Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.7 No. 2 (2026): June 2026 Issue
https://doi.org/10.51168/sjhrafrica.v7i2.2798
Original Article

Diagnostic Accuracy of Artificial Intelligence Expert Systems for Ear, Nose, and Throat Diseases: A Prospective Cross-Sectional Observational Study.

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ABSTRACT

Background:
Artificial Intelligence (AI)-based expert systems are increasingly being explored as decision-support tools in clinical practice. Their application in Ear, Nose, and Throat diseases may improve early diagnosis and facilitate timely referral, particularly in resource-constrained settings.

Objective:
To evaluate the diagnostic accuracy of an Artificial Intelligence expert system in patients presenting with Ear, Nose, and Throat diseases by comparing AI-generated diagnoses with final diagnoses established by consultant ENT specialists.

Methods:
A prospective cross-sectional observational study was conducted in the Department of Ear, Nose, and Throat and Head-Neck Surgery of a tertiary care teaching hospital from March 2025 to February 2026. A total of 150 patients presenting with various ENT complaints were included using consecutive sampling. Clinical information was entered into the AI expert system, and the generated diagnoses were compared with final diagnoses made by consultant ENT specialists. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated.

Results:
The AI expert system demonstrated good agreement with specialist diagnoses and showed satisfactory diagnostic performance across common ENT conditions. The system achieved high sensitivity and specificity for frequently encountered disorders, supporting its utility as an adjunctive diagnostic tool in clinical practice.

Conclusion:
Artificial Intelligence expert systems demonstrated promising diagnostic accuracy for Ear, Nose, and Throat diseases and may serve as valuable decision-support tools alongside specialist clinical assessment.

Recommendation:
AI expert systems may be utilized for preliminary screening, triage, and referral support in ENT practice, especially in settings with limited specialist availability. Further multicenter studies involving larger populations are recommended to validate these findings.

Keywords: *Artificial Intelligence;* ***Ear, Nose, Throat diseases****; diagnostic accuracy; expert systems; decision support systems; sensitivity; specificity.*
Submitted: *April 17, 2026* ***Accepted:*** *May 20, 2026* ***Published:*** *June 30, 2026*
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INTRODUCTION

One of the most revolutionary technologies in contemporary healthcare is artificial intelligence. AI-based expert systems help medical personnel diagnose and plan treatments by using machine learning algorithms, clinical decision trees, and pattern-recognition models. In radiography, pathology, dermatology, ophthalmology, and emergency care, these systems have demonstrated encouraging outcomes. Worldwide, a significant percentage of outpatient consultations are for otorhinolaryngological problems. Otitis media, allergic rhinitis, tonsillitis, sinusitis, and hearing problems are common ENT illnesses that have a substantial impact on healthcare utilisation and quality of life. For proper therapy and the avoidance of problems, fast and accurate diagnosis is still crucial. However, in settings with limited resources, a lack of specialists, high patient loads, and variations in clinical expertise might cause a delay in diagnosis. (1).

Recent developments in artificial intelligence have made it possible to create expert systems that can produce diagnostic recommendations by evaluating symptoms, clinical indicators, and research findings. These devices could decrease diagnostic errors, increase access to care, and assist doctors in making decisions. However, there are still issues with their dependability, especially in intricate clinical situations that call for careful interpretation and clinical judgment. Diagnostic accuracy for AI-assisted healthcare applications has been reported to range from 70% to 90% in a number of worldwide studies. However, there is still little data on how well AI expert systems function in ENT practice, particularly in the Indian healthcare system. Prior to broader use, it is crucial to assess their diagnostic potential in actual clinical settings (2).

In order to evaluate the diagnostic accuracy of an AI expert system in patients presenting with ENT illnesses, the current prospective observational study was conducted in the ENT Department at Uttar Pradesh University of Medical Sciences (UPUMS), Saifai. The study sought to ascertain the system's sensitivity, specificity, predictive values, and overall diagnostic accuracy by contrasting AI-generated diagnoses with final diagnoses made by ENT specialists.(3).

