

Royal College Research Forum

Generative AI and medicine: Transforming competence, learning and practice

October 25, 2023



Chair

**Brian Hodges, MD, PhD,
FRCPC**

Executive Vice-President
Education and Chief Medical
Officer, UHN
Professor, Temerty Faculty of
Medicine, University of Toronto
President, Royal College of
Physicians and Surgeons of Canada



Host

**Tanya Horsley, PhD,
MBA**

Associate Director
Research and Evaluation
Royal College of Physicians
and Surgeons of Canada



Panelist

**Michael Caesar, MBA,
PfMP**

Chief Data & Analytics Officer
UHN Data & Analytics, Adjunct
Faculty, Institute of Health
Policy, Management and
Evaluation University of Toronto



Panelist

Devin Singh, MD, FRCPC

Clinical AI and Machine Learning
Lead, Paediatric Emergency
Medicine Staff Physician, The
Hospital for Sick Children
Co-Founder & CEO Hero AI



Panelist

Lorelei Lingard, PhD

Professor, Department of
Medicine, Schulich School of
Medicine & Dentistry, Western
University
Professor, Faculty of Education,
Western University. Senior
Scientist, CERi, Schulich School of
Medicine & Dentistry, Western
University



Special Address

Bertalan Mesko MD, PhD

The Medical Futurist
Director
The Medical Futurist Institute



Territorial Acknowledgment / Reconnaissance du territoire autochtone

Nous reconnaissons que les terres où bon nombre d'entre nous se trouvent actuellement, à Ottawa, en Ontario, font partie du territoire traditionnel non cédé du peuple anishinabé algonquin. Les Anishinabés habitent ce territoire depuis des millénaires. Nous accueillons aujourd'hui des gens de partout au Canada et de l'étranger. Nous vous invitons à prendre un moment pour reconnaître le territoire, l'histoire et les peuples autochtones qui ont marqué l'endroit où vous habitez actuellement.



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Conflict of Interest Declaration

Michael Caesar, MBA, PfMP

Does not have a relationship with a for-profit and/or a not-for-profit organization to disclose.

Brian Hodges, MD, PhD, FRCPC

Strategy Advisor for AMS Healthcare

Tanya Horsley, PhD, MBA

Does not have a relationship with a for-profit and/or a not-for-profit organization to disclose.

Lorelei Lingard, PhD

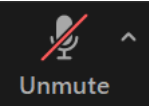
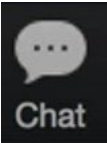



I have received honoraria from the following organizations: University of Bern Switzerland; National University of Singapore; McGill University; NYC Health and Hospitals Simulation Centre; Vanderbilt University; University of Saskatoon Emergency Medicine Research Day; Australia and New Zealand Association of Health Professional Educators; Queen's University Department of Family Medicine; University of California at San Diego, School of Medicine; Feinberg School of Medicine, University of Chicago; CIHR Institute for Muscular-skeletal Health and Arthritis; Boston Emergency Physicians Foundation; Central Michigan University; Queen's University Office of the VP Research. Received a research grant (2023-2023) from the National Board of Medical Examiners Stemmler Fund

Devin Singh

Cofounder and CEO of Hero AI Inc.



