

HomeDOCTOR App: Integrating Medical Knowledge into GPT for Personal Health Counseling

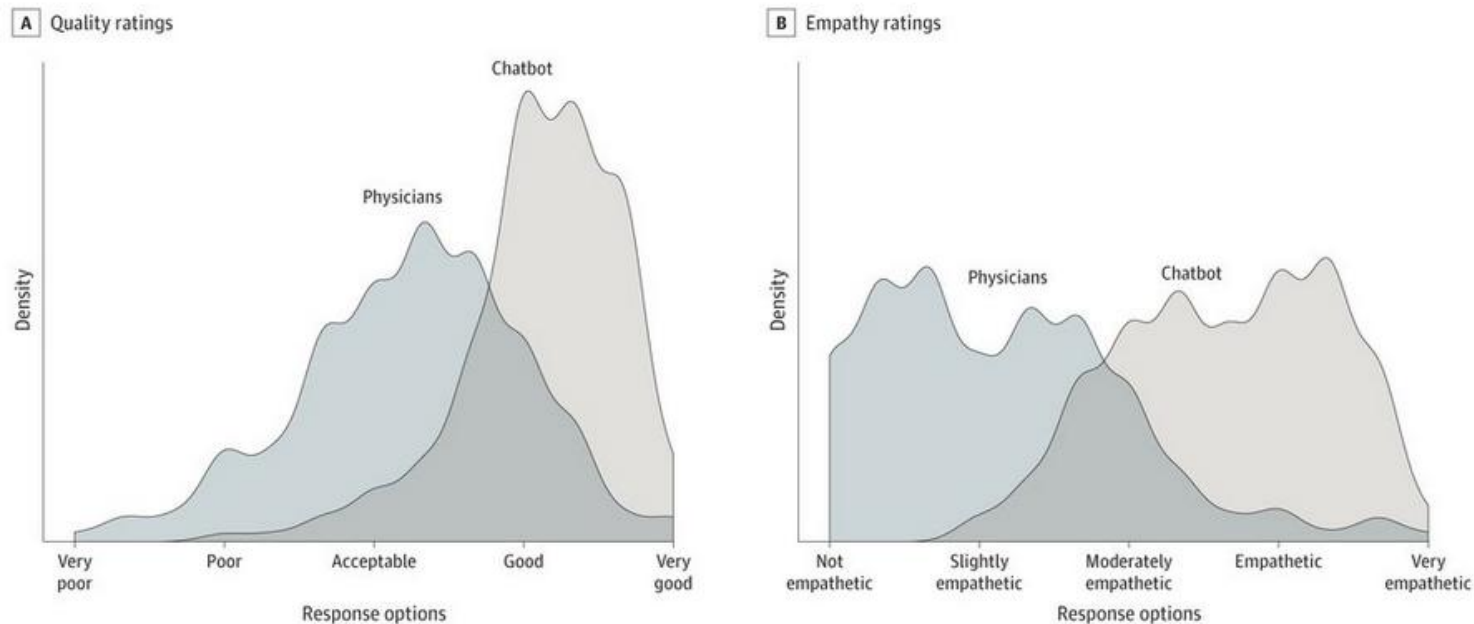
Matjaž Gams; Matic Zadobovšek, Primož Kocuvan
Michael Heider, Tadej Horvat, Filip Ivaniševič, Lana Jarc, ... David Susič, Iva Eftimovska 1

Problems in health sector in Slovenia

- Ageing population
- Shortage of health experts
- Around 135,000 people in Slovenia without their physician, 230,000 women without gynecologists...
similar problems in many countries

Healthcare

John Ayers.



Porazdelitev povprečnih ocen kakovosti odgovorov in empatije za klepetalnik in zdravnike na vprašanja bolnikov | FOTO: JAMA

