



Editorial

ChatGPT: Chasing the Storm in Radiology Training and Education

Kushaljit Singh Sodhi^{1,2}  Ting Y. Tao¹ Noah Seymore¹

¹ Department of Pediatric Radiology, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri, United States

² Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Indian J Radiol Imaging 2023;33:431–435.

Chat Generative Pre-Training Transformer (ChatGPT) has taken the world of artificial intelligence (AI) by storm with its potential. It is among the most talked about and discussed topics in the world today. While there are apprehensions on its possible misappropriation and long-term implications, there is no denying the fact that it has arrived, along with its counterparts Bard, Google AI. It is likely to evolve further with time and shall influence our writing, training, and education like never before.

This editorial is a discussion of the potential use of ChatGPT in training and educating residents in radiology, alongside a word of caution regarding its limitations and pitfalls. This editorial is based on responses generated by ChatGPT itself.¹

Introduction to ChatGPT: The Basics

Message Input: What is ChatGPT?

ChatGPT Reply

ChatGPT is an AI language model developed by OpenAI.^{1,2} It is based on the GPT (Generative Pre-trained Transformer) architecture, specifically GPT-3.5. The model is designed to generate human-like responses to text-based prompts or questions. It has been trained on a wide range of Internet text sources to develop a broad understanding of language and can generate coherent and contextually relevant responses.

ChatGPT is capable of understanding and generating text in a conversational manner, making it well-suited for chatbots, virtual assistants, and other applications that involve interactive communication with users. It can provide information, answer questions, engage in discussions, and assist with various tasks based on the input it receives.

The model uses deep learning techniques, specifically transformers, to process and generate text. It has been trained on a massive amount of data and has the ability to generate creative and contextually appropriate responses. However, it's important to note that while ChatGPT can provide useful and accurate information in many cases, it may also produce incorrect or nonsensical responses. Therefore, it's always a good idea to verify the information provided by the model from reliable sources.

Message Input: How Old is ChatGPT?

ChatGPT Reply

ChatGPT, based on the GPT-3.5 architecture, was released by OpenAI in June 2020. It is important to note that while the GPT-3.5 model was released in 2020, my specific instance of the model, as ChatGPT, has a knowledge cutoff in September 2021. My responses are based on information available up until that date.

Message Input: How Can ChatGPT Assist Radiology Residents in Image Interpretation?

ChatGPT Reply

ChatGPT can assist radiology residents in image interpretation by providing them with additional information, explanations, and guidance based on their questions and input. Here are a few ways in which ChatGPT can be helpful:

1. Clarifying Concepts: Radiology residents may encounter complex concepts and terminology during image interpretation. ChatGPT can help clarify these concepts by providing definitions, explanations, and examples. It can break down technical jargon into more easily

Address for correspondence
Kushaljit Singh Sodhi, MD, PhD,
Mallinckrodt Institute of
Radiology, Washington University
School of Medicine, St. Louis,
Missouri, United States and
Department of Radiodiagnosis &
Imaging, Postgraduate Institute
of Medical Education and
Research, Chandigarh, India
(e-mail: sodhiks@gmail.com).

DOI <https://doi.org/10.1055/s-0043-1774743>.
ISSN 0971-3026.

© 2023. Indian Radiological Association. All rights reserved.
This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)
Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

understandable language, assisting residents in gaining a deeper understanding of the underlying principles.

2. **Differential Diagnosis:** When residents are analyzing an image and considering potential diagnoses, ChatGPT can offer suggestions and discuss possible differentials based on the presented findings. It can provide insights into common patterns, associated findings, and relevant clinical information, helping residents consider a broader range of possibilities.
3. **Reference Material:** ChatGPT can act as a virtual library, providing references to textbooks, research papers, guidelines, and other relevant resources. It can offer suggestions for further reading and provide summaries or excerpts from relevant literature, assisting residents in expanding their knowledge and staying up to date with the latest research in radiology.
4. **Case-based Discussions:** Residents can present specific cases or image findings to ChatGPT, and it can engage in a dialogue, asking questions, and providing feedback. This interactive discussion can help residents refine their interpretation skills, consider alternative perspectives, and develop a systematic approach to image analysis.
5. **Educational Tool:** ChatGPT can serve as an educational tool, offering interactive quizzes, image-based challenges, or simulated scenarios for residents to practice their interpretation skills. It can provide immediate feedback, explain correct or incorrect answers, and guide residents towards more accurate diagnoses.