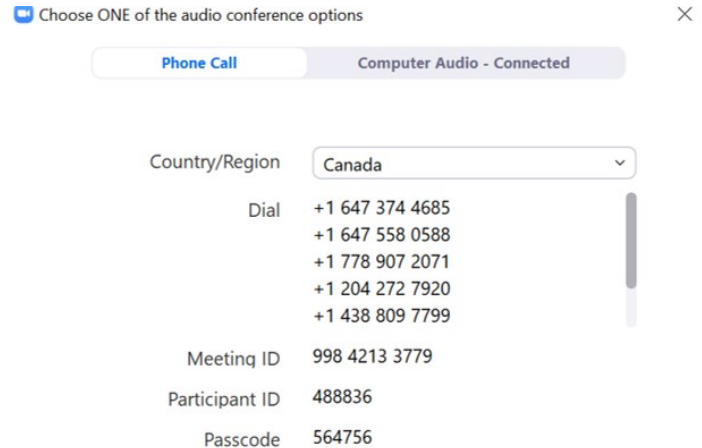
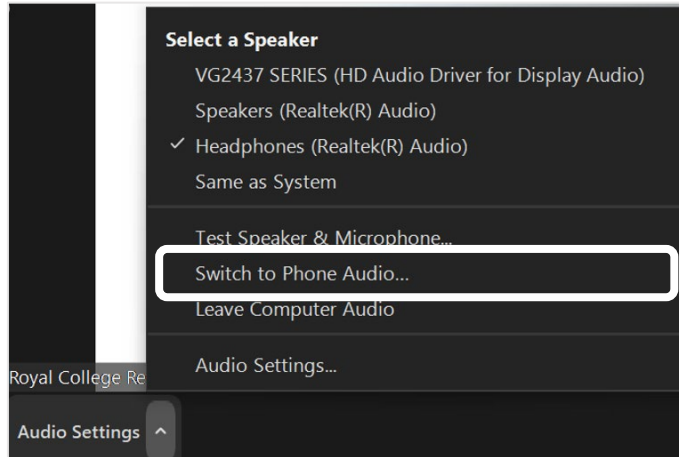
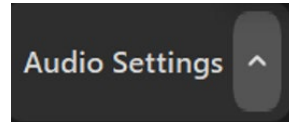
Royal College Research Forum

Before the Event	During the Event	After the Event
 You have been automatically muted	 Use chat function to submit questions	 An event evaluation will circulate to all participants
 Your camera cannot be activated	 The session will be recorded	
<p>For technical support, email: researchunit@royalcollege.ca</p>		

Switching to Phone Audio

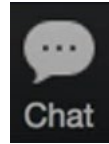
Experiencing issues with your computer audio? Here is how to connect via your phone:

- 1) Click the up-caret symbol near “Audio Settings”
- 2) Select “Switch to Phone Audio”
- 3) Call number provided



Submitting questions

To submit:



- 1) Open the **Chat** feature by clicking
- 2) Within the **Chat** panel, within the **To** drop-down list, please select “*Everyone*”



- 3) Press **Send**.



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Generative AI: introduction, opportunities and challenges

