Fully understanding the details of treatments, medical procedures and post-operative instructions is essential for patients to make informed decisions about their health. The potential of AI to adapt highly specialised medical texts to the level of patient understanding opens up new opportunities for more effective healthcare communication.

# ARTIFICIAL INTELLIGENCE AT THE SERVICE OF PATIENTS

## Using ChatGPT to make medical reports easier to understand

**Adéla Koťátková and Manuel Miralles Hernández**

In this article, we explore the potential of artificial intelligence (AI) as a tool to improve doctor–patient communication, particularly in the reinterpretation of medical reports. We explore the use of chatbots such as ChatGPT to adapt and simplify complex medical texts for patients. We also highlight the benefits of AI in improving the readability of reports, with a pilot study demonstrating a 19–31% improvement in patient understanding. Next, we emphasise the need for human oversight, particularly to ensure the accuracy and confidentiality of clinical information. Finally, we mention future applications, including multilingual adaptation and tools to support doctor–patient conversations.

Keywords: **artificial intelligence**, **medical reporting**, **chatbots**, **patient understanding**, **doctor–patient communication**.

Historically, the doctor–patient relationship has been characterised by a benevolent, paternalistic approach. Its origins, which date back to ancient Greece, were incorporated into Christianity and remained unchanged until relatively recently. This model implies a strictly vertical hierarchical relationship between the doctor as an active figure and the patient in a passive role. This dynamic is based on the perception that patients have a certain lack of moral capacity, autonomy, or decision-making ability, a perspective that tends to infantilise them. Patients are seen as passive objects without the right to receive information about their condition, disease, or treatment, and it is argued that they would not understand this information anyway, because they do not have the capacity to comprehend it.

However, with the emergence of the psychosocial theories of Josef Breuer and Sigmund Freud, and the

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social changes that defended human rights, interest in refocusing on the wellbeing of patients has been growing. This evolution culminated in the development of *patient-centred care*, the dominant paradigm in medical practice today. This new approach seeks to understand and care for the person, not just their illness, and to involve the patient in making decisions about their own health. This school of thought contends that active patients are *empowered* patients (Pekonen et al., 2020), in other words, they have the ability to make decisions, meet needs, and solve problems, with critical thinking and control over their lives and health. However, in order to achieve this, it is essential that they have sufficient information and that it is correctly understood.

In this sense, several studies (DeSai et al., 2021; Estopà & Domènech-Bagaria, 2019; Toledo-Chávarri et al., 2016) support the idea that a full understan-

ding of the details of treatments, medical procedures, and postoperative instructions is essential for patients to make informed decisions about their health. Other work (Gómez González et al., 2023) has highlighted that well-informed patients tend to be more diligent in following the recommendations of healthcare professionals and are more likely to follow medical protocols and actively participate in their treatment process.

In this context, it is crucial to highlight the risk associated with patients seeking medical information mainly from unofficial websites. A lack of understanding of the documents provided by healthcare professionals can lead to widespread mistrust of the healthcare system and motivate the search for alternative sources online. However, the proliferation of false, alarming, or inaccurate information in the virtual environment can lead to confusion, fear, anxiety, and dangerous decisions such as self-diagnosis or self-medication. Many untrained health influencers now offer dubious advice on disease prevention and treatment on easily accessible social network platforms. Such advice ranges from harmless practices such as putting a glass of water on your head to relieve a migraine or using an alcohol-soaked cotton ball to treat a hangover, to dangerous suggestions such as applying lime juice to the eyes to treat conjunctivitis, injecting disinfectants to treat COVID-19 or, most famously, curing the common cold with antibiotics. There is therefore an urgent need to optimise communication with patients to ensure that they not only have access to relevant information, but that they also fully understand it.

In this context, the recent development of new tools based on artificial intelligence (AI) applications has opened up a new perspective that allows patients to improve the comprehensibility of medical language, bringing them closer to doctors and helping them make decisions about their illness.

### ■ ARTIFICIAL INTELLIGENCE AND CHATBOTS

In mid-November 2022, a major event took place in the field of AI with the appearance of ChatGPT, a new generation chatbot based on computational linguistics techniques, with the ability to interpret and generate texts in several languages. Although ChatGPT is probably the most popular and most widely used by non-specialists, there are other platforms on the market with applications as diverse as translation, marketing and business management, data collection and analysis, web page generation, or social network management. There is still no consensus on the scope of AI, but ChatGPT itself defines it as «the discipline responsible for endowing machines with human-like cognitive abilities to enable them to perform complex tasks autonomously».

