



Virtual Care Assistant

FROM HOME

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Problem Statement

MOTIVATION

Implicit Health Cues

During home hospitalization, the patient is not under constant supervision by medical staff and may experience a deterioration in critical indicators (such as blood sugar, blood pressure, or oxygen saturation) or symptoms (such as pain or shortness of breath) without realizing how severe the situation is. The lack of continuous monitoring can lead either to unnecessary hospitalization or, conversely, to neglect of a medical emergency.

Example

Mr. Levi, 73, receiving home hospitalization for chronic heart failure, reported via the app a 3 kg weight gain over three days, shortness of breath at rest, and significant ankle swelling. The system identified a critical cardiac deterioration, integrated sensor data (elevated weight and blood pressure), and immediately alerted the medical team for an urgent home visit with a recommendation to adjust diuretics or consider ER referral.

Application

Without an integrative tool, patients and staff rely on sporadic visits and phone calls that don't provide a full picture. A dedicated app enables trend detection, automatic alerts, and continuous care—crucial for the safety and success of home hospitalization.

NLP TASK

Challenge:

Interpreting patients' free-form reports in everyday language (text and/or speech) and combining them with physiological measurements (blood pressure, glucose, weight, etc.) to detect changes in health status

Input:

- Free-form transcription (written or spoken) from the patient.
- Quantitative data from connected home monitoring devices (blood pressure monitor, blood glucose, weight scale, oxygen saturation, etc.).

Output – Structured Version:

- Classification of the patient's condition into one of the following categories:
- Deterioration /Improvement/ Stable/Normal
- Triggering an alert when needed: ER referral, treatment adjustment, urgent home visit.
- Real-time recommendations to physician/nurse via a dashboard.

Example

Textual input: "I gained 2 kg in 48 hours, and I'm having trouble breathing at rest."

Quantitative input: Sharp weight increase; blood pressure 165/105.
Output: Classified as "cardiac deterioration"; alert sent to physician with recommendation for urgent home visit or adjustment of diuretics



Training and Test Data

“Home Hospitalization Symptom Reports Dataset”

- A database of free-form transcriptions from home-hospitalized patients, labeled by status: deterioration / improvement / stable
- Used to train models for NER (Named Entity Recognition) to identify symptoms, and for text classification to assess patient condition

“Home Monitoring Sensor Dataset”

Data from connected home sensors:

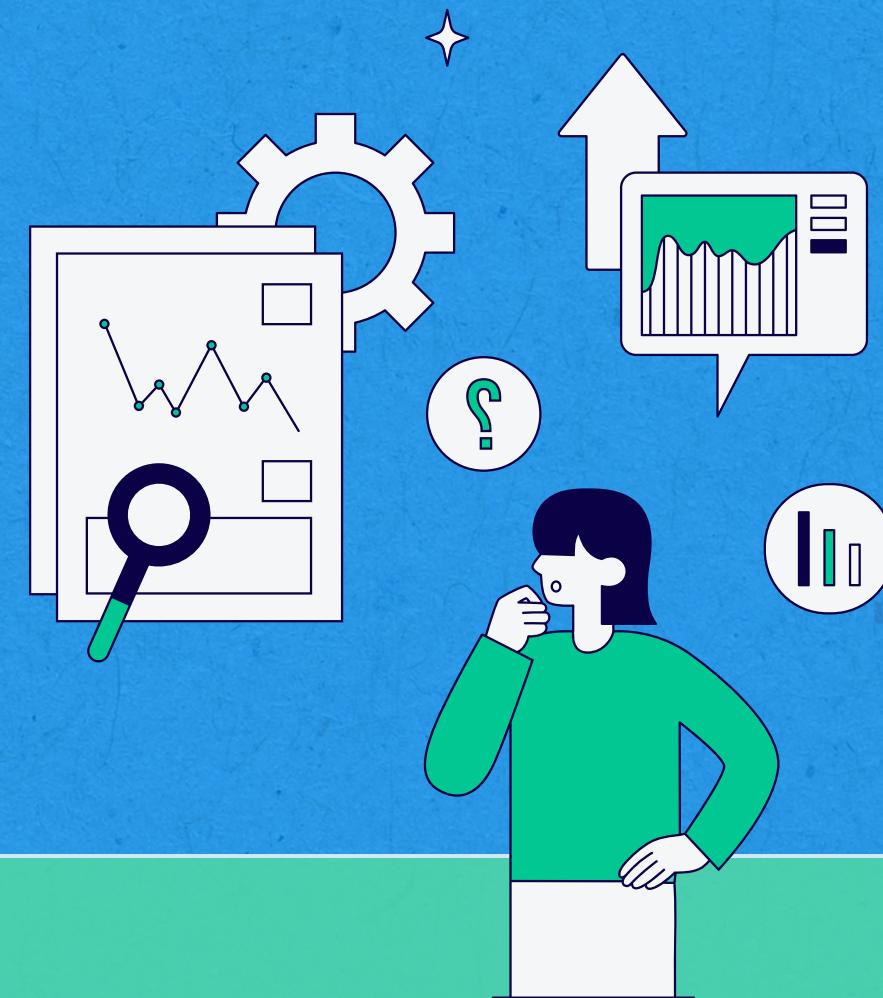
- Daily blood pressure, oxygen saturation, heart rate, weight, activity level
- Additional measurements as needed (temperature, blood glucose, urine output)
- Used for system testing and validation in continuous monitoring scenarios