Royal College Research Forum

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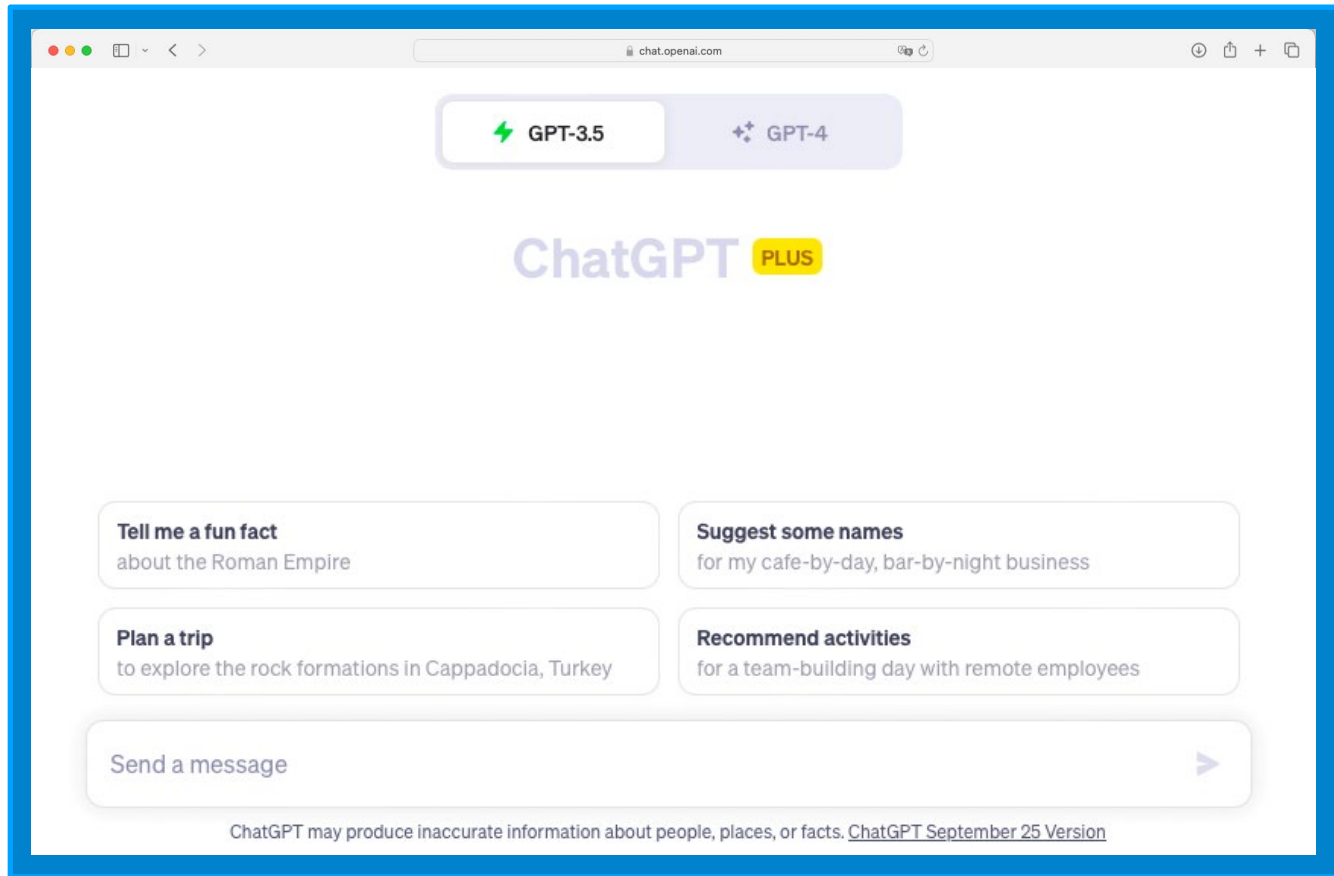
ROYAL COLLEGE
OF PHYSICIANS AND SURGEONS OF CANADA
COLLÈGE ROYAL
DES MÉDECINS ET CHIRURGIENS DU CANADA



UHN

Toronto General
Toronto Western
Princess Margaret
Toronto Rehab
Michener Institute

What is ChatGPT?



The image shows a screenshot of the ChatGPT Plus web interface. At the top, there are two model selection buttons: 'GPT-3.5' (highlighted with a green lightning bolt icon) and 'GPT-4' (with a purple star icon). Below these is the 'ChatGPT PLUS' logo. The main content area features four interactive cards with prompts: 'Tell me a fun fact about the Roman Empire', 'Suggest some names for my cafe-by-day, bar-by-night business', 'Plan a trip to explore the rock formations in Cappadocia, Turkey', and 'Recommend activities for a team-building day with remote employees'. At the bottom, there is a text input field labeled 'Send a message' with a right-pointing arrow. A disclaimer at the very bottom states: 'ChatGPT may produce inaccurate information about people, places, or facts. [ChatGPT September 25 Version](#)'.

ChatGPT 3.5 - Free version available at chat.openai.com

GPT-4

RI

Write a thank you note to the President of the Royal College of Physicians & Surgeons of Canada for hosting a talk on ChatGPT



Subject: Heartfelt Thanks for an Enlightening Event on ChatGPT



Dear President [President's Full Name],

I am writing to extend my deepest gratitude for hosting the recent talk on ChatGPT, an event that was not only informative but also immensely inspiring. It is an honor to have had the opportunity to engage with such a distinguished figure from the Royal College of Physicians & Surgeons of Canada, an institution renowned for its commitment to excellence in medical education and practice.