The objective of this study was to evaluate the diagnostic accuracy of an Artificial Intelligence expert system in patients presenting with Ear, Nose, and Throat diseases by comparing AI-generated diagnoses with final diagnoses established by consultant ENT specialists and determining the system's sensitivity, specificity, predictive values, and overall diagnostic accuracy.

Materials and Methods

Study Design

This study was designed as a **prospective cross-sectional observational study** aimed at evaluating the diagnostic accuracy of an Artificial Intelligence (AI)-based expert system in the diagnosis of Ear, Nose, and Throat (ENT) diseases. The AI-generated diagnoses were compared with the final diagnoses established by consultant ENT specialists, which served as the reference standard. The study evaluated the ability of the AI system to correctly identify ENT conditions using standard diagnostic accuracy measures, including sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy.

Study Setting

The study was conducted in the **Department of Ear, Nose, and Throat and Head-Neck Surgery, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah, Uttar Pradesh, India**. UPUMS is a large tertiary care teaching and referral hospital that provides comprehensive healthcare services, including outpatient care, inpatient services, emergency and trauma care, intensive care facilities, diagnostic and laboratory services, surgical specialties, and superspecialty medical services.

The institution caters to a large patient population from **western, central, and eastern regions of Uttar Pradesh**, as well as neighboring states including Madhya Pradesh and Rajasthan. The Department of ENT and Head-Neck Surgery manages a wide spectrum of otological, rhinological, laryngological, head and neck, and emergency ENT conditions through outpatient clinics, inpatient wards, operation theatres, and emergency services. The large patient volume and broad catchment area make UPUMS an appropriate setting for evaluating AI-based diagnostic tools in routine clinical practice.

Study Duration

The study was conducted over a period of **12 months from 1 March 2025 to 28 February 2026**. Patient recruitment, data collection, and analysis were performed throughout the study period.

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Study Population and Participant Selection

The study population consisted of patients presenting to the ENT outpatient department with symptoms suggestive of ENT diseases during the study period.

A **consecutive sampling technique** was employed, whereby all eligible patients attending the department during the study period were screened and invited to participate until the required sample size was achieved. Consecutive sampling was chosen to minimize selection bias and to ensure that the study population was representative of routine clinical practice.

During the recruitment period, all patients underwent initial clinical assessment by the treating physician. Eligible participants who fulfilled the inclusion criteria and provided written informed consent were enrolled in the study and included in the final analysis.

Study Size Determination

The sample size was calculated using the single population proportion formula:

n=Z2P(1−P)d2n = \frac{Z^2 P (1-P)}{d^2}n=d2Z2P(1−P)

where:

- **n** = required sample size
- **Z** = standard normal deviate at 95% confidence level (1.96)
- **P** = anticipated diagnostic accuracy of the AI expert system based on previous literature (0.80)
- **d** = acceptable margin of error (0.064)

Accordingly, a minimum sample size of **150 participants** was required and was achieved during the study period.

Eligibility Criteria

Inclusion Criteria

Participants were eligible for inclusion if they fulfilled all of the following criteria:

- Patients presenting with symptoms or clinical features suggestive of Ear, Nose, and Throat diseases.
- Patients attending the ENT outpatient department during the study period.
- Patients willing to participate in the study.
- Patients who provided written informed consent for participation.

Exclusion Criteria

Patients were excluded if they met any of the following criteria:

- Patients with incomplete clinical information required for AI analysis.
- Patients requiring immediate life-saving interventions before a detailed clinical assessment could be completed.
- Patients unwilling to participate in the study or unwilling to provide informed consent.
- Patients with an incomplete diagnostic work-up, preventing confirmation of the final diagnosis.

Study Procedure

After obtaining informed consent, demographic information, presenting symptoms, duration of illness, clinical findings, and relevant investigation results were recorded using a standardized case record form.

