


**Review Article**

## Overview of the Potentially Transforming Role of Large Language Models (LLMs) in Creating Patient-Friendly Summaries for Radiology Reports

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### Abstract

Radiology reports typically contain technical terminology and medical jargon that is generally confusing to patients. Large language models such as Generative Pre-Trained Transformer 4 (GPT-4) (Open AI, San Francisco, USA) could play an effective role in bridging the gap between patient comprehension and radiology reports. With the goal of demystifying all of the medical jargon in radiology reports and encouraging patient involvement and understanding, this review paper investigates the possible function of GPT-4 in producing user-friendly summaries. This article demonstrates the capacity of GPT-4 to accurately interpret and simplify various radiological findings in a way that even someone who is not familiar with technical terms can understand. It evaluates how these developments affect treatment plan adherence, patient satisfaction, and overall health outcomes. Additionally, the paper explores the possible drawbacks and moral dilemmas related to applying AI-driven summaries in clinical practice, such as accuracy, privacy, and the requirement for human supervision.

**Keywords:** Large Language Models (LLMs); GPT-4; Radiology Reports; Patient Comprehension; AI-driven Summaries; Patient Engagement.

### Overview

Due to compelling data demonstrating improved patient adherence and compliance with therapeutic standards, patient engagement in healthcare has been a top goal [1]. A key component of high-quality healthcare is effective patient communication, which fosters comprehension, trust, and general patient satisfaction [2]. With the development of electronic health information, patients now have easier access to their medical records, which were designed primarily for physician communication and contained technical medical language that was difficult for the general public to understand [3]. In order to improve their health and level of satisfaction with their care, patients must be able to comprehend their medical records. Patients can take an active role in choosing their course of treatment when they have a clear understanding of these records, which promotes engagement and empowerment. This involvement is essential because well-informed patients are more likely to follow treatment regimens, pose thoughtful questions, and voice concerns about their health, all of which promote a more cooperative and fruitful relationship between the patient and the clinician.

Patient experience is intimately related to clinical safety and effectiveness and is becoming recognised as a quality indicator. This could be partially explained by patient trust leading to compliance with illness management

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[4]. At the moment, the biggest obstacles to patient literacy in reports are complex concepts and words that are difficult for laypeople to understand [5]. The importance of the patient's comprehension increases when it comes to radiology reports, which frequently contain intricate medical jargon and nuanced conclusions. The path of a patient's treatment plan, including diagnosis, follow-up procedures, and general management, can be greatly impacted by radiology data. Rewriting these reports in a way that is more understandable for patients can help to demystify medical information, ease anxiety related to unfamiliar or misinterpreted terminology and improve the patient's capacity to make decisions about their overall treatment.

Digital technology provides creative ways to support and improve both the volume and quality of communication in the current global digitalization race. It is very likely that this digitalization will continue unabatedly. This has been observed in the COVID-19 pandemic recently [6]. The introduction of GPT-4 and other similar sophisticated AI models, offers previously unheard-of capabilities to further transform the health care industry.

### Patient Involvement in Medical Practice

Appropriate patient engagement and involvement in their healthcare plan has become a critical metric in improving health outcomes and, ultimately, patient happiness. Additionally, the clinicians will find it simpler to engage and connect with the patient, which strengthens the highly valued doctor-patient bond. Patient and family engagement is defined as an active partnership across several levels of the healthcare system, including direct care, organisational design, governance, and policy-making, with the goal of improving healthcare, as stressed by Krist et al. [7]. The shift from informed consent to shared decision-making places an emphasis on an equitable information exchange while honouring patients' choices and values.

Patient-centeredness, patient education, and patient empowerment are acknowledged as essential elements in raising the calibre and effectiveness of healthcare services, according to healthcare quality principles [8]. Raising the standard of care increases the probability of reaching the intended result, which enhances patient satisfaction and lowers the risk of anxiety [9].

It is known that social determinants based on socioeconomic class, ethnicity, and other characteristics have an impact on literacy and engagement. To lessen these differences, community engagement initiatives and communication that is both linguistically and culturally appropriate are required.