The insight you provided into ChatGPT's potential applications in the medical field was nothing short of enlightening. The depth of your analysis, combined with your nuanced understanding of both the technology and the ethical considerations involved, contributed to a well-rounded and thought-provoking discussion. It was particularly intriguing to explore how advancements like ChatGPT can revolutionize patient care, medical research, and continuing professional development for physicians and surgeons.

Furthermore, your ability to foster an environment of learning and open dialogue did not go unnoticed. Participants were encouraged to ask questions, share their perspectives, and consider how artificial intelligence can be responsibly integrated into their professional lives. Such a rich exchange of ideas has undoubtedly left a lasting impression on all attendees, myself included.

I also must commend you on the seamless organization of the event. Every detail, from the initial invitations to the session's interactive format, was handled with the utmost

GPT-4

RI

Create a patient-friendly educational handout on hypertension, including an overview of the condition, risk factors, symptoms, potential complications, and management strategies



Title: Understanding Hypertension: A Guide for Patients



[Introduction]

Hypertension, commonly known as high blood pressure, is a prevalent health condition where the force of blood against the artery walls is consistently too high. This condition often develops over several years and can affect everyone, irrespective of age or gender. While it frequently presents with few or no symptoms, uncontrolled hypertension can lead to serious health complications, including heart disease, stroke, and kidney failure. Understanding hypertension is the first step toward managing it effectively and maintaining a healthy life.

[Risk Factors]

Several factors can increase your likelihood of developing hypertension, including:

1. Age: The risk increases as you age, primarily due to the natural stiffening of large arteries.
2. Family history: Genetics play a role; hypertension tends to run in families.
3. Weight: Being overweight or obese can significantly increase your risk.
4. Sedentary lifestyle: Lack of physical activity contributes to higher heart rates and weight gain.
5. Tobacco use: Smoking or chewing tobacco immediately raises your blood pressure and can damage your arteries over time.
6. Diet: Excessive salt intake, low potassium intake, or a lack of vitamin D in your diet can lead to hypertension.
7. Alcohol: Over time, heavy drinking can damage your heart.
8. Stress: High levels of stress can lead to a temporary but dramatic increase in blood

GPT-4

RI

A 45-year-old male patient presents with a 3-month history of progressive fatigue, unintentional weight loss of 15 pounds, and episodes of dizziness. Please provide a differential diagnosis and suggest relevant diagnostic tests in French.



Diagnostic différentiel:



1. **Anémie:** due à différentes causes comme une carence nutritionnelle, une hémorragie chronique, ou une maladie de la moelle osseuse.
2. **Hypothyroïdie:** un dysfonctionnement de la glande thyroïde qui ne produit pas suffisamment d'hormones thyroïdiennes.
3. **Diabète sucré:** une élévation chronique du taux de glucose dans le sang.
4. **Insuffisance cardiaque:** une incapacité du cœur à pomper le sang efficacement.
5. **Insuffisance rénale chronique:** une diminution progressive de la fonction rénale.
6. **Maladies malignes:** comme les lymphomes, les leucémies, ou d'autres cancers.
7. **Troubles de l'adrénaline:** comme l'insuffisance surrénalienne.
8. **Dépression majeure:** bien qu'elle soit principalement un trouble de l'humeur, la dépression peut également présenter des symptômes physiques.
9. **Maladies infectieuses:** comme la tuberculose, l'infection par le VIH, l'endocardite infectieuse, etc.
10. **Maladie cœliaque:** une réaction auto-immune au gluten qui peut causer une variété de symptômes, y compris la fatigue et la perte de poids.

Tests diagnostiques pertinents:

1. **Numération sanguine complète (NFS):** pour vérifier l'anémie ou d'autres anomalies sanguines.
2. **TSH (hormone thyroïdienne) et hormones thyroïdiennes:** pour évaluer la fonction

GPT-4

RI

Write and abstract, methodology, results and conclusion for a multi centre study on sentinel node in breast cancer with citations



Title: Multi-Center Evaluation of Sentinel Lymph Node Biopsy Efficacy and Predictive Accuracy in Breast Cancer Management



Abstract:

Background: Sentinel lymph node biopsy (SLNB) has become a pivotal procedure for axillary staging in early-stage breast cancer, minimizing the morbidities associated with traditional axillary lymph node dissection. This study aimed to assess the efficacy, predictive accuracy, and clinical impact of SLNB across multiple centers in diverse settings.

