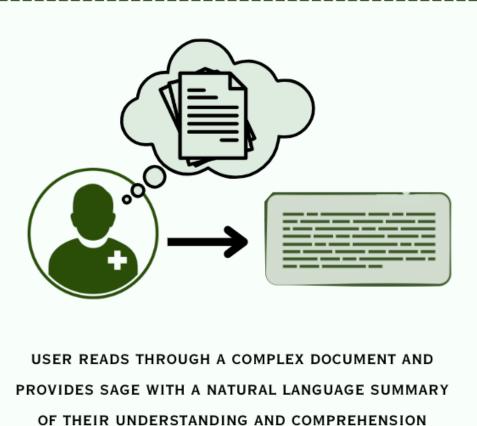


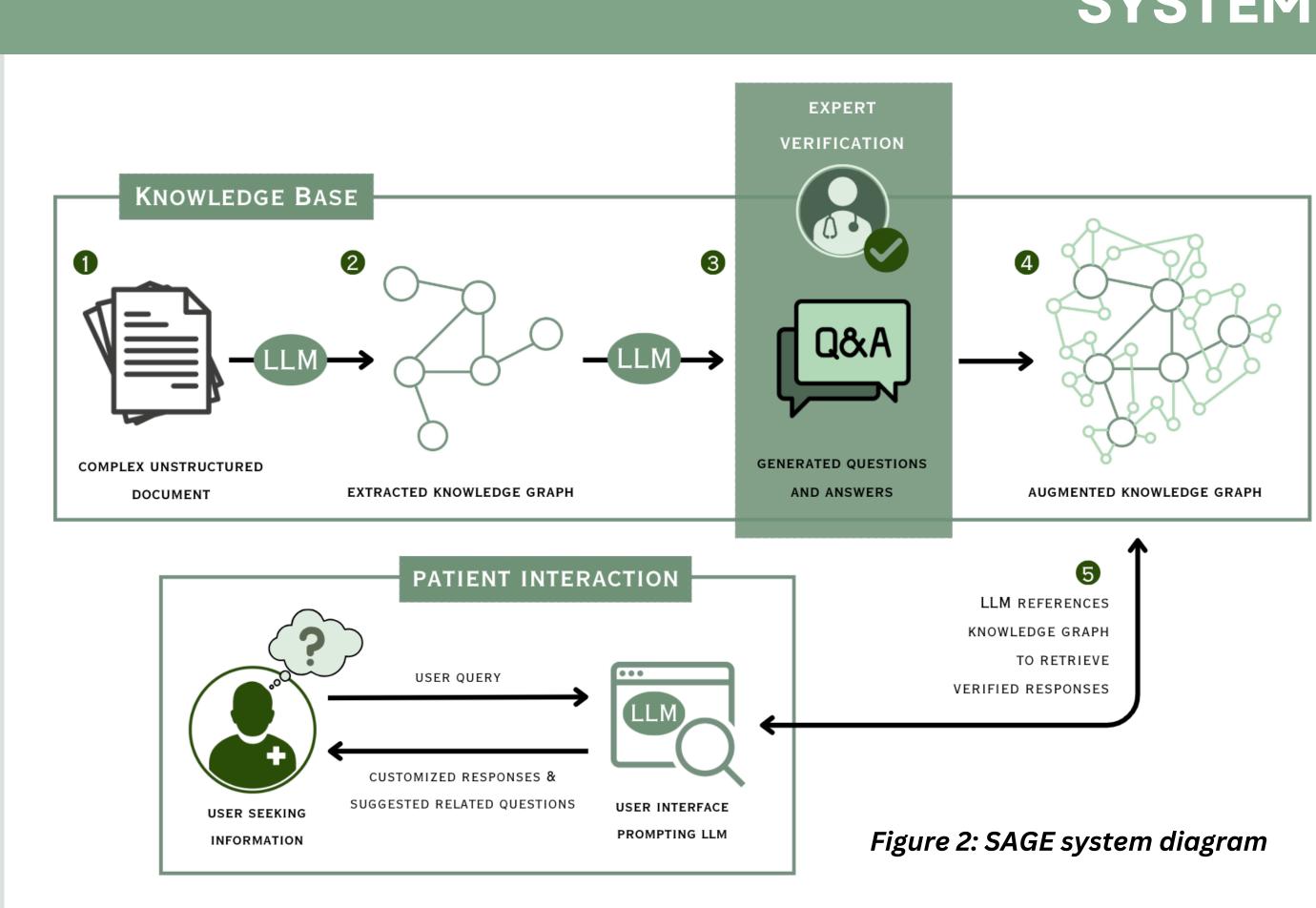
SAGE: Addressing Gaps in User Understanding of Health Information with AI-Assisted Navigation of Knowledge Graphs