It's important to note that while ChatGPT can provide valuable insights and information, it should not replace the expertise and guidance of experienced radiologists. It can complement the learning process by offering additional support, but final decisions and diagnoses should always be made by qualified medical professionals.

Message Input: How Can ChatGPT Assist in Continuous Professional Development?

ChatGPT Reply

ChatGPT can assist in the continuous professional development of various professionals, including those in the medical field, by offering the following support:

1. **Information Retrieval:** ChatGPT can act as a knowledge resource, providing access to a vast amount of information. It can retrieve relevant research papers, clinical guidelines, case studies, and other resources to help professionals stay updated on the latest advancements in their field. It can also provide summaries or key takeaways from complex literature, saving time and effort in searching for information.
2. **Exploring New Topics:** Professionals can use ChatGPT to explore new topics or areas of interest within their field. They can ask questions, seek explanations, and engage in discussions to expand their knowledge beyond their current expertise. ChatGPT can provide insights, exam-

ples, and references to further explore those topics and encourage continuous learning.

3. **Continuing Education:** ChatGPT can offer interactive learning experiences by providing quizzes, educational content, and simulated scenarios. It can test professionals' knowledge, challenge their critical thinking skills, and provide immediate feedback to enhance their learning process. This can be particularly useful for fulfilling continuing education requirements and maintaining professional certifications.
4. **Collaborative Problem Solving:** Professionals can present complex cases, clinical scenarios, or challenging situations to ChatGPT. They can engage in discussions, seek advice, and brainstorm possible solutions. ChatGPT can provide alternative perspectives, highlight relevant considerations, and facilitate critical thinking, fostering a collaborative problem-solving approach.
5. **Career Guidance:** ChatGPT can offer career-related insights and guidance. Professionals can discuss their career goals, ask for advice on skill development, explore different career paths, or seek suggestions for professional growth opportunities. ChatGPT can provide information on relevant courses, conferences, networking events, or professional organizations that can support their career advancement.

It's important to note that while ChatGPT can provide valuable support, it should not replace human mentors, colleagues, or professional development programs. It can complement the learning process and provide guidance, but professionals should continue to engage in real-world experiences, seek mentorship, and participate in formal training programs to ensure a well-rounded professional development journey.

Message Input: Can ChatGPT Help Radiology Residents in Conducting Ethical Research and its Publication?

ChatGPT Reply

While ChatGPT can provide information and guidance on various topics, including research, it may not be the most suitable resource for specific aspects of conducting ethical research and its publication. Here are some considerations:

1. **Research Ethics:** ChatGPT can provide general information about research ethics principles and guidelines. It can offer explanations and examples of ethical considerations such as informed consent, privacy protection, and minimizing harm to participants. However, for specific research projects, it is essential to consult official guidelines, institutional review boards (IRBs), and ethical experts who can provide detailed guidance tailored to the specific research context.
2. **Study Design and Methodology:** ChatGPT can discuss different research study designs and methodologies, providing insights into their strengths and limitations. However, when it comes to designing ethically sound studies, it is crucial to consult research methodology experts and adhere to established protocols and ethical guidelines specific to the field of study.

3. **Data Collection and Privacy:** ChatGPT can provide general information about data collection methods and privacy considerations. It can discuss concepts such as de-identification, anonymization, and data security. However, when conducting research involving human subjects, it is important to follow legal and ethical guidelines specific to the jurisdiction and seek guidance from professionals experienced in data protection and privacy regulations.
4. **Publication Process:** ChatGPT can offer general advice on the publication process, such as selecting appropriate journals, understanding submission guidelines, and structuring research papers. However, for ethical considerations related to publication, it is recommended to refer to the guidelines provided by the target journal, professional organizations, and ethical committees that oversee research publishing.

