HeartWell: Advanced Hypertension Management with Real-Time Alerts and Continuous Monitoring
(Nishant Kumar, 2022326)

Problem Statement:

Millions suffer from hypertension, or high blood pressure. Hypertension must be managed to avoid heart attacks, strokes, and kidney failure. Traditional hypertension management relies on medical visits and self-reported data, which might postpone important interventions.

HeartWell's comprehensive and proactive real-time monitoring solution addresses hypertension treatment concerns. A Bluetooth-enabled blood pressure monitor connected to the "Heartwell" app tracks the patient's blood pressure. Beyond monitoring, the app offers thorough weekly reports that evaluate trends and indicate issues. The app warns the healthcare provider and patient immediately if abnormal readings are noticed, ensuring prompt medical response. The app also has an emergency response system that may call last-dialed contacts and send ambulances to the patient in emergencies. Hypertension patients benefit from timely interventions, tailored care, and better health outcomes with this integrated strategy.

Storyboard Use Case:

Scenario: Sunita Verma is a patient managing hypertension. She uses the "HeartWell" app, connected to a smart blood pressure monitor, to track her condition daily. The app not only records her readings but also sends weekly analysis reports to her doctor. In a critical reading, the app sends an instant alert to her doctor, ensuring immediate medical attention.

Storyboard:

Scene 1: Daily Monitoring Begins
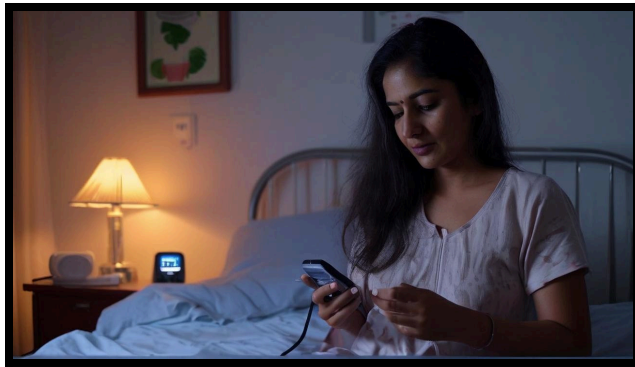
- Setting: Sunita's bedroom, early morning.
- Description: Sunita uses her Bluetooth-enabled blood pressure monitor to take her daily reading. The device automatically syncs with the "HeartWell" app, updating her health data.
- Objective: Show the seamless integration of the device with the app for daily monitoring.

Scene 2: Real-Time Data Sync
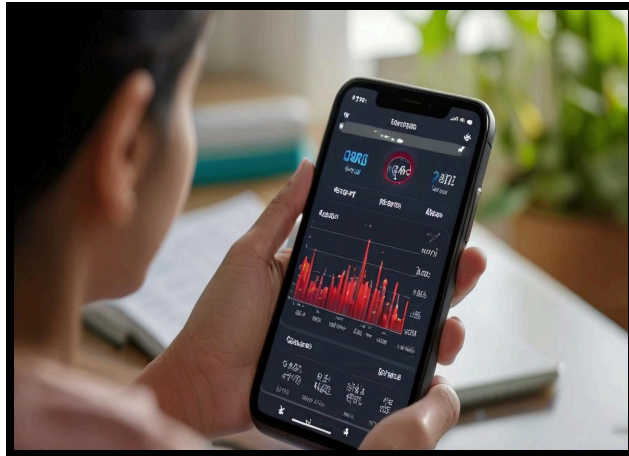
- Setting: Sunita's kitchen.
- Description: As Sunita goes about her morning routine, the app uploads her blood pressure data to a secure FHIR-compliant server accessible by her healthcare provider.
- Objective: Highlight the app's ability to sync and store health data in real-time automatically.

Scene 3: Critical Alert Triggered

- Setting: Sunita's living room, midday.
- Description: Sunita checks her blood pressure, and the monitor detects a dangerously high reading. The "HeartWell" app instantly alerts her cardiologist, Dr. Mehta.
- Objective: Demonstrate the app's real-time alert system for critical health situations.

Scene 4: Emergency Call and Notification

- Setting: Sunita's home, immediately after the alert.
- Description: The app triggers an emergency protocol, sending an automated call and alert to Sunita's last dialed number, her nearest hospital for ambulance dispatch, and her doctor for immediate attention.
- Objective: Emphasize the app's comprehensive emergency response system.

