

Introduction

- Sepsis is a life-threatening condition requiring timely, specialized medical intervention.
- Rural and under-resourced hospitals often lack access to specialists, negatively impacting sepsis outcomes.
- AI-based medical tools offer potential solutions but are limited by accuracy and reliability concerns.
- We developed the MATEC (Multi-AI Agent Team Care) framework to support clinical decision-making in sepsis care using multiple specialized AI agents.
- This pilot study evaluates MATEC's clinical usefulness, accuracy, and potential to assist healthcare providers, particularly in resource-limited settings.

Methods

- We developed specialized AI Agents using Large Language Models (LLM), prompt engineering, Chain of Thought (CoT) Reasoning, Reasoning and Action (ReAct), and Retriever-Augmented Generation (RAG).

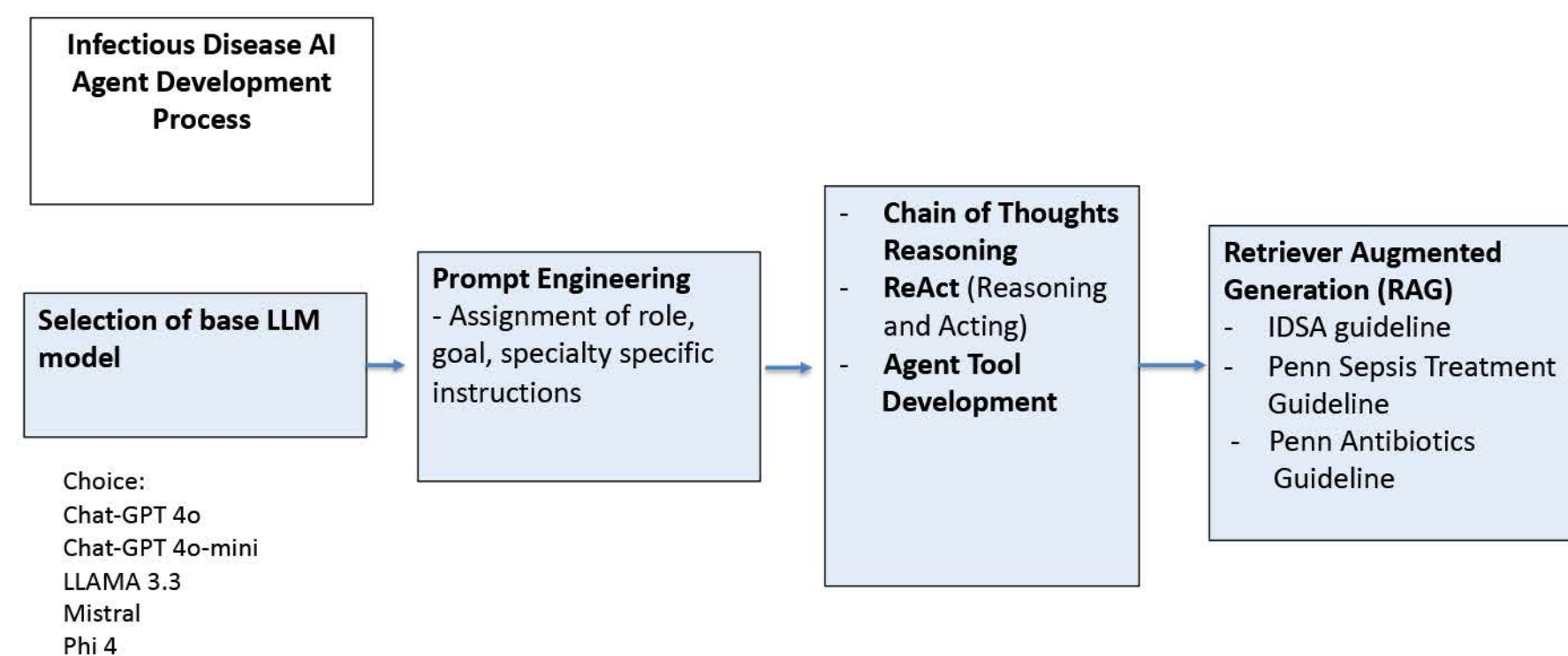


Figure 1: Example Development of Infectious Disease AI Agent.