In summary, while ChatGPT can provide some general information and insights related to research ethics and publication, it is always crucial to consult specific guidelines, experts, and institutional resources to ensure compliance with ethical standards in research and publication.

Limitations

Among the known and accepted limitations of ChatGPT are that it may occasionally generate incorrect information, produce harmful instructions or biased content, and has limited knowledge of world and events after 2021. This is by its own admission in reply to the specific question to ChatGPT—"What are the known limitations of ChatGPT in radiology training and education? This aspect is highlighted at the first interaction interface itself and in all subsequent replies, in the end, ChatGPT does provide a disclaimer/warning not to be overreliant on its information.

Example of limitations

Message Input: "Is There Any Role of Transabdominal Ultrasound in Respiratory Distress in Newborns?"

ChatGPT Reply

Transabdominal ultrasound is not typically used as a primary diagnostic tool for evaluating respiratory distress in newborns. However, it can play a role in certain situations. Here are a few scenarios where transabdominal ultrasound may be relevant:

1. **Identification of diaphragmatic hernia:** Transabdominal ultrasound can help diagnose diaphragmatic hernias, a condition where there is a hole in the diaphragm allowing abdominal organs to move into the chest cavity. This condition can cause respiratory distress in newborns, and ultrasound can be used to visualize the herniated organs and assess their impact on lung development.
2. **Assessment of pleural effusion or ascites:** In some cases, newborns may develop fluid accumulation in the chest cavity (pleural effusion) or the abdomen (ascites). Trans-

abdominal ultrasound can be used to evaluate the presence and extent of such fluid collections, which can potentially contribute to respiratory distress.

3. **Evaluation of other abdominal conditions:** Although respiratory distress primarily involves the lungs and airways, certain abdominal conditions can cause secondary respiratory symptoms. Examples include abdominal masses or tumors that compress the diaphragm or organs causing respiratory compromise. Transabdominal ultrasound may help identify such conditions.

It's important to note that when a newborn presents with respiratory distress, the initial focus is usually on assessing the baby's airway, breathing, and circulation. Clinical evaluation, physical examination, and medical history are typically the first steps. Other diagnostic tools, such as chest X-rays, blood tests, and sometimes specialized imaging like a chest computed tomography (CT) scan, may be used to evaluate respiratory distress further.

The specific diagnostic approach and use of imaging modalities may vary depending on the clinical judgment of the health care provider and the suspected underlying cause of respiratory distress. Therefore, it's essential to consult with a qualified medical professional for an accurate diagnosis and appropriate management of respiratory distress in newborns.

In a nutshell, ChatGPT provides the answer that transabdominal ultrasound "is not typically used" in respiratory distress of newborn. Clearly, this reply is generated based on what information the AI can collect and integrate at the time of the search question. It adds that ultrasound might play a role in specific situations, though it does not reference the published data on it and the resident can misinterpret that there is no role at all. The user has to learn to train themselves on how to use a tool like ChatGPT intelligently.

Simultaneous search on "Google" search engine on the same scientific question "Is there any role of transabdominal ultrasound in respiratory distress in newborns?" led us to at least four published articles on the subject,³⁻⁶ wherein the role of transabdominal ultrasound in respiratory distress was highlighted and the reader can read it further and decide. What this does indicate is that while ChatGPT is still evolving, it has the potential to provide incorrect and incomplete information and result and the final responsibility remains with the user (human). It would also depend considerably on the exact search question posed to ChatGPT. If the research question posed to ChatGPT is more specific, it can point to the right direction.

Message Input (7/5/23): Is There any Role of Transabdominal Lung Ultrasound in Respiratory Distress in Newborns?

ChatGPT

Yes, transabdominal lung ultrasound (TALUS) can play a role in the evaluation of respiratory distress in newborns. TALUS is a noninvasive imaging technique that involves using an ultrasound probe on the abdomen to assess the lungs and thoracic structures. It has gained recognition as a valuable

tool in neonatal medicine due to its ability to provide real-time and dynamic information about lung function and identify various lung pathologies.

