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PROJECT SPRINT 2

GROUP 5

THE SAVVY HEALTH SQUAD

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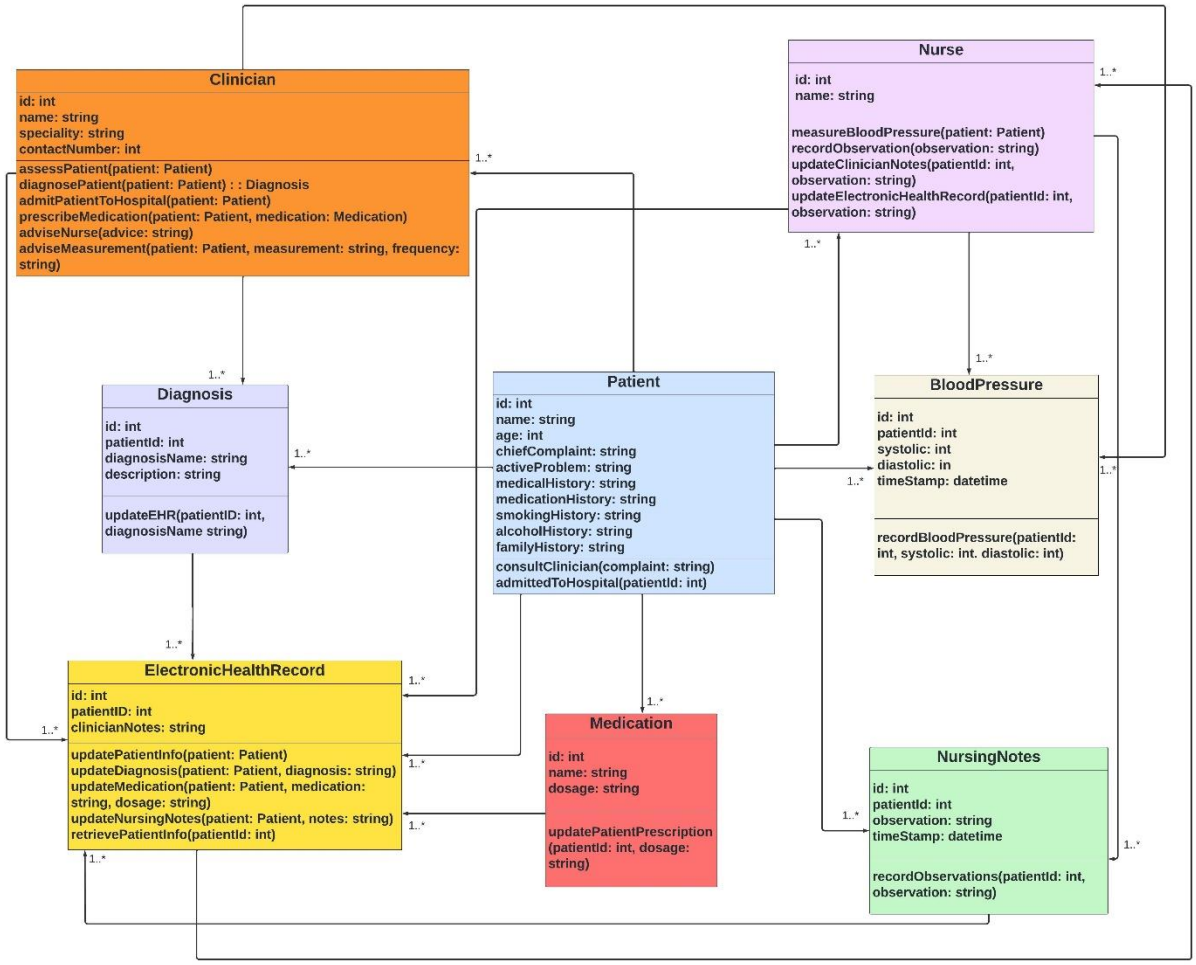
Introduction:

According to Bates and Samal (2018), the ability for systems and organizations to communicate and exchange information meaningfully, known as interoperability, is critical in modern complex environments. To promote technical and business interoperability, standardized modeling languages have been widely adopted, including the Unified Modeling Language (UML) and the Business Process Model and Notation (BPMN). UML offers a unified visual vocabulary for software systems (Bell, 2003), while BPMN, widely adopted in healthcare, provides an intuitive graphical notation for depicting business processes (Pufahl et al., 2022). The interdisciplinary use of these languages is vital for advancing interoperability and systems integration initiatives.

Use case:

A patient aged 65 years consulted clinician with the chief complaints of headache and has been diagnosed with hypertension. He had no past medical or medication history. He is a chronic smoker for 10 years and non-alcoholic. Also, had a family history of diabetes mellitus and hypertension. Physical examination was found be normal. Blood pressure was found to be 190/130 mmHg. The patient was diagnosed with hypertensive urgency and admitted in the hospital. The patient was prescribed with 0.2 mg clonidine. The clinician also advised the nurse to record Blood pressure every 4 hours. All the information has been updated in electronic health records. Nurse followed the clinician notes in EHR and measured the blood pressure accordingly. All the observations should be recorded in nursing notes and update should be sent back to EHR.