- We built the MATEC framework integrating over 40 AI Agents specializing in various important medical fields.

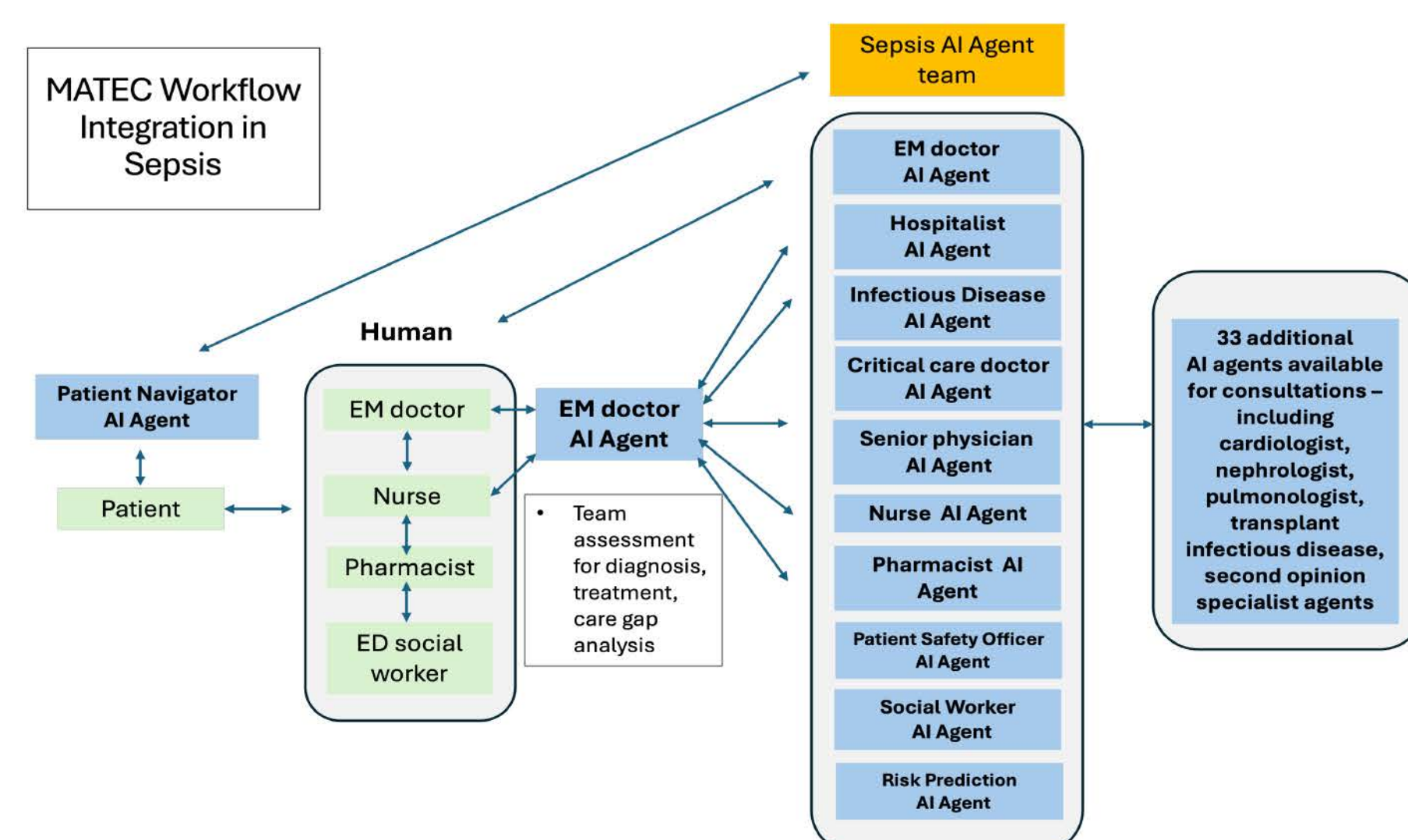


Figure 2: AI Agents work collaboratively to diagnose sepsis and develop treatment plans.

Methods

- We conducted a pilot study with 10 attending physicians interacting with our web-based MATEC interface for about 1 hour.
- Physicians assessed MATEC's usefulness, accuracy, and consistency through a survey using a 5-point scale (1 = unfavorable, 5 = favorable).
- We performed statistical analysis of survey responses using a one-sample Wilcoxon signed-rank test (R software).