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SAGE: System for Accessible Guided Exploration

- helps patients identify and fill gaps in their understanding of health information
- organizes information, generates guiding questions, and retrieves reliable responses
- merges LLMs' flexibility with knowledge graphs' reliability in this high-stakes domain





EVALUATION METHODS

Evaluating self-reported health literacy

30 participants rated their ability to understand healthcare information by reviewing a synthetic diabetic foot ulcer diagnosis letter, noting initial questions, and comparing self-assessment to actual comprehension.

Evaluating SAGE's ability to accurately identify gaps in understanding

SAGE evaluated participants' understanding by asking them to summarize a provided letter using a teach-back strategy, then categorized their comprehension levels using the knowledge graph; participants validated these assessments.

Evaluating SAGE's ability to effectively fill knowledge gaps

Participants were guided through the knowledge graph via an intuitive Q&A interface to fill identified knowledge gaps, with personalized questions suggested based on gaps and iteratively updated, followed by a 10-minute independent exploration and a post-interaction comprehension survey.

OBJECTIVE

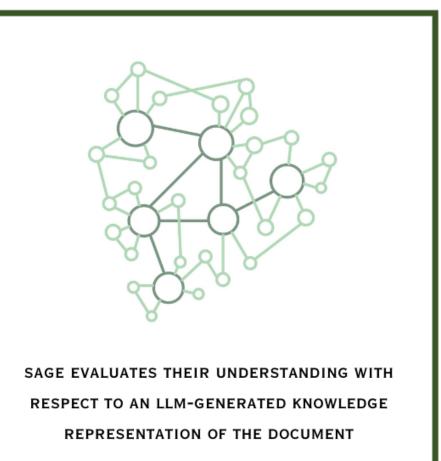


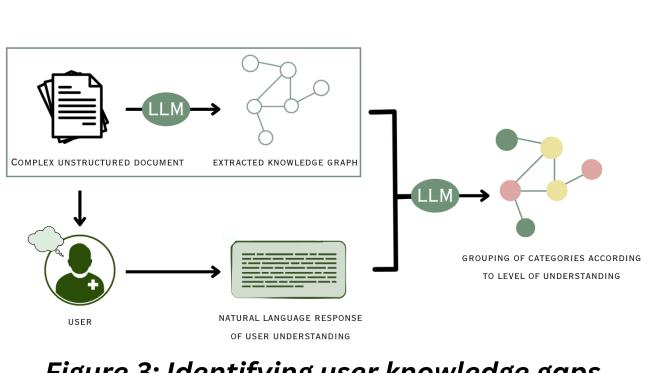
Figure 1: SAGE user interaction



SYSTEM DESIGN

Knowledge Gap Identification

SAGE mimics how physicians use teach-back methods to evaluate patient comprehension by assessing a natural language summary of their understanding.



Knowledge Graph Construction

Q&A pairs are generated using retrieval augmented generation (RAG) from verified patient education material, stored at various literacy levels. Vector similarities are calculated to connect nodes for traversal.

Knowledge Graph Traversal

SAGE tailors traversal of the KG, suggesting questions in areas of partial understanding to anchor new information, guiding users to new categories based on established comprehension. New relevant questions are suggested at each interaction.

You may want to ask...

How can I incorporate physical activity into my daily routine while ensuring it doesn't negatively impact my foot ulcer? What lifestyle changes should I make to better manage my diabetes and support the healing of the diabetic foot ulcer?

Are there any habits or activities I should avoid to prevent complications and facilitate the healing process of the diabetic foot ulcer?

