

High-Level Description of the Data Generation Operation

In data generation we have some rules:

- The measurements should eventually indicate the patient's true state

Each episode contains a sequence of vital signs (e.g., HR, BP, SpO2, Temp) that evolve over time. For sick patients, these worsen and trend toward disease-specific patterns. For healthy patients, vital signs may fluctuate but won't progressively degrade.

- A healthy person can have some "off days"

Healthy individuals may show temporary abnormal readings due to stress, fatigue, or noise. These irregularities do not escalate over time, helping differentiate them from actual disease.

- A healthy person can become sick during the episode

A patient may begin healthy and transition to a disease state partway through the episode. This simulates real-world illness onset and challenges the model to revise its belief based on new evidence.

- Allow for false positives/negatives in test results

Diagnostic tests are imperfect:

- May return false positives/negatives.
- A hidden mental state can impair test accuracy, simulating confusion or anxiety (low probability).
- For sick patients, test accuracy improves as symptoms progress, since indicators become more detectable.

- Replace vague "symptom score" with structured self-reported experiences

Patients provide subjective input on a fixed set of ~5 dimensions to reduce ambiguity and cognitive burden:

- Breathing quality
- Body soreness or pain
- Energy level or fatigue
- Mental clarity
- Appetite or nausea

These are rated on a simple scale (e.g., 0-3). They enhance interpretability and offer additional decision signals.

- There are two levels of tests: general and detailed

1. General Test

- Can be performed at any time.
- Provides a noisy but broad view of the patient's condition.
- Has moderate cost, and may help identify candidate illnesses.

2. Detailed Test

- Can only be done after a general test and after the agent proposes a specific early diagnosis.
- It is illness-specific:
 - If the proposed diagnosis is correct, the detailed test gives a near-perfect confirmation.
 - If the diagnosis is wrong, it returns a strong negative signal.
- However, it is expensive:
 - If followed by a correct diagnosis, the cost is justified.
 - If followed by a wrong diagnosis or no diagnosis, the agent is penalized heavily for wasting

time and resources.

The goal:

- Get a good diagnosis as early as possible

The agent should aim to diagnose correctly and early. Early correct diagnoses give the highest reward.

- Giving an alert is good

When confident diagnosis isn't possible but deterioration is suspected, issuing an alert is rewarded. It's better than silence and encourages early risk detection.

- Running unnecessary tests is wasteful

Tests consume resources and time. Especially the detailed test, which is expensive and requires a commitment (early diagnosis + justification). Penalties apply for misuse:

- Running a detailed test and not diagnosing = high penalty
- Running it after a wrong early diagnosis = high penalty
- Using tests recklessly in healthy patients = penalized

The agent must strategically manage uncertainty, choosing what to test, when, and why, mimicking rational diagnostic behavior.