Scene 5: Doctor's Immediate Action
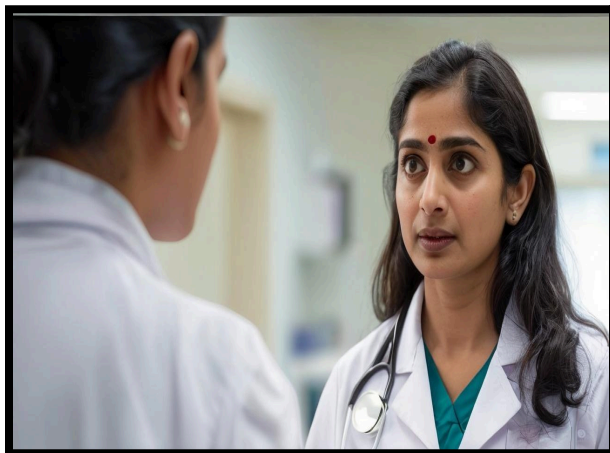
- Setting: Dr. Mehta's office.
- Description: Dr. Mehta receives the alert and emergency call. She reviews Sunita's recent data and advises immediate rest while coordinating with the hospital for further action.

- Objective: Show the doctor's role in managing the emergency, facilitated by the app.

Scene 6: Emergency Services Arrive

- Setting: Sunita's home.
- Description: An ambulance arrives at Sunita's home, guided by the location sent from the "HeartWell" app. Paramedics assess her condition and prepare for transport if needed.
- Objective: Demonstrate the app's ability to integrate with emergency services for swift response.

Scene 7: Weekly Report Generation

- Setting: Sunita's home, end of the week.
- Description: The app compiles Sunita's blood pressure data and generates a detailed weekly report. This report is sent automatically to Dr. Mehta, summarizing key trends and any critical events.
- Objective: Highlight the app's analytical capabilities and continuous monitoring.

Scene 8: Doctor Reviews Weekly Report

- Setting: Dr. Mehta's office.
- Description: Dr. Mehta reviews the weekly report, noting any concerning trends or improvements. Based on this data, she decides whether to adjust Sunita's treatment plan.
- Objective: Emphasize the role of data analysis in ongoing patient care.

Scene 9: Appointment Suggestion
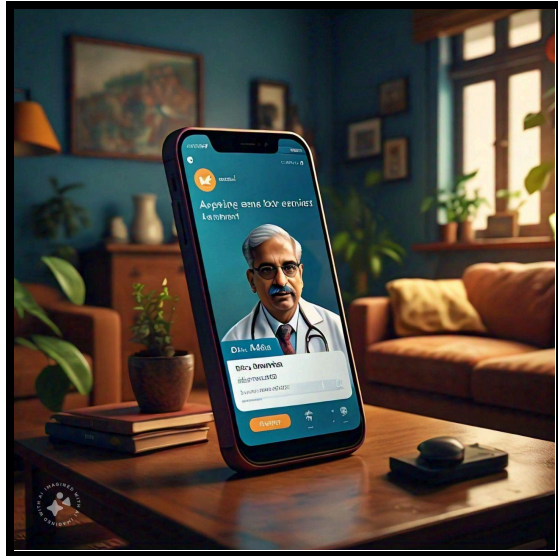
- Setting: Sunita's home, app notification.
- Description: Based on the weekly report and Sunita's health stats, the app suggests scheduling an appointment with Dr. Mehta. Sunita receives a notification to review and approve the suggested appointment time.
- Objective: Show how the app proactively manages healthcare appointments based on patient data.

Scene 10: Appointment Confirmation
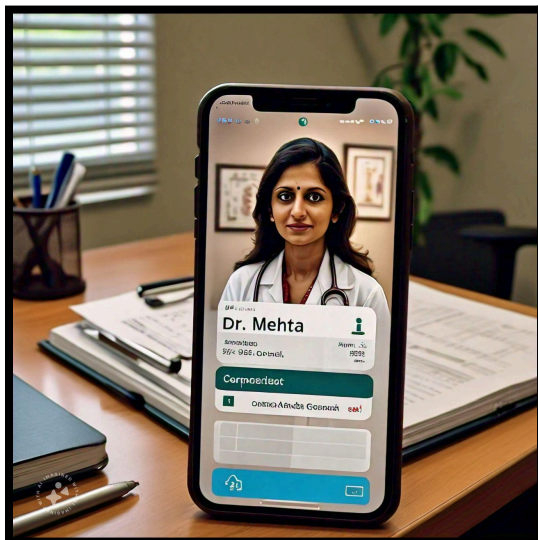
- Setting: Dr. Mehta's office and Sunita's phone.

