ChatGPT for Neurosurgical Decision Support

- Knowledge Graph-Enhanced Deep Learning Model (H-SYSTEM) for Hypertensive Intracerebral Hemorrhage: Model Development and Validation
- Transforming neurosurgical practice with large language models: comparative performance of ChatGPT-omni and Gemini in complex case management
- Transforming Neurosurgical Practice with Large Language Models: Comparative Performance of ChatGPT-Omni and Gemini in Complex Case Management
- Evaluating ChatGPT o1's Capabilities in Peripheral Nerve Surgery: Advancing Artificial Intelligence in Clinical Practice
- Large language models in neurosurgery: a systematic review and meta-analysis
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- Enhancing Diagnostic Support for Chiari Malformation and Syringomyelia: A Comparative Study of Contextualized ChatGPT Models
- Medical Ethics and Artificial Intelligence in Neurosurgery-How Should We Prepare?

ChatGPT and similar language models can potentially transform decision-making in neurosurgery by providing real-time insights, aiding in research, and improving patient care workflows. Here's how ChatGPT can support neurosurgical decision-making:

Clinical Decision Support

1. **Diagnostic Assistance**: ChatGPT can synthesize patient histories, imaging findings, and lab results to suggest differential diagnoses or confirm diagnostic hypotheses.
2. **Treatment Recommendations**: ChatGPT can suggest treatment options, such as surgical versus conservative management for herniated discs or other conditions based on clinical guidelines.
3. **Risk Analysis**: It can analyze risk factors for complications like infections or neurological deficits based on patient-specific data.

Intraoperative Support

1. **Real-Time Data Access**: By integrating with electronic health records (EHR) and surgical navigation systems, ChatGPT can provide immediate access to relevant patient information during surgery.
2. **Checklist Reminders**: It can assist in maintaining adherence to surgical protocols, such as WHO surgical safety checklists.
3. **Simulation and Planning**: ChatGPT could aid in preoperative simulation by suggesting approaches based on imaging and prior cases.

Educational Applications

1. **Training Residents and Students**: ChatGPT can provide tailored explanations of complex surgical techniques or neuroanatomical details.
2. **Access to Literature**: It can summarize recent neurosurgical publications, enhancing learning and keeping surgeons updated on advances in the field.

3. **Quizzes and Simulations**: It could generate interactive case-based quizzes for medical education.

Administrative and Research Assistance

1. **Case Documentation**: ChatGPT can assist in drafting operative reports, discharge summaries, and referral letters, saving valuable time.
2. **Research Support**: It can help in literature reviews, data analysis, and hypothesis generation for neurosurgical research.
3. **Patient Triage and Scheduling**: Using natural language processing, it can prioritize surgical cases based on urgency and resource availability.

Patient Communication

1. **Simplified Explanations**: ChatGPT can help explain complex surgical procedures or diagnoses to patients in layman's terms.
2. **Preoperative and Postoperative Guidance**: It can provide educational material tailored to specific procedures or conditions.

Limitations and Considerations

1. **Accuracy and Reliability**: ChatGPT is not a replacement for clinical judgment. It must be used as a complementary tool, with all suggestions verified by a qualified neurosurgeon.
2. **Data Security**: Ensuring patient confidentiality and compliance with HIPAA/GDPR regulations is paramount.
3. **Bias and Scope**: ChatGPT’s suggestions are only as good as the data it was trained on and may not account for nuances of individual cases.

Future Directions

1. **Integration with Imaging Systems**: By analyzing radiological images, ChatGPT could offer additional insights into pathologies such as tumors or vascular anomalies.
2. **Predictive Modeling**: Leveraging patient data, it could forecast surgical outcomes or complications.
3. **Real-Time Collaboration**: Enabling live dialogue between the surgical team and ChatGPT during critical decision points.

By harnessing ChatGPT’s capabilities, neurosurgeons can streamline workflows, improve patient care, and stay at the forefront of medical innovation. However, the integration of AI in neurosurgery demands continuous validation, ethical oversight, and collaboration between clinicians and technologists.

To assess the reliability of ChatGPT, we compared its responses against the 2023 Congress of Neurological Surgeons (CNS) guidelines for patients with Chiari I Malformation (CIM).

Methods: ChatGPT-3.5 and ChatGPT-4 were prompted with revised questions from the 2023 CNS guidelines for patients with CIM. ChatGPT responded were compared to CNS guideline recommendations using cosine similarity scores and reviewer assessments of 1) contradiction with guidelines, 2) recommendations not contained in guidelines, and 3) failure to include guideline recommendations. A scoping review was conducted to investigate reviewer-identified discrepancies between CNS recommendations and GPT-4 responses.

Results: A majority of ChatGPT responses were coherent with CNS recommendations. However, moderate contradiction was observed between responses and guidelines (15.3% ChatGPT-3.5 responses, 38.5% ChatGPT-4 responses). Additionally, a tendency toward over-recommendation (30.8% ChatGPT-3.5 responses, 46.1% ChatGPT-4 responses) rather than under-recommendation (15.4% ChatGPT-3.5 responses, 7.7% ChatGPT-4 responses) was observed. Cosine similarity scores revealed moderate similarity between CNS and ChatGPT recommendations (0.553 ChatGPT-3.5, 0.549 ChatGPT-4). The scoping review revealed 19 studies relevant to CNS-ChatGPT substantive contradictions, with mixed support for recommendations contradicting official guidelines.

Moderate incoherence was observed between ChatGPT responses and CNS guidelines on the diagnosis and management of CIM. The recency of the CNS guidelines and mixed support for contradictory ChatGPT responses highlights a need for further refinement of large language models prior to their application as clinical decision support tools [1)].

1)

Brown EDL, Maity A, Ward M, Toscano D, Baum GR, Mittler MA, Lo SL, D'Amico RS. ChatGPT as a Decision Support Tool in the Management of Chiari I Malformation: A Comparison to 2023 CNS Guidelines. World Neurosurg. 2024 Nov;191:e304-e332. doi: 10.1016/j.wneu.2024.08.122. Epub 2024 Aug 28. PMID: 39214295.