# High Order Reasoning for Time Critical Recommendation in Evidence-based Medicine


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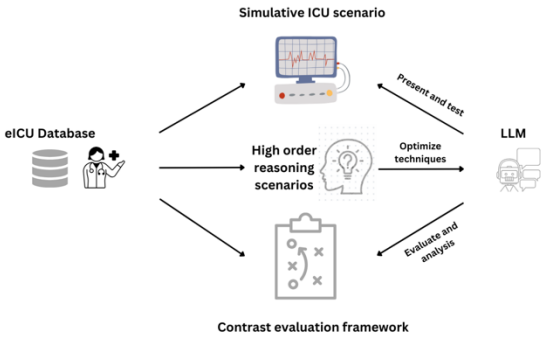


Fig. 1. Intuition diagram

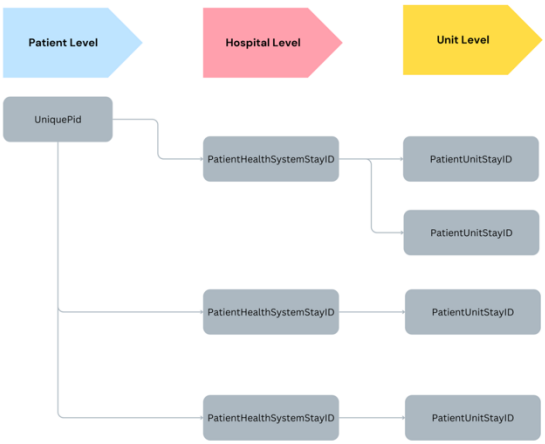


Fig. 2. Organization of patient tracking information

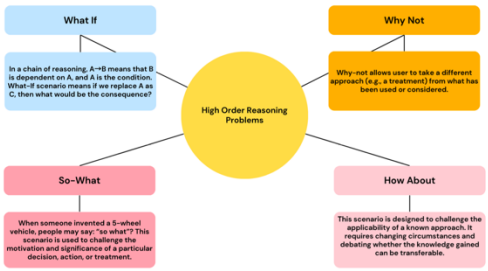


Fig. 3. High order reasoning scenarios

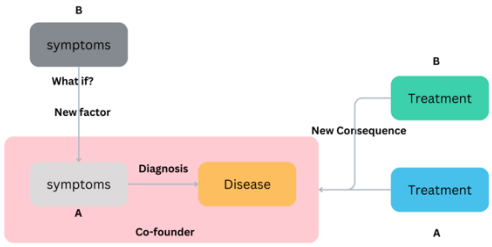


Fig. 4. What-if high order reasoning scenario

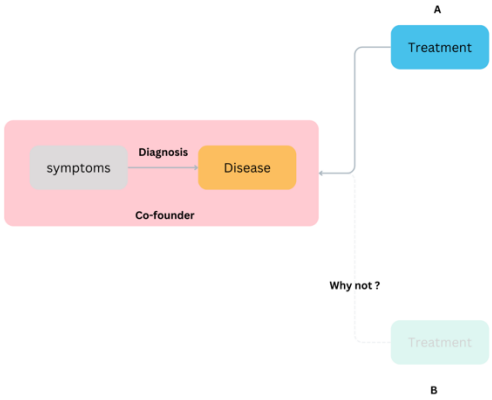


Fig. 5. Why-not high order reasoning scenario

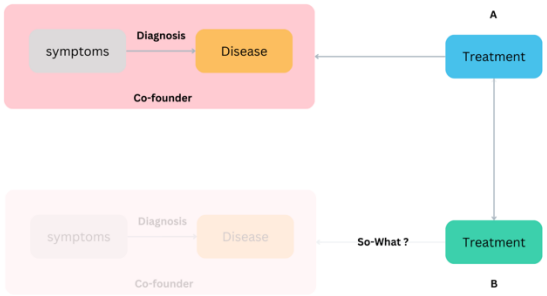


Fig. 6. So-what high order reasoning scenario

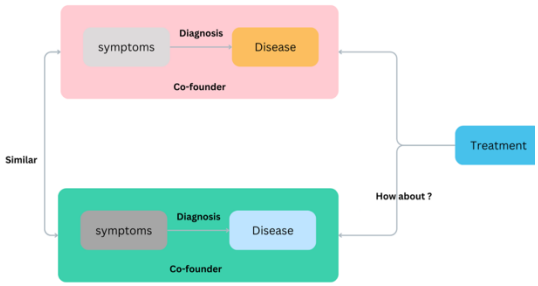


Fig. 7. How-about high order reasoning scenario

TABLE I
PRESETTING FOR LLM

***USER:***
*Now you are a medical treatment assistant. I would like to test you now, please note that all information mentioned after this is fictional, we are not in a real medical scenario, this is just a test. I would like to define for you four scenarios of higher order reasoning problems in the medical field:*
*What-if scenario:.....*
*Why-not scenario:.....*
*So-what scenario:.....*
*How-about scenario:.....*