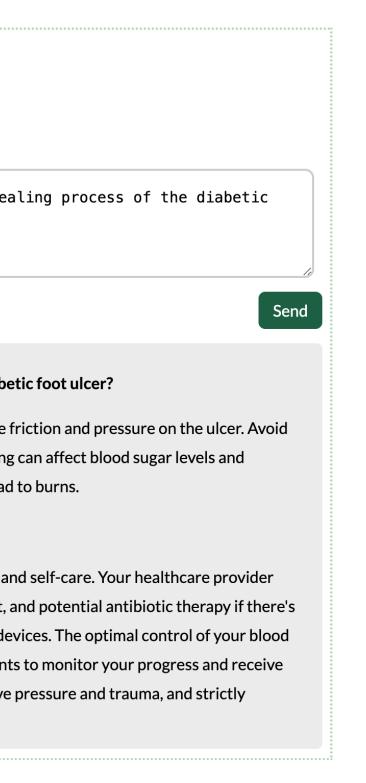
Q: Are there any habits or activities I should avoid to prevent complications and facilitate the healing process of the diabetic foot ulcer? A: Firstly, refrain from walking barefoot to minimize the risk of injuries. Steer clear of tight or ill-fitting shoes that can cause friction and pressure on the ulcer. Avoid

smoking, as it can impede circulation and hinder the healing of wounds. Minimize alcohol consumption, as excessive drinking can affect blood sugar levels and overall health. Additionally, be cautious of hot water or heating pads near the foot ulcer, as compromised sensation may lead to burns. Q: What is the best way to have my foot treated?

A: The best way to have your diabetic foot ulcer treated is through a comprehensive approach that combines medical care and self-care. Your healthcare provider will lead the treatment, which typically includes regular wound cleaning, proper dressing to maintain a sterile environment, and potential antibiotic therapy if there's an infection. Offloading pressure from the affected area is crucial, which might involve specialized footwear or offloading devices. The optimal control of your blood glucose levels is also essential for effective wound healing. Additionally, you'll need to attend regular follow-up appointments to monitor your progress and receive guidance on self-care. Active involvement in your own care by keeping the wound clean, protecting your feet from excessive pressure and trauma, and strictly adhering to your diabetes management plan will be vital for a favorable outcome and to reduce the risk of recurrence.

Figure 4: Addressing users' knowledge gaps through interactive Q&A

Figure 3: Identifying user knowledge gaps



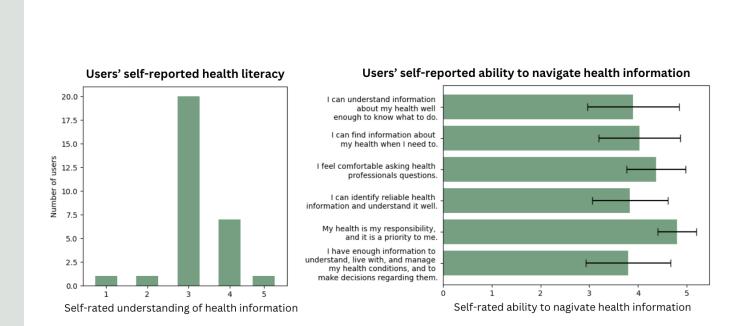
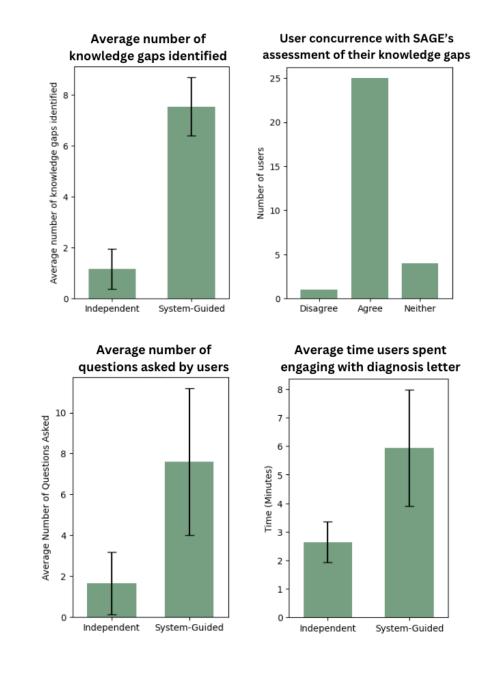


Figure 5: Users' self-reported health literacy

Identifying knowledge gaps reveals discrepancies in health literacy and diverse comprehension patterns: SAGE's assessment of users' natural language summaries uncovered knowledge gaps acknowledged as accurate by nearly all.