### Involvement of Patients in Radiology

A collaborative healthcare environment, improved comprehension of radiographic results, and improved patient

outcomes can all be made possible by increased patient participation in radiology. Patient engagement in radiology involves more than just providing imaging results; it also includes knowing and being able to access radiological information, as well as the consequences of radiological findings for patient care and decision-making.

Cooper et al. [10] emphasise the importance of shared decision-making (SDM) as a fundamental element of radiology's patient- and family-centered treatment. The four main components of SDM in radiography are information access, information understanding, information assessment, and knowledge application in healthcare decision-making. This paradigm places a strong emphasis on the role radiologists play in not just providing imaging results but also making sure patients are able to actively engage in their treatment decisions and understand their results. The potential for radiology to significantly contribute to patient-centered care is highlighted by the encouragement given to radiologists to help patients access imaging results, use multimedia reports to aid in patient comprehension, and interact directly with patients to clarify findings and discuss next steps.

The possibility of enhancing patient communication through radiology report readability is explored by Trofimova et al. [11]. The study points to a weakness in the way radiology reports are currently used, which is that patients frequently find them difficult to understand due to their frequent use of technical terms and jargon. The authors argue that radiology may play a key role in improving patient understanding and participation by supporting reports that are written at a level that is understandable to patients. By guaranteeing that patients are active players in comprehending and acting upon their imaging results, in addition to being recipients of imaging services, this method is consistent with the larger objective of making radiology more patient-centered.

According to a comprehensive study by Nickel et al., patients who try to comprehend medical jargon are more likely to feel anxious, believe their condition is more severe, and choose more harsh therapies [12]. The fact that imaging reports are becoming more readily available immediately raises this worry. Patients could benefit greatly from having instant access to understandable imaging findings since better informed patients are more likely to follow treatment regimens.

Together, these viewpoints highlight how radiology's place in patient care is changing. A healthcare model that values and prioritises patient involvement can greatly benefit from radiology's adoption of tactics targeted at enhancing access, comprehension, and engagement. This change affirms radiology's vital position in the multidisciplinary healthcare team and may also lead to better patient outcomes and satisfaction. By making these efforts, radiology can strengthen its position as a vital component of patient-centered care, improving the general efficacy and quality of healthcare provision.

## GPT-4's Evolution and History

With the emergence of Large Language Models (LLM), artificial intelligence is revolutionising radiology reporting. A new use for LLM is summarisation of radiology reports, and the goal has been gradually attained. When provided with a range of cues, LLMs can produce text that resembles that of a human being since they have been trained on enormous volumes of text data to provide high-quality language predictions. The state-of-the-art LLM Generative Pre-trained Transformer 4 (GPT-4) can read and translate radiological records, which include technical terms and intricate details, into comprehensible summaries that are available in several languages.

Tracing its lineage back to the first GPT model unveiled in 2018, the journey of GPT-4 starts with the foundational advancements in artificial intelligence and natural language processing developed by Open AI. Every iteration of GPT has marked a significant leap in AI's (artificial intelligence) ability to understand and generate human-like text. A number of technological advancements have been made from GPT to GPT-4, with GPT-4 and GPT-4o being the most advanced. The groundwork for it was laid by the groundbreaking transformer architecture, which brought in self-attention mechanisms. As a result, the model was able to interpret and produce text with previously unheard-of subtlety and complexity. In order to capture the diversity of online content and the range of human knowledge, the creation of GPT-4 was based on the examination of large datasets. Its predecessors, most notably GPT-3, enabled applications ranging from writing aid to coding by setting new standards for AI's capacity in language generation and understanding. Particularly in specialised domains like radiology, GPT-4 represents a quantum leap in the potential of AI with its larger knowledge base and highly honed algorithms. In this area, GPT-4's sophisticated linguistic and contextual comprehension translates into its capacity to produce precise, understandable summaries of intricate radiological data, filling in the knowledge gap between patients and technical medical information. This development highlights a more general pattern of fast development in AI technology, and GPT-4 is proof of this continuous innovation and its revolutionary potential in healthcare and other fields. Several other similar LLMs have been and are being developed by other groups/companies.

