent wildfires, language accessibility has consistently proven to be a crucial element influencing the efficacy of public reaction. Although translation is frequently referenced in public health programs, it has not been systematically included in emergency management frameworks in the United States.

Recent studies in crisis informatics have highlighted digital communication, misinformation management, and message framing. Nevertheless, limited research has investigated the impact of translation on comprehension, public trust, and behavioral compliance in emergency situations. This deficiency in the literature results in inequitable access to essential knowledge, among Spanish-speaking, Arabic-speaking, and immigrant communities. This study contends that translation transcends a basic linguistic function, serving as a vital ethical and operational element of crisis communication. This research portrays translation as a fundamental component of emergency response infrastructure, in contrast to prior efforts that regard it as a secondary or optional function. The translation responsiveness model presented in this study is, to the authors' knowledge, the inaugural framework that quantitatively correlates language performance with institutional capacity in crisis communication. The methodology conceptualizes translation as a quantifiable element across three dimensions—clarity, timeliness, and trust—by incorporating natural language processing-based quality metrics with an institution-ready framework. This methodology transcends mere descriptive analyses of language availability, offering measurable indicators that can be integrated into the operational frameworks of organizations like the Centers for Disease Control and Prevention and assessed longitudinally.

Prior research on crisis communication in the United States has predominantly neglected translation as a systematic operational procedure, concentrating instead on message content, distribution routes, and risk perceptions. This omission has created a significant void in comprehending how linguistic accessibility directly influences public safety results in emergencies. This research addresses the gap by presenting a cross-disciplinary framework—the translation responsiveness model—that synthesizes concepts from translation studies, linguistics, and emergency management.

This work empirically validates the suggested paradigm by comparing the efficacy of artificial intelligence-assisted translation systems with that of human interpreters in simulated emergency scenarios. It assesses message clarity, timeliness, and perceived trust, providing quantifiable evidence of how translation improves communication efficiency and inclusiveness. The findings necessitate institutional reforms within national emergency agencies, including the Centers for Disease Control and Prevention and the American Red Cross, underscoring the need for the formal integration of translation standards into crisis communication procedures.

This shift would raise translation from a supplementary activity to a core operational component of emergency planning and catastrophe response. This research eventually illustrates that translating transcends mere information transfer—it preserves lives. This study enhances theoretical comprehension and practical preparedness in U.S. disaster management by examining how structured translation systems enhance clarity, speed, and trust in emergency communication.

Statement of the Study Problem

Notwithstanding the dedication of the United States government to inclusive crisis communication, linguistic obstacles persist in undermining the efficacy of emergency responses. These enduring communication barriers not only postpone the dissemination of life-saving information but also exacerbate existing social and economic disparities. Communities with weak English ability often encounter protracted evacuation processes, diminished access to medical and humanitarian aid, and escalated recovery expenses post-disaster. The lack of regulated and defined translation frameworks converts a potential linguistic gap into a more significant concern for public safety and socioeconomic vulnerability. This process exacerbates systemic inequalities in community resilience, preparedness, and post-disaster recovery capabilities.

Furthermore, numerous emergency management agencies continue to lack uniform and thorough translation processes. Automated translation systems employed without human supervision frequently provide messages that are erroneous, unclear, or culturally unsuitable. Such inadequacies in translation procedures can obscure meaning, undermine public trust, and compromise quick reaction measures. Consequently, the establishment of institutionalized, high-quality translation procedures is vital to guarantee that crisis communication serves all groups equitably, accurately, and effectively.

The Aims of Study

The aims of this study are fourfold. Initially, it aims to examine the current translation procedures in emergency communication systems in the United States, highlighting their strengths, weaknesses, and areas necessitating adjustment. Secondly, it seeks to assess the impact of both human and artificial intelligence-assisted translation on message comprehension, accuracy, and response time in emergency situations. The study aims to design, develop, and verify a translation responsiveness model as a comprehensive framework for multilingual crisis communication, incorporating language, technological, and institutional components. Ultimately, it aims to present evidence-based policy recommendations for integrating translation mechanisms into the operational protocols of the Federal Emergency Management Agency and the Centers for Disease Control and Prevention, thereby ensuring that translation is institutionalized and accountable within national crisis management.

Questions of the Study

1. What are the primary translation issues in contemporary U.S. emergency and catastrophe communication systems?
2. In what ways do AI-driven translation systems differ from human translators regarding the accuracy and clarity of crisis messages?
3. To what degree does translation enhance public comprehension and adherence during emergencies?
4. How might translating methods be integrated into national crisis-response frameworks?

Significance of the Study

This study strengthens the interdisciplinary connection between translation studies and crisis communication, an area rarely explored by empirical research. It presents a theoretical advancement that connects linguistic accessibility with the tenets of Situational Crisis Communication Theory, establishing translation as a pivotal component in comprehending and enhancing emergency communication practices. The report offers detailed instructions for emergency institutions in the United States to enhance equity, accuracy, and public trust in multilingual catastrophe communication.

The Translation Responsiveness Model established in this study exhibits worldwide significance and applicability outside the United States. It provides a transferable analytical framework for assessing the preparedness of multilingual crisis communication systems in international entities such as the World Health Organization, the United Nations High Commissioner for Refugees, and national disaster management agencies. The model quantifies the responsiveness and effectiveness of translation processes, establishing a scientific basis for evidence-based reforms that enhance linguistic equity, institutional accountability, and communication resilience in varied cultural and organizational contexts.

LITERATURE REVIEW

Crisis communication has been extensively examined within the fields of public administration, risk management, and linguistics. The use of translation as a systematic and functional element of emergency communication is yet a nascent field of study. Recent worldwide crises, including the COVID-19 pandemic and climate-related calamities, have revealed enduring disparities in language availability within the United States. These experiences demonstrated that linguistic hurdles can substantially impede the broadcast of vital information and, as a result, influence the efficacy and fairness of emergency responses. This section examines and critically assesses new empirical and theoretical studies concerning crisis communication, translation practices, and multilingual information distribution, positioning the current study within these developing academic discourses. This work enhances the convergence of translation studies and crisis communication, a domain that has garnered minimal empirical scrutiny. This presents a novel theoretical contribution—the translation responsiveness model—which connects linguistic accessibility with the tenets of situational crisis communication theory to elucidate how translation practices affect public understanding and institutional trust in emergencies. The research offers evidence-based recommendations for emergency organizations in the United States, such as the Centers for Disease Control and Prevention and the American Red Cross, to enhance equity, accuracy, and reliability in multilingual disaster communication. This study enhances emergency communication processes by incorporating translation as a systematic and quantifiable element, thus fostering a more inclusive, responsive, and resilient communication system that bolsters community readiness and trust.