UML Diagram:



Foot notes:

Classes:

Clinician: Healthcare professionals managing patient care. Attributes include id, name, specialty, and contactNumber. Methods involve patient assessment, diagnosis, hospital admission, medication prescription, and advice to nurses.

Patient: Individuals receiving medical care. Attributes cover id, name, age, chief complaint, and various histories (medical, medication, smoking, alcohol, family). A method allows consulting a clinician with a complaint.

Electronic Health Record (EHR): Digital system for patient information management. Attributes are id and patientID, with methods for updating and retrieving patient information, including diagnosis, medication, and nursing notes.

Nurse: Healthcare professionals providing care and following clinician instructions. Attributes include id and name, with methods for measuring blood pressure, recording observations, and updating the EHR with nursing notes.

Blood Pressure: Details of blood pressure measurements. Attributes consist of id, patientId, systolic, diastolic, and timeStamp.

Diagnosis: Represents diagnoses given to patients. Attributes are id, patientId, diagnosisName, and description.

Medication: Covers prescribed medications. Attributes include id, name, and dosage.

Nursing Notes: Observations recorded by nurses. Attributes are id, patientId, observation, and timeStamp.

Class Relationships:

- Patient to Clinician (1..*): The patient sees one clinician for the hypertensive urgency diagnosis.
- Patient to Nurse (1..*): The patient, while admitted, may be attended to by multiple nurses for blood pressure monitoring.
- Patient to Diagnosis (1..*): The patient is diagnosed with a single condition, hypertensive urgency.
- Patient to Medication (1..*): The patient is prescribed one type of medication, clonidine.

- Patient to Nursing Notes (1..*): The patient will have multiple nursing notes created during their hospital stay
- Nurse to Blood pressure (1..*): A nurse will take multiple blood pressure readings from this patient.
- Nurse to Nursing Notes (1..*): A nurse may record several observations in the nursing notes for this patient.
- Patient to EHR (1..*): The patient has one electronic health record where all information is stored.
- Patient to Blood Pressure (1..*): The patient has multiple blood pressure readings taken by the nurse.
- Medication to EHR (1..*): The patient is prescribed clonidine which is documented in the EHR.
- Diagnosis to EHR (1..*): The single diagnosis of hypertensive urgency is recorded in the EHR.
- Nursing Notes to EHR (1..*): There could be multiple entries of nursing notes for the patient in the EHR over time.
- Clinician to Blood Pressure (1..*): Clinician is associated with many blood pressure readings.
- Clinician to EHR (1..*): The clinician may contribute to and interact with multiple EHRs.
- Clinician to Diagnosis (1..*): Clinician can make multiple diagnoses.
- Nurse to EHR (1..*): Nurses access or update multiple EHRs.

Interoperability:

