AI language models are transforming the medical writing space – like it or not!

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Abstract

Whether you're an early adopter, an occasional user, or yet to acknowledge its transformative potential, artificial intelligence (AI) – specifically generative AI applications underpinned by large language models – is undeniably shaping our present and destined to influence the future of medical writing. Achieving a comprehensive understanding of these models can pave the way for their optimal application in areas where they excel. Additionally, this understanding helps to maintain a realistic, balanced perspective, allowing us to avoid the pitfalls associated with excessive or unfounded fear stirred by the current AI hype and related exaggerated promises.

A selection of AI applications offers insights into specific tasks for which generative AI can be effectively utilised. These applications can truly make a difference by saving time, streamlining workflows, and potentially enhancing the quality of the resulting outputs.

Introduction

In an era of rapid technological progression, artificial intelligence (AI) language models have emerged as transformative forces, significantly altering traditional workflows and methodologies across many fields, including medical writing.

As medical writers preparing for an AI-dominated future, we need to understand how these AI language models work. It will allow us to truly leverage their potential, comprehend their capabilities and limitations, and integrate them effectively into our writing processes.

Many of us tend to view the quantity of training data and parameters as crucial determinants of a model's performance. Indeed, we get all hyped up when respective players announce that the next-generation AI language model will be trained on x amount more data or are tailored towards a more specific subject, additionally claiming enhanced speed, reliability, and accuracy. Yet, are these factors truly game-changing? Maybe not exclusively. The intrinsic nature of the model, the underlying algorithms, and their data processing methodologies hold equal significance.

Therefore, let's aim to grasp the mechanics of AI language models before delving into their practical applications.

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Understand AI language models and their limitations

Behind the scenes – Terminology

A **large language model (LLM)** is a deep learning technique, and a subset of machine learning, that uses artificial neural networks to analyse immense volumes of data, unveil intricate patterns, and guide decision-making. Through extensive training on massive datasets, LLMs develop an unparalleled capacity to recognise, comprehend, predict, and generate novel content spanning myriad domains (Figure 1).

The term **generative AI (genAI)** refers to all AI tools that use LLMs to primarily create content such as images (e.g., Midjourney or Stable Diffusion), text (e.g., GPT-4, PaLM, or Claude), code (e.g., Copilot), or audio (e.g., VALL-E or resemble.ai) in response to short **prompts**. To process a prompt, its words need to be converted into a model-readable input format, such as vectors or tokens.

Tokens can be as small as individual characters or punctuation symbols, or as large as words or even whole sentences, depending on the model and tokenisation method (e.g., rule-based, statistical, neural). This process of breaking down text into individual units is called **tokenisation** (Figure 2).
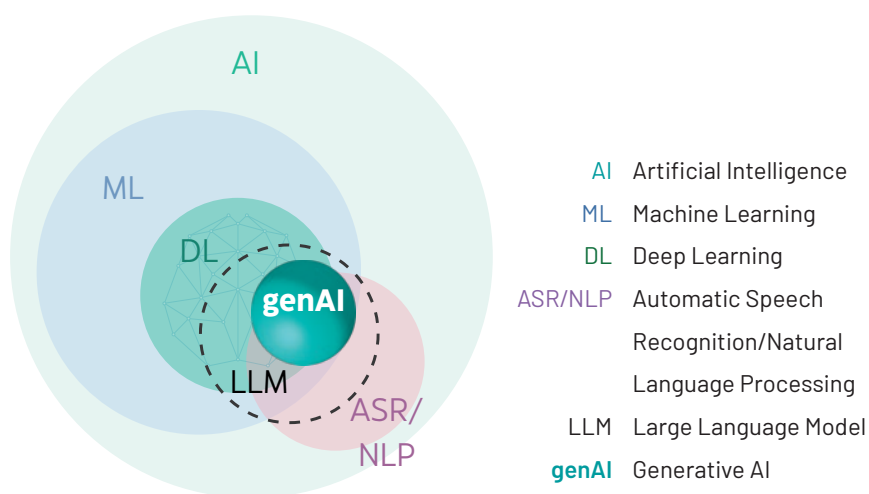

Figure 1. Large language models (LLMs) and generative AI (genAI) as a subset of artificial intelligence (AI)

Tokens are processed by assigning each token a numerical ID as AI models can only process numerical data.