The collected clinical information was subsequently entered into the AI expert system, which independently generated one or more probable diagnoses based on the entered parameters. The AI output was recorded before the specialist diagnosis was established to avoid incorporation bias.

All participants subsequently underwent routine clinical evaluation by consultant ENT specialists, including physical examination and additional investigations such as audiological testing, nasal endoscopy, laryngoscopy, imaging studies, microbiological investigations, or histopathological examination whenever clinically indicated.

The final diagnosis established by the consultant ENT specialist after completion of the diagnostic work-up was considered the reference standard against which AI-generated diagnoses were compared.

Measures to Minimize Bias

Several measures were implemented to reduce potential sources of bias. Consecutive recruitment of eligible patients minimized selection bias. Standardized data collection forms were used to reduce information bias and ensure uniform recording of clinical variables. The AI-generated diagnosis was documented before the specialist diagnosis was finalized, thereby minimizing observer and incorporation bias.

Consultant ENT specialists establishing the final diagnosis were blinded to the AI output whenever feasible to reduce diagnostic review bias. Furthermore, standardized diagnostic criteria and institutional protocols were applied uniformly across all participants to minimize classification bias.

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Quantitative Variables and Statistical Analysis

Continuous quantitative variables such as age were expressed as **mean ± standard deviation (SD)** or median with interquartile range where appropriate, depending on data distribution. Categorical variables, including sex, disease categories, and diagnostic outcomes, were presented as frequencies and percentages.

For analytical purposes, diseases were grouped into major ENT categories, including otological, rhinological, pharyngeal, laryngeal, and head and neck disorders, to facilitate comparison of diagnostic performance across subspecialties.

Diagnostic performance measures, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy, were calculated using standard formulas with corresponding 95% confidence intervals whenever appropriate.

Associations between AI-generated diagnoses and specialist-confirmed diagnoses were evaluated using the Chi-square test. Statistical analysis was performed using **SPSS version 26.0 (IBM Corp., Armonk, NY, USA)**, and a **p-value less than 0.05** was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the **Institutional Ethics Committee of Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah, Uttar Pradesh, India**.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent was obtained from all participants prior to enrollment after explaining the objectives, procedures, benefits, and potential risks associated with participation. Participant confidentiality and anonymity were maintained throughout the study, and all collected data were used solely for research purposes.

RESULTS

During the study period from **1 March 2025 to 28 February 2026**, a total of **176 patients** presenting with symptoms suggestive of Ear, Nose, and Throat diseases attended the ENT outpatient department and were screened for eligibility. Of these, **161 patients fulfilled the inclusion criteria and were considered eligible for participation**.

Among the eligible patients, **11 patients declined to provide informed consent** and were therefore excluded from the study. An additional **5 patients were excluded due to incomplete clinical information required for AI analysis or incomplete diagnostic work-up that prevented confirmation of the final diagnosis**.

Consequently, **150 participants were enrolled and included in the final analysis**, and all enrolled participants completed the study and were included in the statistical analysis.

Table 1: Demographic Distribution

Variable	Frequency	Percentage
Male	84	56.0
Female	66	44.0
Total	150	100

Interpretation

Male patients constituted 56.0% of the study population, while females accounted for 44.0%.

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Table 2: Distribution of ENT Diseases

Disease	n (%)
Otitis Media	34 (22.7)
Allergic Rhinitis	28 (18.7)
Sinusitis	26 (17.3)
Tonsillitis	24 (16.0)
Hearing Loss	20 (13.3)
Head & Neck Tumors	18 (12.0)

p = 0.031

Interpretation

Otitis media was the most common diagnosis, followed by allergic rhinitis and sinusitis.

Table 3: Diagnostic Performance of the AI System

Parameter	Value (%)
Sensitivity	82.5
Specificity	73.3
PPV	80.3
NPV	76.4
Overall Accuracy	78.7

Interpretation

The AI expert system demonstrated an overall diagnostic accuracy of 78.7%.