Data Integration:

- Integration of free-form transcriptions with real-time sensor readings
- Training and validation of the Virtual Care Assistant on deterioration and improvement scenarios
- Supports tasks such as symptom extraction, triage prediction, and real-time recommendations

LLM Integration:

- Use of a Large Language Model (LLM) to interpret patient-reported descriptions
- Extract, normalize, and classify symptoms using natural language processing (NLP)
- Enhance triage decisions by combining chronological text with sensor data
- Generate real-time, personalized recommendations for the patient and medical team via a dashboard



Evaluation

Closed-World Metrics

Classification Metrics (Symptom Extraction / Triage)

- Precision, Recall, F1
- Measure the accuracy of identifying known symptoms or classifying patients into risk levels

Baseline

- Dictionary-based / keyword-matching approach for symptom extraction
- Static rules (thresholds) applied to sensor values



Open-World Metrics

Text Generation & Recommendation Quality

- ROUGE / BLEU or LLM-based evaluation for clarity and accuracy of recommendations
- Human rating (clinician-rated helpfulness)

Clinical Impact & Outcomes

- Reduction in unnecessary ER visits
- Shorter time-to-intervention
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Patient & Clinician Satisfaction

- SUS or NPS surveys to assess system usability and trust

Baseline

- Template text messages without contextual adaptation
- Manual recommendations based on static clinical rules



PROMPT 1

Scenario – Mr. Levi, 73, 5-Day Home Hospitalization for Chronic Heart Failure

Day 1 (Intake):

Patient: Reports 71 kg, swollen ankles, difficulty moving.

Sensors: BP 145/95, SpO₂ 92%.

System: Classified as Critical deterioration. Alert sent to care team.

Day 3 (Follow-up):

Patient: Reports less swelling, 70 kg, improved breathing.

Sensors: BP 135/85, SpO₂ 94%.

System: Watch status. Stable trend; continue routine monitoring.

Day 5 (Discharge):

Patient: Feels stable, 68.5 kg, no swelling.

Sensors: BP 130/80, SpO₂ 96%.

System: Normal status. No alerts; home hospitalization ended.



PROMPT 2

Scenario – Ms. Cohen, 65, Home Treatment for Left-Leg Cellulitis

Day 1 (Intake):

Reports redness and swelling, feels okay otherwise.

Vitals: Temp 37.1°C, BP 125/80, Pulse 78

System: Normal. Routine monitoring continues.

Day 2 (Mild Improvement):

Swelling remains, redness reduced, no fever.

Vitals: Temp 36.8°C, BP 120/78, Pulse 75

System: Watch. Stable, continue monitoring.

Day 3 (Sudden Deterioration):

High fever, burning leg pain, worsened condition.

Vitals: Temp 38.7°C, BP 140/90, Pulse 110

System: Critical. Emergency protocol triggered; ER referral issued.



PROMPT 3

Scenario – Mr. Ben-Ami, 58, Home Monitoring for COPD

Day 1 (Intake):

Patient: Increased coughing, difficulty breathing when lying down.

Sensors: SpO₂ 91%, BP 130/85, Pulse 88

System: Watch – Early instability; start daily monitoring.

Day 2 (Deterioration):

Patient: Shortness of breath even while sitting, increased fatigue.

Sensors: SpO₂ 88%, BP 140/90, Pulse 96

System: Critical – Urgent home visit triggered; inhaler adjusted.

Day 3 (Slight Improvement):

Patient: Breathing somewhat better, less coughing post-medication.

Sensors: SpO₂ 90%, BP 132/84, Pulse 86

System: Watch – Stabilizing. Continue monitoring for two more days.

Data

Symptom-Based Disease Labeling Dataset:

https://www.kaggle.com/datasets/krish0202/symptom-based-disease-labeling-dataset?utm_source=chatgpt.com

Healthcare_IOT_Data

<https://www.kaggle.com/datasets/ziya07/healthcare-iot-data>

Thank you for listening!