Modern LLMs and hence genAI tools successfully apply **transformer architecture** (Figure 3). Two key features define transformers: the *encoder-decoder* structure and the *attention mechanism*. The encoder processes the input data and generates a set of context vectors. Using these vectors, the decoder generates the output by selecting the token with the highest probability in a sequence of tokens. The attention mechanism, a crucial element in transformers, assigns a weight to an input token, guiding the model on where to focus during output generation. This process enables the model to manage long-range data dependencies, effectively equipping the model with long-term memory (Figure 3).

> In simple terms, these models are mathematical functions supported by powerful computing capabilities, but they cannot think.

When a prompt is submitted to an AI language model, it generates the response by selecting the most likely next token based on calculated context and specific rules/settings. That means tokens/words are chosen based on their likelihood to follow.

In simple terms, these models are mathematical functions supported by powerful computing capabilities, but they cannot think. This is an important factor to consider when assessing the results produced by these AI tools, setting your expectations, and highlighting their limitations.

Sophisticated **prompt engineering**, which involves giving specific and detailed instructions to guide the model in its decision-making or prediction process, can enhance a model's performance. Depending on the task, methods such as **few-shot prompting**, which provides a few input-output examples, **chain of thought**

Tokens | Words | Characters
32 | 23 | 104

Figure 2. Example of tokenisation

Can genAI assist medical writing? Yes it can.

GenAI, and ChatGPT in particular, can be used to assist with many tasks, including:

- Paraphrasing
- Reformatting references to different styles
- Rewriting materials and methods sections
- Explaining statistical tests
- Rewriting abstracts
- Extracting article highlights
- Suggesting keywords
- Writing submission letters
- Summarising scientific articles or medical information for various audiences
- Writing lay summaries
- Repurposing available information for different formats and various audiences
- Creating educational and other training materials such as courses, webinars, presentations, hand-outs
- Compiling product and safety information
- Generating responses to customer inquiries
- Generating scripts for chatbots/virtual assistants and much more.

prompting (CoT), which uses sequential prompts to encourage reasoning or guide the model through complex tasks, and **prompt iteration**, have been found to be most successful in elevating a model's performance.

To avoid confusion, the term LLM/AI language model is used in conjunction with a range of natural language processing tasks, including text generation, translation, content summary, rewriting content, classification and categorisation, sentiment analysis, and conversational AI and chatbots.

OpenAI's GPT-series (the GPT stands for Generative Pre-trained Transformer) is widely recognised as one of the most extensively utilised LLMs at present. ChatGPT, along with its respective plugins, stands out as a prominent representative within this series.

In the following sections, we will focus on

text-generating AI tools and use terminology such as LLM, AI language model, AI assistant interchangeably.

Limitations of AI language models

Despite being trained on increasingly larger datasets, using more parameters and unprecedented computational power, current genAI models are primarily sophisticated "prediction engines". While their performance consistently improves, it is important to remember that their output lacks true comprehension, critical thinking, or consciousness. Consequently, the generated texts have a tendency to be lengthy and articulate replies that could potentially include plausible but inaccurate or biased information. Therefore, it is mandatory that users review the output critically and always check its accuracy, appropriateness, context, and actual usefulness before accepting any result.

Especially in medical writing, text-generating AI tools should be regarded as assistants or a tool in the toolbox supporting workflows, providing a starting base, or helping to overcome writer's block. The human ability to comprehend context, strategise, critically evaluate, and convey nuanced emotions remains irreplaceable.

It is also essential to address privacy concerns when using text-generation tools. Careful consideration should be given to the inclusion of safe input data to prevent the inadvertent sharing of confidential or proprietary information.

The potential disruptiveness of this

Embracing an open mind and adopting a trial-and-error approach will facilitate exploration, learning, and the development of an AI-driven mindset.

technology is not going unrecognised. Many journals and organisations have published guidelines with the intent to regulate the use of text-generation tools for publications (Springer-*Nature*,[1] Elsevier,[2] Taylor & Francis,[3] JAMA Network,[4] the World Association of Medical Editors [and *British Medical Journal*],[5] and the International Committee of Medical Journal Editors[6]).

