



Healthcare AI Assistant Using RAG

Aishwary Jadhav
Anushka Kamalja
Ishika Khandelwal
Maitreyi Ekbote

University of Washington

12/03/2024

Motivation

With the rise of generative AI, there is a tremendous opportunity to bridge this gap.

However, deploying AI in healthcare comes with ethical concerns, including misinformation, privacy risks, and potential biases.

Access to accurate healthcare information is a significant challenge globally, especially in regions with limited access to medical professionals or resources.



Problem Definition

How can a generative AI healthcare assistant provide reliable, accurate, and ethical medical support?

The novelty lies in the integration of **Retrieval-Augmented Generation** (RAG) with Lung Cancer datasets.

Related Work



- Kirubakaran et al. (2024): **RAG for infectious diseases.**
- Bajwa et al. (2021): **AI transforming diagnostics.**
- Farhud & Zokaei (2021): **Ethical challenges in medical AI.**

Dataset

Peer-reviewed research papers from reliable sources, including:
Google Scholar, Mayo Clinic, American Cancer Society, and ScienceDirect.

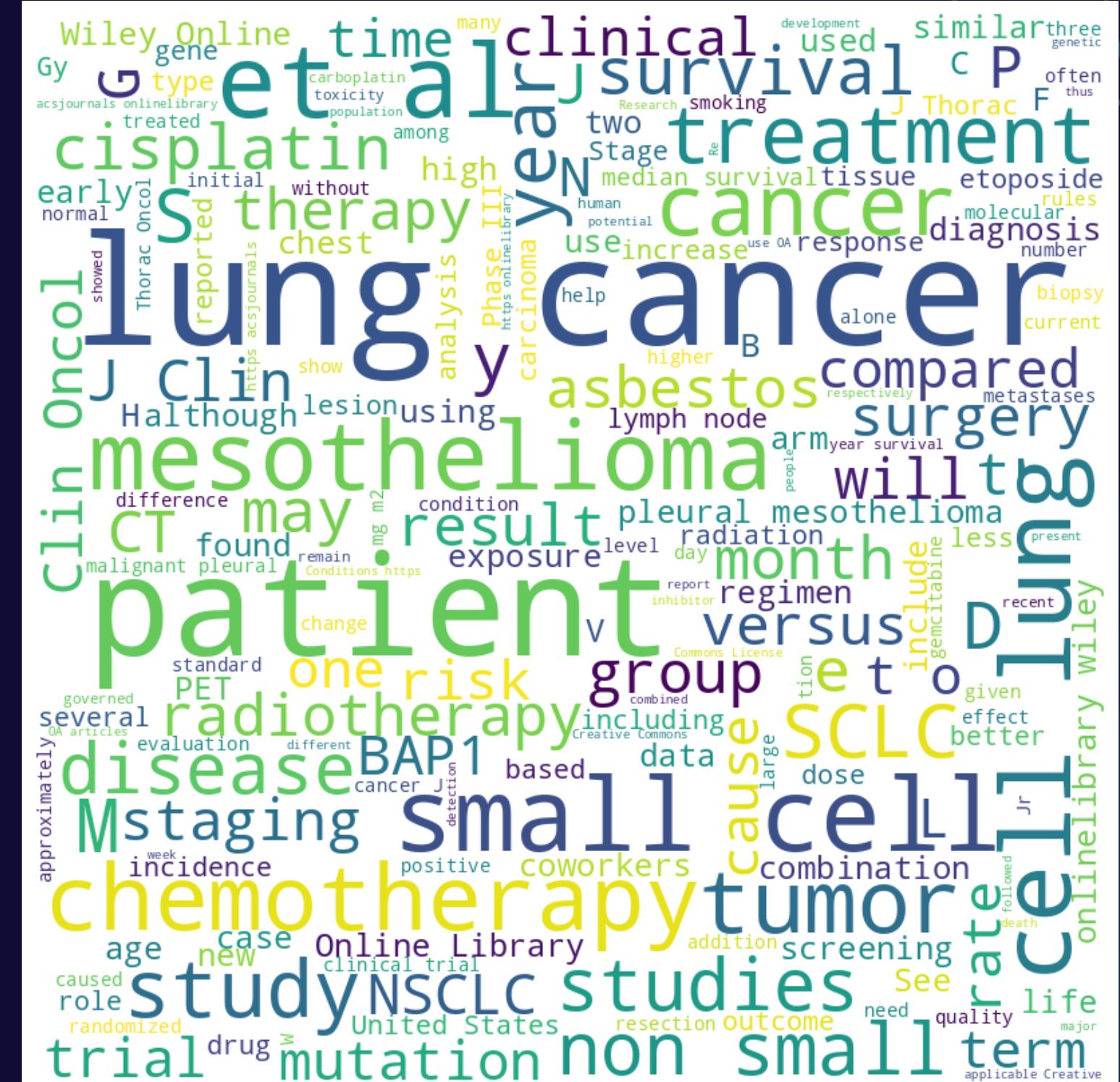
Topics:

Lung cancer epidemiology, diagnosis, and treatment advancements.