## GPT-4 and Patient Friendly Summaries

When LLMs, like Chat GPT, are used to create patient-friendly summaries of radiological data, it is a revolutionary step towards improving patient understanding and involvement in their own care. Asser Abou Elkassem et al. [13] talk about ChatGPT's ability to make radiology reports simpler. They describe how ChatGPT can improve the reading of radiology reports by prompting users to translate

medical texts into simpler English. It is also highlighted how allowing people to engage in conversational interactions with the model may lead to increased patient involvement.

An empirical investigation by Li et al. [14] shows that using ChatGPT to streamline radiology reports across key imaging modalities significantly improves readability scores. Their results highlight the effectiveness of Chat GPT in demystifying complicated radiological knowledge, showing a significant decrease in the Flesch-Kincaid reading level and an increase in the Flesch Reading Ease Score.

By lowering the readability score to a sixth-grade level, Chung et al. showed the new possibility of utilising Chat GPT to generate patient-friendly summaries of prostate cancer MRI findings. This may improve the patient's ability to read and comprehend radiological reports [15].

Figure 1 illustrates a patient-friendly summary created using GPT-4 for a patient who underwent low-dose CT screening for lung cancer.

## Patient friendly summaries in multiple languages

Radiology reports are frequently prepared in English using specialist medical terminology used for healthcare

**Study Type:** Low Dose Lung Cancer Screening CT

**Date of Study:** [Study Date]

**Clinical History:**  
Patient referred for low dose CT lung cancer screening. No known history of malignancy. Non-smoker.

**Technique:**  
Low dose CT of the chest was performed without the use of intravenous contrast.

**Findings:**

**Lungs and Pleura:**

- No evidence of pulmonary nodules or masses.
- The lung parenchyma is clear without evidence of infiltrates or consolidation.
- No pleural effusions or pneumothorax.

**Liver:**

- Incidentally noted is a focal lesion in the right lobe of the liver, measuring approximately [size in cm], with characteristics consistent with a simple cyst. No other liver lesions identified.

**Other Findings:**

↓

- The visualized portions of the upper abdomen are unremarkable.
- No enlarged mediastinal or hilar lymph nodes.
- The heart and great vessels are within normal limits for age.

**Impression:**

1. No evidence of primary lung cancer identified on low dose screening CT.
2. Incidental finding of a focal lesion in the right lobe of the liver, likely representing a simple cyst. Given the lesion's characteristics, it is likely benign.

**Recommendations:**  
Considering the likely benign nature of the liver lesion identified, further evaluation with ultrasound can be considered to confirm its cystic nature if clinically warranted. If the patient has a history of malignancy or if there are clinical concerns, further evaluation with MRI or contrast-enhanced CT for characterization may be advised. In the absence of any concerning features, clinical correlation and observation with follow-up imaging in 6-12 months can be considered to ensure stability.

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**Radiologist:**

**Figure 1a:** Original report depicting an incidental liver lesion

ChatGPT

Patient-Friendly Summary of Your CT Scan

Dear [Patient Name],

We recently performed a special type of CT scan on your chest, known as a low dose lung cancer screening, because of its ability to check for early signs of lung cancer using a lower amount of radiation. I'm here to share the results with you in a way that's easy to understand.

What We Found:

- **Lungs:** Good news! We didn't find any signs of lung cancer or any unusual growths in your lungs. Your lungs are clear, and there are no signs of infection or fluid buildup.
- **Liver:** While we were looking at your scan, we noticed a small spot on the right side of your liver. It looks like a simple cyst, which is a small, fluid-filled sac. These are quite common and usually don't cause any problems.
- **Everything Else:** We also had a quick look at some other areas visible in the scan, like your heart and the major blood vessels, and everything appears normal.

What Does This Mean for You?