Table 4: Disease-wise Diagnostic Concordance

Disease	Concordance (%)
Otitis Media	88.2
Allergic Rhinitis	85.7
Sinusitis	80.8
Tonsillitis	79.2
Hearing Loss	75.0
Head & Neck Tumors	66.7

p < 0.001

Interpretation

The highest concordance was observed for otitis media, while the lowest was seen for head and neck tumors.

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DISCUSSION

The current prospective observational study assessed an AI expert system's diagnosis precision in patients with ENT diseases at UPUMS, Saifai. The results underline the ongoing significance of expert evaluation while showing that AI-based diagnostic tools have significant potential as clinical decision-support systems. Males made up a tiny majority of the 150 patients in the study. Otitis media, allergic rhinitis, and sinusitis were the most frequent ENT ailments seen, which reflects the range of illnesses frequently seen in tertiary-care ENT outpatient settings. Previous epidemiological investigations of ENT diseases have revealed similar distributions (4).

The AI expert system's overall diagnostic accuracy was 78.7%, indicating strong agreement with expert diagnoses. The results of current research assessing AI applications in clinical medicine, where stated diagnostic accuracies often range between 75% and 90%, are similar to this level of accuracy. The current study's high sensitivity (82.5%) suggests that the AI system was successful in detecting ENT illness patients. This feature is especially useful from a screening standpoint because a missed diagnosis can cause treatment to be delayed and the disease to worsen. (5).

At 73.3%, specificity was somewhat lower, suggesting the possibility of false-positive classifications. In clinical screening settings, such errors are typically less detrimental than false negatives, even if they may increase the requirement for confirmatory assessment. The use of AI-assisted diagnostic techniques in standard ENT practice is further supported by the positive predictive value of 80.3% and the negative predictive value of 76.4%. Otitis media and allergic rhinitis had the highest concordance rates, according to a disease-specific study.(6). These disorders are more susceptible to algorithm-based diagnosis since they frequently exhibit distinctive symptoms and clinical findings. On the other hand, head and neck tumours showed reduced concordance. The intricacy of malignant diseases, which often necessitate thorough clinical examination, endoscopic evaluation, imaging studies, and histological confirmation before establishing a clear diagnosis, is probably reflected in this observation. (7).

The potential therapeutic utility of expert systems in otorhinolaryngology is demonstrated by the statistically strong correlation between diagnoses made by AI and diagnoses confirmed by specialists. In primary healthcare settings, remote clinics, and telemedicine platforms where access to expert consultation is restricted, such systems may be especially helpful. AI-assisted decision assistance could speed up referrals, increase the effectiveness of triage, and improve access to healthcare. Although the results are encouraging, there are a few things to be aware of. AI systems continue to rely on the accuracy and comprehensiveness of incoming data. Algorithm design, disease prevalence, and patient demographics can all affect diagnostic performance. Moreover, contextual clinical judgement, patient behaviour, psychological aspects, and subtle examination findings—all of which skilled physicians frequently take into account during diagnosis—are not integrated by expert systems. (8).

Therefore, rather than taking the position of ENT specialists, AI should be seen as an addition. Diagnostic performance may be further enhanced by future research utilising bigger multicentric populations, sophisticated deep-learning models, and the integration of endoscopic and imaging data. Continuous algorithm refinement and validation will be essential to ensure safe and effective clinical implementation. Overall, the results demonstrate artificial intelligence's ability to improve diagnostic efficiency while upholding high standards of patient care and support the field's expanding role in otorhinolaryngology. (9).

CONCLUSION

In this prospective observational study carried out at UPUMS, Saifai, artificial intelligence-based expert systems showed good diagnostic performance in assessing ENT illnesses. When compared to diagnoses confirmed by specialists, the AI system's total diagnostic accuracy was 78.7%, with high sensitivity and adequate specificity. AI can be a useful decision-support tool in everyday ENT practice, as evidenced by the significant agreement between AI-generated diagnoses and final clinical diagnoses.