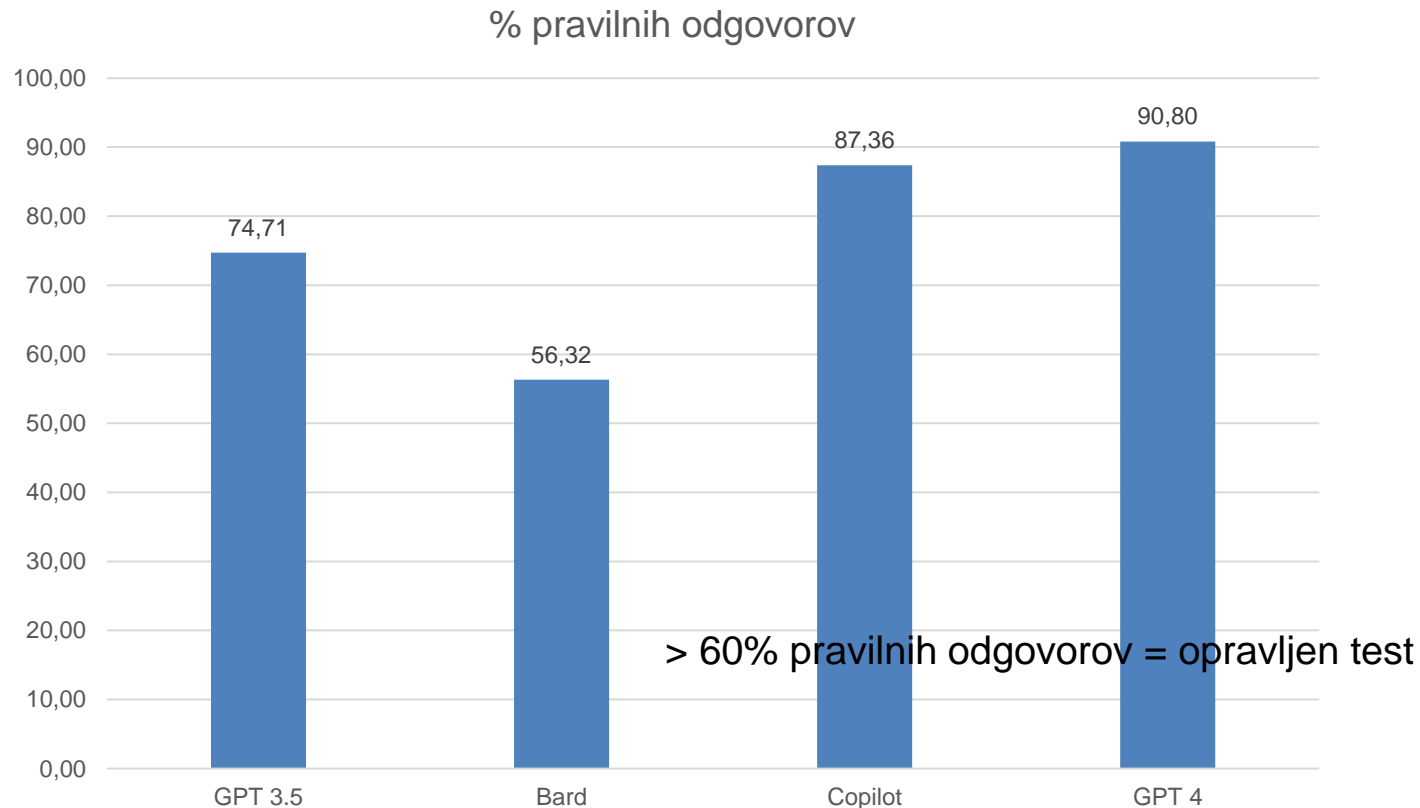
Internal Medicine

Zdravnik: 5 GPT3.5, 9 GPT4;

pravosodni / sodnik: 3 GPT3.5, 8 GPT4



Our tests USMLE (developing HomeDOctor)



USMLE test

A 12-year-old girl is brought to the emergency department by her mother because of a 1-week history of worsening swelling in her legs. The patient also noticed blood in her urine yesterday. The bleeding has not recurred. She had an upper respiratory tract infection and sore throat 1 week ago that caused her to miss several days of school. Medical history is otherwise unremarkable and she takes no routine medications. Menarche has not yet occurred. BMI is 20 kg/m². Vital signs are temperature 37.0°C (98.6°F), pulse 78/min, respirations 12/min, and blood pressure 136/84 mm Hg. Pulse oximetry on room air shows an oxygen saturation of 100%. Physical examination discloses erythema of the posterior pharynx, mild cervical lymphadenopathy, and 3+ pitting edema to both knees. Results of urinalysis are shown:

Protein	150 mg/dL
Blood	Positive
Leukocyte esterase	Positive
Nitrite	Negative
WBCs	5–10/hpf
RBCs	10–25/hpf
Casts	1–2/hpf

Results of which of the following laboratory studies are most likely to be abnormal in this patient?

