AI AND ACCESSIBILITY ADVANCES IN 112 EMERGENCY CALL MANAGEMENT

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Abstract. *This article explores the role of artificial intelligence (AI) in enhancing accessibility for persons with disabilities within Europe's 112 emergency communication systems. Despite regulatory and ethical commitments to inclusion, individuals with hearing, speech, cognitive, and mobility impairments continue to encounter significant barriers when attempting to request emergency assistance. These barriers range from non-adaptive voice-based systems to high-stress environments that limit effective communication. This research responds to a critical gap between inclusive design principles and their real-world implementation in emergency services. Using the SALSA methodology (Search, Appraisal, Synthesis, Analysis), this study systematically reviews literature, EU policy documents, and pilot initiatives conducted between 2020 and 2025. It categorizes findings into key domains where AI shows significant impact: real-time transcription, emotion detection, chatbot support, and multimodal interfaces. Case studies such as the ODIN 112 project in Romania and the EENA–Corti cardiac arrest detection pilot is analysed alongside conceptual and ethical frameworks from EU bodies. The results suggest that while AI technologies hold transformative potential—offering personalized, scalable, and context-sensitive support—many tools remain in pilot phases and face limitations related to linguistic coverage, stress-induced error, data privacy, and ethical oversight. The research highlights the importance of inclusive, co-designed systems and calls for cross-sector collaboration to scale AI solutions ethically and effectively. This article contributes to the evolving discourse on accessible public service delivery by bridging theoretical models with empirical evidence, offering insights into how AI can support more humane and equitable emergency response systems across Europe.*

Keywords: *Artificial Intelligence in Emergency Services, Accessibility Technologies, Disability-Inclusive Communication, Human-Centered AI Design, SALSA Method*

JEL: O33, I18, H83

Introduction

In emergencies, every second counts. Yet for individuals with disabilities, those seconds are often lost to invisible barriers—barriers not of their own making but embedded in the design of systems that were never built with them in mind. Imagine a deaf caller attempting to request help from a voice-only emergency line, or a person with a cognitive impairment trying to explain their crisis under extreme stress. These are not isolated cases. They are the lived reality for thousands of people across Europe who find themselves marginalized by communication systems meant to protect them. Accessible emergency services, therefore, are not merely technical enhancements—they are expressions of equity, dignity, and justice.

Despite decades of advocacy, Europe's 112 emergency systems remain, in many ways, inaccessible

to people with hearing, speech, cognitive, or mobility impairments (Deetjen-Ruiz et al., 2024). Communication gaps persist, often exacerbated by rigid protocols and one-size-fits-all interaction models that ignore functional diversity. Although universal design has long been a guiding principle (Dattilo, 2021), its operationalization within emergency call centers remains inconsistent, fragmented, and in many contexts, absent altogether.

Recent advances in artificial intelligence (AI) offer a new avenue of hope. Technologies such as real-time speech-to-text transcription (Luo et al., 2025), emotion recognition (Visave, 2025), and chatbot-mediated interactions (Sezgin et al., 2024) are beginning to demonstrate significant promise in enhancing accessibility. A conceptual model for disability inclusion through AI outlines how these tools can improve access across healthcare, mobility, and communication domains (Almfareh et al., 2024). Building on these conceptual foundations, Bokor et al. (2024) analyse the evolution of Romania's 112 emergency system, demonstrating how AI, wearables, and location-based services like AML and eCall can significantly improve response times, coordination, and classification accuracy.

However, innovation alone is not enough. Many current approaches remain technocentric—focused more on what AI can do than on what people need. As Newman-Griffis et al. (2023) rightly argue, any attempt to automate accessibility must begin with the communities most affected. Similarly, ethical guidance from the European Platform for Rehabilitation (2024) urges that AI be co-designed with, not just for, persons with disabilities. Legal and operational safeguards—outlined in frameworks by the European Commission (2019)—stress that AI must be transparent, inclusive, and data-secure.

Real-world pilots such as the ODIN 112 initiative in Romania and the EENA–Corti study on cardiac arrest detection confirm that AI can meaningfully augment human judgment in emergency contexts (Ungureanu et al., 2023; EENA and Corti, 2020). Still, many of these innovations remain confined to pilot stages, hindered by underfunding, linguistic gaps, and limited adaptability under stress.

This study investigates how AI has enhanced accessibility in 112 emergency call systems across Europe from 2020 to 2025. Using the SALSA methodology (Search, Appraisal, Synthesis, Analysis) (Booth et al., 2012), we review academic literature, EU policy documents, and applied pilot programs. Our aim is to bridge the gap between theory and practical deployment, offering evidence-based insights into how AI can ethically and effectively transform emergency communication for all.