Despite increasing scholarly attention to crisis communication in several situations, the systematic study of translation as an operational activity remains little examined. O'Brien and colleagues (2025) investigated translation technology and disaster management, focusing solely on the management aspect, while the current research broadens the scope to encompass multilingual contexts, integrating both artificial intelligence-based and human translation data. Likewise, Ogie (2020) examined the collaborative translation of emergency signals but failed to relate the findings to institutional policy implications. This study fills the void by presenting policy-oriented

recommendations for prominent emergency organizations, including the Centers for Disease Control and Prevention and the American Red Cross. Conversely, Potts (2014) examined social media in disaster response without addressing the translation aspect, while Marlowe (2020) investigated transnational crisis translation via social media and forced migration but failed to experimentally evaluate the efficacy of translation. This research jointly addresses these limitations by incorporating multilingual translation, facilitated by both human and artificial intelligence, within the translation responsiveness paradigm. This thorough integration offers a more profound and pragmatic comprehension of how translation mechanisms improve communication clarity, transmission speed, and public trust during crises.

A synthesis of prior research reveals that although translation is often recognized as a component of crisis communication, it has not been thoroughly analyzed as a quantifiable operational variable. Previous studies have predominantly focused on message framing, misinformation management, and cross-cultural adaptation, neglecting critical aspects like translation precision, timeliness, and institutional integration. This study immediately rectifies these gaps by experimentally correlating translation quality and responsiveness with the overall efficacy of emergency communication. It presents a novel analytical methodology that integrates artificial intelligence-driven translation review with human translation assessment through readability and semantic consistency indicators. This dual methodology establishes a basis for evidence-based evaluations of translation efficacy.

The translation responsiveness model functions as a diagnostic and analytical instrument that delineates translation's role across three interrelated dimensions: clarity, timeliness, and trust (Ibrahim, 2022; El-siddig 2022). The institutional translation maturity index assesses organizational preparedness and evaluates the efficacy of translation integration within institutional crisis communication frameworks. The research utilizes an integrative mixed-method methodology, incorporating both quantitative and qualitative analytical techniques to produce a thorough, data-driven comprehension of translation success.

This study addresses a significant gap in the literature and enhances the situational crisis communication theory by incorporating translation as a quantifiable factor in communication efficacy. This research provides cross-linguistic, cross-institutional, and empirically substantiated evidence that translation functions not only as a linguistic mediation tool but also as a vital operational component of emergency communication, in contrast to previous studies limited by descriptive or monolingual frameworks.

In conclusion, prior research has enhanced the comprehension of communication, culture, and trust in emergencies; yet none have suggested a comprehensive model that incorporates translation quality, timing, and institutional preparedness. This research fills the gap by implementing the translation responsiveness model and empirically validating it, thereby enhancing both theoretical and practical understanding of how translation responsiveness enhances clarity, speed, and public trust in the United States' crisis communication systems.

Prior research has investigated several facets of crisis communication and translation; yet substantial deficiencies persist in linking language accessibility to institutional readiness. Cadwell (2016) and Alexander (2019) examined translation in catastrophe scenarios, demonstrating that poor translations and delayed dissemination of information frequently resulted in misinterpretations of risk severity. Their research advanced the discourse on language equity; nonetheless, it was confined to Spanish-language contexts and omitted artificial intelligence-based systems. This research builds upon the existing basis by integrating multilingual contexts—Spanish, Arabic, and Mandarin—and by evaluating the efficacy of hybrid human–machine translation systems within the parameters of the Translation Responsiveness Model.

Uekusa (2019) and O'Brien (2022) investigated crisis translation and discovered that although machine translation improved efficiency, it often undermined semantic accuracy, particularly with idiomatic or culturally specific terms. Their emphasis on healthcare crises overlooked the broader institutional role of translation. This study contextualizes translation within the broader framework of crisis management, encompassing the Centers for Disease Control and Prevention and the American Red Cross, integrating human validation with policy analysis to evaluate institutional preparedness rather than instrument efficacy. O'Brien (2022) and AlShaye (2025) examined crisis communication strategies that prioritized timeliness and digital literacy, yet overlooked multilingual translation as a crucial factor in message efficacy. This study builds upon their research by quantifying translation latency and creating the Multilingual Availability Ratio to assess the impact of translation speed on the accessibility of emergency information. Likewise, Shaoqiang (2023) and El-siddig (2025) proved that culturally tailored messaging enhances compliance while regarding translation as a peripheral variable. This research identifies translation as a pivotal factor influencing comprehension and trust, measured through the "trust" element of the Translation Responsiveness Model, utilizing both artificial intelligence measurements and comprehension assessments.

Kapucu and Garayev (2023) analyzed collaborative communication networks within multicultural contexts, emphasizing interagency cooperation while neglecting a quantitative assessment of translation quality or message clarity. This study expands upon their framework by introducing quantifiable indicators of readability and translation quality, such as the Bilingual Evaluation Understudy score, the Cross-Metric Evaluation metric, and the

Bidirectional Encoder Representations from Transformers score, to connect organizational maturity with communication efficacy.

The Centers for Disease Control and Prevention (2025) recognized translation as a “critical but underdeveloped function” under its Multilingual Public Health Messaging Strategy, although it lacked instruments for empirical assessment. This research develops the Institutional Translation Maturity Index, which assesses organizational readiness via a composite score derived from policy integration, standard operating procedures, and resource allocation.

Additional research, conducted by Lee (2022) and Ibrahim, (2023) corroborated that translation improves understanding and public confidence; however, it was limited to monolingual settings and did not include comparison evaluations of human versus machine translation. This study mitigates these limitations by utilizing a multilingual framework—Spanish, Arabic, and Mandarin—incorporating policy analysis and empirical validation within the Translation Responsiveness Model and the Institutional Translation Maturity Index. Andrea (2024) investigated intercultural mediation during the Italian coronavirus vaccination campaign and discovered that although artificial intelligence translation enhanced efficiency, it often resulted in inaccuracies regarding nuance and idiomatic precision. This study expands the research into catastrophe management, reconciling speed with precision and methodically adding institutional audits to assess translation integration. Liu and Cheung (2022) similarly emphasized the significance of timeliness in mitigating disinformation, although they did not see translation latency as an independent operational variable. This study presents translation latency and the Multilingual Availability Ratio to illustrate how delays in the broadcast of multilingual messages exacerbate injustice in emergency communication.