- (A) Bleeding time
- (B) Erythrocyte count
- (C) Serum concentration of C3
- (D) Serum IgA concentration
- (E) Serum rheumatoid factor assay

(C) Serum concentration of C3.

In our testing, when given a full battery of USMLE problems, GPT-4 answers them correctly more than 90 percent of the time. (This shows dramatic progress since ChatGPT, which scored only “at or near” passing scores.⁵) Furthermore, it can provide detailed reasoning behind its answers:

This patient's clinical presentation, including the recent upper respiratory tract infection, edema, and blood and protein in the urine, is consistent with acute poststreptococcal glomerulonephritis (APSGN). APSGN is associated with low serum levels of complement component

Protein	150 mg/dL
Blood	Positive
Leukocyte esterase	Positive
Nitrite	Negative
WBCs	5-10/hpf
RBCs	10-25/hpf
Casts	1-2/lpf

Results of which of the following laboratory studies are most likely to be abnormal in this patient?

- (A) Bleeding time
 - (B) Erythrocyte count
 - (C) Serum concentration of C3
 - (D) Serum IgA concentration
 - (E) Serum rheumatoid factor assay
- (C) *Serum concentration of C3.*

In our testing, when given a full battery of USMLE problems, GPT-4 answers them correctly more than 90 percent of the time. (This shows dramatic progress since ChatGPT, which scored only “at or near” passing scores.⁵) Furthermore, it can provide detailed reasoning behind its answers:

This patient's clinical presentation, including the recent upper respiratory tract infection, edema, and blood and protein in the urine, is consistent with acute poststreptococcal glomerulonephritis (APSGN). APSGN is associated with low serum levels of complement component

HomeDOCtor

- Medical help for individuals / plans for doctors as well
- Now on PCs, soon mobile phone
- Run an application free of charge or by GPT API calls; 40 (mini)
- Similar to GPT application, specialized for Slovenia
- Slovenian, English; and any language
- A typical scenario: description of a problem, DOC asks a couple of questions and suggests actions

HomeDOctor

- Quality: better than GPT, ... similar to human doctors
- Not intended to replace doctors / physicians, to help!
- Motivation: provide quality advice
- Send to professionals as much as needed – regulate best influx
- Specialized for Slovenia
- Partner countries will get the system and if desired specialize to their country

HomeDOctor

- Quality medical help 24/7 fast and free of cost / not expensive
- Medical professionals need to retain influence over DOC – in Slovenia Medical Chamber
- Promote use of advanced AI (GAI)
- Dilemmas:
 - test and improve the prototype
 - promote in public
 - deal with “attacks”
 - prototype or full application / commercialisation

Datasets

- The main dataset is Insieme platform (ISE-EMH)
- Med.Over.Net
- Home Doctor encyclopedia
- Slovenian medical protocols
- ...

Melanom

Melanom je rak, ki nastane zaradi maligne spremembe pigmentnih celic (melanocitov). Največkrat se pojavi na koži, lahko pa tudi na drugih mestih, kjer se nahajajo melanociti (npr. oko, možganske ovojnice in notranje uho). Tveganje za njegov nastanek predstavljajo dednost, svetla polt, izpostavljanje sončni svetlobi in tudi uporaba solarijev. Na leto so diagnosticirani približno 3 melanomi na 100 000 ljudi, vendar incidenca že zadnjih 40 let narašča. Navkljub večanju številu primerov pa smrtnost pada.

Za preprečevanje melanoma je potrebna fizična zaščita pred direktnim vplivom sončnih žarkov, uporaba zaščitnih krem in izogibanje solarijem. Pomembno pa je tudi samopregledovanje kože.