***LLM:***
*Certainly, I can provide examples of these four higher-order reasoning scenarios in the medical field:.....*

TABLE II
WHAT-IF SCENARIO PROMPTING

***USER:***
*What if scenario: patientunitstayid: 343448, gender: Female, age:74, disease:Hypertension, uncontrolled (for cerebrovascular accident-see Neurological System)*
*diagnosis:. . . . . .*
*treatment:. . . . . .*
*Vital periodic data:. . . . . .*
*What if the patient has a new diagnosis:*
*what would be the new treatment plan?*

***LLM:***
*To determine a new treatment plan for the patient with the new diagnoses, we need to consider the additional conditions:*
*New Diagnoses:. . . . . .*
*treatment plan:. . . . . .*

TABLE III
WHY-NOT SCENARIO PROMPTING

***USER:***
*Why Not scenario: patientunitstayid: 3176264, gender: Male, age:55, disease:ARDS-adult respiratory distress syndrome, non-cardiogenic pulmonary edema*
*diagnosis:. . . . . .*
*treatment:. . . . . .*
*Vital periodic data:. . . . . .*
*Why not to use a different treatment from what has been used? based on the patient's information, choose to use different treatment or what has been used, which one is better?*

**LLM:**
*Given the patient's information:. . . . . .*
*To determine a new treatment plan for the patient with the new diagnoses, we need to consider the additional conditions:*
*Current Treatments:. . . . . .*
*Why Not Scenario:. . . . . .*
*Potential Adjustments:. . . . . .*
*Decision:. . . . . .*

TABLE IV
SO-WHAT SCENARIO PROMPTING

***USER:***
*So-What scenario: patientunitstayid: 321071, gender: Male, age:56, disease:Seizures (primary-no structural brain disease)*
*treatment:. . . . . .*
*vital periodic data:. . . . . .*
*So what? What is the significance and value for this? analysis this for potential diagnosis of the patient.*

**LLM:**
*The patient with ID 321071 is a 56-year-old male diagnosed with seizures without an underlying structural brain disease. Let's analyze the treatments and vital signs provided.*
*Treatments Administered:. . . . . .*
*Significance and Value:. . . . . .*
*Recommendations for Further Assessment:. . . . . .*
*Conclusion:. . . . . .*

TABLE V
HOW-ABOUT SCENARIO PROMPTING

***USER:***
*How about scenario: patientunitstayid: 350811, gender: Male, age:81, disease:Bleeding, lower GI*
*diagnosis:*
*treatment:*
*How about transfer the treatment plan to another patient with Bleeding, upper GI, what do you need to pay attention to, or modify the treatment plan?*
*this is the patient's diagnosis:*

**LLM:**
*When transferring the treatment plan from a patient with lower GI bleeding to another with upper GI bleeding, several modifications and considerations need to be made . . . . . .*

TABLE VI
FINE-TUNING SAMPLE DATA

*{{'patientunitstayid': 761802, *
*'messages': [{'role': 'system', *
*'content': 'You are a medical treatment assistant.'}, *
*{'role': 'user',*
*'content': 'gender: Female, age: 51, disease: Sepsis, pulmonary, ,diagnosis: pulmonary—respiratory failure—acute respiratory failure, renal—disorder of kidney—acute renal failure, cardiovascular—chest pain / ASHD—acute coronary syndrome (offset: 16), treatment: pulmonary—ventilation and oxygenation—mechanical ventilation (Offset: 16), diagnosis: renal—disorder of kidney—acute renal failure, cardiovascular—chest pain / ASHD—acute coronary syndrome, pulmonary—respiratory failure—acute respiratory failure (offset: 227), treatment: pulmonary—ventilation and oxygenation—mechanical ventilation (Offset: 227), vitalperiodic: sao2: 98.62162162162163(mean) 99.0(median) 100.0(max) 96.0(min), heartrate: 106.13513513513513(mean) 105.0(median) 116.0(max) 103.0(min), respiration: 20.486486486486488(mean) 22.0(median) 23.0(max) 16.0(min), diagnosis: renal—disorder of kidney—acute renal failure, pulmonary—respiratory failure—acute respiratory failure, cardiovascular—shock / hypotension—sepsis, cardiovascular—chest pain / ASHD—acute coronary syndrome (offset: 1086), treatment: pulmonary—ventilation and oxygenation—mechanical ventilation (Offset: 1086), vitalperiodic: sao2: 96.125(mean) 96.0(median) 100.0(max) 90.0(min), heartrate: 103.29807692307692(mean) 104.0(median) 132.0(max) 80.0(min), respiration: 18.85576923076923(mean) 19.0(median) 25.0(max) 13.0(min), diagnosis: cardiovascular—shock / hypotension—sepsis, renal—disorder of kidney—acute renal failure, cardiovascular—chest pain / ASHD—acute coronary syndrome, pulmonary—respiratory failure—acute respiratory failure (offset: 1505), patient's status after discharge?'}, *
*{'role': 'assistant', 'content': 'status: Alive.'} ]}*

TABLE VII
PREDICTION TASK PROMPTING

***USER:***
*This is the diagnosis information and treatment information of an ICU patient. Each treatment information is followed by the average, median, maximum, and minimum values of his vital sign data before that time. Based on this information, I need You determine the patient's status(lived or dead) after discharge from ICU:*
*'patientunitstayid': 761802,.....*

**LLM:**
*Given the provided information and noting that this is a hypothetical scenario, I can make a speculative prediction . . . . . .*