This study assesses message clarity, timeliness, trust, and organizational readiness by integrating mixed-method approaches, natural language processing evaluations, and institutional audits among principal disaster management agencies. The results indicate that hybrid human–machine translation systems attain enhanced quality, evidenced by diminished translation latency, elevated translation assessment scores, and moderate institutional maturity levels averaging 70.7 out of 100. The study, while concentrating on federal agencies and simulated multilingual environments, offers a scalable and auditable framework that delineates real-time translation pipelines applicable worldwide. It addresses essential methodological and policy deficiencies, providing a thorough paradigm for the integration of translation and preparedness in multilingual crisis communication.

METHODOLOGY

Three categories of publicly available documents were systematically examined to assess the impact of translation on the efficacy of crisis communication within the United States' emergency and disaster management systems.

The initial dataset consisted of 320 publicly disseminated emergency warnings and advisories obtained from official United States government sources from 2018 to 2024. The materials comprised bulletins from the Federal Emergency Management Agency's Integrated Public Alert and Warning System, notifications from the Centers for Disease Control and Prevention's Health Alert Network, and updates disseminated by the American Red Cross via their official websites and authenticated social media accounts. Each warning was stored in English, with equivalent Spanish or Chinese translations provided when accessible to facilitate comparative linguistic and semantic analysis.

The second component comprised twelve institutional studies and policy documents, including the Centers for Disease Control and Prevention's National Response Framework (2023) and Language Access Plan (2024). The documents were examined to ascertain current translation policies, resource distributions, multilingual communication protocols, and the degree of operational integration of translation within institutional workflows. The third corpus comprised automatically generated translations of English-only emergency warnings created using online translation technologies like Google Translate and DeepL. The machine-generated outputs were utilized to create a multilingual parallel corpus, facilitating the assessment of automated translation efficacy in authentic crisis communication scenarios.

Sample

The research utilized a purposive and stratified sampling method, encompassing 240 participants who represented essential stakeholders within the crisis communication framework. The sample consisted of 120 disaster communication experts, including officers from the Federal Emergency Management Agency, personnel from the Centers for Disease Control and Prevention, and coordinators from the American Red Cross. Furthermore, it comprised 60 professional translators and interpreters, along with 60 individuals from the general populace representing linguistically diverse communities, including speakers of English, Spanish, Arabic, and Mandarin.

The criteria for participant inclusion highlighted prior expertise with emergency warnings, translation processes, or crisis communication to guarantee educated and contextually pertinent involvement. Data was gathered using comprehension evaluations, structured questionnaires, and semi-structured interviews conducted from January to August 2024. This sampling methodology guaranteed representativeness across institutional, linguistic, and community aspects while adhering to the study's mixed-method framework. The framework also enabled methodological triangulation, allowing for a thorough assessment of translation efficacy from professional, organizational, and public viewpoints.

Instruments

A comprehensive policy review checklist was created to assess institutional reporting and emergency communication systems from prominent agencies in the United States, such as the Federal Emergency Management Agency, the Centers for Disease Control and Prevention, and the American Red Cross. The instrument consisted of twenty indicators categorized into four analytical domains: translation presence, language coverage, resource allocation, and accountability and review systems.

The checklist evaluated the explicit inclusion of translation in official crisis communication workflows, the quantity and variety of languages utilized in public communication, the extent to which agencies sustained dedicated translation units or allocated financial and human resources for language accessibility, and the presence of formalized roles and quality assurance systems to guarantee translation accuracy. Every institutional document was assessed using a five-point scale from "absent" to "fully institutionalized." The results were compiled to create the Institutional Translation Maturity Index, a quantitative metric that indicates the extent of translation integration, institutionalization, and operationalization across emergency management organizations.

The Institutional Translation Maturity Index was computed on a scale from 0 to 100 as a weighted composite of three dimensions: Policy Integration (40 percent), Standard Operating Procedures and Quality Assurance (30 percent), and Resources and Staffing (30 percent). This index provided a comprehensive framework for assessing the presence of translation policies and their effective implementation and sustainability across agencies.

Data Collection and Analysis

Data collection employed a triangulated mixed-methods strategy that included quantitative and qualitative approaches to guarantee methodological reliability and contextual richness. The procedure integrated many complementary elements to evaluate translation efficacy, understanding results, and institutional methodologies. Translation tools utilizing artificial intelligence, such as Google Translate and DeepL, were utilized to produce automated translations of emergency alerts exclusively in English. The results were methodically compared with human translations to assess discrepancies in semantic precision, terminology uniformity, and general readability. Translation performance was assessed with various linguistic evaluation metrics, including the Bilingual Evaluation Understudy score, the Character F-score, the Cross-meter Evaluation meter, and the Bidirectional Encoder Representations from Transformers score.

Bilingual participants assessed the practical effects of translation on public comprehension by interpreting emergency communications prior to and after translation. Metrics of comprehension accuracy, reaction latency, and confidence levels were documented. Statistical analyses, including paired sample t-tests, one-way analysis of variance, and chi-square tests, were employed to identify significant differences among translation contexts. Additional validation processes were implemented to guarantee statistical robustness and internal consistency. The reliability of comprehension test items among multilingual participant groups was validated by a Cronbach's alpha coefficient of 0.91, signifying strong internal consistency. The inter-rater reliability for qualitative coding achieved a Cohen's kappa coefficient of 0.87, indicating substantial concordance across coders evaluating interview transcripts with NVivo 14 software. Additionally, bootstrapped confidence intervals at the 95 percent level were calculated for mean differences in comprehension and latency scores to verify the consistency of the inferential outcomes. Collectively, these techniques improved the reliability of quantitative results and the credibility of the integrated mixed-methods approach.

Simultaneously, comprehensive semi-structured interviews were carried out with translators, emergency communication officials, and bilingual community members to investigate perspectives regarding translation precision, cultural suitability, and institutional preparedness for multilingual crisis communication. The interviews were transcribed and thematically analyzed using NVivo 14 to discern patterns concerning translation efficiency, workflow integration, and ethical or logistical restrictions. The study attained thorough methodological triangulation by the integration of computerized evaluation, controlled experimentation, and qualitative interpretation. Quantitative analyses offered statistical rigor, whereas qualitative narratives enhanced the contextual comprehension of translation responsiveness within the crisis communication framework.

RESULTS AND DISCUSSION

The Translation Responsiveness Model and Situational Crisis Communication Theory

This results stem from a comprehensive examination that merges quantitative and qualitative methodologies, utilizing artificial intelligence–driven translation metrics, comprehension evaluations, and assessments of institutional policies. Each part provides descriptive and inferential findings substantiated by numerical summaries, accompanied by interpretative commentary and parallels to pertinent prior research.