Strokovna pomoč:

- [Dermatovenerološka ambulanta, UKC Ljubljana](#), T: 01 522 37 44, e-pošta: derma.narocanje@kclj.si
- [Splošna dermatološka ambulanta, UKC Maribor](#), T: 02 321 27 18, e-pošta: derma.narocanje@ukc-mb.si
- [Medicinski center Cardial, Ljubljana](#), T: 01 548 40 80, e-pošta: info@cardial.net
- [Onkološki inštitut Ljubljana](#), T: 01 587 91 63 ali klicni center Ol: T: 080 29 00, e-pošta: info@onko-i.si, triaza@onko-i.si;
- Onkofon za pogovor in svetovanje onkološkim bolnikom, T: 080 23 55;

Aplikacije:

- [SkinVision](#)
- [MelanomaTNM8](#)

Društva:

- [Društvo onkoloških bolnikov Slovenije](#)
- [Društvo za boj proti raku in drugim kroničnim boleznim](#)

Članki:

- [Subungvalni melanom - prikaz primera \(Medicinski razlgedi\)](#)
- [Melanoma: Epidemiology, Risk Factors, Pathogenesis, Diagnosis and Classification \(In Vivo\)](#)

Izdelki:

- [Lekarnar.si](#)

Forum/Življenjska zgodba:

- [Med.Over.net](#)
- [Zgodba bolnice: "Čudežno so me obdržali pri življenju"](#)
- [Viva.si](#)

Video:

- [Kožni melanom - kako se mu lahko izognemo in od česa je odvisna uspešnost zdravljenja?](#)
- [Melanoma - Overview \(signs and symptoms, pathology, risk factors, treatment\)](#)
- [Battling Melanoma: Brooke Wilson Shares Her Story](#)

Slike:

- [Zgodnji znaki razvoja melanoma](#)
- [Melanom na koži – klinična in dermatoskopska slika](#)

Dodatne informacije:

- [Najpogostejša vprašanja o kožnih znamenjih in melanomu](#)
- [Intervju: prof. dr. Igor Bartenjev, dr. med., dermatovenerolog](#)

Datasets - Insieme

- 300 common medical issues – diseases, problems
- 200 medical web applications
- Help yourself – exercises, rest, medications ..
- Help check prescriptions, doses ..
- Can input previous problems, laboratory tests ...
- Anonymous, no problems with data privacy
- Options: private DOC or municipality (Dragomer) or national

Datasets - Insieme

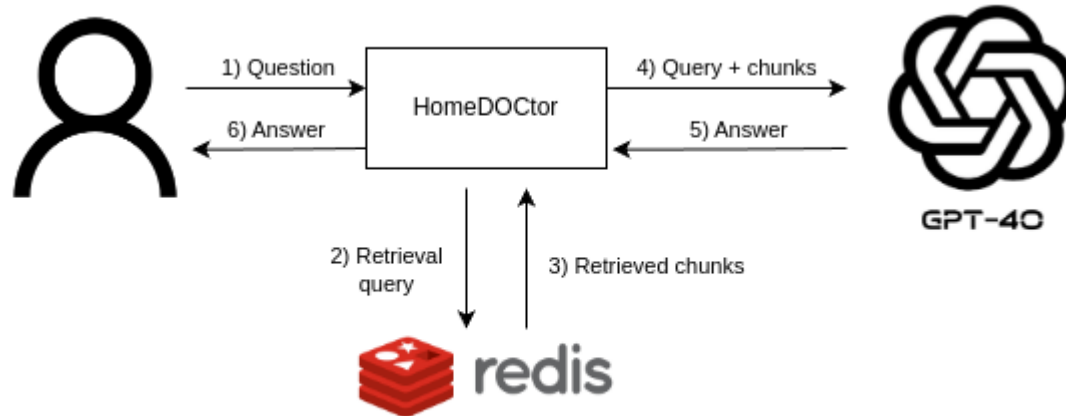
- 300 common medical issues – diseases, problems
- 200 medical web applications
- Help yourself – exercises, rest, medications ..
- Help check prescriptions, doses ..
- Can input previous problems, laboratory tests ...
- Anonymous, no problems with data privacy
- Options: private DOC or municipality or national
- **1st in the world!**

The application stack

- Flutter
- FastAPI
- Langchain
- Redis
- Docker

Fine-tuning vs. RAG

- Fine-tuning is a way to retrain the basic model with new data.
- At RAG LLM calls external database. Relevant data is passed directly to LLM.



Welcome to HomeDOctor



Start conversation

HomeDOctor is a research project in the prototype phase. The app is designed to offer Slovenian citizens friendly and accessible assistance with health and medical questions.

This is a trial version, and occasional operational issues may arise. During periods of high user activity, you may experience slowdowns or interruptions. If you encounter any issues, please try again later.