With a grasp of these basics, you're well-prepared to begin or continue your journey with AI language models. Embracing an open mind and adopting a trial-and-error approach will facilitate exploration, learning, and the development of an AI-driven mindset. Establishing a clear understanding of these models will enable their effective use in workflow areas where they truly excel. This knowledge also helps to maintain a realistic perspective, preventing undue fear or over-enthusiasm sparked by the current AI hype and its associated promises and expectations.

AI tools that can assist medical writers

Besides **ChatGPT** and its respective plugins, hundreds of AI-assisted, text-generating tools are launched weekly or integrated into existing applications as AI assistants. Keeping track of these numerous tools can be daunting for a busy professional. Therefore, below is presented a curated selection of widely accepted tools which could prove valuable to the majority of medical writers (see also Figure 4).

Don't forget

✓ Text-generating AI applications are sophisticated prediction engines; they predict words or tokens based on their likelihood to follow.

✓ Think of them as "word calculators" that use mathematic functions and mechanisms to fill in the gaps/blanks in a data set with the intental ways to provide an answer.

✓ Their performance depends not only on the quantity and quality of their training data or parameters, but also on factors such as model characteristics (transformer architecture, fine-tuning, combination of models), tokenisation method, and human skills (e.g., prompt engineering).
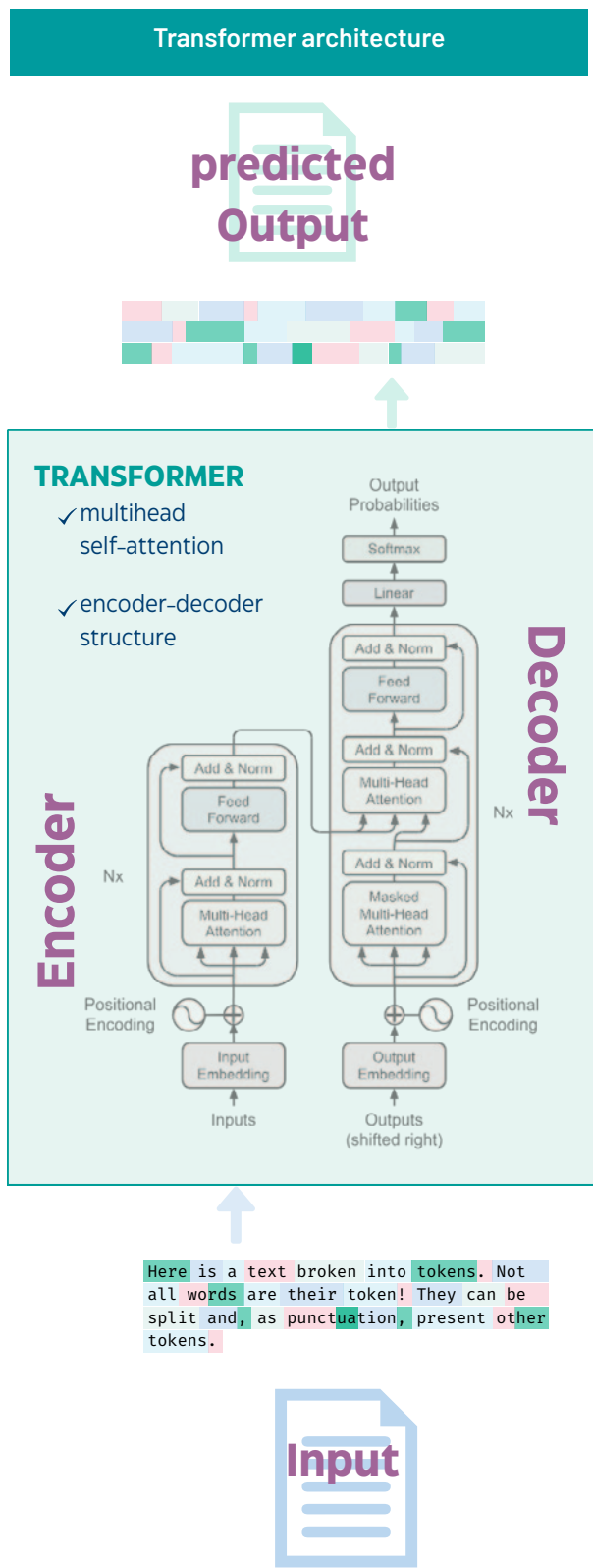
Transformer architecture

Figure 3. Illustration of transformer architecture

Writing and rewriting assistants

Let's start with **Quillbot** and **Wordtune**, two AI-rewriting assistants. Quillbot is a comprehensive paraphrasing tool targeted at improving grammar and enhancing wording; it also features a summariser tool. Its smaller alternative, Wordtune, helps you rephrase, improves tone and word choice, and is able to shorten or expand given text.

