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PROSPECTS FOR THE USE OF ARTIFICIAL INTELLIGENCE AND DIGITAL TECHNOLOGIES IN OTORHINOLARYNGOLOGY

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Annotation. The rapid development of artificial intelligence (AI) and digital technologies is creating new opportunities for improving the diagnosis, treatment, monitoring, and prevention of otorhinolaryngological diseases. AI-based systems can support physicians in the interpretation of medical images, audiological data, endoscopic examinations, and clinical information, while digital platforms facilitate remote consultations, continuous patient monitoring, and personalized treatment planning. The integration of machine learning, computer vision, telemedicine, electronic health records, and digital decision-support systems may increase diagnostic accuracy, reduce the time required for clinical assessment, and improve the accessibility and quality of otorhinolaryngological care. This article examines the current prospects for applying AI and digital technologies in otorhinolaryngology, with particular attention to early diagnosis, personalized medicine, clinical decision support, and telemedicine. The effective implementation of these technologies requires appropriate clinical validation, data protection, interoperability, and continuous professional training. Overall, AI and digitalization represent promising directions for the modernization of otorhinolaryngological practice.

Keywords: artificial intelligence, digital technologies, otorhinolaryngology, machine learning, telemedicine, digital diagnostics, medical imaging, clinical decision support, personalized medicine, ENT diseases.

Introduction. Otorhinolaryngology is a rapidly developing field of medicine in which timely diagnosis and appropriate treatment are essential for preventing complications and improving patients' quality of life. Diseases of the ear, nose, and throat are among the most common health problems and may affect hearing, speech, breathing, balance, sleep, and overall physical and social functioning. Traditional diagnostic approaches rely largely on clinical examination, endoscopy, audiological testing, radiological imaging, and laboratory investigations. However, the increasing volume and complexity of clinical data require more efficient and accurate diagnostic and analytical approaches.

The development of artificial intelligence (AI), machine learning, computer vision, telemedicine, and other digital technologies has created new opportunities for transforming otorhinolaryngological practice. AI-based systems can analyze large amounts of medical information and identify patterns that may be difficult to recognize through conventional assessment alone. In particular, digital image analysis can assist in the interpretation of endoscopic and radiological images, while machine-learning algorithms can support the assessment of audiological parameters and prediction of disease-related outcomes.

Digital technologies also have considerable potential in remote healthcare delivery. Telemedicine platforms allow patients to receive specialist consultations without direct physical access to an otorhinolaryngologist, which is especially relevant for patients living in geographically remote areas. Electronic medical records and integrated digital platforms can facilitate the exchange of clinical information, improve continuity of care, and support long-term monitoring of patients.

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Literature review. Artificial intelligence (AI) has emerged as an important technological direction in modern otorhinolaryngology. Early studies demonstrated that machine learning, deep learning, computer vision, and natural language processing could potentially support diagnosis, prognosis, clinical decision-making, and workflow optimization in ENT practice. Bur et al. emphasized that AI could enhance the diagnostic capabilities of otolaryngologists, particularly through automated analysis of complex clinical and imaging data. At the same time, they noted that successful implementation requires high-quality datasets, appropriate validation, and collaboration between clinicians and technology specialists [1]. The application of AI in otology has developed rapidly. You et al. described numerous applications of artificial intelligence in hearing assessment, hearing aids, auditory brainstem response interpretation, imaging, vestibular disorders, and prediction of treatment outcomes. [2]. A particularly promising area is the application of AI to otoscopic image analysis. Habib et al. conducted a systematic review and meta-analysis evaluating AI systems for the classification of ear diseases from otoscopic images. [3] AI technologies are also increasingly being used in endoscopy and laryngoscopy. Sampieri et al. reviewed applications of artificial intelligence in upper aerodigestive tract endoscopy and laryngoscopy and identified classification, detection, and segmentation as major areas of application. [4] The development of AI in otology, rhinology, and laryngology has subsequently expanded. Moulic, Gaurkar, and Deshmukh reported applications involving hearing aids, imaging technologies, auditory brainstem response interpretation, surgical navigation, robotic surgery, detection of anatomical abnormalities, voice pathology, and laryngeal imaging. [5] Generative artificial intelligence and large language models represent a newer stage in the digital transformation of ENT practice. Alter et al. examined the potential applications of machine learning and generative AI for otolaryngologists and head and neck surgeons. These technologies may support clinical documentation, medical education, information retrieval, communication, and clinical decision-making. [6] Recent bibliometric research demonstrates that AI research in otorhinolaryngology is expanding rapidly. Demir et al. analyzed 498 original publications and identified diagnostic imaging, MRI, CT, radiomics, hearing loss, cochlear implants, laryngology, otitis media, chronic rhinosinusitis, patient education, prognosis, and surgery among the major research directions [7].