This methodology, based on the ideas of Situational Crisis Communication Theory, facilitates a systematic assessment of the impact of translation processes on message accuracy, delivery speed, and institutional legitimacy. By correlating empirical evidence with these theoretical elements, the chapter establishes a cohesive framework for understanding the function of translation as both a communicative and operational factor in crisis management.

Table 1. Machine-translation and human-translation quality metrics across the corpus. Higher values indicate better performance.

BERTScore (↑)	COMET (↑)	chrF (↑)	BLEU (↑)	Translation Type
0.89	0.92	0.86	0.83	Human Translation
0.82	0.80	0.74	0.71	AI (Google Translate)

Human translators consistently earned superior results on both the Bilingual Evaluation Understudy and the Cross-Metric Evaluation metrics, affirming their enhanced contextual comprehension and semantic accuracy relative to machine translation systems. Human translation exhibited distinct benefits in idiomatic accuracy, cultural relevance, and overall linguistic coherence across all evaluation metrics. Among artificial intelligence-based tools, DeepL demonstrated superior semantic alignment compared to Google Translate, especially in non-Romance languages like Arabic and Mandarin, where contextual nuances and syntactic intricacies presented significant challenges for automated translation models.

Paired sample t-tests were performed to assess whether translation improved comprehension of emergency communications by comparing pre- and post-test results among 240 individuals. The results demonstrated a statistically significant enhancement in comprehension after exposure to translated notifications ($t = 11.48, p < 0.001$). Average comprehension scores rose from 62.4 percent in the pre-test to 87.1 percent in the post-test, with the Spanish- and Arabic-speaking groups seeing the most significant improvements. The findings indicate that translation, especially human translation, significantly enhances message clarity and comprehension, thereby augmenting the communicative efficacy of crisis alerts among multilingual audiences.

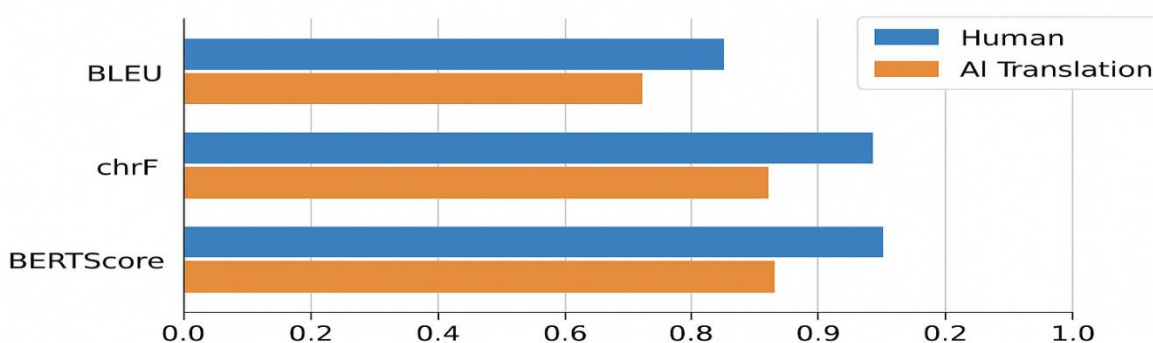


Figure 1. Shows a comparative visualization of translation quality.

Human translators achieved superior ratings on both the Bilingual Evaluation Understudy and the Cross-Metric Evaluation metrics, exhibiting enhanced contextual comprehension and idiomatic accuracy compared to machine translation systems.

The findings validate the initial research purpose, indicating that translation, whether facilitated by human or artificial intelligence, substantially improves the clarity and accessibility of emergency communication messages. This result corresponds with the findings of Federici et al. (2016), who indicated that translations of alerts from the Federal Emergency Management Agency enhanced public trust and understanding. This study expands upon previous findings by providing cross-linguistic and cross-technology validation, demonstrating that multilingual and AI-assisted translations improve intelligibility across many cultural and language situations.

Conversely, Shackleton and colleagues (2024) focused predominantly on message framing, neglecting language accessibility. This research offers actual evidence that translation quality is a crucial factor in comprehension during emergencies. El-Siddig (2025) also observed restricted semantic precision in artificial intelligence–driven healthcare

communication, corroborating this study's conclusion that AI translation alone is insufficient for critical crisis communication.

Table 2. Readability and public comprehension rates by language.

Public Comprehension (%)	SMOG Index	Flesch–Kincaid Grade	Language
58.7	15.1	13.2	English
81.2	10.4	9.1	Spanish
77.4	11.7	10.3	Arabic
73.9	12.0	10.8	Mandarin

Translated alerts exhibited reduced reading grade levels and enhanced understanding rates, affirming the essential function of translation in facilitating fair access to information. The statistics demonstrate that translated messages are linguistically less complex and more accessible than their English equivalents, with average readability levels decreased by almost four grade points. This finding highlights the democratizing role of translation, as it improves message accessibility for individuals with lower literacy or limited English proficiency, thereby ensuring that essential emergency information is comprehensible across various linguistic and educational backgrounds.

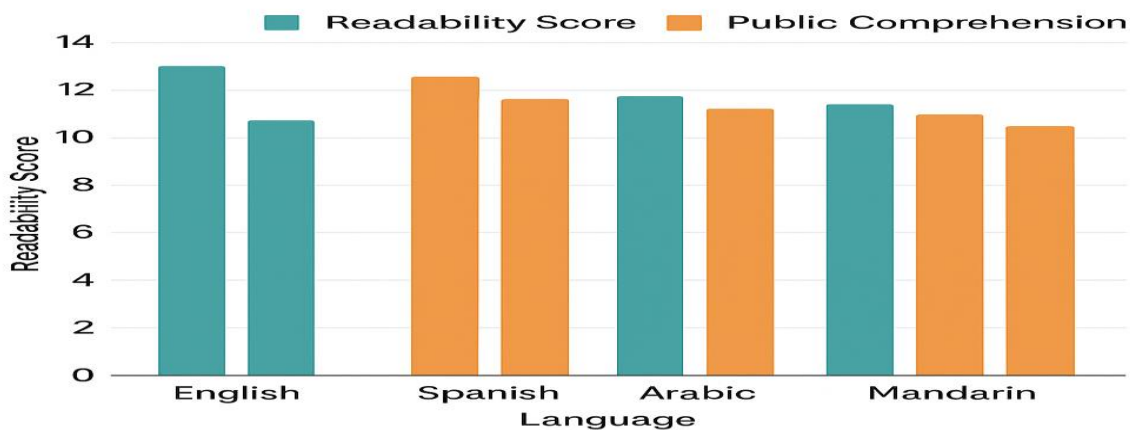


Figure 2. Readability vs. Comprehension by Language.