This study aims to bridge the gap between theoretical frameworks for accessible emergency communication and the practical realities of AI deployment in European 112 systems. To guide this inquiry, we pose the following research question:

How has artificial intelligence contributed to enhancing accessibility in Europe's 112 emergency call systems for persons with disabilities between 2020 and 2025?

To explore this, we advance two hypotheses:

H1: AI implementation in 112 systems significantly reduces accessibility barriers for disabled users.

H2: Most AI tools used in pilot programs are not yet ethically or operationally scalable across national emergency infrastructures.

By applying the SALSA methodology (Search, Appraisal, Synthesis, Analysis), we aim to provide a nuanced, evidence-based understanding of the role AI plays in building a more inclusive emergency response landscape.

Methodology

This study employs the SALSA framework—an acronym for Search, Appraisal, Synthesis, and Analysis—as a structured method for conducting systematic reviews in the social sciences and interdisciplinary fields (Booth et al., 2012). This approach is particularly well-suited to synthesizing evidence from both academic and policy sources, enabling a comprehensive evaluation of how artificial intelligence (AI) technologies have been applied to enhance accessibility within Europe's 112 emergency communication systems for persons with disabilities.

The Search phase began with a broad and systematic retrieval of literature from multiple platforms. Academic databases such as Scite AI, Google Scholar, and ResearchGate were used in combination

with institutional repositories from the European Commission, the European Emergency Number Association (EENA), the European Parliament, and national emergency services. The inclusion timeframe was limited to documents and publications released between 2020 and 2025 to ensure the analysis reflects the most recent advancements in AI implementation. Search terms were carefully selected to capture a range of relevant topics and included: *"AI emergency calls," "112 accessibility," "disability and emergency communication," "inclusive emergency services," "chatbots and disability,"* and *"emotion detection in emergency response."*

In the Appraisal phase, identified sources were screened and evaluated based on predetermined inclusion and exclusion criteria. To be included, sources needed to demonstrate a clear focus on AI applications designed to improve communication accessibility for persons with disabilities in the context of emergency response. Studies that focused on general AI innovations without an accessibility dimension, or publications prior to 2020, were excluded. Each selected document was critically assessed for methodological soundness, policy alignment with EU accessibility strategies, and clarity of outcomes.

The Synthesis phase involved grouping the selected sources into thematic categories. These included conceptual frameworks for inclusive AI design, real-world pilot projects (e.g., ODIN 112, Gladia transcription), ethical evaluations, and digital policy integration. This categorization allowed for clearer comparison of theoretical models and applied technologies. Representative examples include EENA's 2024 accessibility report, which outlines AI-supported enhancements in emergency call centers, and Romania's ODIN 112 pilot, which tested real-time emotion recognition and multimodal interfaces (European Emergency Number Association, 2024; Bokor et al., 2025).

Finally, the Analysis phase placed these findings in the broader context of European accessibility legislation and strategy. Policy documents such as the *Union of Equality Strategy 2021–2030* and European Parliament briefings were used to assess whether the technological innovations were not only functional but also aligned with ethical standards and legal mandates (European Commission, 2021; European Parliament, 2024). This phase also identified gaps between pilot-stage innovations and their scalability or sustainability within national emergency infrastructures.

Together, these four phases provided a rigorous, transparent, and policy-relevant assessment of how AI is being deployed—and in some cases, underutilized—to support equitable access to emergency services for all.

Findings and Discussion

Between 2020 and 2025, a range of AI pilot projects demonstrated meaningful progress toward enhancing accessibility in emergency call systems across Europe. These innovations targeted the most persistent communication barriers experienced by individuals with hearing, speech, and cognitive disabilities, offering both technical solutions and conceptual shifts in emergency response design.

One breakthrough involved real-time speech-to-text transcription tools, such as Gladia and NatalíA, which enabled immediate conversion of spoken dialogue into text, supporting deaf and hard-of-hearing callers (European Emergency Number Association, 2024). These systems performed with high accuracy under optimal conditions. However, their reliability dropped in high-stress scenarios involving background noise, strong emotions, or regional accents—elements that are typical during actual emergencies (Bahrami and Rubulotta, 2025). This discrepancy between lab-based performance and field conditions highlights the need for robust, adaptable AI training that reflects real-world variability.