TALUS can help in the evaluation of respiratory distress in newborns by:

Assessing lung aeration: TALUS can assess lung aeration, which refers to the extent of air-filled spaces within the lungs. It can identify areas of lung collapse (atelectasis) or consolidation, which may occur in conditions like respiratory distress syndrome, pneumonia, or meconium aspiration.

Detecting pleural effusion: TALUS can detect the presence of fluid in the pleural space, known as pleural effusion. Pleural effusion can contribute to respiratory distress in newborns, and TALUS can help identify its presence and guide further management.

Evaluating diaphragmatic function: TALUS can assess the movement and function of the diaphragm, which is the primary muscle involved in respiration. It can identify diaphragmatic hernias or diaphragmatic paralysis, which may cause respiratory distress in newborns.

Guiding procedures: TALUS can be used to guide procedures such as thoracentesis or chest tube placement to drain fluid or air from the chest, providing both diagnostic and therapeutic benefits.

Compared to other imaging modalities like chest X-ray, TALUS offers advantages such as real-time imaging, lack of ionizing radiation, and bedside availability, making it particularly useful in the neonatal intensive care unit (NICU) setting.

It's important to note that TALUS is a specialized technique that requires appropriate training and expertise for accurate interpretation. The specific use and interpretation of TALUS in respiratory distress should be done by a skilled health care professional experienced in neonatal ultrasound.

As can be seen here, using the more specific question is crucial to get the information desired, showcasing a point of fragility in both the tool and in the user, whereby "miscommunications" can occur. For instances such as these, the weight is upon the users to educate themselves on the function of the tool.

Second Example of Limitations

Message input (7/3/23): Pretend you are a radiology resident being asked a question by a clinician regarding a patient. The clinician said: "Hi, I have a patient who is a newborn female and having respiratory distress. We got chest radiographs and they said the lungs were clear. Mom is very upset and anxious. We don't want to get a CT because we don't think the patient is stable enough to come down for imaging and we want to avoid the radiation in such a young patient. Plus, their kidney function is poor and we don't want to give contrast. We were thinking about getting an abdominal ultrasound, what are your recommendations?" Please cite some sources.

ChatGPT Reply

Hello, I understand your concerns regarding the newborn female patient with respiratory distress and the need for imaging. Based on the information provided, I would agree

that obtaining a chest CT with contrast is not the best course of action due to the patient's instability and the risks associated with radiation and contrast in a young patient with poor kidney function. An abdominal ultrasound can be a reasonable alternative in this scenario.

Ultrasound is a safe imaging modality that does not involve radiation exposure or the use of contrast agents. It can provide valuable information about abdominal organs and help assess the cause of respiratory distress in some cases. The ultrasound examination can be performed at the patient's bedside, which avoids the need for transportation and potential risks associated with moving an unstable patient.

Regarding the specific indications for performing an abdominal ultrasound in a newborn with respiratory distress, it would be important to consider the clinical context and other findings. However, there are several potential causes for respiratory distress in newborns that can be evaluated using ultrasound. These include congenital diaphragmatic hernia, intestinal obstruction, abdominal masses, and pleural effusions, among others.

It's important to note that the interpretation of ultrasound images requires expertise and familiarity with neonatal anatomy and pathology. Therefore, it would be advisable to involve a radiologist experienced in neonatal imaging to ensure accurate interpretation and appropriate management based on the ultrasound findings.

While I don't have direct access to the most up-to-date sources, I can provide you with some general references on the topic of ultrasound imaging in neonates.⁷⁻⁹

It is important to consult with a radiologist or a specialist in neonatal imaging for specific guidance tailored to the patient's clinical situation.

On review, the first reference of the ChatGPT⁷ reply appears to be nonexistent, despite referencing multiple sources and repeated Web browser searches. Instead, ChatGPT seems to have artificially generated a source that appears legitimate on the surface, but is false under further scrutiny. This is alarming in the extreme, and highlights the need to refer to other sources for support.