Methods: This was a retrospective, multi-center study spanning five years (2018-2023), involving 15,000 patients from ten global healthcare centers. We evaluated SLNB's sensitivity, specificity, negative predictive value (NPV), and false-negative rate (FNR) using histopathology as the standard reference. Outcomes measured included recurrence rates, overall survival (OS), and disease-free survival (DFS).

Results: SLNB demonstrated high sensitivity (96.5%) and specificity (99.1%) in detecting axillary nodal metastases. The NPV was 98.7%, and the FNR was 3.5%. Five-year OS and DFS were significantly higher in the sentinel-node-negative group compared to the positive group (92% vs. 77% and 89% vs. 72%, respectively; $p < 0.001$).

Conclusions: This study reaffirms the efficacy and reliability of SLNB in axillary staging of early-stage breast cancer patients. Consistent outcomes across multiple centers underscore its universal applicability, necessitating broader adoption and standardization in breast cancer management protocols.

Why is this important in healthcare?

Generative AI is emerging as a transformative force in healthcare

- Education and navigation for **patients**
- **Appointment** scheduling & reminders
- Clinical **research** support
- Automate treatment and **discharge summaries**
- Virtual health **assistants & mental health**
- Teach and support **students**
- **Administrative** documentation and correspondence



Capacity

Operating at 100%+ occupancy,
Long waitlists



Safety

"Never events"
Adverse drug events



Social Medicine

Underserved patient populations



Financial

Year over year pressure - zero budget increase



Burnout

Workload, documentation, regulations



Integrated Care

Seamless transitions of care

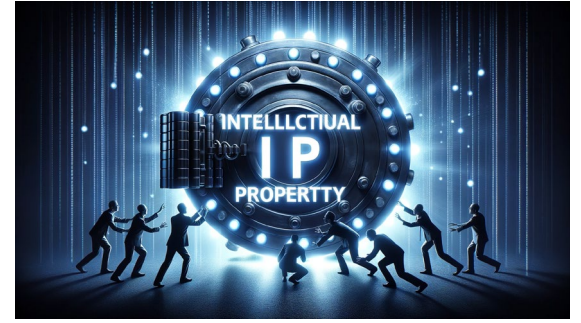
However, there are some serious risks



Bias



Incorrect information with authority “Hallucinations”



Plagiarism & Risk to Intellectual Property



Privacy



Cyber Security

BRIEFING

EU Legislation in Progress



Artificial intelligence act

OVERVIEW

The European Commission proposed the Artificial Intelligence Act (AI) in April 2021. The proposed legal framework for AI. The Commission proposed a 'risk-based approach' to AI, with a wide range of 'high-risk' AI systems. Obligations to gain access to data. Subject to very light transparency requirements in December 2021. Starting negotiations to finalise the Commission's proposal in

Government of Canada / Gouvernement du Canada

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Guide on the use of Generative AI

Table of contents

- [Overview](#)
- [What is generative AI?](#)
- [Challenges and concerns](#)
- [Recommended approach](#)
- [Policy considerations and best practices](#)
- [Use of this guide and additional support available](#)
- [Frequently asked questions](#)

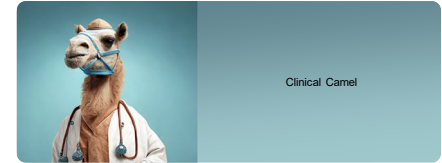
Overview

Generative artificial intelligence (AI) tools offer many potential benefits to Government of Canada (GC) institutions. Federal institutions should explore potential uses of generative AI tools for supporting and improving their operations. However, because these tools are evolving, they should not be used in all cases. Federal institutions must be cautious and evaluate the risks before they start using them. The use of these tools should be restricted to instances where risks can be effectively managed.