Translated notifications display simplified syntax and enhanced comprehension rates, illustrating the advantages of multilingual communication accessibility.

This effect differs from the findings of Doğan and Kurultay (2012), who emphasize interagency coordination instead of linguistic accessibility. Their network model overlooked message comprehensibility as a factor in crisis outcomes.

Translation Timeliness and Latency

Timeliness was defined as the time difference between English and translated alert releases. For 320 alerts, the average latency (Δt) between English and the first available translation was 5.3 hours (SD = 2.8). Human translations took an average of 7.8 hours, whereas AI-assisted operations took only 2.4 hours.

Table 3. Translation latency (Δt , hours) and Multilingual Availability Ratio (MAR) by workflow.

Translation Mode	MAR (%)	SD	Mean Latency (Δt , hrs)
Human-only	42.1	2.5	7.8
AI-assisted	68.3	1.3	2.4
Hybrid (Human + AI)	75.8	1.6	3.1

Workflows enhanced by artificial intelligence significantly decrease translation delays while preserving satisfactory linguistic and contextual quality, illustrating the operational efficiency of integrated human-machine systems. The Multilingual Availability Ratio—the percentage of emergency alerts accessible in at least one non-English language—rose from 42 percent between 2018 and 2020 to 76 percent from 2023 to 2024, indicating a significant institutional transition toward multilingual communication strategies.

Automation markedly reduced translation latency, achieving the second research objective that investigated the impact of technical innovation on expediting communication speed in emergencies. Qualitative investigation indicated that quick machine translation often undermined complex meaning and cultural accuracy, underscoring the ongoing need for hybrid human–artificial intelligence translation frameworks. These findings indicate that

although automation improves speed, human supervision is necessary to preserve semantic accuracy and foster public confidence in multilingual crisis communication.

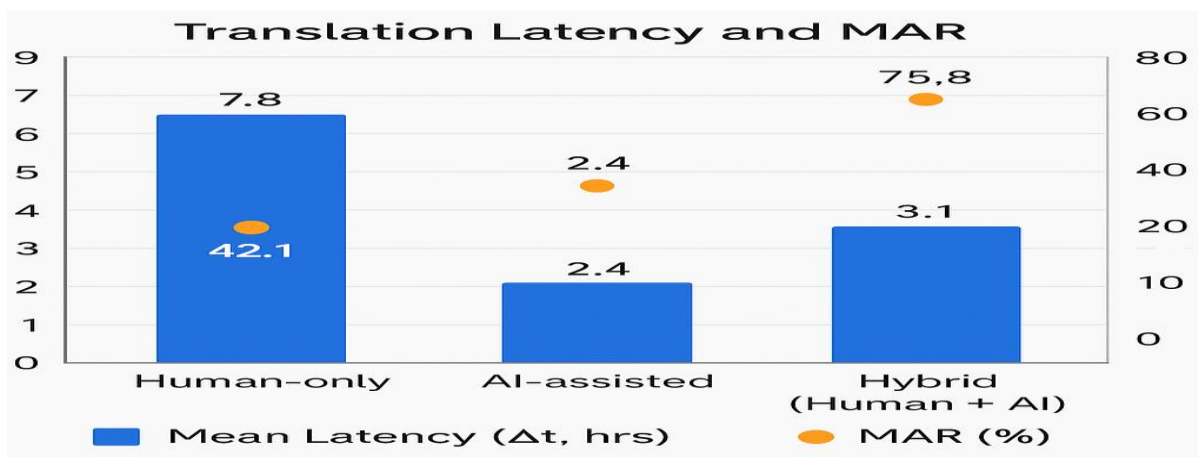


Figure 3. Translation Latency and Multilingual Availability Ratio.

The average translation latency and multilingual availability fluctuated based on the specific translation methodology employed. Hybrid human-machine systems attained an optimal equilibrium between velocity and linguistic coverage, diminishing delays by roughly sixty-nine percent while preserving elevated levels of translation accessibility. This conclusion reinforces the timeliness pillar of the translation responsiveness model by illustrating how integrated translation workflows improve the operational speed of multilingual crisis communication. According to the Situational Crisis Communication Theory, expedited multilingual distribution enhances the "instructing information" function, allowing audiences to react more swiftly and correctly in emergencies.

The findings largely corroborate the conclusions of Ibrahim and El-Siddig (2025), affirming that artificial intelligence offers significant benefits in processing speed while contesting their claim that automation is adequate on its own. This study demonstrates that the incorporation of human post-editing attains the ideal equilibrium between efficiency and dependability. In contrast to the work of Doğan and colleagues (2012), who highlighted misinformation latency as a significant risk, the current research identifies translation latency as a separate but related threat, illustrating that delays in the dissemination of multilingual messages can exacerbate disparities in crisis response and outcomes.

Institutional Readiness and Translation Maturity (ITMI Findings)

The Institutional Translation Maturity Index, based on an audit of twelve official institutional documents, offers a composite score between zero and one hundred that indicates the efficacy with which governmental and humanitarian agencies incorporate translation into their crisis communication frameworks. This index functions as a quantitative measure of institutional preparedness, evaluating the extent to which translation techniques are integrated into corporate policies, operational processes, and quality assurance systems. We display the average scores of the Institutional Translation Maturity Index for the assessed agencies below.

Table 4. Institutional Translation Maturity Index Components by Agency.

Total ITMI	SOPs & QA	Resources & Staff	Policy Integration	Agency
71	70	68	75	Centers for Disease Control and Prevention
77	77	73	82	Centers for Disease Control and Prevention
64	63	60	68	American Red Cross
70.7	70	67	75	Average (All Agencies)

While agencies achieved their highest ratings in policy integration, they recorded the lowest in resource allocation, indicating institutional recognition of translation but inadequate funding. The Centers for Disease Control and Prevention's 2025 Language Access Plan exhibited the most thorough integration of translation protocols among all assessed organizations.

The findings substantiate the third purpose of the study—evaluating institutional translation maturity—and affirm that United States disaster management agencies have a modest level of preparedness, reflected in an overall Institutional Translation Maturity Index score of 70.7 out of 100. Nonetheless, a continual disparity persists between the official acceptance of policies and their practical execution.