The system's ability to diagnose common ailments, including sinusitis, allergic rhinitis, and otitis media, was especially good, suggesting that it could be useful for screening and initial evaluation. Reduced accuracy for complicated illnesses like head and neck tumours, however, highlights the ongoing need for thorough clinical evaluation by qualified ENT specialists.

By facilitating early diagnosis, streamlining patient triage, and increasing access to specialist-level diagnostic support in underserved areas, AI expert systems may enhance the delivery of healthcare. However, rather than taking the role

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of clinical experience, these technologies should enhance it. To improve diagnostic precision and generalizability, more multicentric research with bigger sample sizes and integration of imaging and endoscopic data is advised.

In summary, AI expert systems are a promising development in otorhinolaryngology and, when combined with professional clinical judgement, have the potential to greatly enhance patient outcomes and diagnostic efficiency.

Generalizability

The study was conducted in a large tertiary care teaching hospital serving urban and rural populations across Uttar Pradesh and neighboring states. The broad patient base and wide spectrum of ENT diseases encountered in this setting enhance the external validity of the findings and suggest that the results may be generalizable to similar tertiary care institutions and referral hospitals in low- and middle-income countries. However, caution should be exercised when extrapolating these findings to primary healthcare settings, highly specialized referral centers, pediatric-only populations, or healthcare systems utilizing different AI algorithms and diagnostic pathways.

Limitations

Several limitations of the present study should be acknowledged. First, the study was conducted at a single tertiary care institution, which may limit the generalizability of the findings to other healthcare settings. Second, although the sample size was adequate for the primary objectives, larger multicenter studies would provide more precise estimates of diagnostic performance. Third, the AI expert system primarily relied on clinical history and examination findings and did not incorporate imaging, endoscopic findings, audiological assessments, or histopathological data, which may have affected diagnostic accuracy in complex cases. Fourth, spectrum bias may have occurred because tertiary care centers often manage more complicated or advanced disease presentations than primary care facilities. Finally, the study evaluated diagnostic performance at a single time point and did not assess the impact of AI-assisted diagnosis on patient outcomes, healthcare utilization, or cost-effectiveness.

Recommendations

Clinical Practice

Artificial Intelligence expert systems may be considered as useful decision-support tools for preliminary screening, triage, and referral of patients with ENT disorders, particularly in healthcare settings with limited access to specialist services.

Future Research

Future multicenter studies involving larger and more diverse populations are needed to validate these findings. Further research should explore the integration of imaging data, endoscopic findings, audiological investigations, and advanced machine learning models to improve diagnostic accuracy and clinical utility.

Acknowledgement

The authors express their sincere gratitude to the faculty members, resident doctors, nursing staff, and technical personnel of the Department of Ear, Nose, and Throat and Head-Neck Surgery, Uttar Pradesh University of Medical Sciences, Saifai, Etawah, Uttar Pradesh, India, for their support during the conduct of the study. The authors also thank all study participants for their valuable contribution to this research.

Funding

No external funding or financial support was received for this study. The funding body had no role in study design, data collection, analysis, interpretation of data, manuscript preparation, or the decision to submit the manuscript for publication.

Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

List of Abbreviations

Abbreviation	Full Form
AI	Artificial Intelligence
ENT	Ear, Nose, and Throat
PPV	Positive Predictive Value

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Abbreviation	Full Form
NPV	Negative Predictive Value
SPSS	Statistical Package for the Social Sciences
UPUMS	Uttar Pradesh University of Medical Sciences
SD	Standard Deviation
CI	Confidence Interval

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request, subject to institutional policies and ethical considerations regarding participant confidentiality.

Author Contributions

All authors read and approved the final version of the manuscript.

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Original Article

PUBLISHER DETAILS

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa