Chronic Disease Management: Hypertension Patient Monitoring Data Management

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Introduction

Hypertension is one of the most common chronic conditions globally, affecting over a billion people. In Germany, about 30–35 % of adults live with diagnosed or undiagnosed hypertension (Robert Koch Institute, 2023), underscoring the public-health significance of long-term monitoring. Proper management prevents complications such as stroke, heart failure, and kidney damage. Structured health-data management with interoperable standards can improve care, reduce emergency visits, and enable proactive interventions.

Importance

Managing hypertension involves regular monitoring, medication adherence, lifestyle counseling, and lab follow-up. A data management system that integrates clinical encounters, observations, and prescriptions ensures continuity of care. Additionally, digital models built with standard data formats (like FHIR) support remote care, alerts, analytics, and health app integration.

Methods (Use Cases)

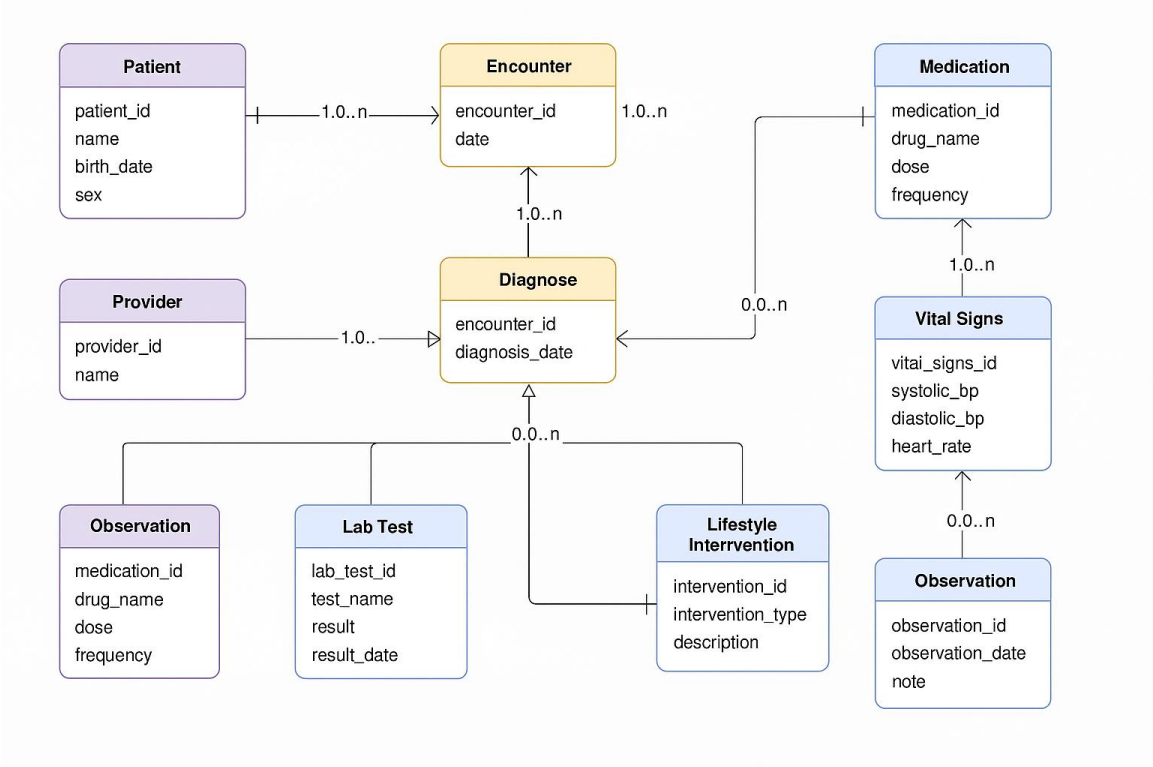
Use Case 1: Blood Pressure Monitoring
Patients with diagnosed hypertension visit clinics regularly to have their blood pressure measured. These values are recorded in structured fields using LOINC-coded observations. Sudden spikes trigger alerts for clinical action.

Use Case 2: Medication Adherence Tracking
After each consultation, patients are prescribed medications (e.g., Lisinopril). MedicationRequests with RxNorm codes track prescriptions. Refill frequency and medication gaps can be flagged.

Use Case 3: Lab Follow-up and Provider Coordination
Creatinine and lipid profile tests are recorded as Observation resources. Lab results inform therapy adjustments. A Practitioner resource links the patient to their responsible doctor.

Data Model Description

The diagram below models the 10 key entities relevant to hypertension management: Patient, Encounter, Vital Signs, Lab Test, Medication, Appointment, Diagnosis, Lifestyle Intervention, Provider, and Observation Notes.



This Entity-Relationship Diagram (ERD) illustrates the core components of a patient monitoring system for chronic hypertension care. Each box represents an entity such as Patient, Encounter, or Diagnosis, and is linked to related entities to describe how data flows through clinical encounters, vitals, labs, and medications. These relationships define cardinality and dependencies to support accurate data recording and analysis.

FHIR Resource Mapping and Entity Relationships

The following table lists the 10 ERD entities used in the hypertension monitoring model, with their mapped FHIR resources and justifications for use:

ERD Entity	FHIR Resource	Justification
Patient	Patient	Stores demographic / ID data
Encounter	Encounter	Represents outpatient visit
Vital Signs	Observation	Captures BP & pulse
Medication	MedicationRequest	Tracks prescribed drugs
Lab Test	Observation	Records serum creatinine, etc.
Appointment	Appointment	Schedules follow-up
Diagnosis	Condition	Documents hypertension
Lifestyle Intervention	CarePlan	Outlines behaviour changes
Provider	Practitioner	Identifies clinician
Observation Notes	Observation	Stores symptoms / remarks

Results

In this project, multiple data formats and resources help structure and transmit clinical data.

JSON (JavaScript Object Notation) : is used as a lightweight format to structure data for sharing between systems. For example, FHIR resources like Patient, Observation, and Condition are serialized in JSON for integration across electronic health records and apps.

FHIR Resources : standardize the structure and meaning of clinical data. Resources like Observation (for BP and labs), Condition (hypertension diagnosis), and MedicationRequest (for prescriptions) are used to exchange data reliably.

Medical Terminology Mapping : ensures consistency in data interpretation. Examples include:
- ICD-10 code 'I10' for hypertension diagnosis
- LOINC code '8480-6' for systolic blood pressure
- RxNorm code '197361' for Lisinopril prescription

Discussion

Challenges:
- Fragmentation of health data across systems
- Inconsistent coding or terminology usage
- Privacy concerns and consent handling
- Technical integration of EHR and mobile health apps

Solutions:
- Adoption of FHIR standards for uniform APIs
- Use of LOINC, ICD-10, RxNorm for coding
- Secure data transfer protocols (e.g., OAuth 2.0)
- Modular system design for scalability

Future Considerations:
- Integration with wearable devices for real-time monitoring
- AI-based prediction of hypertensive crises
- Patient dashboards and reminders for self-management

Conclusion

This project demonstrates the application of core data management skills to model and support the care of hypertensive patients. By using structured data models and interoperable FHIR resources, the system enhances clinical communication, enables automation, and empowers both patients and providers with timely, actionable insights.

References

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