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Written information lasts over time because patients can take home the documents provided by healthcare professionals. This material lends itself to repeated reading, allowing patients to go back and forth through it, picking up details that may have initially escaped them so they can reflect on the content with a more thoughtful perspective.

These algorithms were formally designed for prediction or decision making and require the processing of huge amounts of data – so-called big data – that cannot be analysed with conventional software. These systems can make decisions and learn from their results, i.e., they can perform actions that do not need to be explicitly programmed, a capability known as *machine learning* or ML (Dorado-Díaz et al., 2019).
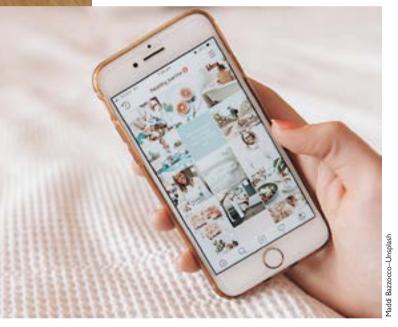
ML sometimes requires human oversight, not only to control the process but also to validate its effectiveness. For example, a recent study of a new chatbot, Med-PaLM 2, found that it was 86.5% accurate on quiz-style exams (Singhal et al., 2023), such as the MIR exam that Spanish medical doctors must pass before starting their specialisation (Mediavilla, 2023).

An even more sophisticated type of ML is one that simulates multiple levels of repeated processing, similar to the connections between layers of neurons in the brain (neural networks). This system, called *deep learning* (DL), is used to analyse datasets with more complex patterns, including speech processing, robotics, or even image reconstruction and analysis (Dorado-Díaz et al., 2019). However, because of their versatility and ease of interaction with the user, chatbots are the most well-known tool associated with AI.

To date, conversational bots have been used in a variety of areas in medicine including to answer frequently

asked questions, collect patient data, help patients request and manage medical appointments through websites, as interactive tools for symptom self-care and triage, remote symptoms monitoring, promotion of health education by making relevant scientific information available to interested individuals, and even to implement mental and physical health programmes (Giansanti, 2023).

Other types of AI are mainly applied in healthcare to facilitate diagnosis in different specialties, such as psoriasis and skin cancer in dermatology, early detection of diabetes in endocrinology, grading of diabetic retinopathy in ophthalmology, genomic analysis to detect rare diseases, identification of images suggestive of malignancy in histological sections, or prediction of arrhythmias or myocardial infarction in cardiology (Dorado-Díaz et al., 2019; Hamet & Tremblay, 2017).

However, the medical application of AI has had its greatest impact in the field of radiology, particularly in diagnosing magnetic resonance imaging and computed tomography scans. New algorithms for 3D image segmentation and reconstruction have made it possible to improve workflow and diagnostic accuracy through DL techniques. In addition, combining its use with biological and genetic markers opens up new possibilities not only for diagnosis, but also for personalised and precise treatments (Cowen, 2023).

This range of medical uses has increased the response and interest in AI in the mainstream scientific publications, which have developed sections or even created new specialised journals specifically for these technologies. Examples include *Nature* (*Nature Machine Intelligence*), *New England Journal of Medicine* (*NEJM AI*), and *The Lancet* (*Lancet Digital Health*).

However, communication still remains one of the biggest challenges in healthcare. Thus, the emergence of ChatGPT and other chatbots still in development has marked the beginning of a new era in improving doctor–patient interactions. Indeed, within weeks of the initial launch of ChatGPT, the first articles were published exploring the possibilities of AI in patient-centred written communication (Navarro, 2022). Some highlighted its potential to adapt highly specialised medical texts to the level of understanding of patients, opening up new opportunities for more efficient communication in healthcare.

Maddi Bazzocco–Unsplash

A lack of understanding of the documents provided by healthcare professionals can lead to widespread mistrust of the healthcare system and motivate the search for alternatives online.

**«The dominant paradigm today seeks to understand and care for the person, not just their illness, and to involve the patient in making decisions about their health»**

## ■ THE DIFFICULTY OF UNDERSTANDING MEDICAL REPORTS

As we have emphasised, it is important that patients understand both the verbal and written information given to them by healthcare professionals about their health. However, our focus is on written communication. The characteristics of this type of communication are very different from those of oral communication. Written information persists over time because patients can take home the documents provided by health professionals. This material lends itself to repeated reading and allows patients to go back and forth, perhaps picking up details that may have initially escaped them, and to reflect on the content with a more thoughtful perspective.