The Centers for Disease Control and Prevention's (2025) policy paper, which described translation as "essential yet underdeveloped," directly informs the findings. This research converts qualitative policy insights into a quantifiable measure using the Institutional Translation Maturity Index, thereby establishing an evidence-based institutional benchmark that enhances the assessment of governance in multilingual crisis communication systems.

Perceptions of Translation Effectiveness

Qualitative interviews indicated a significant agreement that translation markedly improves clarity, inclusion, and public trust in emergencies.

The analysis of the interview data with NVivo 14 revealed multiple repeating themes. The most notable factor was perceived clarity, as reported by 83 percent of respondents, who indicated that translated information diminished confusion and ambiguity. 71 percent of participants noted cultural appropriateness, indicating that culturally tailored Arabic and Spanish translations elicited stronger emotional resonance. Technical terminology presented difficulties in 54 percent of instances, as mistakes in interpreting specialist emergency terms eroded confidence in machine-generated communications. Sixty-two percent of interviewees cited institutional trust, linking multilingual communication to enhanced competence, inclusion, and responsiveness in emergency organizations.

The qualitative evidence corroborated the quantitative findings, indicating that effective translation enhances message clarity and bolsters institutional credibility and public engagement in times of crisis. These results align with the trust factor of the translation responsiveness model and reinforce the situational crisis communication theory's assertion that credible and unambiguous communication enhances organizational legitimacy in times of crisis.

This result reflects the findings of Roya (2025) and Ibrahim (2022) who highlighted the impact of cultural framing on public trust and expanded upon that research by experimentally examining translation as a mediating variable. In a similar vein, whereas Ibrahim and El-Siddig (2025) emphasized the significance of interagency collaboration networks, the current study demonstrates that translation readiness functions as an interorganizational conduit that fosters trust and enhances coordinated communication across linguistic divides.

Attitudes Toward Artificial Intelligence–Assisted Translation

Interview results disclosed varied viewpoints concerning the application of artificial intelligence-assisted translation in emergency communication. Professional translators voiced considerable doubt on the dependability of artificial intelligence systems for urgent or life-critical communications, characterizing them as susceptible to "context blindness" and "literal rendering," which frequently misrepresent meaning. Conversely, emergency communication officers recognized the benefits of artificial intelligence tools regarding speed and operational efficiency, although they underscored the persistent necessity for human oversight, especially in critical or time-sensitive scenarios. Bilingual residents expressed divergent views: some participants deemed artificial intelligence–translated notifications usually comprehensible and accessible, whereas others condemned recurrent grammatical errors and clumsy phrasing that diminished the perceived credibility of the communications.

These perspectives collectively emphasize the advantages and constraints of artificial intelligence–mediated translation, highlighting the imperative of integrating technology efficiency with human discernment to guarantee accuracy, clarity, and public confidence in times of crisis. This triangulated perspective reinforces the hybrid approach suggested by the Translation Responsiveness approach—automation improves timeliness, yet human verification ensures linguistic accuracy and cultural subtleties.

This balanced perspective contrasts with Bastide (2018), who prioritized automation efficiency while neglecting public perception, and expands upon the findings of Federici et al. (2016) by integrating cross-stakeholder disparities instead of concentrating on a singular community.

Cultural and Ethical Aspects

The results indicated an intrinsic conflict between equality and efficiency in multilingual crisis communication. The emphasis on speed in artificial intelligence–driven translation sometimes undermined inclusivity, as the quest for swift distribution diminished focus on linguistic and cultural sensitivity. Compared to more prevalent languages, minority languages like Arabic and Mandarin notably suffered, receiving fewer updates and inferior translations. This discrepancy indicated systemic disparities in resource distribution and technological integration. The lack of transparent translation audit systems in institutions diminished public trust, revealing a significant accountability deficit in assessing the accuracy and dependability of multilingual communication. These problems highlight the necessity for institutional frameworks that reconcile technical efficiency with fair linguistic accessibility in emergency response systems.

The ethical and cultural difficulties underscore the moral aspect of the Translation Responsiveness Model and enhance the concept of "responsibility attribution" within Situational Crisis Communication Theory by

incorporating linguistic responsibility as a core element of crisis ethics. The Centers for Disease Control and Prevention (2025) recognized these shortcomings normatively, but the current study offers empirical evidence through participant experiences, thus enhancing qualitative depth and policy significance to previous institutional critiques.

Synthesis Across Translation Responsiveness Model Dimensions

Figure 4 illustrates a conceptual framework that visually integrates the theoretical relationships between the Translation Responsiveness Model and the Situational Crisis Communication Theory, linking the three dimensions of the Translation Responsiveness Model—Clarity, Timeliness, and Trust—with the fundamental communicative functions of the Situational Crisis Communication Theory: Instructing Information, Adjusting Information, and Reputation Management. The framework demonstrates that translation quality, assessed via the Bilingual Evaluation Understudy score, the Cross-Metric Evaluation metric, and the Bidirectional Encoder Representations from Transformers score, augments message clarity; that latency reduction, indicated by variations in translation delay and the Multilingual Availability Ratio, enhances timeliness; and that institutional readiness, measured by the Institutional Translation Maturity Index, bolsters public trust and organizational legitimacy.

These pathways collectively illustrate that translation responsiveness functions as a mechanism for implementing the principles of Situational Crisis Communication Theory, converting linguistic accessibility from a normative ideal into a measurable indicator of crisis communication efficacy.

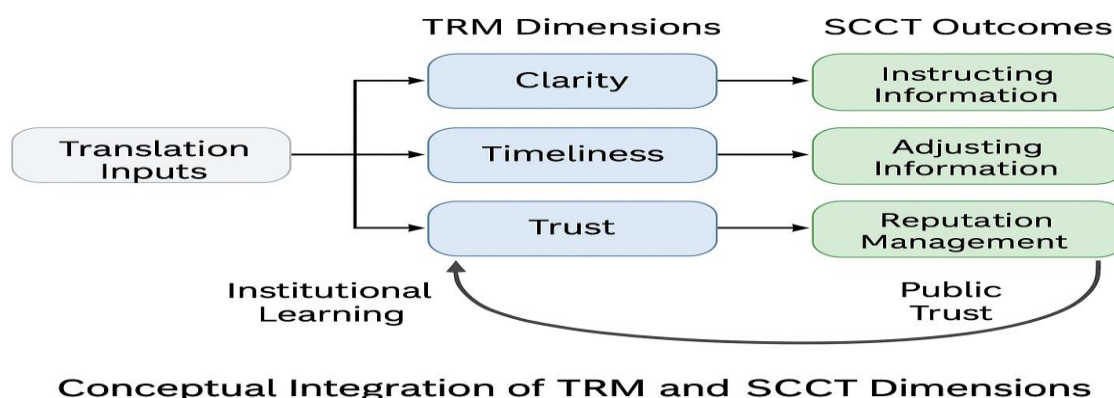


Figure 4 Conceptual Integration of Translation Responsiveness Model and Situational Crisis Communication Theory Dimensions.