Materials and methods. This study analyzed the prospects for the application of artificial intelligence (AI) and digital technologies in otorhinolaryngology (ENT). A comprehensive review of scientific literature, clinical studies, and technological developments was conducted to identify current applications, potential benefits, and future directions of digital transformation in ENT practice.

A total of 40 scientific sources and clinical technological materials were included in the analytical review. The literature was grouped according to the main areas of AI and digital technology application in otorhinolaryngology.

Table 1. Distribution of selected digital technologies by research area and number of sources

Research area	Number of sources
Artificial intelligence and diagnostics	12
Digital imaging and image analysis	10
Telemedicine and remote monitoring	8
Electronic health records and digital platforms	6

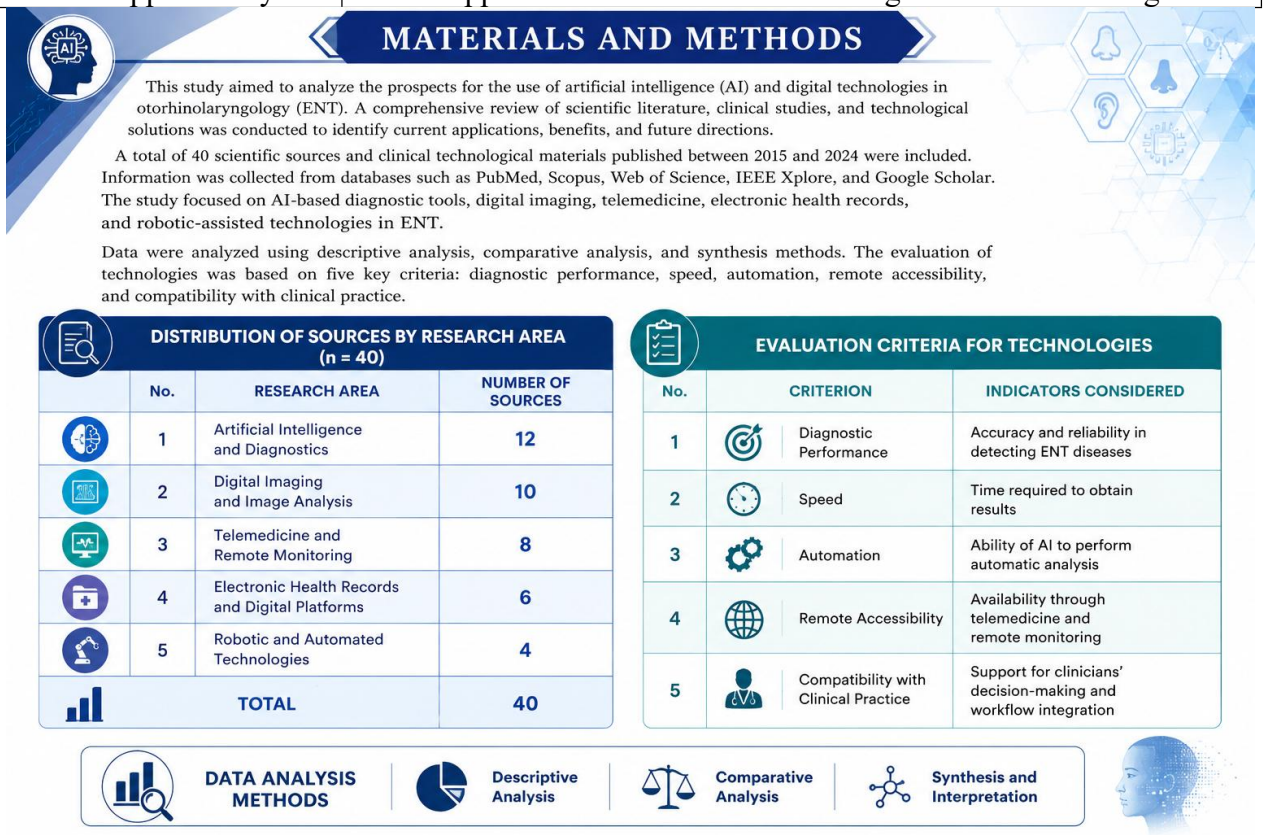
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Robotic and automated technologies	4
Total	40