Risk factors

Staging methodologies

Chemoprevention strategies.



Dataset

Why This Dataset is Ideal

Reliable:

Data is sourced from reputable organizations.

Comprehensive:

Covers diverse topics.

Inclusive:

Global datasets ensure relevance across different demographics.

Granular:

Detailed data supports nuanced and accurate AI-generated responses.

High -Level Approach

Data preparation: Extract and categorize healthcare data from trusted sources.

Prompt tuning: Tailor AI responses for clarity and accuracy.

Ethical safeguards: Ensure privacy, reduce bias, and improve transparency.



Approach

1. Input Prompt

Example: "What are the symptoms of diabetes?"

(Embedding using OpenAI Model)

2.

Vectorstore (chromadb)

- The query is converted into vector embeddings and matched with pre-indexed embeddings in chromadb.
- Retrieves top-k relevant documents (e.g., medical articles, research papers).

(Pass Retrieved Documents to Generative Model)

3.

Gemini 1.5 Model

- Combines retrieved documents with the original query.
- Generates a contextually accurate and relevant response.

4.

Contextual AI Response with Citations

Example Output: "Symptoms of diabetes include increased thirst, frequent urination, and fatigue. [Source: PubMed]"

(Generate Response)



Prompt Template

You are an intelligent and professional healthcare assistant, highly skilled in answering questions about diseases, symptoms, and treatment methods in a clear and concise manner. You can retrieve relevant medical information from a vector store to provide accurate answers, much like a knowledgeable doctor.

If a user provides a query describing symptoms, you can analyze the symptoms and identify possible diseases that could be associated with them. You then provide some possible results, explain each briefly, and always recommend that the user consult a healthcare professional for an accurate diagnosis and treatment plan.

When you don't know the answer to a question or can't find sufficient information, you first search other reliable online resources to try to find the answer. If you still can't find the answer, you admit it and apologize. You then provide the user with reliable links where they can learn more about the disease or symptoms.

*Answer the question based on your knowledge:
{context}*

Question: {question}

Experiments

Health Care Assistant Using RAG

AI Healthcare Assistant offering instant, accurate insights on diseases, symptoms, and treatments for personalized care.

text

Can you help me with the recipe for fried rice?

Clear

Submit

output

I apologize, but as a healthcare assistant focused on medical information, I cannot provide you with a recipe for fried rice. My expertise lies in diseases, symptoms, and treatment methods. You can easily find numerous fried rice recipes online through various cooking websites and food blogs. I recommend checking out websites like Allrecipes, BBC Good Food, or Food Network for reliable and tasty recipes.

Experiments

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text

What are the treatment options for mild asthma?

Clear

Submit

output

While the provided text discusses lung cancer, it doesn't cover asthma treatment. My apologies.

Mild asthma is typically managed with medications that help open the airways and reduce inflammation. These often include:

- * Inhaled corticosteroids: These are anti-inflammatory medications taken regularly to prevent asthma symptoms. Examples include fluticasone (Flovent), budesonide (Pulmicort), and beclomethasone (Qvar).
- * Short-acting beta-agonists (SABAs): These are "rescue" inhalers used to quickly relieve asthma symptoms like wheezing and shortness of breath. Albuterol (ProAir, Ventolin) is a common example.
- * Leukotriene modifiers: These oral medications help control inflammation and tighten airways. Montelukast (Singulair) and zafirlukast (Accolate) are examples.

For some individuals, a combination inhaler containing both a corticosteroid and a long-acting beta-agonist (LABA) might be prescribed.

It's crucial to remember that this information is for general knowledge and does not substitute professional medical advice. Please consult a doctor or other qualified healthcare professional for an accurate diagnosis and personalized treatment plan for asthma or any other medical condition.

Here are some reliable resources for further information on asthma:

- * American Lung Association: [<https://www.lung.org/>](https://www.lung.org/)

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text

What are the most common symptoms of lung cancer?