- Description: After Sunita confirms the appointment suggestion, the app sends a request to Dr. Mehta for final approval. Once approved, the appointment is confirmed, and both parties receive notifications.
- Objective: Demonstrate the app's ability to coordinate and confirm appointments efficiently.

Scene 11: Continuous Monitoring and Support
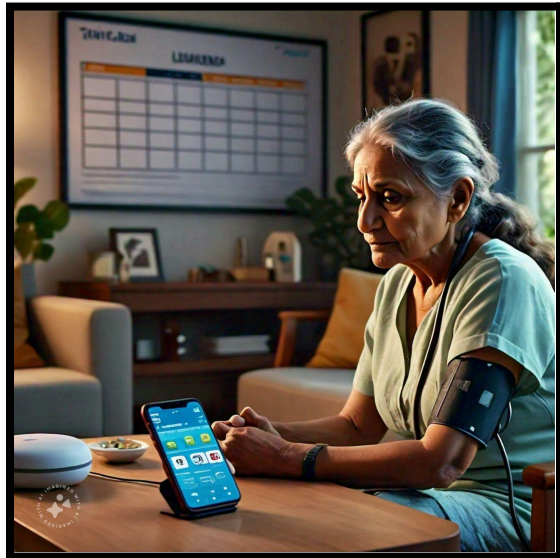
- Setting: Sunita's home, over several days.
- Description: The app continues to monitor Sunita's blood pressure, providing daily health tips and reminders to keep her condition stable. It also keeps her informed about upcoming appointments and medication schedules.
- Objective: Highlight the app's ongoing role in patient engagement and support.

Scene 12: Long-Term Health Management
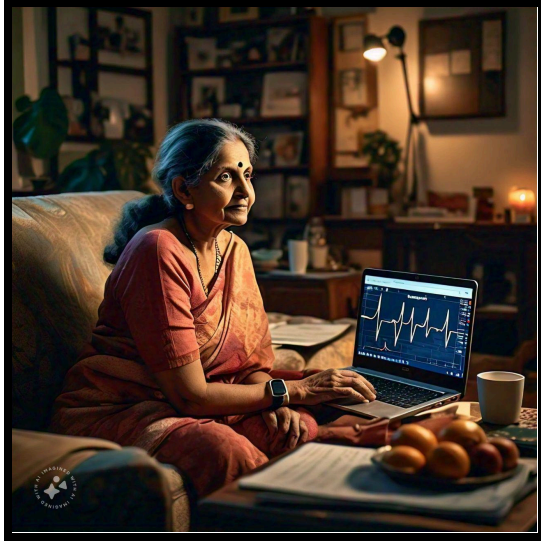
- Setting: Sunita's home, months later.
- Description: Over time, Sunita's health stabilizes with fewer critical alerts. The app adjusts its monitoring frequency based on her improved condition while maintaining regular check-ins.
- Objective: Show the app's adaptability and effectiveness in managing long-term health conditions.

Actors Involved:

1. **Patient (Sunita Verma):**

   Role: Monitors her blood pressure daily and interacts with the app for ongoing health management.