The spot on your liver is likely nothing to worry about, as these cysts are often harmless. However, it's always good to be thorough. We suggest two possible steps:

- **Option 1:** We can check this cyst more closely with an ultrasound, which is a simple and painless
- **Option 2:** If you or your doctor have any concerns, or if there's a history of other health issues, we might use a different type of scan, like an MRI or a CT with dye, to get a better look.

If there are no particular concerns, we might just keep an eye on it with another scan in 6 to 12 months to make sure it's not changing.

What's Next?

Your doctor will discuss these results with you and help decide if any further steps are needed based on your overall health and medical history. It's always important to keep us informed about any changes in your health or if you have any concerns.

We're here to answer any questions you have and support you in any way we can. Thank you for entrusting us with your care.

Sincerely,

[Your Radiologist's Name]

Figure 1b: Screenshot of the GPT-4-generated patient-friendly summary

professionals in a variety of specialties. It may be difficult for patients to understand these reports because of the large variations in health literacy and the diversity of first languages spoken by them. Reports for the general public can be produced using Chat GPT, which can also translate them into more than 40 languages and adjust them to different educational backgrounds [14]. Customised reports based on a patient's primary language and level of health literacy may improve their understanding and empower them to take an active role in their care. This interaction may result in a cooperative effort and in developing individualised care plans that suit their particular requirements and preferences.

The patient-friendly summaries produced by GPT-4 for the identical report used in Figure 1 are displayed in Figure 2 below.

Pitfalls and Risks

This review emphasises how sophisticated language models, like GPT-4, can greatly enhance patients' comprehension of radiological reports and their involvement. It is imperative to acknowledge, however, that these models are not currently recognised as regulated medical devices, and their use in healthcare requires strict supervision, assessment,

ChatGPT

Resumen amigable para el paciente de su tomografía computarizada

Estimado/a [Nombre del Paciente],

Recientemente realizamos un tipo especial de tomografía computarizada en su pecho, conocida como un examen de detección de cáncer de pulmón de baja dosis, debido a su capacidad para verificar signos tempranos de cáncer de pulmón utilizando una menor cantidad de radiación. Estoy aquí para compartir los resultados con usted de una manera fácil de entender.

Lo que encontramos:

- **Pulmones:** ¡Buenas noticias! No encontramos signos de cáncer de pulmón ni ningún crecimiento inusual en sus pulmones. Sus pulmones están claros y no hay signos de infección o acumulación de líquido.
- **Hígado:** Mientras mirábamos su escaneo, notamos una pequeña mancha en el lado derecho de su hígado. Parece ser un quiste simple, que es un saco pequeño lleno de líquido. Estos son bastante comunes y generalmente no causan problemas.
- **Todo lo demás:** También echamos un vistazo rápido a algunas otras áreas visibles en el escaneo, como su corazón y los principales vasos sanguíneos, y todo parece normal.

¿Qué significa esto para usted?

La mancha en su hígado probablemente no es nada de qué preocuparse, ya que estos quistes a menudo son inofensivos. Sin embargo, siempre es bueno ser minucioso. Sugerimos dos pasos posibles:

- **Opción 1:** Podemos examinar este quiste más de cerca con una ecografía, que es una prueba simple y sin dolor que utiliza ondas de sonido para crear imágenes del interior de su cuerpo.
- **Opción 2:** Si usted o su médico tienen alguna preocupación, o si hay un historial de otros problemas de salud, podríamos utilizar un tipo diferente de escaneo, como una resonancia magnética o una tomografía computarizada con tinte, para obtener una mejor vista.

Si no hay preocupaciones particulares, podríamos simplemente vigilarlo con otro escaneo en 6 a 12 meses para asegurarnos de que no esté cambiando.

¿Cuáles son los próximos pasos?

Su médico discutirá estos resultados con usted y ayudará a decidir si se necesitan pasos adicionales según su salud general e historial médico. Siempre es importante mantenernos informados sobre cualquier cambio en su salud o si tiene alguna preocupación.

Estamos aquí para responder cualquier pregunta que tenga y apoyarlo de la manera que podamos. Gracias por confiarnos su cuidado.