Conversation

Another extremely useful application and time-saver is **ChatPDF**. It allows you to chat with uploaded pdfs, such as scientific articles. It can answer specific questions and, when prompted correctly, returns structured responses.

Research plus writing assistance

scite_ is a platform that helps discover and evaluate scientific articles via Smart Citations. Smart Citations allows users to see how a publication has been cited by providing the context of the citation and a classification describing whether it provides supporting or contrasting evidence for the cited claim. Importantly, scite_ offers an integrated conversational AI Assistant, based on GPT-3.5. It can answer questions from a database of 180 million articles, book chapters, and data sets. Just like ChatGPT, it can assist you in the writing process for a plethora of materials.

SciSpace, an AI research assistant, is not only able to read, understand, and explain uploaded scientific literature, but it also comprises a citation generator, paraphraser, and AI detector.

SciSpace Copilot, available as Chrome Extension, can help understand technical language, math, and tables in PDFs, and allows you to organise and annotate materials to keep track of important information. This one is to watch!

Another free AI research assistant is **Elicit**. It assesses publications from Semantic Scholar and helps expedite the literature review process. When queried, it retrieves relevant papers and summarises key information in table format.

In addition, the AI tools **ResearchRabbit** and **Connected Papers** are definitely worth checking out. For these tools, the user provides specific citations (seeding) and the models search and visually map similar work. This greatly speeds up and deepens the discovery phase, no matter what research phase you are in.

Summary plus writing assistance

Scholarcy is an online article summariser tool for articles, reports, and book chapters. It highlights key sections for users to easily save and export summaries to return to at a later date.
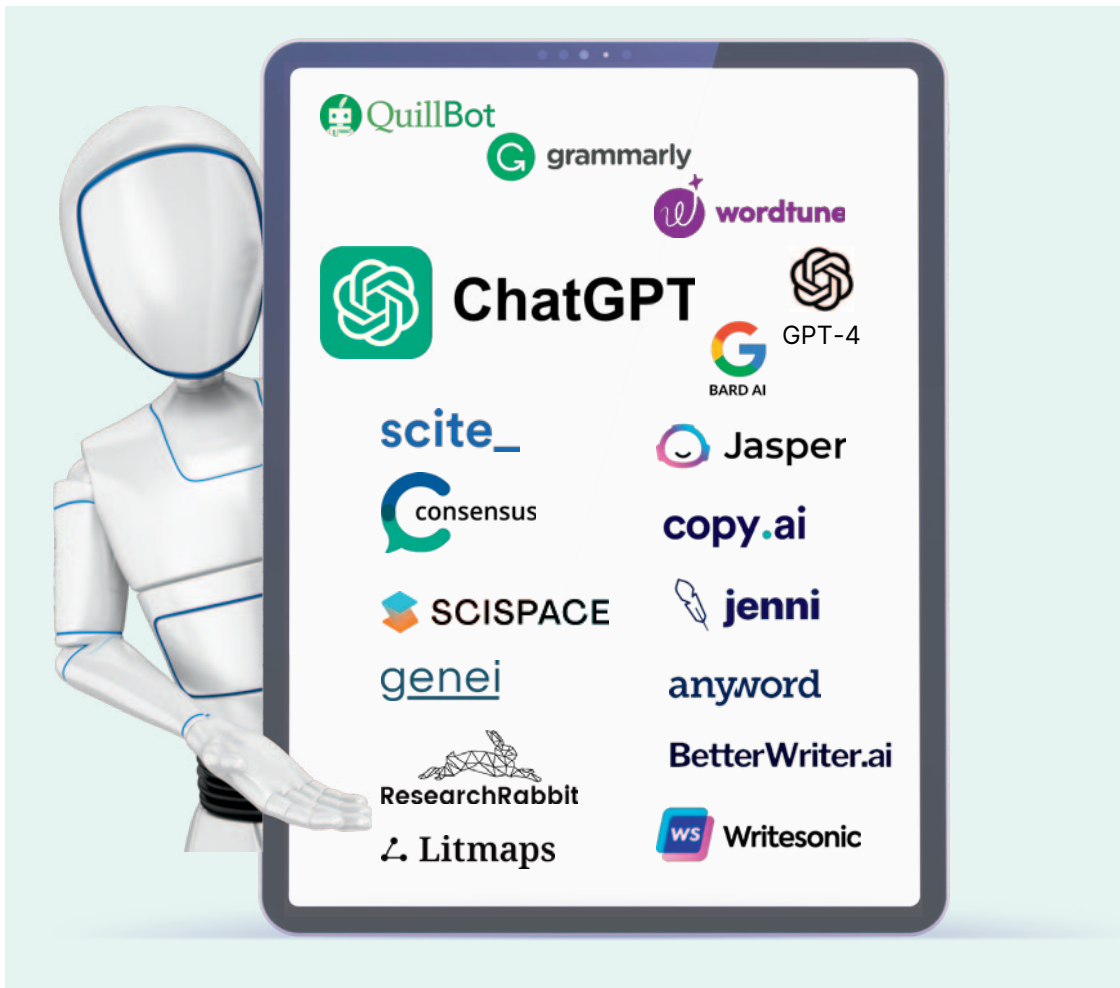
Figure 4. Selection of AI-assisted applications that can support a medical writer's workflow