2. **Device:**

   Role: Tracks and transmits blood pressure readings in real-time to the app and healthcare provider.
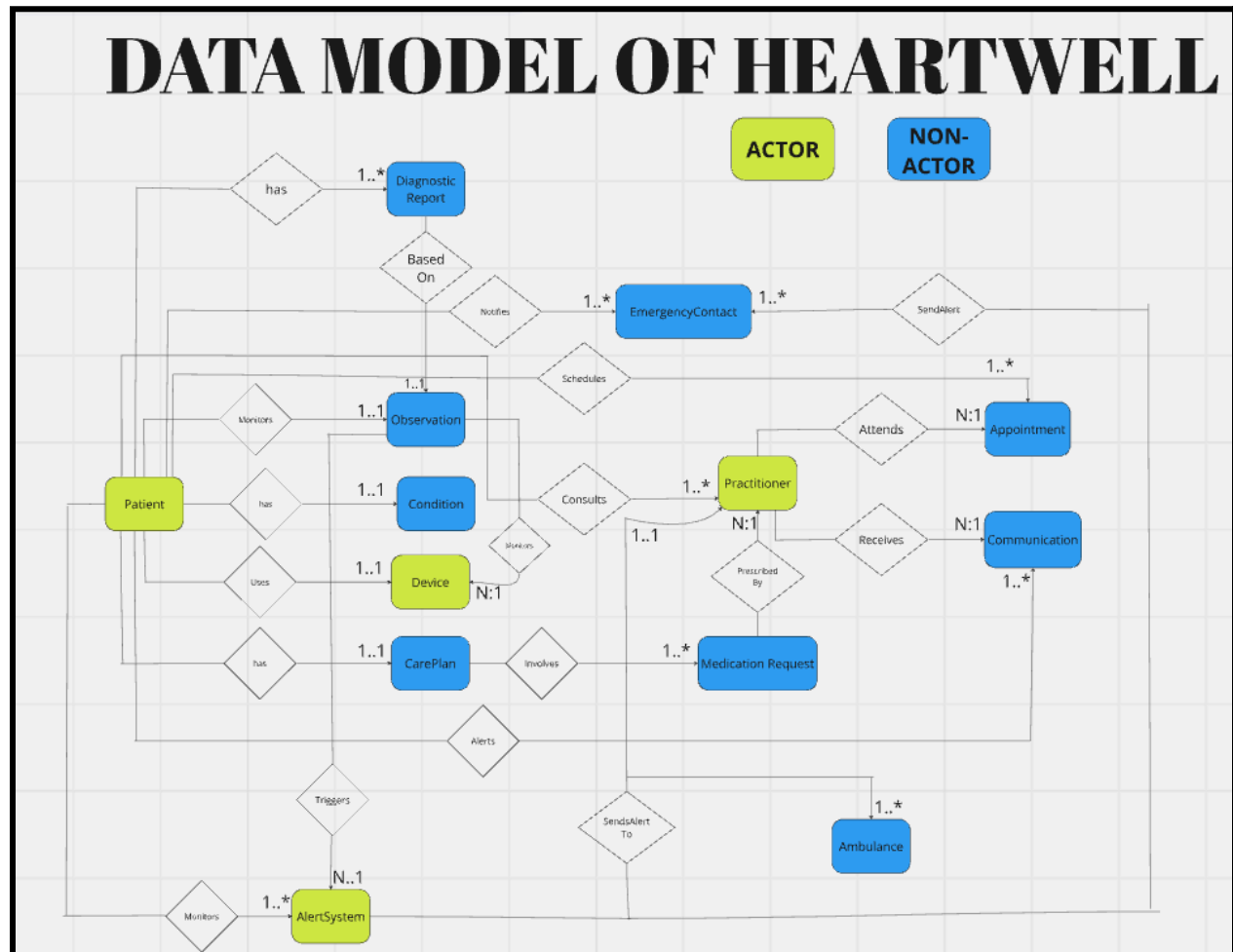
3. **Medical Practitioner (Dr. Mehta - Cardiologist):**

   Role: Monitors Sunita's health data, responds to alerts, provides medical guidance, and adjusts the care plan as needed.

4. **Alert System**

Role: Sends alerts based on the patient's health data and triggers notifications to relevant parties.

Data Model Diagram:

Link to Miro board: [Data Model Link to Miro](#)

Appropriate FHIR resources and artifacts to implement the model in the real world:

(All resources are referred from the [HL7 FHIR Resource List](#))

1. Patient: FHIR Patient Resource ([FHIR Patient Resource](#))

- **Purpose**: Stores all patient data, including personal details such as name, age, gender, and contact information.

Profile Features:

1. **Gender**

   It's Value Set: [Administrative Gender](#)

2. **Age**: Determined by the birthdate.
3. **Contact Details**: Emergency contacts, address, etc.
4. **Identifier**: Unique patient identifier within the system.

2. Practitioner: FHIR Practitioner Resource ([FHIR Practitioner Resource](#))

- **Purpose**: Stores information about healthcare providers involved in patient care, including doctors, nurses, and their roles in the system.

Profile Features:

1. **Practitioner Name**: Personal and professional identification.
2. **Roles**: Role in patient care (e.g., physician, nurse).
3. **Contact Information**: Phone numbers, email, and addresses.