This document provides preliminary guidance to federal institutions on their use of generative AI tools. This includes instances where these tools are deployed by federal institutions. It provides an overview of generative AI, identifies

- Disclosing content was **generated by AI**
- Right to know you are **interacting with AI**
- Ensure “**true and accurate**” content
- AI developers **accountability & liability**
- **Source of training data** - Copyright & IP
- Identify AI systems considered “**threat**” to **society or illegal content**

- **Clinic note generated** from clinician to patient conversation
- Translation of clinical notes into **plain-language**
- **Focused training** data sets: i.e. research journals
- Create **digital patient twin** to simulate “what if” scenarios
- Automation of **patient outreach** and scheduling



Clinical Considerations for

GEN-AI in Canada

Royal College of Physicians And Surgeons of Canada

Research Forum

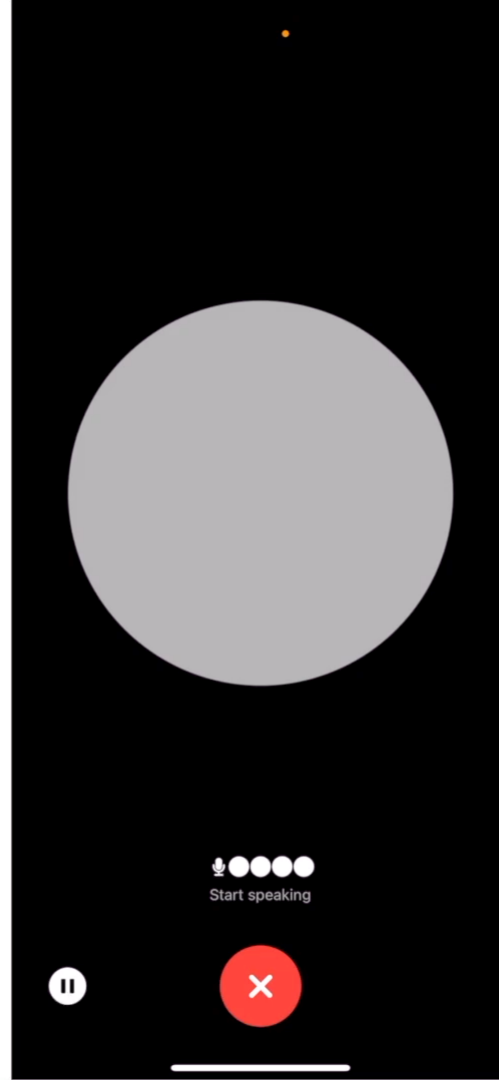
Dr. Devin Singh (@drdevsk)

Clinical Lead for Artificial Intelligence in Medicine | Hospital for Sick Children

Assistant Professor | University of Toronto | Temerity Faculty of Medicine & Division of
Computer Science

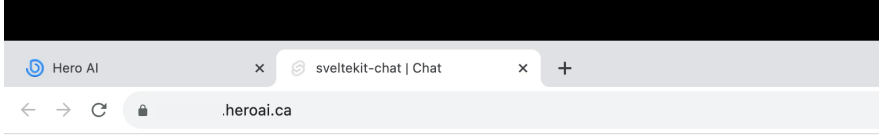
Co-Research Lead | T-CAIREM

Co-founder & CEO | Hero AI



Automated Patient Education





Chat!

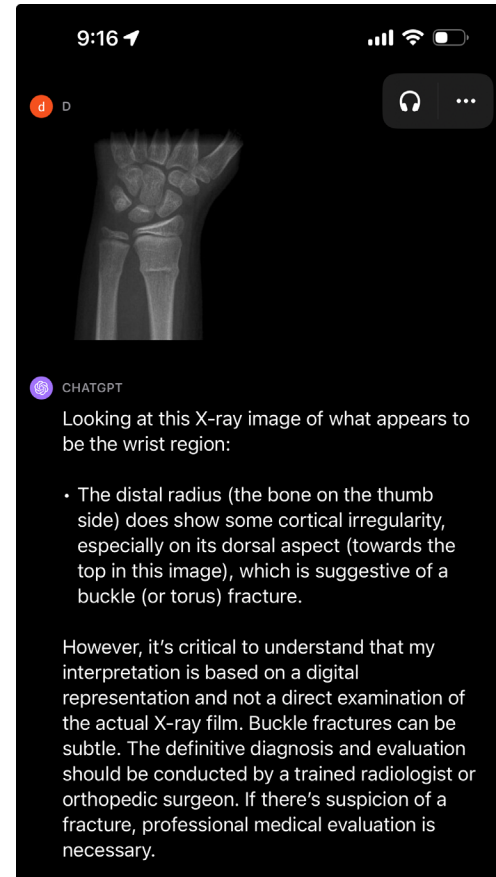
Example made for **SickKids**.