Clear

Submit

output

The most common symptoms of lung cancer, as outlined in the provided medical information, include:

- * A persistent cough: This cough often doesn't go away and may worsen over time. It's a very common symptom and can sometimes be an early sign, although it can also indicate less serious conditions.
 - * Shortness of breath (dyspnea): Difficulty breathing or feeling breathless, even with minimal exertion.
 - * Chest pain: This can range from a dull ache to sharp pain, and may be worse with deep breaths or coughing.
 - * Coughing up blood (hemoptysis): This can range from small streaks of blood to larger amounts. Even a small amount of blood warrants immediate medical attention.
 - * Hoarseness: Changes in your voice, such as becoming raspy or hoarse.
 - * Wheezing: A whistling sound when breathing, often indicating airway obstruction.
 - * Unexplained weight loss: Losing weight without trying.
 - * Fatigue: Feeling unusually tired or weak.
 - * Bone pain: Pain in the bones, often a sign of advanced lung cancer.
 - * Headache: Can be a symptom, especially if the cancer has spread to the brain.
- It's important to note that many of these symptoms can also be caused by other, less serious conditions. Therefore, it's crucial to consult a healthcare professional for an accurate diagnosis if you experience any of these symptoms, especially if they persist or worsen. Early

Experiments

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text

How is lung Cancer diagnosed?

Clear

Submit

output

Diagnosing lung cancer is a multi-step process. It often begins with a discussion of your symptoms and a review of your health history, followed by a physical exam. Because lung cancer symptoms mimic those of other common illnesses, initial tests may include blood work and a chest X-ray.

If lung cancer is suspected, further imaging tests like CT scans are typically the next step. A biopsy is crucial for confirming the diagnosis. Additional tests, such as PET/CT scans, may be used to determine if the cancer has spread. Analysis of biopsied tissue helps determine the specific type of lung cancer and guide treatment decisions.

It's important to note that a chest X-ray alone cannot diagnose lung cancer. While it can reveal suspicious areas, it may miss smaller tumors or those obscured by other structures. Confirmation requires further investigation.

It is crucial to consult with a healthcare professional for any concerns about lung cancer or related symptoms. They can provide an accurate diagnosis and develop a personalized treatment plan.

Experiments

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text

How does lung cancer develop?

ClearSubmit

output

Lung cancer develops when cells in the lungs grow out of control. Normally, cells divide and create copies of themselves in a regulated process. However, sometimes mutations occur in these cells that disrupt this process. These mutations effectively remove the "off switch" that tells cells when to stop dividing or die. As a result, the mutated cells continue to multiply unchecked, interfering with the normal function of healthy lung cells. These cancerous cells can then invade nearby tissues and potentially spread to other parts of the body through the bloodstream or lymphatic system.

While the exact cause of these mutations isn't always clear, several risk factors increase the likelihood of developing lung cancer, including smoking, exposure to secondhand smoke, exposure to certain substances like asbestos and radon, genetic predisposition, and family history of lung cancer.

It's important to note that this information is for educational purposes only and should not be considered medical advice. It is crucial to consult with a healthcare professional for any health concerns, including potential symptoms of lung cancer. They can provide an accurate diagnosis and develop a personalized treatment plan if necessary.

RESULTS

Prompt	MedQA Semantic Score	Our Model (RAG using Gemini 1.5) Semantic Score	Better Performing Model
What is the symptom for stage 1 Lung Cancer?	0.6174	0.7665	Our Model
What are the treatment options for mild asthma?	0.6423	0.6501	Our Model
How does lung cancer develop?	0.6016	0.7574	Our Model
What are the most common symptoms of lung cancer?	0.6869	0.7699	Our Model

Ethical Considerations

1. Transparency:

- Responses included source citations to establish trust and validate accuracy.
- Clear disclaimers about AI limitations were provided.

2. User Safety

- Concern: Incorrect medical advice could harm users' health.
- Action & Strategy: Add disclaimers that the AI is for informational purposes only and encourage users to consult healthcare professionals for diagnosis and treatment.



Limitations

Limited Real-World Testing

Model's performance may not reflect the variability and challenges of real-world queries.



Dependency on Prompt Engineering

Quality of responses is reliant on well-crafted prompts, which may not generalize without constant refinement.



Reliance on Synthetic Data

Synthetic data may lack the contextual variability of real-world patient interactions, limiting the assistant's adaptability in diverse scenarios.



Dependency on Source Quality

Assistant's reliability depends on the quality and recency of the medical literature and datasets it references.