3. Observation: FHIR Observation Resource [FHIR Observation Resource](#))

- **Purpose**: Captures valuable clinical data about the patient, including vital signs such as blood pressure readings.

Profile Features:

1. **Systolic Pressure**

   It's Value Set: [Systolic BP (LOINC 8480-6)](#)

2. **Diastolic Pressure**

It's Value Set: [Diastolic BP (LOINC 8462-4)](#)

3. **Timestamp**: For each observation.
4. **Linkage to Device**: Reference to the Device resource for the recording device.

4. MedicationRequest: FHIR MedicationRequest Resource ([FHIR MedicationRequest Resource](#))

- **Purpose**: Manages all medication orders for the patient, including prescribed antihypertensive medications and their dosages.

Profile Features:

1. **Prescribed Medications**: Lists medications and dosages.
2. **Administration Instructions**: Dosage guidelines.
3. **Associated Condition**: Links to hypertension condition.
4. **Prescribing Practitioner**: Who prescribed the medications.
5. **Value Set**: [RxNorm](#) - standard terminology for medications.

5. CarePlan: FHIR CarePlan Resource ([FHIR CarePlan Resource](#))

- **Purpose**: Outlines the overall management plan for the patient's hypertension, including medication, lifestyle changes, and follow-up actions.

Profile Features:

1. **Goals**: Goals for blood pressure control.
2. **Scheduled Activities**: Daily monitoring or interventions.

   It's Value Set: [Care Plan Activity Category](#)

3. **Links to Healthcare Services**: Scheduled appointments and follow-ups.

6. Appointment: FHIR Appointment Resource ([FHIR Appointment Resource](#))

- **Purpose**: Stores information regarding scheduled appointments between the patient and healthcare providers, ensuring timely follow-ups.

Profile Features:

1. **Appointment Status**: (e.g., booked, pending, confirmed).

   It's Value Set: [Appointment Status](#)

2. **Appointment Type**: (e.g., routine, emergency).
3. **Participants**: Involves patient and healthcare provider.

7. Condition: FHIR Condition Resource ([FHIR Condition Resource](#))

- **Purpose**: Documents the patient's diagnosis of hypertension, including onset details and relevant health conditions.

Profile Features:

1. **Hypertension Condition Details**: Diagnosis, severity, and management plan.

   It's Value Set: [SNOMED CT](#) - for clinical terminology.

2. **Start Date of Diagnosis**: When the condition was diagnosed.
3. **Links to Observations and Medication Requests**: Connections to related data.
4. **ICD-10 Codes**: classification of diseases.

8. Device: FHIR Device Resource ([FHIR Device Resource](#))

- **Purpose**: Stores information about the blood pressure monitoring device used by the patient, including its functionality and performance data.

Profile Features:

1. **Device Type**: (e.g., blood pressure monitor).

   It's Value Set: [Device Type](#)

2. **Unique Device Identifier (UDI)**: Ensures traceability.
3. **Manufacturer and Model Number**: Identification of the device.

9. DiagnosticReport: FHIR DiagnosticReport Resource ([FHIR DiagnosticReport Resource](#))

- **Purpose**: Contains diagnostic information, including test results and patient hypertension management reports.

Profile Features:

1. **Compilation of Observation Data**: Aggregates relevant observation results.
2. **Automated Report Generation**: Summarizes findings for healthcare providers.
3. **Links to Care Plan Adjustments**: Based on data trends.

   It' Value set [Report Type Codes](#) - categorization of report types.

10. Communication: FHIR Communication Resource ([FHIR Communication Resource](#))

- **Purpose**: Used to send alerts and notifications to both the patient and the healthcare provider, including emergency alerts in critical situations.

Profile Features:

1. **Communication Method**: (e.g., SMS, email).

   It's Value Set: [Communication Function Type](#)

2. **Urgency**: (e.g., critical, routine).

   It's Value Set: [Request Priority](#)

3. **Link to Patient's Condition and Observations**: Relevant health updates.

11. CodeSystem: FHIR CodeSystem Resource ([FHIR CodeSystem Resource](#))

- **Purpose**: Defines the code system used for classifying medications, symptoms, and conditions relevant to hypertension management.

Profile Features:

1. **Classification Codes**: For various resources (medications, conditions).
2. **Mapping to LOINC, SNOMED, etc.**: Ensures standardization in healthcare records.