

Healthcare Content Generator

Course Name: Generative AI

Institution Name: Medicaps University – Datagami Skill Based Course

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Problem Statement

The Healthcare GenAI SaaS platform is designed to address a significant and growing challenge in the healthcare ecosystem: the need for efficient, standardized, compliant, and privacy-preserving medical document generation. Healthcare professionals routinely create structured documents such as disease overviews, patient education materials, discharge summaries, and medical certificates. These documents must follow strict medical language standards, comply with regulatory guidelines, and avoid exposing sensitive patient data. However, traditional document preparation methods are largely manual, time-consuming, and dependent on individual writing styles. This often results in inconsistencies in terminology, formatting, and clarity. In busy clinical environments where time is limited and patient load is high, preparing such documents can divert valuable time away from patient care.

Therefore, the core problem is to design and implement a secure, Retrieval-Augmented Generation (RAG)-based healthcare content generation system that strictly operates within predefined, verified reference materials. The system must eliminate reliance on general AI knowledge for medical content and instead retrieve context only from curated institutional documents. It must incorporate strict safety filters that prevent the generation of diagnoses, medication recommendations, or fitness/unfitness decisions where prohibited. Additionally, the architecture must follow a privacy-first approach, ensuring that documents are accessible only through secure, unique Document IDs and never through patient-identifiable information. The system must also implement safe failure mechanisms, explicitly notifying users when sufficient reference data is unavailable rather than generating speculative content.

In essence, the challenge is not merely to automate document creation, but to build a trustworthy, compliant, and privacy-preserving healthcare content generation platform. Such a system must combine the efficiency of AI with the reliability of verified reference retrieval, enforce strict regulatory safeguards, protect sensitive data, and provide hospital-level isolation in a scalable SaaS architecture. Addressing this problem enables healthcare professionals to generate consistent, high-quality medical documentation efficiently while maintaining the highest standards of safety, privacy, and compliance.

Project Objectives

- To build a secure, RAG-based Healthcare Content Generation System.
- To ensure all generated content is derived strictly from verified and approved reference materials.
- To implement strict safety filters that prevent:
 - Diagnosis generation
 - Medication or treatment advice
 - Fitness/unfitness determinations
- To design a privacy-first architecture where documents can be retrieved only using a unique Document ID.
- To develop a mobile-first, SaaS-ready web platform for healthcare professionals.
- To implement multi-tenant architecture with complete hospital-level data isolation.

Scope of the Project

The project focuses on:

- Generating structured, standardized, and compliance-ready medical documents using a Retrieval-Augmented Generation (RAG) architecture that strictly relies on approved and verified reference materials rather than general AI knowledge.
- Producing disease-specific educational content that is carefully scoped to curated institutional references, ensuring that all generated information remains accurate, consistent, and medically appropriate.
- Creating draft-only medical certificates that follow predefined templates, include mandatory disclaimers, and require clinician review and signature before any official use.
- Implementing secure document storage and controlled retrieval mechanisms where generated documents can be accessed only through a unique Document ID, thereby minimizing the risk of unauthorized access or data exposure.
- Designing and deploying a multi-tenant, SaaS-ready hospital architecture that ensures complete isolation of data, reference materials, and vector indexes at the hospital level without requiring code changes for new tenants.

Proposed Solution

To address the identified challenges, we developed a secure and scalable Healthcare GenAI SaaS platform built using modern, production-ready technologies. The frontend is developed using React to provide a responsive, mobile-first user interface tailored for healthcare professionals. The backend is implemented using FastAPI, enabling high-performance API handling, structured request validation, and seamless integration with AI components. For semantic search and reference retrieval, FAISS (Facebook AI Similarity Search) is used as the vector search engine, while MongoDB serves as the primary database for securely storing generated documents and metadata. Sentence Transformers are used as the embedding model to convert reference documents into dense vector representations, enabling accurate similarity-based retrieval.

The system is built on a Retrieval-Augmented Generation (RAG) architecture to ensure that all generated content is grounded strictly in approved reference materials. When a user submits a document generation request, the backend first identifies the document type and required category scope. The system then queries the FAISS vector index to retrieve only the most relevant reference chunks based on semantic similarity and predefined metadata filters. This ensures disease-specific and context-specific retrieval without accessing unrelated data.