Hello! I am a chatbot that answers questions about fever in children.

Type your message...

Send

Image Inputs into Gen AI



Critical Consideration



Privacy



Data Sovereignty



Cybersecurity

What About Mistakes?

Legal Concerns?



Thank You!

Dr. Devin Singh (@drdevsk)

Clinical Lead for Artificial Intelligence in Medicine | Hospital for Sick Children

Assistant Professor | University of Toronto | Temerity Faculty of Medicine & Division of
Computer Science

Co-Research Lead | T-CAIREM

Co-founder & CEO | Hero AI

What does GenAI mean for research & writing?

Lorelei Lingard, PhD





Writing with ChatGPT: An Illustration of its Capacity, Limitations & Implications for Academic Writers

LORELEI LINGARD 

Year: 2023 Volume: 12 Issue: 1 Page/Article: 261–270 DOI: [10.5334/pme.1072](https://doi.org/10.5334/pme.1072)

Perspectives on
Medical Education
Journal of the Netherlands
Association of Medical Education

PME

THE WRITER'S CRAFT

ubiquity press

Researchers' concerns & hopes

PROBLEMS OF GENERATIVE AI

Q: Where do you think generative AI may have negative impacts on research? (Choose all that apply.)

May proliferate misinformation

Makes plagiarism easier, and harder to detect

May bring mistakes or inaccuracies into research texts (papers, code)

Makes it easier to fabricate or falsify research and harder to detect

May bring biases into literature searches

Makes it harder to assess student learning

May entrench bias or inequities into research texts

Raises energy consumption and carbon footprint of research

Other

0

100%

BENEFITS OF GENERATIVE AI

Q: What do you think are currently the biggest benefits of generative AI for research? (Choose all that apply.)

Helps researchers without English as a first language (through editing or translation)

Makes coding easier and faster

Summarizes other research to save time reading it

Speeds administrative tasks

Helps write manuscripts faster

Improves scientific search

Helps creative work by brainstorming new ideas

Generates new research hypotheses

Helps peer-review manuscripts faster

Other

0

100%

- + New Chat
- Yesterday
 - ChatGPT Researcher Writin
 - Scholarly Writing with Chat
 - ChatGPT Writing Study
 - New chat
 - Create PowerPoint Video
 - Methodology for Academic
- Previous 7 Days
 - Methodology for ChatGPT 5
 - Ethno Method for ChatGPT
 - Specific Feedback Request
 - Relevant Info: Verb Suggest
 - PDF Summary Requested
 - Medical Learning Culture O
 - ChatGPT Research Writing
- Previous 30 Days
 - New chat
 - Edit German Academic Writ
- Renew Plus
- User lorelei.lingard@schulich.uwo.c

GPT-3.5 GPT-4

ChatGPT

Show me a code snippet
of a website's sticky header

Help me pick
a birthday gift for my mom who likes gardening

Create a workout plan
for resistance training

Give me ideas
for what to do with my kids' art

Send a message



ChatGPT can

- ✓ Turn summaries into first drafts
- ✓ Brainstorm titles
- ✓ Create outlines
- ✓ Trim long abstracts or sections
- ✓ Write learning objectives
- ✓ Generate potential limitations
- ✓ Describe competing ideas
- ✓ Revise paragraphs for coherence
- ✓ Language edit