Results

- A user submits patient information and a question using our interface.
- Users can also select predefined question templates to perform care gap analysis.
- Figure 3 displays the Senior Physician Agent's output which incorporates a final diagnosis, areas of consensus/divergence, comprehensive care plan, and next steps based on inputs of four other doctor agents in the sepsis care team.

TEAM RECOMMENDATIONS SUMMARY

1. Final Diagnosis

- The specialists collectively agree on the diagnosis of **Infective Endocarditis** with tricuspid valve involvement, likely secondary to IV drug use. This is supported by the presence of vegetation on the tricuspid valve, Osler's nodes, and a new systolic murmur. The elevated lactate and leukocytosis suggest **Sepsis** secondary to the endocarditis. The level of certainty is high given the clinical presentation and echocardiogram findings.

2. Areas of Consensus/Divergence

- **Consensus:**
- All specialists agree on the diagnosis of infective endocarditis and the need for immediate initiation of broad-spectrum IV antibiotics after obtaining blood cultures.
- There is a consensus on the need for ICU admission due to the risk of rapid clinical deterioration and the need for close monitoring.
- Frequent monitoring and fluid resuscitation are universally recommended to manage potential sepsis-induced hypoperfusion.
- The need for cardiology consultation is agreed upon to manage the tricuspid valve vegetation and potential complications.
- Social and addiction support is emphasized by all specialists to address the patient's homelessness and substance use disorder.

- **Divergence:**
- There is no significant divergence in the recommendations. All specialists align on the critical aspects of the patient's management, focusing on infection control, cardiac monitoring, and supportive care.

3. Comprehensive Care Plan

- **Immediate Interventions:**
- Initiate broad-spectrum IV antibiotics (e.g., Vancomycin) after obtaining blood cultures.
- Begin fluid resuscitation to address potential hypoperfusion.
- Admit the patient to the ICU for continuous monitoring of vital signs, hemodynamics, and organ function.

- **Further Management:**
- Cardiology consultation for further evaluation of the tricuspid valve and potential surgical intervention if indicated.
- Infectious disease consultation to tailor antimicrobial therapy based on culture results.
- Social services and addiction specialists to engage the patient in support programs for homelessness and substance use disorder.

- **Monitoring and Follow-up:**
- Continuous cardiac monitoring to detect arrhythmias.
- Regular assessment of renal function and fluid balance.
- Follow-up echocardiograms to monitor the response to treatment and valvular function.

4. Implementation Strategy

- Immediate Next Steps:

Social work and case management AI Agent

As a Social Work and Case Management specialist, my role is to focus on the psychosocial aspects of the patient's care, addressing social determinants of health, and ensuring effective care transitions and resource coordination. Here is my assessment of the patient's condition:

Key Concerns:

- **Homelessness and Housing Instability:** The patient is currently homeless, staying in shelters or with friends, which poses a significant barrier to consistent healthcare access and recovery.

- **Substance Use Disorder:** Ongoing IV drug use, particularly heroin, complicates the patient's medical condition and requires specialized addiction support.

- **Lack of Support System:** The patient has minimal support from family or friends, which can impact adherence to treatment and follow-up care.

- **Unemployment and Financial Instability:** The patient's unemployment status may limit access to necessary healthcare services and medications.

Figure 3: Example output from sepsis medical team and social worker AI agent. A case with sepsis due to endocarditis.