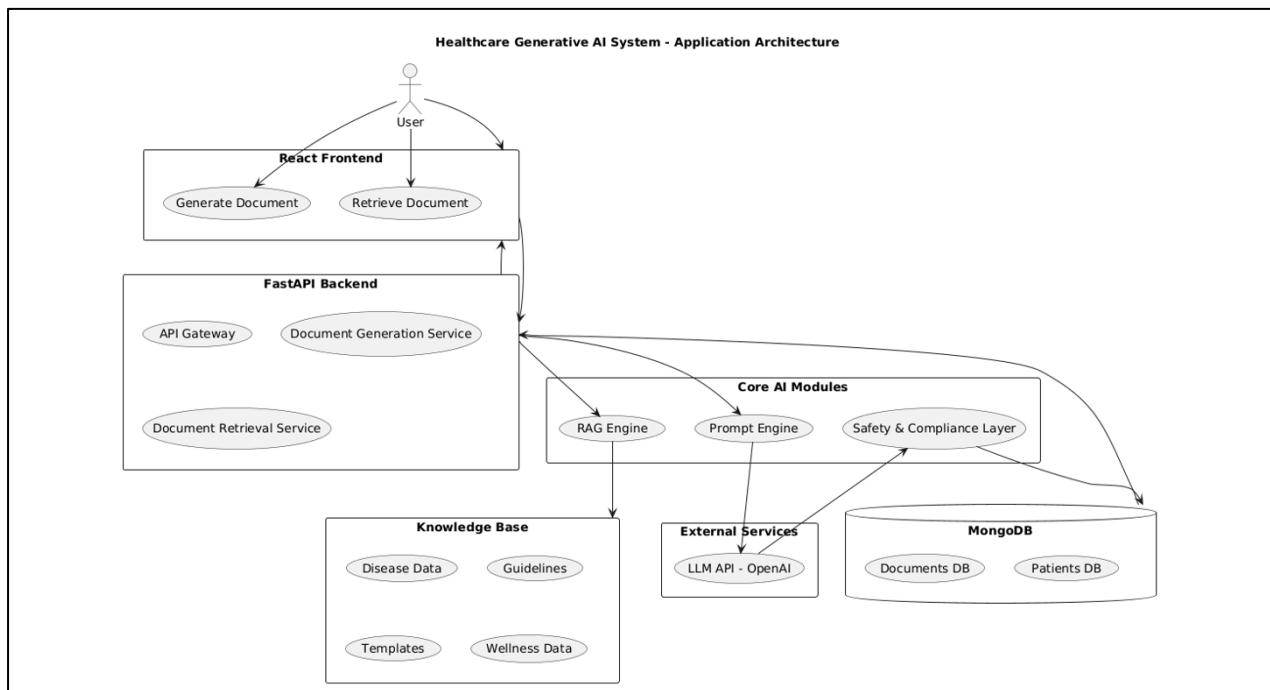
The retrieved reference content is then passed to the Large Language Model (LLM) along with carefully engineered prompts that enforce strict generation rules. The LLM is instructed to produce structured medical content exclusively based on the retrieved references, without introducing external or generalized knowledge. After generation, a dedicated safety and compliance layer validates the output to ensure it does not contain diagnosis statements, medication advice, fitness determinations, or other restricted content.

Once validated, the final document is securely stored in MongoDB, and a unique Document ID is generated. This ID is the only mechanism through which the document can be retrieved, reinforcing the privacy-first design. In cases where sufficient reference data is not available, the system does not attempt to generate speculative content. Instead, it fails safely by returning a clear "Insufficient reference data" message, thereby preventing hallucination and maintaining compliance integrity.

Key Features

- RAG-powered document generation
- Strict reference-only content generation
- Safety compliance layer
- Draft-only medical certificates
- No diagnosis or medication allowed
- Disease-specific scoped retrieval
- Multi-tenant hospital architecture
- Secure Document ID-based retrieval
- Mobile-first responsive UI
- Source transparency
- Fail-safe mechanism for missing data

Overall Architecture / Workflow



1. User Layer (Frontend – React)

- User selects document type
- Enters topic
- Selects disease (if required)
- Submits request

2. API Layer (FastAPI Backend)

- Validates input
- Applies safety checks
- Calls RAG engine

3. RAG Engine

- Embedding model: all-MiniLM-L6-v2 (384 dimension)
- FAISS IndexFlatIP used for similarity search
- Top 5 reference chunks retrieved
- Category-based metadata filtering

4. LLM Layer

- Model: gpt-3.5-turbo (OpenAI compatible)
- Temperature: 0.3 (low hallucination)
- Strict prompt rules enforced

• 5. Safety Layer

- Blocks restricted medical content
- Ensures compliance rules

6. Database Layer (MongoDB)

- Stores generated documents
- Stores patients (if required)
- Stores hospital-specific data

Tools & Technologies Used

- Frontend Framework: React (with Vite)
- Styling Framework: Tailwind CSS
- Backend Framework: FastAPI
- Programming Languages: Python, JavaScript
- Database: MongoDB
- Vector Database: FAISS (Facebook AI Similarity Search)
- Embedding Model: all-MiniLM-L6-v2 (384-dimension sentence transformer)
- Large Language Model (LLM): GPT-3.5-turbo (OpenAI-compatible API)
- API Communication: REST APIs with Axios
- Architecture Pattern: RAG (Retrieval-Augmented Generation)
- Indexing Method: FAISS IndexFlatIP (Inner Product similarity search)
- Environment Management: Python Virtual Environment (venv)
- Version Control: Git (for source code management)

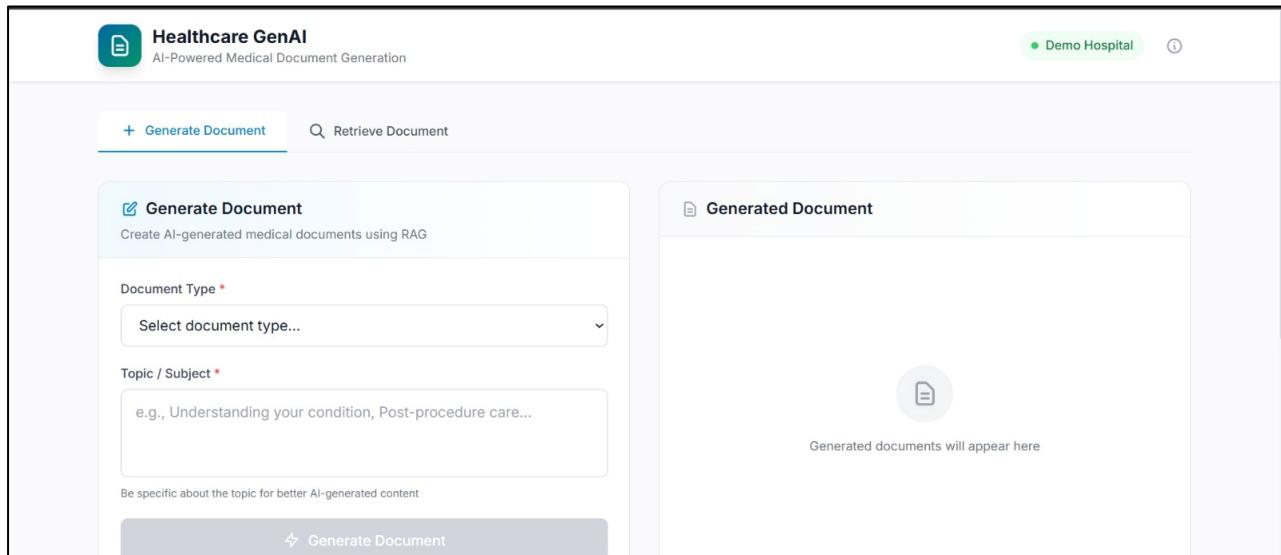
Key Outcomes

- Successfully built a working RAG-based healthcare document generator.
- Achieved strict compliance filtering.
- Prevented hallucination using reference-only content.
- Implemented privacy-first document retrieval.
- Designed scalable multi-tenant SaaS architecture.
- Ensured safe failure when data unavailable.
- Built fully responsive mobile-first UI.

Results & Output

Add the below details here:

Screenshots / outputs



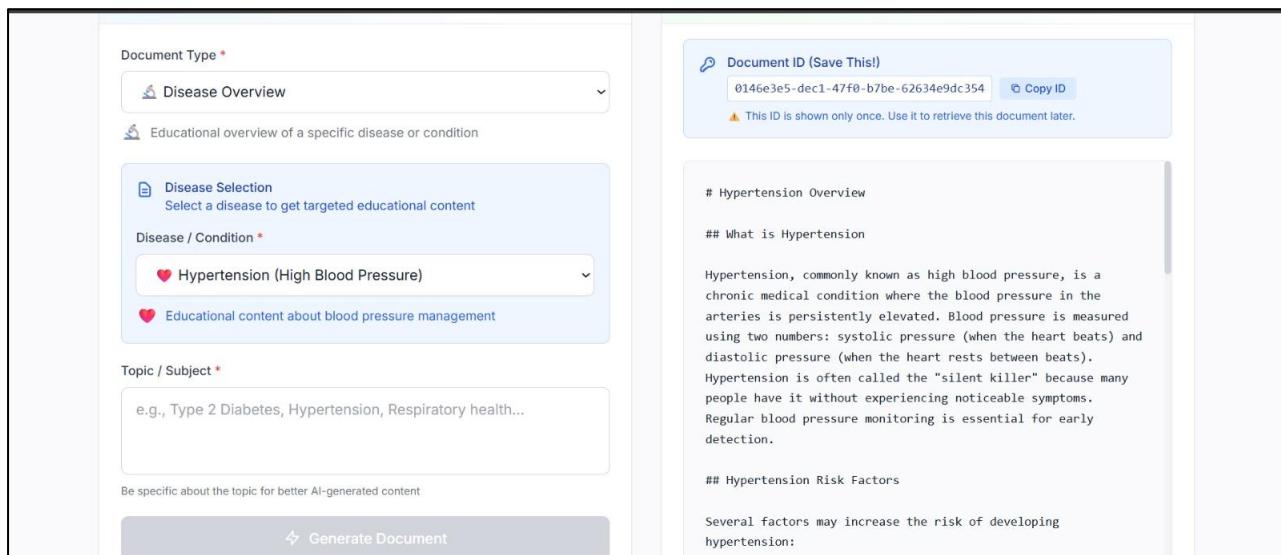
The screenshot shows the main interface of the Healthcare GenAI tool. At the top, there's a logo for 'Healthcare GenAI' and a subtext 'AI-Powered Medical Document Generation'. On the right, there's a 'Demo Hospital' button and a help icon. Below the header, there are two main sections: 'Generate Document' on the left and 'Generated Document' on the right.

Generate Document Section:

- Section Title:** Generate Document
- Description:** Create AI-generated medical documents using RAG
- Document Type:** A dropdown menu labeled 'Select document type...'.
- Topic / Subject:** A text input field with placeholder text 'e.g., Understanding your condition, Post-procedure care...'. Below it is a note: 'Be specific about the topic for better AI-generated content'.
- Generate Document Button:** A grey button with a white arrow icon labeled 'Generate Document'.

Generated Document Section:

- Section Title:** Generated Document
- Icon:** A circular icon with a document symbol.
- Note:** 'Generated documents will appear here'.