Many different types of written documents may make it into the hands of patients. Among them, however, medical reports stand out as one of the texts containing the most important information about patient health. These reports contain both the diagnosis and prescribed treatment and represent the basic guidelines they must follow during their healing process (Delàs, 2005).

However, medical reports are often complex by nature. They have two intended readers, not just one. On the one

hand, reports are destined for use by other doctors or health professionals, while on the other, they are addressed to patients and their families. Obviously, the two groups have different levels of knowledge about the topic and specific concerns about the content (Domènech-Bagaria et al., 2020). Furthermore, these two groups are only the main audiences: medical reports can have many more users including researchers, documentalists, or lawyers. Thus, these reports are extremely complex types of text aimed at readers with asymmetric medical knowledge and they need to fulfil multiple functions. This asymmetry is particularly evident in the language used, which is characterised by technical terminology, acronyms, and abbreviations that can be impenetrable to non-experts.

The limited time professionals have to write reports exacerbates this aforementioned situation. Time pressure can lead to errors, excessive use of abbreviations, incomplete sentences, and chaotic syntax, making them even more difficult to understand. Their wording, often in the form of hasty notes, accumulates data but provides little explanation, creating a scenario in which patients can feel disconnected from their medical information. In fact, exploration of the experiences of patients illustrates this complexity. Some express frustration: «I don't understand anything because it's full of abbreviations» or «[there are] abbreviations, data and numbers, and I don't really know what they mean» (Toledo-Chávarri et al., 2016).

### ■ ARTIFICIAL INTELLIGENCE FOR REINTERPRETING MEDICAL REPORTS

Thanks to previous studies, such as that by Estopà and Domènech-Bagaria (2019), our own analysis identified the six main areas that cause the most problems for patients: medical terminology, acronyms and other abbreviations, drug names, specific health professional expressions, unclear syntax, and information overload.

Medical reports contain several sections, such as the patient medical history, physical examination, complementary tests, evolution, diagnosis, and treatment, but these vary according to the needs of each speciality or centre. Of course, some of the information is more relevant to patients. In general, they are looking for what is wrong with them and how they can be cured, so their main interest is in diagnosis and treatment. Paradoxically, however, these sections contain most of the elements that make the text difficult to understand (Domènech-Bagaria et al., 2020).

This is where AI can help, given the limited time and resources available in healthcare facilities. In this sense, a joint project developed by the Angiology and Vascular Surgery Service in the La Fe University Hospital in



L. Sapiña

Our analysis identified the six main areas that cause the most problems for patients: medical terminology, acronyms and other abbreviations, drug names, medical jargon, unclear syntax, and information overload. The image shows a patient reading a medical report.

**«Medical reports are extremely complex types of text aimed at readers with asymmetric medical knowledge, but they still need to fulfil multiple functions»**

Valencia and the Department of European Languages and Cultures at the Jaume I University in Castellón, is analysing and developing the best way to use a chatbot to adapt and rewrite these texts for patients. The first step would be to select the most relevant information because, as we have seen, not everything is equally important to patients. For example, instead of an endless list of analysis results such as «red blood cells: 4.45 x 10^6/ µL; haemoglobin: 13.7 g/dL; haematocrit: 43.1%; mean corpuscular volume: 97 fL», the patients could simply be presented with a statement such as «the blood test showed values within normal ranges», which would be much more reassuring.

Secondly, all medical jargon must be 'de-terminologised' or explained. AI allows us to give a short explanation next to the medical term such as «bilateral inguinal hernia (a lump or protrusion of part of the internal organs through the abdominal wall into the groin area)», «pulmonary fibrosis (a disease that damages the lungs)»,

Bilastin 20 mg, etc.), it would be useful to understand what they were prescribed for: e.g., Rosuvastatin 10 mg (statin to reduce cholesterol), Bilastin 20 mg (antihistamine) etc.

It should also be noted that these reports usually contain some medical jargon that may have a double meaning or could even offend the patient. Thus, these need to be adapted and AI can do this. For example, «carrier of 2 coronary stents» could be rendered as «she had two tubes called stents placed in an artery in her heart to help keep the artery open and improve blood flow to the heart». This is a particularly interesting example, because for many people, the primary meaning of *carrier* – especially in relation to health – is that of «carrying a contagious disease». There are also some phrases that are better left out because they can alter the doctor–patient relationship. An example would be a phrase such as «pregabalin, but the patient denies it. The patient denies smoking and drinking». The doctor is implying that because the patient denies using alcohol and tobacco, they may also be lying about using pregabalin (an anti-epileptic drug). So, in summary, the report indicates that the doctor suspects that the patient might be lying.