Results

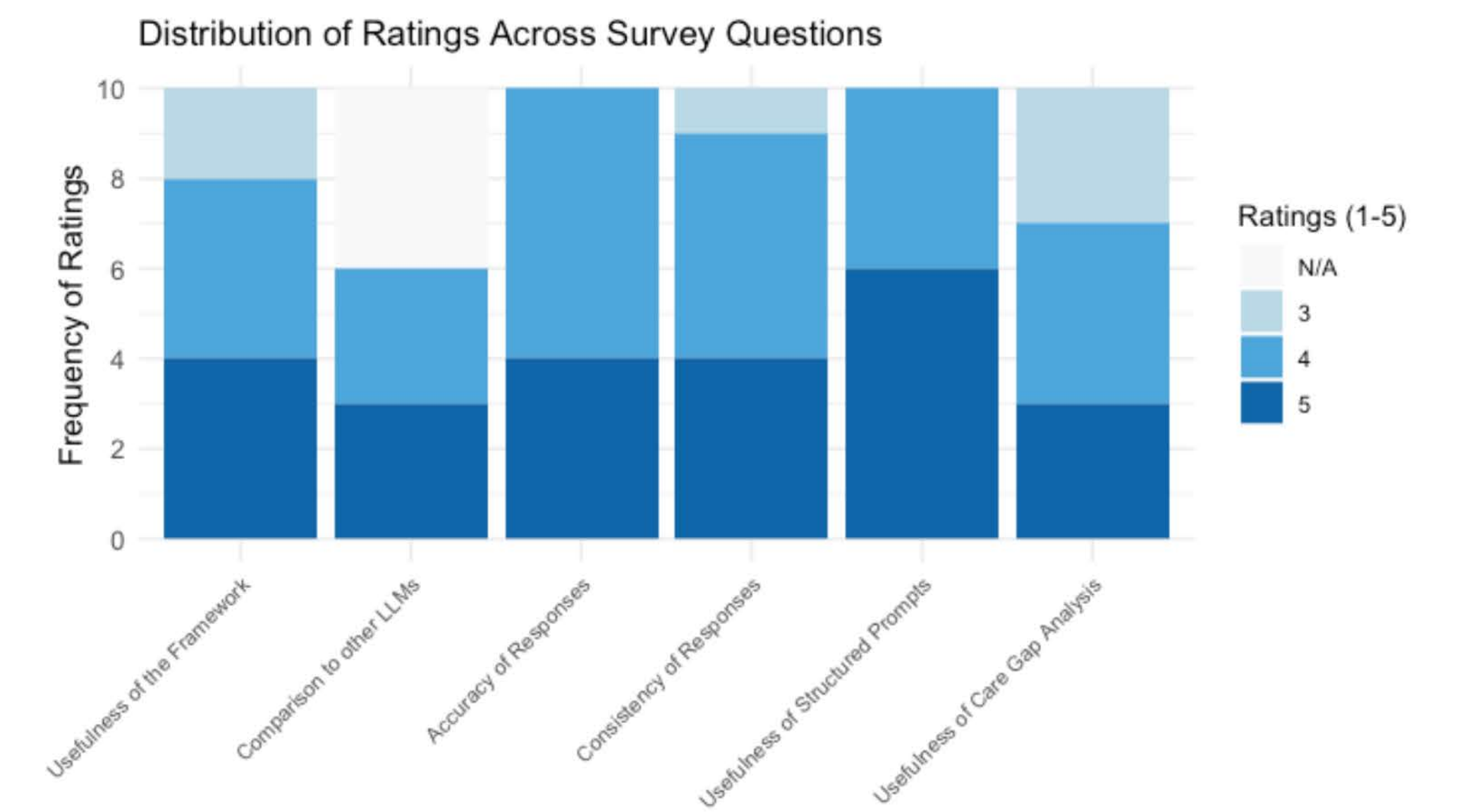


Figure 4: Survey results based on 5-point scale from 1 to 5.

Discussion

- Physicians rated MATEC highly useful (**Median=4, p=0.01**) and accurate (**Median=4, p=0.005**) in supporting clinical decisions for sepsis care.
- Those experienced with existing LLM tools found MATEC comparatively more useful (**Median=4.5, p=0.03**).
- Structured prompts significantly improved usability (**Median=5, p=0.005**), streamlining clinical interactions.
- Care gap analyses were considered beneficial (**Median=4, p=0.02**) for identifying critical treatment deficiencies.
- Multi-agent collaboration effectively addressed reliability concerns by reducing hallucinations and enhancing accuracy through cross-verification.
- Integration of social determinants of health via the Social Worker AI agent improved comprehensive patient care by addressing real-world barriers.
- MATEC offers potential to bridge specialist gaps in under-resourced hospitals, improving patient outcomes and healthcare delivery.

Conclusion

- This pilot study demonstrates that the Multi-AI Agent Team Care (MATEC) framework can potentially be used to assist medical professionals, particularly in under-resourced hospital settings.
- More studies are necessary for applications of the multi-agent framework in clinical settings.