Instructions for Use:

- Asking questions: You can ask questions by pressing the send button or by pressing the 'enter' key.
- Add documents: If necessary, you can attach PDF documents by clicking on the attachments button.
- Additional information: Clicking on the additional information button will open three side windows with information on possible diseases, ways to help yourself and the urgency to seek professional medical help.
- Download summaries: You can download summaries of chat in PDF format.
- End session: Clicking the »End session« button will delete all your data.

Chat History

I am coughing for 2 weeks now. What should I do?

- You

- How severe is your cough? Is it dry or productive (with mucus)?
- Are you experiencing any other symptoms such as fever, shortness of breath, or chest pain? It's important to monitor your symptoms. If they worsen or if you develop additional symptoms, consider consulting a healthcare professional.

Sources:

- <https://drmed.org/wp-content/uploads/2022/11/III-22.pdf>

- AI Message

I have shortness of breath but no fever.

- You

- How would you describe the shortness of breath? Is it constant or does it occur during specific activities?
- Do you have any history of respiratory conditions such as asthma or allergies? Given your symptoms, it is advisable to consult a healthcare professional for a proper evaluation.

Sources:

- <https://drmed.org/wp-content/uploads/2022/11/III-22.pdf>

- AI Message



Enter your question, and press send



Chat History

I am coughing for 2 weeks now. What should I do?

- You

- How severe is your cough? Is it dry or productive (with mucus)?
- Are you experiencing any other symptoms such as fever, shortness of breath, or chest pain? It's important to monitor your symptoms. If they worsen or if you develop additional symptoms, consider consulting a healthcare professional.

Sources:

- <https://drmed.org/wp-content/uploads/2022/11/III-22.pdf>
- AI Message

I have shortness of breath but no fever.

- You

- How would you describe the shortness of breath? Is it constant or does it occur during specific activities?
- Do you have any history of respiratory conditions such as asthma or allergies? Given your symptoms, it is advisable to consult a healthcare professional for a proper evaluation.

Sources:

- <https://drmed.org/wp-content/uploads/2022/11/III-22.pdf>
- AI Message

POSSIBLE CONDITIONS

1. Acute bronchitis
2. Chronic obstructive pulmonary disease (COPD)
3. Asthma

HOW YOU CAN HELP YOURSELF:

Here are some self-care methods to relieve your symptoms:

Symptom Relief

1. **Stay Hydrated:** Drink plenty of warm fluids (water, herbal teas, broth) to soothe your throat and keep mucus thin.
2. **Steam Inhalation:** Inhale steam from a hot shower or bowl of hot water to help open airways.
3. **Humidifier:** Use a humidifier in your room to

SHOULD YOU VISIT A DOCTOR?

Yes, you should see a doctor. The combination of a persistent cough for two weeks and shortness of breath is concerning and may indicate an underlying condition that requires medical evaluation. It's essential to seek professional help, especially if your symptoms worsen or if you feel worse overall. Koda: 5/5 (A doctor visit is needed) This response was generated with an AI system, therefore they might contain mistakes We strongly recommend the users, to independently check all the information they receive from the AI system, with other trustworthy



Enter your question, and press send



SUMMARY

"The user has been coughing for 2 weeks and is experiencing shortness of breath but no fever. They were advised to monitor their symptoms and consult a healthcare professional for a proper evaluation, especially considering the shortness of breath."

POSSIBLE CONDITIONS

1. Acute bronchitis
 2. Chronic obstructive pulmonary disease (COPD)
 3. Asthma
 4. Pneumonia
 5. COVID-19
 6. Allergic reaction
 7. Pulmonary embolism
 8. Heart failure
 9. Interstitial lung disease
 10. Respiratory syncytial virus (RSV) infection
- HOW YOU CAN HELP YOURSELF:

Here are some self-care methods to relieve your symptoms:

Symptom Relief

1. **Stay Hydrated** : Drink plenty of warm fluids (water, herbal teas, broth) to soothe your throat and keep mucus thin.
2. **Steam Inhalation** : Inhale steam from a hot shower or bowl of hot water to help open airways.
3. **Humidifier** : Use a humidifier in your room to keep the air moist, which can ease breathing.
4. **Salt Water Gargle** : Gargle with warm salt water to relieve throat irritation.
5. **Rest** : Ensure you get plenty of rest to support your immune system.

Over-the-Counter Medications

1. **Cough Suppressants** : For a dry cough, consider medications containing

Thank you, you can test the application at:

<https://home-doctor.ijs.si/>