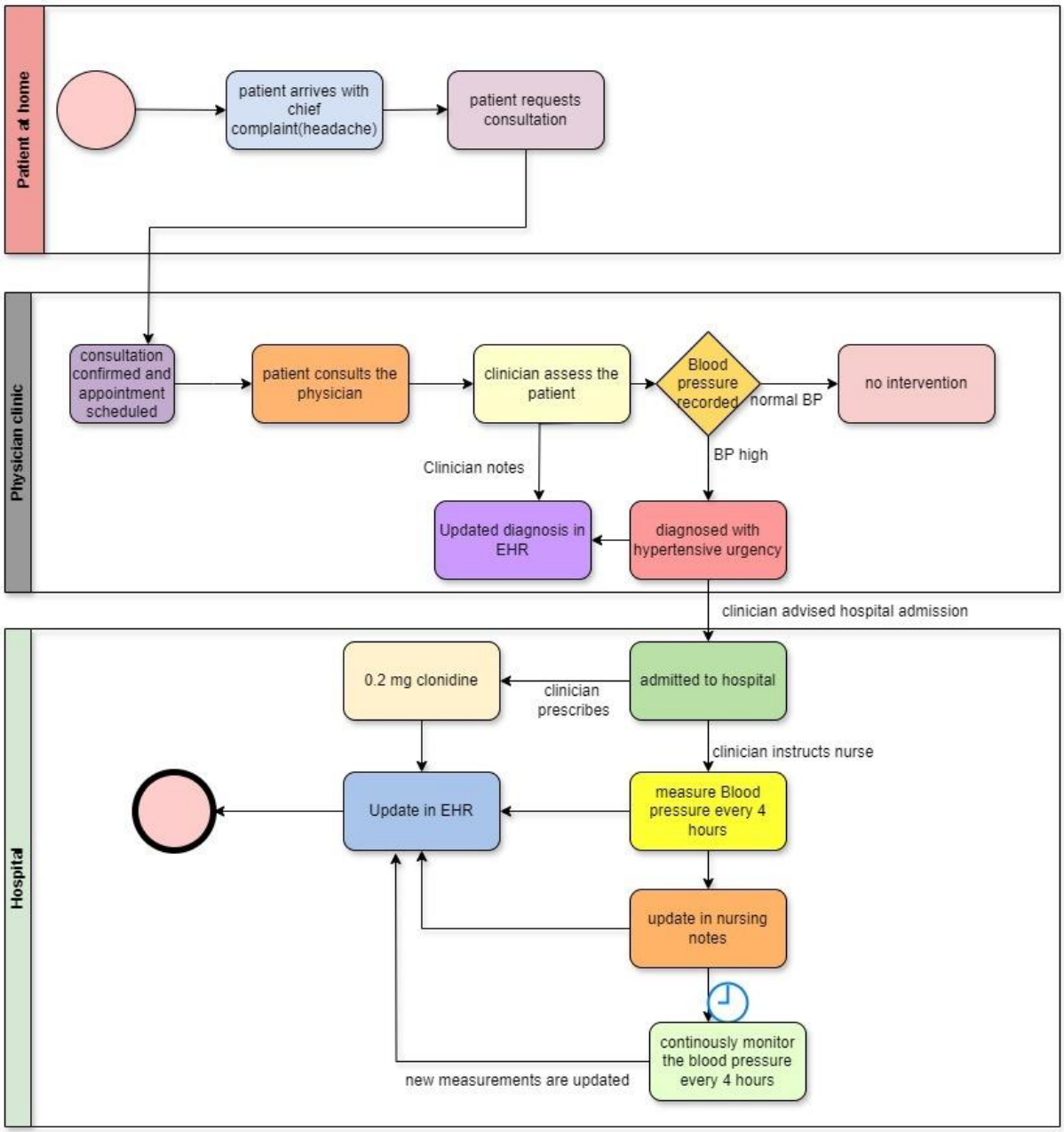
Our UML diagram illustrates semantic interoperability in the following relationships:

a. Diagnosis to EHR: Standard medical terminologies like SNOMED CT or ICD-10 are used, ensuring diagnoses, like hypertensive urgency, are consistently understood and correctly interpreted across healthcare providers through the EHR system.
b. Medication to EHR: Leveraging coding standards such as RxNorm for medication information standardizes the communication of medication details (e.g., name, dosage, instructions for clonidine) across healthcare systems, ensuring accurate understanding and medication management.

Organizational interoperability is seen in the following scenarios:

a. Clinician to EHR: Clinicians use HL7 or FHIR standards to input diagnoses and treatment plans into EHRs, ensuring consistent information accessibility across the healthcare ecosystem.
b. Nurse to EHR: Nurses systematically record observations, such as blood pressure readings, in EHRs using standard protocols, enhancing care coordination and informed decision-making.

BPMN Diagram:



Foot Notes:

Swimlane 1: Patient at Home:

The patient experiences a headache, prompting a medical consultation request, initiating the process.

Swimlane 2: Physician’s Clinic:

The physician assesses the patient, noting a high blood pressure reading (190/130 mmHg), leading to a diagnosis of hypertensive urgency recorded in the EHR.

The physician prescribes 0.2 mg of clonidine and recommends hospital admission for comprehensive care.

Swimlane 3: Hospital:

Clinician's instructions for medication and blood pressure monitoring are documented in the EHR upon hospital admission.

Nursing staff systematically measures blood pressure every 4 hours, documenting observations in the EHR for continuous patient monitoring and effective management of hypertensive urgency

Interoperability:

Syntactic Interoperability is observed in the following scenarios:

a. In the "Physician’s Clinic" swimlane, syntactic interoperability is observed when the physician's diagnosis, such as "hypertensive urgency," is entered into the EHR. This step requires the physician’s assessment tools and the EHR to share and interpret data formats, such as text entries and numerical blood pressure readings.

b. Another instance is in the "Hospital" swimlane where the nursing staff's blood pressure measurements are updated in the EHR. The compatibility between the monitoring devices, possibly using HL7 messaging standards, and the EHR system ensures that the data is accurately transferred and recorded.

Semantic Interoperability is observed:

a. Semantic interoperability is evident in the "Physician’s Clinic" swimlane, where standardized medical codes are likely used to record the diagnosis of hypertensive urgency in the EHR so that it can be universally understood by other healthcare professionals.

b. It is also present in the "Hospital" swimlane, where the prescribed medication (0.2 mg of clonidine) is recorded. The use of a standardized medication terminology system ensures that the prescription is clearly understood across different practitioners and healthcare settings.

Missing Elements:

We found the following data elements missing from our use case model:

a. Detailed records of drug administration, vital for evaluating patient adherence to hypertension medication.
b. Follow-up data necessary for monitoring blood pressure and medication efficacy over time.
c. Patient education information, crucial for fostering understanding of their condition's severity and health implications.

References

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