Another significant innovation was the integration of emotion recognition technologies, notably through the ODIN 112 project. These systems analysed vocal tone and intensity to detect signs of distress and urgency in callers (Ungureanu et al., 2023; Bokor et al., 2025). When functioning correctly, emotion AI enhanced dispatcher awareness and supported better prioritization. However, research from Haque et al. (2024) found that voice modulation caused by extreme stress could trigger false positives or lead to missed cues. Cultural and linguistic diversity further complicates emotion

detection accuracy, especially when AI models are trained on narrow datasets.
Low-bandwidth and structured text-based solutions also emerged as crucial tools. The ODIN 112 chatbot, for example, allowed users with speech impairments to interact through accessible menu-based messaging—even under poor network conditions (Sezgin et al., 2024). Meanwhile, systems like NOTITIA provided structured dialogue templates to assist call-takers in communicating effectively with cognitively impaired individuals (European Emergency Number Association, 2024). Although both tools improved clarity and consistency, they lacked embedded medical or contextual reasoning. This limitation reduced their adaptability in unpredictable or medically complex situations.
Across all pilots, three recurring challenges were identified. First, many AI tools remained confined to pilot phases without a roadmap for national deployment or legal integration. Second, technical and regulatory limitations—including stress-induced voice variability, low multilingual support, and GDPR compliance issues—slowed down scalability (Visave, 2025; Schmager et al., 2024). Third, and most critically, there remains limited inclusion of end-users—specifically persons with disabilities—in the design and training of AI models (Newman-Griffis et al., 2023). Without participatory feedback loops, the risk persists that AI tools will reinforce existing inequities rather than resolve them.
Despite these challenges, the pilots revealed that AI holds transformative potential to personalize emergency communication, reduce misinterpretation, and increase user autonomy during crisis calls. The technologies are not yet universally deployable—but they are undeniably promising. As summarized in Table 1, each project brought forward tangible advancements alongside identifiable constraints. This discussion underscores that successful implementation will require not only technological sophistication but also inclusive co-design, cross-sector coordination, and sustained policy alignment. Without these, even the most innovative tools risk remaining underutilized.

Table 1 AI accessibility contributions and their limitations.

AI Tool	Accessibility Feature	Main Limitation
Gladia	Real-time transcription	Limited offline functionality
ODIN 112	Emotion detection	Early-stage accuracy issues
NOTITIA	Structured call support	Beta, lacks medical expertise
Corti AI	Cardiac arrest detection	Data dependency, GDPR complexity

Source: Authors' elaboration based on the reviewed projects

This systematic review confirms that while artificial intelligence offers considerable potential to improve accessibility in 112 emergency communication systems, its widespread and equitable deployment remains incomplete. Technological innovations such as transcription tools, emotion detection, and chatbot interfaces have demonstrated effectiveness in pilot settings; however, persistent gaps in inclusivity, scalability, and ethical design continue to limit their real-world impact. Bridging these gaps will require not only further applied research, but also robust policy frameworks, inclusive co-design practices, and sustained collaboration between AI developers, emergency service institutions, and disability advocacy organizations.

Conclusion

This systematic review provides robust support for Hypothesis 2 and partial confirmation of Hypothesis 1. Between 2020 and 2025, a range of AI technologies demonstrated clear potential to improve accessibility within 112 emergency call centers across Europe, particularly in aiding individuals with hearing, speech, and cognitive disabilities (Alnfiai et al., 2025). Innovations such as speech-to-text transcription tools, emotion recognition systems, structured chatbot interfaces, and co-pilot support modules represent important advances toward more inclusive, responsive emergency communication systems.
However, significant limitations remain. Many of the AI solutions examined in this review are still at the pilot stage and have not been scaled nationally. Technical barriers—such as stress-induced

speech variability, multilingual complexity, and limited offline or low-bandwidth functionality—continue to affect usability in real-world crisis conditions (Bahrami and Rubulotta, 2025; Haque et al., 2024). In parallel, ethical and legal considerations, particularly those related to GDPR compliance and algorithmic transparency, have slowed full implementation (European Commission, 2019).

The most concerning limitation is the insufficient involvement of persons with disabilities in the development, testing, and training phases of AI systems. This exclusion results in tools that may be technically advanced but fail to meet the actual communication needs of their intended users (Newman-Griffis et al., 2023). The diversity and complexity of disabilities further emphasize the need for adaptive, user-centered design approaches capable of responding to varied communication profiles and contexts.

Looking forward, future research should prioritize inclusive design, multilingual and multicultural adaptability, and strong ethical frameworks that ensure transparency, accountability, and user agency. Longitudinal pilot studies, broader pan-European collaborations, and iterative design processes will be crucial in validating and refining AI-supported accessibility tools.

Finally, genuine progress will depend on sustained cross-sector collaboration—between AI developers, emergency service providers, disability rights advocates, policymakers, and end-users. Only through shared responsibility and inclusive innovation can AI-enhanced 112 systems evolve from promising prototypes into universal lifelines accessible to all.

Affiliation

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