Atentamente,

[Nombre de su radiólogo]

Figure 2a: Spanish-language patient-friendly summary produced by GPT-4

and validation by medical professionals for each unique situation.

Fifteen radiologists assessed the quality of the radiology reports created by Jeblick et al. using ChatGPT. Even while the reports were largely accepted as accurate and safe, there were several mistakes and omissions that suggested a possible risk to the patients. According to their study's findings, ChatGPT has the potential to improve patient-centred care, but for safe usage in healthcare, it still has to be further refined and supervised by medical professionals [16]. GPT-4, like previous GPT models, has limitations despite its potential. One prominent shortcoming of GPT-4 is the occurrence of "hallucinations," where the model could offer persuasive but wrong or invented facts, potentially leading to erroneous interpretations. It is not entirely dependable, has a limited context window, and does not learn from experience [17].

Given the sensitive nature of medical data, data privacy protection is particularly important. To safeguard patient



ChatGPT

Résumé convivial pour le patient de votre scan CT

Cher/Chère [Nom du Patient],

Nous avons récemment effectué un type spécial de scan CT sur votre poitrine, connu sous le nom de dépistage du cancer du poumon à faible dose, en raison de sa capacité à vérifier les signes précoces du cancer du poumon en utilisant une quantité réduite de rayonnement. Je suis ici pour partager les résultats avec vous d'une manière facile à comprendre.

Ce que nous avons trouvé :

- **Poumons :** Bonne nouvelle ! Nous n'avons trouvé aucun signe de cancer du poumon ou de croissance inhabituelle dans vos poumons. Vos poumons sont clairs et il n'y a aucun signe d'infection ou d'accumulation de liquide.
- **Foie :** Pendant que nous examinons votre scan, nous avons remarqué une petite tache sur le côté droit de votre foie. Il semble s'agir d'un kyste simple, qui est une petite poche remplie de liquide. Ces kystes sont assez communs et ne causent généralement pas de problèmes.
- **Autres découvertes :** Nous avons également jeté un coup d'œil rapide à certaines autres zones visibles dans le scan, comme votre cœur et les principaux vaisseaux sanguins, et tout semble normal.

Qu'est-ce que cela signifie pour vous ?

La tache sur votre foie est probablement sans danger, car ces kystes sont souvent inoffensifs.

Cependant, il est toujours bon d'être minutieux. Nous suggérons deux étapes possibles :

- **Option 1 :** Nous pouvons examiner ce kyste de plus près avec une échographie, qui est un test simple et indolore utilisant des ondes sonores pour créer des images de l'intérieur de votre corps.
- **Option 2 :** Si vous ou votre médecin avez des préoccupations, ou s'il y a des antécédents d'autres problèmes de santé, nous pourrions utiliser un type de scan différent, comme une IRM ou un CT avec colorant, pour mieux voir.

Si il n'y a pas de préoccupations particulières, nous pourrions simplement surveiller cela avec un autre scan dans 6 à 12 mois pour s'assurer qu'il n'y a pas de changement.

Quelles sont les prochaines étapes ?

Votre médecin discutera de ces résultats avec vous et aidera à décider si des étapes supplémentaires sont nécessaires en fonction de votre santé générale et de vos antécédents médicaux. Il est toujours important de nous tenir informés de tout changement dans votre santé ou si vous avez des préoccupations.

Nous sommes ici pour répondre à toutes vos questions et vous soutenir de toutes les manières possibles. Merci de nous avoir confié votre soin.

Cordialement,

[Nom de votre radiologue]

**Figure 2B:** Patient-friendly summary in French produced by GPT-4

privacy, GPT-4 must make sure that it complies with stringent regulations like HIPAA. Furthermore, there are a lot of ethical questions, especially with relation to patient permission and the transparency of AI decision-making. Patients must be adequately told about the potential for GPT-4 errors and the precautions that can be taken to reduce those chances.