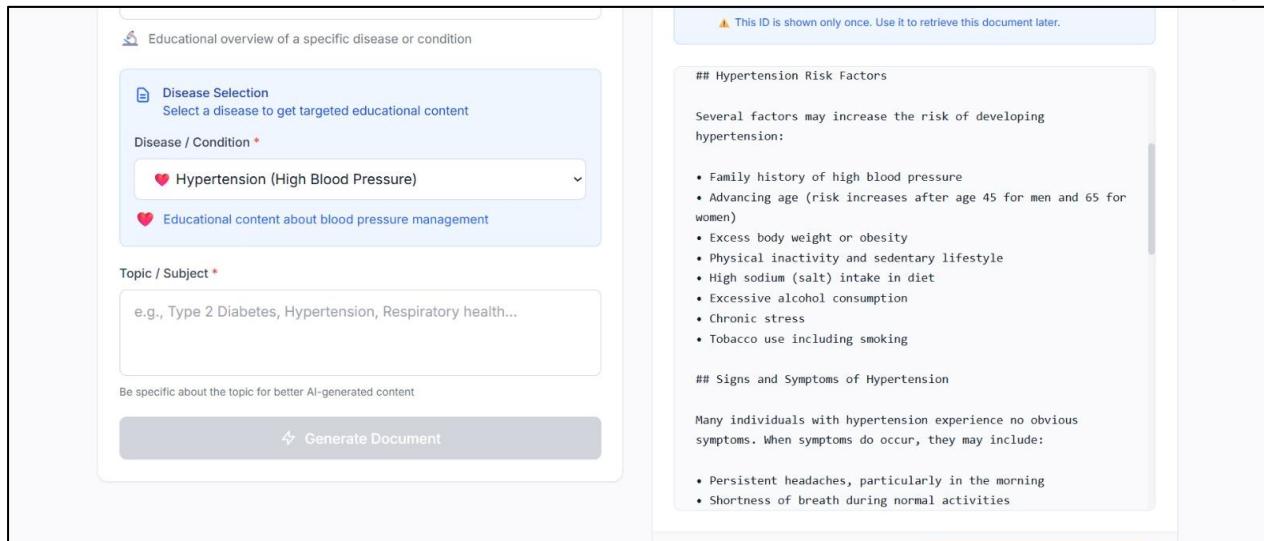
This screenshot shows the generated document for 'Hypertension Overview'.

Left Panel (Form Fields):

- Document Type:** Selected 'Disease Overview'.
- Topic / Subject:** Placeholder text 'e.g., Type 2 Diabetes, Hypertension, Respiratory health...'. Note: 'Be specific about the topic for better AI-generated content'.
- Generate Document Button:** Grey button with a white arrow icon labeled 'Generate Document'.

Right Panel (Generated Content):

- Section Title:** # Hypertension Overview
- Section Subtitle:** ## What is Hypertension
- Text:** Hypertension, commonly known as high blood pressure, is a chronic medical condition where the blood pressure in the arteries is persistently elevated. Blood pressure is measured using two numbers: systolic pressure (when the heart beats) and diastolic pressure (when the heart rests between beats). Hypertension is often called the "silent killer" because many people have it without experiencing noticeable symptoms. Regular blood pressure monitoring is essential for early detection.
- Section Subtitle:** ## Hypertension Risk Factors
- Text:** Several factors may increase the risk of developing hypertension:



Educational overview of a specific disease or condition

Disease Selection
Select a disease to get targeted educational content

Disease / Condition *

Topic / Subject *

e.g., Type 2 Diabetes, Hypertension, Respiratory health...