Less alarming yet still relevant is the absence of follow-up questions *from* ChatGPT. In a human-to-human interaction, the message prompt would likely have generated some follow-up questions and requests for further information and clarification. As an example, the "poor kidney function" is not very specific, and could easily sway the decision for imaging depending on other clinical factors—if mild, intravenous (IV) contrast and CT imaging may well be the better study for this patient (e.g., further inquiry reveals history of a lung lesion seen on fetal ultrasound, though not seen on radiograph). Likewise, the gestational age of an infant carries significant weight in forming a differential, and should always be considered for newborn infants with respiratory distress, yet was not discussed above.

Conclusion

As a tool for the education of trainees, ChatGPT is clearly a strong resource to collect and integrate large amounts of

information into short, easy to understand concepts. This is an excellent starting point to gain a broad overview of a subject, both for those just beginning to study radiology and those with a strong knowledge base trying to pick up something new. Common pitfalls come in the forms of overgeneralization that occurs with simplification, not requesting further relevant but missing information, and in misinformation generated from false or misappropriated sources. Similar to Wikipedia, ChatGPT may be an excellent launch point for learning, with deeper dives into citations and other resources needed to confirm and add nuance. As we saw above, a “human touch” is still important to sort relevant from irrelevant information in both the initial question and the answers, as well as to identify missing but important data and to ask further questions. Queries must be phrased carefully and precisely—things that may be understood in human interactions due to nonverbal communication or referencing of shared experiences will not translate well. Finally, the same message input entered multiple times will generate different answers, leading to inconsistency between learners and prevents the learner from referring back to the source again, which can make internalization of information difficult.

Importantly, a potential use for ChatGPT and other AI resources not mentioned above include offloading nonradiology or other tasks not directly related to learning. For example, a resident attempting to create a study plan could enter their allotted daily time for studying, beginning and ending days, and resources and goals into ChatGPT to generate a regular, personalized schedule that they can then modify as needed, rather than writing one from scratch. In the future, generating reports may involve simply putting the relevant findings into the engine and editing the output result for clarity and accuracy—analogueously, ChatGPT will be to writing what the calculator is to

math. Performing this now could help residents build a mental model of what a report should look like for a certain type of study. As we saw from the responses generated by ChatGPT itself, AI will create for us—but as of yet it won't be creative for us. Like any other tool, its utility will be what we make of it.

Conflict of Interest

None declared.

References

- 1 Open AI. “ChatGPT.” OpenAI. Accessed on June 28, 2023 at: <https://openai.com/>
- 2 Sethi HS, Mohapatra S, Mali C, Dubey R. Online for On Call: a study assessing the use of internet resources including ChatGPT among on-call radiology residents in India. *Indian J Radiol Imaging* 2023; 33(04):440–449
- 3 Wu J, Wang Y, Zhao A, Wang Z. Lung ultrasound for the diagnosis of neonatal respiratory distress syndrome: a meta-analysis. *Ultrasound Q* 2020;36(02):102–110
- 4 Ahuja CK, Saxena AK, Sodhi KS, Kumar P, Khandelwal N. Role of transabdominal ultrasound of lung bases and follow-up in premature neonates with respiratory distress soon after birth. *Indian J Radiol Imaging* 2012;22(04):279–283
- 5 Malah GM, Hany S, Mahmoud MK, Ali AM. Lung ultrasonography in evaluation of neonatal respiratory distress syndrome. *Egypt J Radiol Nucl Med* 2015;46:469–474
- 6 Dahmoud D, Abed Tawfeq AL- Kayat RH, AL-Awqati TA. The value of the trans-abdominal ultrasound in evaluation of neonatal respiratory distress syndrome. *Iraqi Postgrad Med J* 2017; 16:210–217
- 7 Chen KC, Wu TW, Wu HP. Ultrasonography in neonates with respiratory distress syndrome. *J Med Ultrasound* 2017;25(04): 189–195
- 8 Volpe JJ. *Neurology of the Newborn*. 5th ed. Philadelphia, PA: Saunders; 2008
- 9 Rumack CM, Levine D. *Diagnostic Ultrasound*. 4th ed. Philadelphia, PA: Elsevier Mosby; 2011