## Summary

Generative Pre-trained Transformer 4 (GPT-4) offers a promising advance in improving the readability and comprehensibility of radiology reports for patients. By converting complicated medical information into clear, concise summaries, this technology has the potential to completely transform patient involvement and give individuals the power to actively participate in their healthcare decisions. The significance of developing patient-centric approaches in radiology is emphasised by this review, which also shows how GPT-4 can help patients and healthcare practitioners

work together to create a better educated patient community.

Nevertheless, there are risks and difficulties associated with integrating GPT-4 and related AI technology in the healthcare industry. In order to prevent misinterpretations that could influence clinical decision-making, this review emphasises the necessity of strict oversight and ethical considerations, including protecting data privacy and verifying the veracity of information generated by AI.

In conclusion, GPT-4 is a useful tool in the transition to patient-centered, transparent healthcare. It has the ability to greatly enhance patient satisfaction and healthcare outcomes by promoting greater understanding and involvement. However, in order for it to be implemented successfully, the ethical, privacy, and supervision issues mentioned in this review must be carefully considered.

## References

1. Urquhart R, Liang L, Cako A, et al. Scoping review: patient involvement in hospital health care planning and enhancement. *BMJ Accessible* 8 (2018): e018263.
2. Arosh S, Niccolò S. Rethinking Patient Communication in Radiology and Nuclear Medicine: Finding a Balance for Optimal Care. *Clinical and Translational Imaging* 12 (2024): 225-228.
3. Li H, Gichoya JW, Banerjee I, et al., Decoding radiology records: Potential application of OpenAI ChatGPT to better patient understanding of diagnostic information. *Clinical Imaging* 101 (2023): 137-141.
4. Doyle C, Lennox, Bell. A systematic review of evidence on the links between clinical safety and effectiveness and patient experience. *BMJ Open* 3 (2013): e001570.
5. Kanhai A, Pavan K, Rushabh D. Artificial Intelligence to Enhance Radiology Report Understanding for Patients. *Journal of Biology and Medicine, Yale University*, 96 (2023): 407-414.
6. Rockall AG, Justich C, Helbich T. Increasing the importance of patient communication in radiology: *European Journal of Radiology* 155 (2022): 110464.
7. Aycock RA, Longo DR, Tong ST, involving patients in behaviour modification and decision-making in order to encourage prevention. *Information Services & Use* 37 (2017): 105-122.
8. Barello S, Graffigna G, Vegni E. Patient engagement as a growing challenge for healthcare services: a literature mapping study, *Nurs Res Pract* (2012): 905934.
9. Marzban S, MPH, Najafi M, et al., *Journal of Patient Experience, Impact of Patient Engagement on Healthcare Quality: A Scoping Review*. 9 (2023): 1-12.
10. Cooper K, Kadom N, Vey BL, et al., *The Role and*

- Opportunities of Radiology in Shared Decision Making. in American Journal of Roentgenology 214 (2020): W62-W66.
11. Duszak R, Trofimova A, Vey BL, et al., An opportunity to enhance patient communication is presented by the readability of radiology reports. American College of Radiology Journal 15 (2018): 1182-1184.
  12. Nickel B, Barratt A, Copp T, Moynihan R, McCaffery K. Words do matter: a systematic review on how differing terminology for the same ailment effects management preferences, BMJ is open. 7 (2017): e014129.
  13. Smith AD, Elkassem AA. Possible Applications of ChatGPT for Reporting in Radiology. American Journal of Roentgenology 221 (2023): 373–376.
  14. Li H, Gichoya JW, Banerjee I, et al., Decoding radiology records: Potential application of OpenAI ChatGPT to better patient understanding of diagnostic information. Clinical Imaging 101 (2023): 137–141.
  15. Acceptability and viability of radiology report summaries produced by ChatGPT for cancer patients Digital health 9 (2021): 1-7.
  16. Jeblick K., Schachtner B, Dextl J, et al., An exploratory case study on simplified radiology reports using ChatGPT makes medicine easy to swallow. Eur Radiol 34 (2023): 2817-2825.
  17. Christopher Berner. GPT-4 Technical Report, Open AI (2023).