Be specific about the topic for better AI-generated content

Generate Document

Hypertension Risk Factors

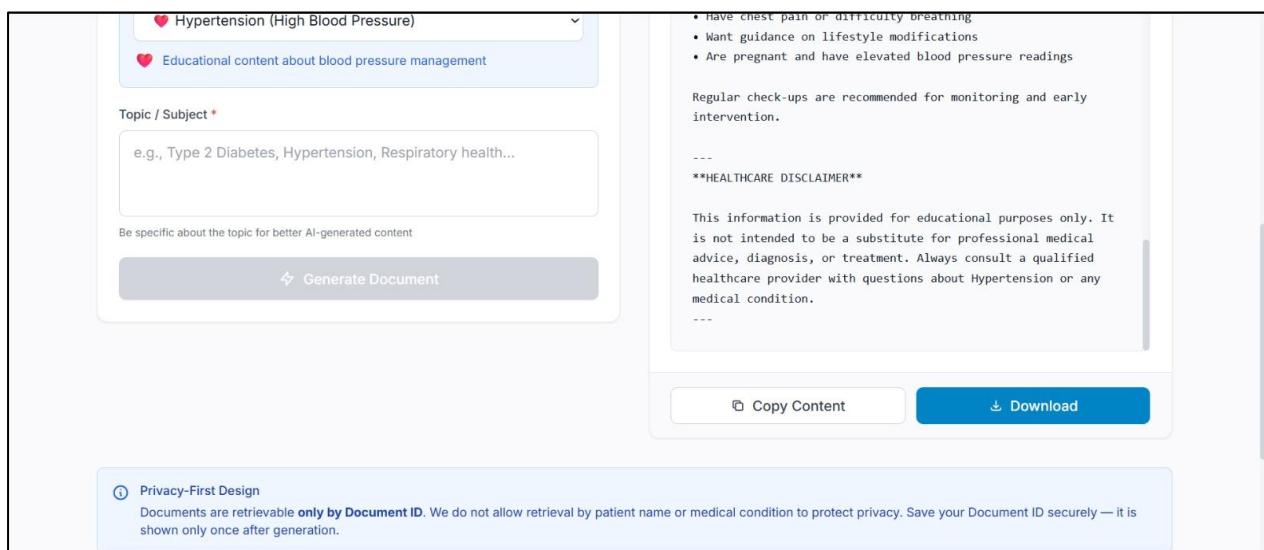
Several factors may increase the risk of developing hypertension:

- Family history of high blood pressure
- Advancing age (risk increases after age 45 for men and 65 for women)
- Excess body weight or obesity
- Physical inactivity and sedentary lifestyle
- High sodium (salt) intake in diet
- Excessive alcohol consumption
- Chronic stress
- Tobacco use including smoking

Signs and Symptoms of Hypertension

Many individuals with hypertension experience no obvious symptoms. When symptoms do occur, they may include:

- Persistent headaches, particularly in the morning
- Shortness of breath during normal activities



Hypertension (High Blood Pressure)

Educational content about blood pressure management

Topic / Subject *

e.g., Type 2 Diabetes, Hypertension, Respiratory health...

Be specific about the topic for better AI-generated content

Generate Document

Risk Factors

- Have chest pain or difficulty breathing
- Want guidance on lifestyle modifications
- Are pregnant and have elevated blood pressure readings

Regular check-ups are recommended for monitoring and early intervention.

HEALTHCARE DISCLAIMER**

This information is provided for educational purposes only. It is not intended to be a substitute for professional medical advice, diagnosis, or treatment. Always consult a qualified healthcare provider with questions about Hypertension or any medical condition.

Actions

Copy Content Download

Privacy-First Design

Documents are retrievable **only by Document ID**. We do not allow retrieval by patient name or medical condition to protect privacy. Save your Document ID securely — it is shown only once after generation.

Key outcomes

- **Strong privacy protection with Document ID-based retrieval.**
- **Built-in safety filters blocking diagnosis, medication, and fitness decisions.**
- **Accurate disease-specific content using scoped FAISS retrieval.**
- **Scalable multi-tenant, SaaS-ready architecture.**

Conclusion

The Healthcare GenAI SaaS platform successfully demonstrates how Generative AI can be safely applied in the healthcare domain using a strict RAG-based architecture.

Unlike generic AI systems, this platform ensures:

- No hallucinated medical content
- No diagnosis or medication advice
- Privacy-first document handling
- Secure Document ID-based retrieval
- Multi-tenant scalability

Through this project, we gained hands-on experience in:

- RAG architecture
- Vector databases (FAISS)
- Embedding models
- API development using FastAPI

- AI safety and compliance engineering

This project highlights how AI can be responsibly implemented in sensitive domains like healthcare.

Future Scope & Enhancements

- Integration with Electronic Health Records (EHR)
- Role-based access control (RBAC)
- PDF export functionality
- Audit logging and compliance reports
- HIPAA/GDPR deployment-ready configuration
- Cloud deployment (AWS/Azure/GCP)
- Fine-tuned healthcare-specific LLM
- Multi-language document generation
- Admin dashboard for hospital analytics
- Deployment as enterprise SaaS product