But beware, it might

- Make up references
- Provide biased information
- Incorrectly understand
- Present false corrections
- Make changes you didn't ask for
- Get the tone wrong
- Homogenize your voice & ideas
- Disregard controversy

Prompt engineering competency

Annals of Biomedical Engineering
<https://doi.org/10.1007/s10439-023-03272-4>

BMES BIOMEDICAL
 ENGINEERING
 SOCIETY

LETTER TO THE EDITOR



Prompt Engineering with ChatGPT: A Guide for Academic Writers

Louie Giray¹

Received: 31 May 2023 / Accepted: 1 June 2023
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Abstract

Prompt engineering is a relatively new discipline that refers to the practice of developing and optimizing prompts to effectively utilize large language models, particularly in natural language processing tasks. However, not many writers and researchers are familiar about this discipline. Hence, in this paper, I aim to highlight the significance of prompt engineering for academic writers and researchers, particularly the fledgling, in the rapidly evolving world of artificial intelligence. I also discuss the concepts of prompt engineering, large language models, and the techniques and pitfalls of writing prompts. Here, I contend that by acquiring prompt engineering skills, academic writers can navigate the changing landscape and leverage large language models to enhance their writing process. As artificial intelligence continues to advance and penetrate the arena of academic writing, prompt engineering equips writers and researchers with the essential skills to effectively harness the power of language models. This enables them to confidently explore new opportunities, enhance their writing endeavors, and remain at the forefront of utilizing cutting-edge technologies in their academic pursuits.

Keywords Academic writing · ChatGPT · Large language models · Natural language processing · Prompt engineering · Prompts

Journal AI policies and disclosure

Box 1: Requirements for reporting use of artificial intelligence–assisted technologies for manuscripts submitted to *CMAJ* (based on recommendations of the International Committee of Medical Journal Editors¹)

- At article submission, *CMAJ* requires authors to disclose any use of artificial intelligence (AI)–assisted technologies (e.g., large language models, chatbots, image creators) in any aspect of the creation of the submitted work. Authors should describe the nature of such use in the cover letter as well as in the manuscript itself.
- Artificial intelligence and AI-assisted technologies must not be listed as an author or co-author of a manuscript.
- Artificial intelligence and AI-assisted technologies must not be cited as a reference or other primary source or as an author of a reference.
- Human authors are responsible for any submitted material that includes the use of AI-assisted technologies, including its correctness, completeness and accuracy.
- Authors must be able to assert that there is no plagiarism in the article, including in text and images produced by AI-assisted technologies, and must ensure appropriate attribution of all material, including full citations where appropriate.
- Peer reviewers must not upload *CMAJ* manuscripts to software or other AI technologies where confidentiality cannot be assured.
- Even if AI-assisted technologies are used in a manner in which manuscript confidentiality can be guaranteed, peer reviewers who choose to use such technologies to facilitate their review must disclose their use and its nature to *CMAJ* and are responsible for ensuring that any AI-generated content incorporated into reviews is correct, complete and unbiased.

Declaration of AI-usage

For drafting parts of the presented text, we used the pre-trained ChatGPT (3.5, 2023 Jan-9) model developed by OpenAI as described in the paper by Brown et al (2020). All prompts and their generated texts are available in the Supplement. We checked the text for unintended plagiarism, and we verified all facts and references that we used from LLM outputs.

Adapted from: Aczel, B.; Wagenmakers, E. Transparency Guidance for ChatGPT Usage in Scientific Writing. PsyArXiv 2023, Preprint.

Revolutionary potential

- Can GenAI help to democratize scientific knowledge?
- Could it contribution to a re-evaluation of our academic currencies?

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Helps creative work by brainstorming new ideas

Generates new research hypotheses

Helps peer-review manuscripts faster

Other

0

100%



Photo by Jason Leung,
Unsplash

Carefully outsource
writing labor, not craft.

“Writing is thinking.
To write well
is to think clearly.
That’s why it’s so hard.”
~David McCullough



Photo by Michael Dzedzic,
Unsplash

Thank you!
Please submit your
questions using the chat
function