Guiding questions increase user engagement: Interaction with SAGE led to a significant increase in participant-generated questions (M = 7.60, SD = 3.64) compared to independent questioning (M = 1.67, SD = 1.56, t(29) = -8.2, p < .01), and a significant increase in time engaging with the diagnosis letter and follow-up questions (M = 5.94, SD = 2.03) compared to initial engagement (M = 2.64, SD = 0.72, t(29) = -8.3, p < .001).

Figure 7: SAGE evaluation metrics

DISCUSSION

Human-AI Complementarity Enhancing Information-Seeking Behaviors

SAGE and similar tools can enhance understanding of novel, complex, or specialized knowledge, enriching comprehension and knowledge acquisition for users by detecting and filling knowledge gaps with complementary expertise.

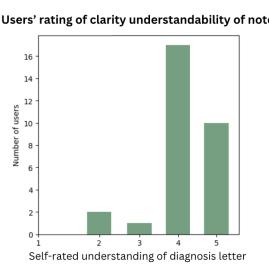
Various knowledge models can support, reinforce, and verify each other in practical applications. LLMs can construct KGs, and KGs verify LLM outputs, while LLMs aid in personalized delivery of information.

LLMs Promoting Information Equity and Democratizing Access to Knowledge SAGE showcases how LLMs can provide tailored, accessible learning pathways and ensure proper information reception during self-directed learning.

We extend our appreciation to our partners at UCSF Medicine—Dean Schillinger, Elaine Khoong, and Wagahta Semere—for their valuable insights. This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE 2146752. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



RESULTS



Self-reported health literacy lacks depth:

Vast majority of participants rated themselves as average or above, expressing high confidence in understanding the note, with few initial questions.

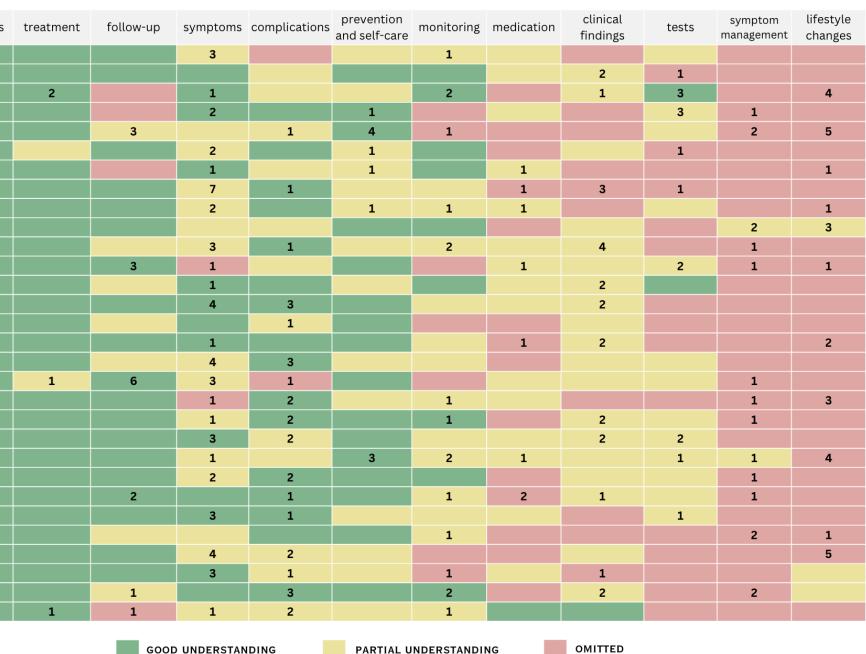


Figure 6: Users' knowledge gaps and comprehension patterns

Mutually Supportive Knowledge Models for Information Management and Retrieval