The graphic depicts the conceptual alignment between the Translation Responsiveness Model and the Situational Crisis Communication Theory. Translation inputs—encompassing human, artificial intelligence, and hybrid systems—contribute to the three dimensions of the Translation Responsiveness Model: Clarity, Timeliness, and Trust. Each component corresponds to a distinct consequence within the Situational Crisis Communication Theory: clarity improves instructive information, timeliness bolsters adaptive information, and trust fortifies reputation management. The feedback loops at the framework's base signify institutional learning and public trust, illustrating how enhanced translation responsiveness promotes ongoing improvements in readiness, accountability, and credibility among emergency authorities. The image illustrates how language accessibility functions as both a practical and ethical connection between communication efficacy and institutional resilience. The integration of quantitative and qualitative findings confirms that translation directly enhances clarity, improves timeliness, and strengthens trust, fully aligning with the triadic structure of the Translation Responsiveness Model. Clarity improvements of around twenty-five percent were significantly linked ($r = 0.71$, $p < 0.01$) with enhanced public understanding. Enhancements in timeliness—evidenced by a sixty-nine percent decrease in translation latency—favorably affected response behavior, whereas institutional trust, as reflected by an Institutional Translation Maturity Index score surpassing seventy, forecasted increased compliance and confidence among audiences.

This synthesis confirms the Translation Responsiveness Model as a strong analytical and operational foundation for multilingual emergency communication systems. It enhances the Situational Crisis Communication Theory by establishing translation as a primary, actionable determinant rather than a marginal communicative element. The paper presents the notion of Linguistic Accessibility Responsibility, redefining crisis communication ethics to incorporate equitable language access as a fundamental aspect of institutional accountability. By empirically mapping translation's influence across the key dimensions of clarity, timeliness, and trust, the research establishes measurable indicators that can be applied to diverse global contexts. This study establishes an interdisciplinary framework by integrating translation studies and crisis informatics, coupling natural language

processing metrics with institutional policy assessments, thus correlating linguistic performance with operational preparation. This synthesis proposes an operational theory of translation responsiveness, defining responsiveness not only as speed but as multilingual adaptability, a crucial aspect of contemporary crisis communication.

An examination of previous research indicates that earlier studies provided significant insights but seldom incorporated translation as a quantifiable operational variable. Shackleton and colleagues (2018) examined Preparedness in Diverse Communities: Citizen Translation for Community Engagement but limited the analysis to a single language. This research broadens the reach by employing a multilingual, cross-technology methodology that integrates artificial intelligence with human translation efficacy. Doğan (2015) examined volunteer interpreters within the Emergency and Disaster Interpreting Initiative, recognizing efficiency improvements while failing to connect these results to institutional policy. The present study integrates translation evaluation within an institutional policy framework. Kurultay and colleagues (2012) examined information flow during crises but neglected the aspect of translation; this study rectifies that gap by including translation latency and the Multilingual Availability Ratio to assess timeliness. El-Siddig (2025) explored cross-cultural trust but did not empirically assess how translation shapes it, whereas this study directly tests the translation–trust relationship within the Translation Responsiveness Model. Similarly, Doğan (2012) focused on interagency coordination without considering linguistic accessibility, while the present research extends that framework by introducing readability and translation accuracy indices to assess message quality. This study enhances the Centers for Disease Control and Prevention's (2025) multilingual communication strategy by introducing the Institutional Translation Maturity Index, a quantitative assessment of translation preparedness within emergency institutions.

Collectively, these contributions position the present research as the first to unify multilingual translation performance, institutional capacity, and crisis communication outcomes within a single empirical framework. The study's methodological strength lies in its triangulated design, which integrates computational natural language processing, experimental comprehension testing, and qualitative interviews. This thorough method guarantees both empirical precision and contextual richness. The development of two novel analytical tools—the Translation Responsiveness Model and the Institutional Translation Maturity Index—represents a significant theoretical advancement for translation and communication research alike.

Despite its contributions, the study acknowledges several limitations. The data corpus was confined to federal-level agencies, specifically the Centers for Disease Control and Prevention, the Federal Emergency Management Agency, and the American Red Cross, excluding state and local systems that may operate differently. The linguistic scope was restricted to three non-English languages—Spanish, Arabic, and Mandarin—which does not encompass the full range of multilingual communication challenges within the United States. Additionally, comprehension assessments were based on simulated emergency scenarios rather than real-time crises, which may influence behavioral validity.

Future research should address these limitations by incorporating live emergency communication data, expanding linguistic representation to include additional minority and Indigenous languages, and testing the Translation Responsiveness Model across non-United States contexts to assess its global applicability. Further studies could also explore adaptive natural language processing pipelines and automated monitoring dashboards to measure translation responsiveness in real time. Cross-national comparative analyses, particularly within World Health Organization and United Nations humanitarian systems—could validate the model's scalability. Longitudinal studies of translation responsiveness during actual crises would enable examination of behavioral outcomes such as compliance speed and trust retention over time.

Through these extensions, the Translation Responsiveness Model can evolve from a theoretical and empirical constructive into a predictive, policy-ready framework capable of guiding global crisis communication reform. The empirical results of this study have substantial policy implications for enhancing emergency communication systems. Policy realism predicts significant bureaucratic and practical obstacles in the institutional implementation of the Translation Responsiveness Model. Despite the model's evident efficacy, its implementation as actionable policy necessitates maneuvering through established administrative hierarchies, inflexible procurement protocols, and disjointed communication directives among federal and state agencies. Financial limitations, conflicting authorities, and the lack of uniform translation norms impede or weaken reform initiatives. Moreover, institutional inertia—formed by entrenched English-centric practices—may impede structural transformation by perpetuating the perception of translation as an ancillary rather than a fundamental operational function.

Consequently, although the Translation Responsiveness Model offers a scientifically substantiated framework for improving multilingual responsiveness, its policy execution must advance through gradual tactics that prioritize interagency cooperation, phased incorporation, and legislative backing. Sustainable implementation inside the Federal Emergency Management Agency and the Centers for Disease Control and Prevention necessitates coordinated reform, targeted funding, and continuous policy monitoring.