The selected technologies were evaluated according to their diagnostic performance, speed, level of automation, remote accessibility, and compatibility with clinical practice.

Table 2. Evaluation criteria for digital technologies in otorhinolaryngological practice

Evaluation criterion	Indicator considered
Diagnostic performance	Accuracy in detecting ent diseases
Speed	Time required to obtain results
Automation	Ability of ai to perform automated analysis
Remote accessibility	Possibility of telemedicine-based monitoring
Clinical applicability	Support for clinical decision-making and workflow integration



1-Figure. Materials and methods

The collected information was analyzed using descriptive, comparative, and synthesis methods. Particular attention was given to the potential of AI-assisted diagnostic systems, digital imaging, telemedicine, electronic health records, and robotic technologies to improve diagnostic accuracy, reduce processing time, support clinical decision-making, and enhance patient monitoring in otorhinolaryngology.

Discussion. The analysis of the current literature demonstrates that artificial intelligence (AI) and digital technologies are becoming increasingly important in otorhinolaryngology. Recent studies indicate that AI applications are expanding from experimental diagnostic systems toward practical tools for screening, imaging analysis, clinical decision support, prognosis prediction, patient education,

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and workflow optimization. This trend suggests that digital transformation may substantially influence the future organization of ENT care.

One of the most promising areas is AI-assisted diagnosis. Machine-learning and deep-learning algorithms can analyze otoscopic, endoscopic, CT, and MRI images and identify pathological patterns. In otology, AI has demonstrated potential in the assessment of otitis media, hearing-related disorders, temporal bone imaging, and other conditions. In rhinology, AI-based systems are increasingly being investigated for chronic rhinosinusitis, anatomical assessment, surgical planning, and prediction of postoperative outcomes. Such technologies may provide additional diagnostic support and help physicians make more consistent clinical assessments.

The application of AI in laryngology and voice medicine is also particularly promising. Computer-vision and machine-learning approaches can be used to analyze laryngoscopic images and voice characteristics, potentially assisting in the detection and classification of vocal pathologies. This may be especially useful when large amounts of visual or acoustic information must be evaluated systematically. However, AI should be regarded as a complementary clinical instrument rather than a replacement for specialist examination and professional judgment.

Another important direction is the use of generative AI and large language models.

Conclusion. Artificial intelligence and digital technologies have significant potential to transform modern otorhinolaryngology by improving the accuracy, speed, and accessibility of diagnostic and therapeutic services. AI-based systems can assist in the analysis of otoscopic, endoscopic, radiological, audiological, and clinical data, thereby supporting early detection of ENT diseases and more individualized clinical decision-making.

Digital platforms and telemedicine can additionally improve communication between patients and specialists, facilitate remote consultations, and support continuous monitoring of patients. The integration of machine learning, computer vision, electronic medical records, and clinical decision-support systems may contribute to more efficient healthcare delivery and improved patient outcomes.

At the same time, the successful implementation of these technologies requires careful consideration of data quality, patient privacy, cybersecurity, algorithmic bias, clinical validation, and ethical responsibility. AI should therefore be viewed as a supportive tool that complements, rather than replaces, the professional knowledge and clinical judgment of otorhinolaryngologists.

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