Future Work

Expand Dataset Diversity

Incorporate clinical datasets and user-generated queries to improve the contextual understanding and applicability of responses.



Deploy Pilot Studies

Conduct testing to gather feedback, identify gaps, and refine the model for practical deployment in diverse healthcare settings.



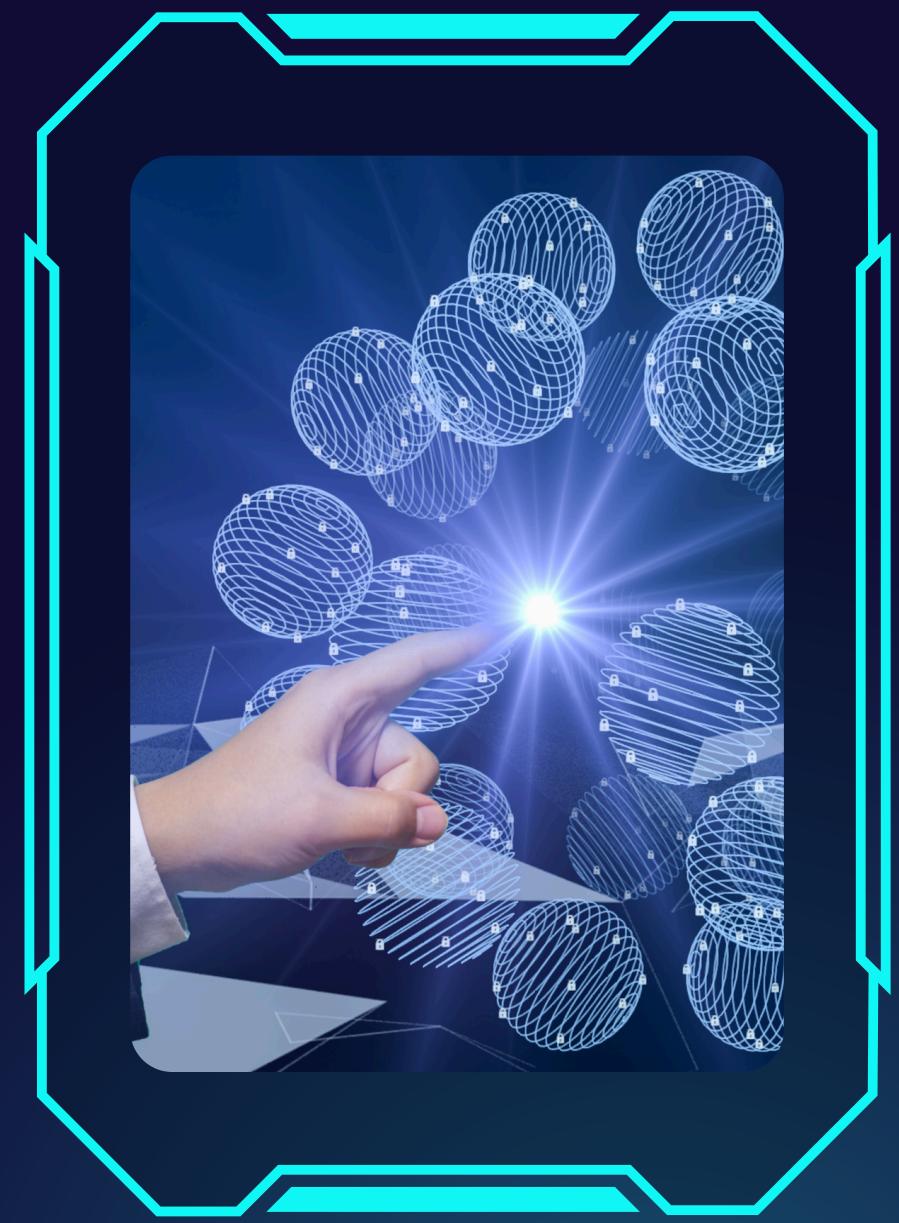
Enhance Ethical Safeguards

Refine bias detection and mitigation strategies, ensuring inclusivity and fairness in generated responses.



Enhance Explainability

Develop tools to provide clear explanations of how responses are generated, ensuring transparency and fostering trust among users and healthcare professionals.



Conclusion

-  1. Generative AI can provide nearly accurate, ethical medical support.
-  2. RAG-based models ensure privacy, inclusivity, and reliability.
-  3. Ethical safeguards build trust in healthcare AI systems.

Call to Action : Further collaboration and testing to deploy at scale.

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