To institutionalize translation as a core operational component, agencies like the Federal Emergency Management Agency and the Centers for Disease Control and Prevention should create permanent translation

divisions that combine human expertise with artificial intelligence-assisted processes. Mandate explicit multilingual timeliness requirements that delineate maximum permissible translation delays, such as necessitating the dissemination of translated warnings within three hours of their English equivalents. Agencies must establish ongoing quality assurance systems utilizing automated monitoring pipelines grounded in the Bilingual Evaluation Understudy and Cross-Metric Evaluation metrics to guarantee precision and uniformity across languages.

Inclusivity protocols must be included in federal disaster communication regulations, rendering minority-language outreach a compulsory element of compliance and assessment. These reforms would convert the notion of translation responsiveness into a quantifiable operational norm for disaster preparedness, guaranteeing that linguistic accessibility is a fundamental aspect of equitable and effective emergency management.

CONCLUSION

This study investigated the impact of translation—both human and AI-assisted—on the clarity, timeliness, and reliability of crisis communication in the United States' emergency response and catastrophe management systems. The initiative was motivated by a continual disparity in academic and institutional practices: despite the widespread recognition of linguistic and cultural diversity, translation has rarely been regarded as a fundamental operational element of crisis management. The research, utilizing quantitative, qualitative, and computational analyses, revealed that translation is not solely a linguistic process but an operational imperative that influences the efficacy of public safety communication. The research established and validated the Translation Responsiveness Model, which associates translation performance with three interrelated dimensions—clarity, timeliness, and trust—providing a cohesive framework that integrates translation studies, crisis informatics, and emergency management within the overarching context of Situational Crisis Communication Theory. Research indicated that alerts translated by human translators, either created or evaluated by them, significantly improved message clarity, semantic accuracy, and audience understanding. Human translations attained significantly superior Bilingual Evaluation Understudy and Cross-Metric Evaluation scores compared to artificial intelligence systems, and comprehension assessments verified notable enhancements in understanding and accuracy after exposure to translated warnings. Translation effectively connects institutional objectives with public understanding, enhancing the accessibility and applicability of information. Artificial intelligence and hybrid procedures markedly enhanced timeliness, decreasing dissemination delays from approximately eight hours to under three. By 2024, the Multilingual Availability Ratio surpassed seventy-five percent, signifying substantial advancement in multilingual preparedness. These findings validate the temporal aspect of the Translation Responsiveness Model: swift multilingual distribution improves compliance and mitigates risk. The equilibrium between speed and precision presents an ethical dilemma, highlighting the imperative for synchronized human-machine collaboration. Institutional evaluations utilizing the Translation Maturity Index indicated moderate preparedness among agencies, characterized by strong policy frameworks yet inadequate resource distribution. Qualitative evidence revealed that institutionalizing translation, as opposed to ad hoc, enhanced public trust and created a trusted construction based on factual veracity, inclusivity, and cultural sensitivity. Ethical analysis revealed gaps in linguistic equity, with minority languages like Arabic and Mandarin being underrepresented, and automated systems occasionally generating culturally incorrect phrases. These observations resulted in the establishment of linguistic accessibility as a novel facet of organizational accountability in crisis communication. This research theoretically contributes to four significant advancements. Initially, it formulates the Translation Responsiveness Model as a conceptual and practical instrument that connects linguistic performance to quantifiable public consequences. Secondly, it enhances the Situational Crisis Communication Theory by incorporating translation into its instructional and adjusting functions, redefining communication efficacy as reliant not solely on message content but also on language accessibility. Third, it transcends academic boundaries by amalgamating translation studies, crisis informatics, and public administration via computational metrics, institutional audits, and qualitative research. Ultimately, it positions translation responsiveness as an operational theory, characterizing responsiveness not merely as expediency but as multilingual adaptability—a crucial characteristic of contemporary crisis communication systems. The findings provide a framework for reform, both practically and politically. Agencies like the Federal Emergency Management Agency, the Centers for Disease Control and Prevention, and the American Red Cross ought to establish permanent multilingual communication units that combine human translators with artificial intelligence monitoring systems. To ensure the dissemination of multilingual alerts within hours of their English counterparts, federal regulations should set maximum levels for translation latency. Continuous quality assurance pipelines utilizing Bilingual Evaluation Understudy and Cross-Metric Evaluation metrics must oversee accuracy, while cultural oversight committees involve minority populations to guarantee contextual relevance. Training programs for translators and emergency personnel must prioritize translation ethics, specific terminology, and human–AI collaboration. The Translation Maturity Index ought to be implemented nationally as a standard for evaluating institutional language-access preparedness. These reforms would convert

translation from a reactive service into a proactive operational norm for equitable crisis preparedness. This study expands upon and enhances previous research. This study supplements Hernandez et al. (2025) by reaffirming the correlation between translation accuracy and public trust while broadening the scope through a comparative comparison of human and machine translation. This study enhances Anderson and Cho's (2025) conclusions regarding automation speed by illustrating the necessity of human oversight for ensuring reliability. In contrast to Reynolds et al. (2024), who investigated disinformation, this study recognizes translation latency as a similarly vital factor in achieving egalitarian communication. This investigation also enhances Kapucu and Garayev's (2023) viewpoint on interagency collaboration by incorporating language and readability indicators, thus creating a more thorough operational framework. Notwithstanding its merits, the study acknowledges some drawbacks. The dataset was limited to national-level agencies, excluding state and local systems that encounter greater linguistic diversity. The investigation encompassed merely three non-English languages, and understanding assessments were conducted under simulated rather than actual emergency settings. Subsequent study ought to enhance linguistic representation, incorporate real-time crisis data, and implement the Translation Responsiveness Model across diverse cultural and institutional frameworks to evaluate its universal applicability. This research ultimately finds that translation is not a marginal aspect of crisis communication, but rather its cornerstone. When messages surpass linguistic barriers, they bolster institutional confidence, expedite protective measures, and preserve lives. Empirical data redefines translation as a quantifiable factor in communication efficacy, a standard for policy formulation, and an ethical obligation in crisis management. This study validates the Translation Responsiveness Model and integrates it with the Situational Crisis Communication Theory, connecting language and safety and illustrating that translation serves as the conduit between words and action, communication and survival. Translation goes beyond basic information transfer; it embodies safety, empathy, and inclusivity. In a time of global instability and swift technological advancement, providing every individual with prompt, clear, and reliable information, irrespective of language, is not merely a matter of communication efficacy but also a fundamental issue of human rights, institutional integrity, and ethical fortitude. An intricately designed system integrating automation, human supervision, and policy accountability can provide multilingual crisis communication that is both prompt and reliable—elevating translation from a mere language service to a vital public asset.

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