Unlike Elicit, it can only summarise one publication at a time but in much more detail. It extracts key concepts, a synopsis of the full-text, comparative analysis, and more.

An alternative AI-assisted research and summary tool is **genei**. It is designed to help users improve productivity by quickly extracting key information from articles, analyzing research, and summarizing articles. The paid subscription has the usual GPT-3 capabilities.

Generative AI tools excel in marketing support

GenAI tools have long been embraced in content marketing, where they outperform classical copywriters. From blogs, and website content, to social media posts, email marketing campaigns, newsletters, ads, and much more – genAI is widely adopted.

I recommend trying out **Jasper.ai**, a powerful all-in-one content generation platform trained to write original, creative content for all sorts of marketing assets. It also builds on OpenAI but adds other models to provide tailored solutions to specific content marketing needs. A big plus is that it comes with templates that help you structure and detail your prompts and a plagiarism checker.

Copy.Ai is a valid alternative to Jasper. Another tool, **AI-writer**, searches, writes content, and adds valid references to this content.

Every week, more than 100 new AI tools are released, and it is up to us, the users, to stay informed and check their feasibility to enhance our workflows. Only the most valuable applications will get adopted and survive. It is impossible to predict what the next developments and releases will be and how the tools will integrate and complement each other. Exciting times are ahead!

> *Only the most valuable applications will get adopted and survive.*

Future-proof yourself and let AI amaze you!

AI language models and applications are set to reshape the medical writing space, redefining traditional workflows and methodologies in the process. Navigating this shift requires an open attitude, curiosity, and a commitment to continuous learning. Consider genAI applications as tools in your arsenal. Merely possessing a toolbox isn't enough; you need to know which tool to use for which task and how to use it effectively.

Our unique human abilities – understanding context, strategic thinking, critical evaluation, and conveying nuanced emotions – remain invaluable. They set us apart and play a crucial role in moderating and refining AI-generated output. Harness the potential of these AI tools to boost your productivity and elevate the quality

of your work instead of fighting them.

Crafting credible, evidence-based materials that are accurate, clear, and compelling still demands the expertise of a skilled medical writer. Remember, AI tools are not substitutes but powerful allies in our writing journey. Let's leverage these advancements to build a promising future in medical writing.

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I used ChatGPT (OpenAI, model GPT-4, version May 24, 2023) to rephrase some passages. I reviewed the AI-generated text and edited it as needed. I take full responsibility for the generated content.

Disclaimers

The opinions expressed in this article are the author's own and are not necessarily shared by EMWA. This article was prepared in May 2023 and reflects the status quo at that time. It is intended to provide understandable and memorable background information on AI language models. The importance of the selected tools may have changed by the time of publication.

Disclosures and conflicts of interest

The author is self-employed and declares no conflicts of interest.

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