Finally, the syntax of medical reports is very similar to the notes that professionals take for themselves or for others. It is therefore extremely difficult to understand for those who are not part of their community of practice. AI allows us to reorder information and reconstruct sentences to include verbs, connectors, and apply a more natural order. In this way, we can improve readability and the patient can better see the relationship between different pieces of information.

In the same pilot study, the effectiveness of modifying medical reports using ChatGPT was analysed through a linguistic readability analysis of 50 discharge reports from the La Fe Hospital. The results showed a 19–31% improvement in comprehension and readability, and texts initially classified as *difficult* or *very difficult* were subsequently classified as *normal or not difficult* (unpublished data; La Fe Hospital, 2023).

### ■ LIMITATIONS OF CHATBOTS IN THE REISSUE OF MEDICAL REPORTS

Despite the obvious benefits, the use of ChatGPT and other bots to rewrite medical texts can constitute a breach of clinical and patient confidentiality. Given the sensitive nature of the information contained in medical reports, specialist supervision and ratification by medical staff is essential.

Nevertheless, the growing awareness of the risks associated with AI, including chatbots, is leading to new regu-

The main points of interest for patients are diagnosis and treatment. Paradoxically, these sections usually contain most of the elements that make the text difficult to understand. Given the limited time and resources available in healthcare facilities, this is where AI could help.

«shingles (a viral infection that causes pain and blisters on one side of the body)», or «right-sided hypoacusis (hearing loss)».

On another note, original medical reports tend to be full of acronyms that are often impossible for non-experts to decipher. What is more, when we search for these acronyms or abbreviations on the internet, there is very often more than one possibility. In fact, in most cases, there are dozens of possible meanings for the same letters. This polysemy is one of the biggest problems affecting comprehension in healthcare contexts. The advantage of AI is that it does not need to be fed a list of acronyms and their meanings, the bot will look for them in context. Therefore, if we see the abbreviation AAA in a vascular surgery report, the AI will interpret it as «abdominal aortic aneurysm» and not, for example, «acquired aplastic anaemia», or «American Automobile Association».

It is also a good idea to include a brief explanation of the prescribed or recommended medications in patient-adapted reports. This is particularly important if patients have to take more than one medication because they may forget which medication treats which symptom. This can be detrimental to patient health, because if they disregard their treatments and simply take their medicines if and when they like, they may think they do not need them, mix them up, or change the dose, etc. Furthermore, medicine packaging does not indicate the purpose (nor would it be possible to do so), making it difficult for patients to organise them. So, in medical reports, instead of finding a list of obscure names (Rosuvastatin 10 mg,

lations in different countries. In Europe, for example, this protection is guaranteed by the General Data Protection Regulation (GDPR), which requires the informed consent of the interested party and guarantees the right not to be subject to an automated process (Article 22), although a simple human intervention, such as a revision, invalidates its application (AEPD, 2020).

On the other hand, the introduction of errors or *hallucinations* – as they are known in AI jargon – is an inherent risk in the design of the underlying algorithms. In addition, all AI systems have biases as a result of their design or training databases. The generation of false or biased information is currently one of their main limitations, although this problem has been partially corrected in later versions of ChatGPT 4. Although its potential performance is not fully known, the increase in the number of parameters (sources) used by AI allows, in principle, more consistent and precise answers.

## ■ FUTURE APPLICATIONS

While the media focuses on the risks to humanity associated with AI, this project is a positive example of how this technology can be used to benefit patients and their communication with doctors.

However, it is imperative to address the potential risks associated with the use of AI in this context. We need to ensure that its use does not replace interpersonal communication between health professionals and patients. Moreover, the tailored report generated by AI should be seen as a support tool for both, promoting better understanding and facilitating communication, without replacing human interaction. It is vital that healthcare professionals maintain open and clear communication with patients, using tailored reports as a tool to improve transparency and mutual understanding.

Another possibility is to use AI to adapt reports to different languages. For example, from an original report written in Spanish, we can obtain an adapted version in Catalan or English, which can significantly improve communication and patient understanding.

Finally, the development of online support tools for doctor-patient conversations may seem a long way off, but it is possible. These would include some form of visual or auditory warning that the doctor is using overly complex language and is in danger of losing the linguistic and emotional connection with the patient.

In any case, despite the criticisms and warnings about the risks, such as the potential loss of jobs, AI and chatbots are already fully integrated into our lives. Thus, it is our responsibility to embrace the opportunities they offer us as helpful tools, while neutralising or minimising their threats by using them appropriately and responsibly. ⊕

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