Problem Analysis & Modelling-Revised

The Semantics Squad (Group 7)

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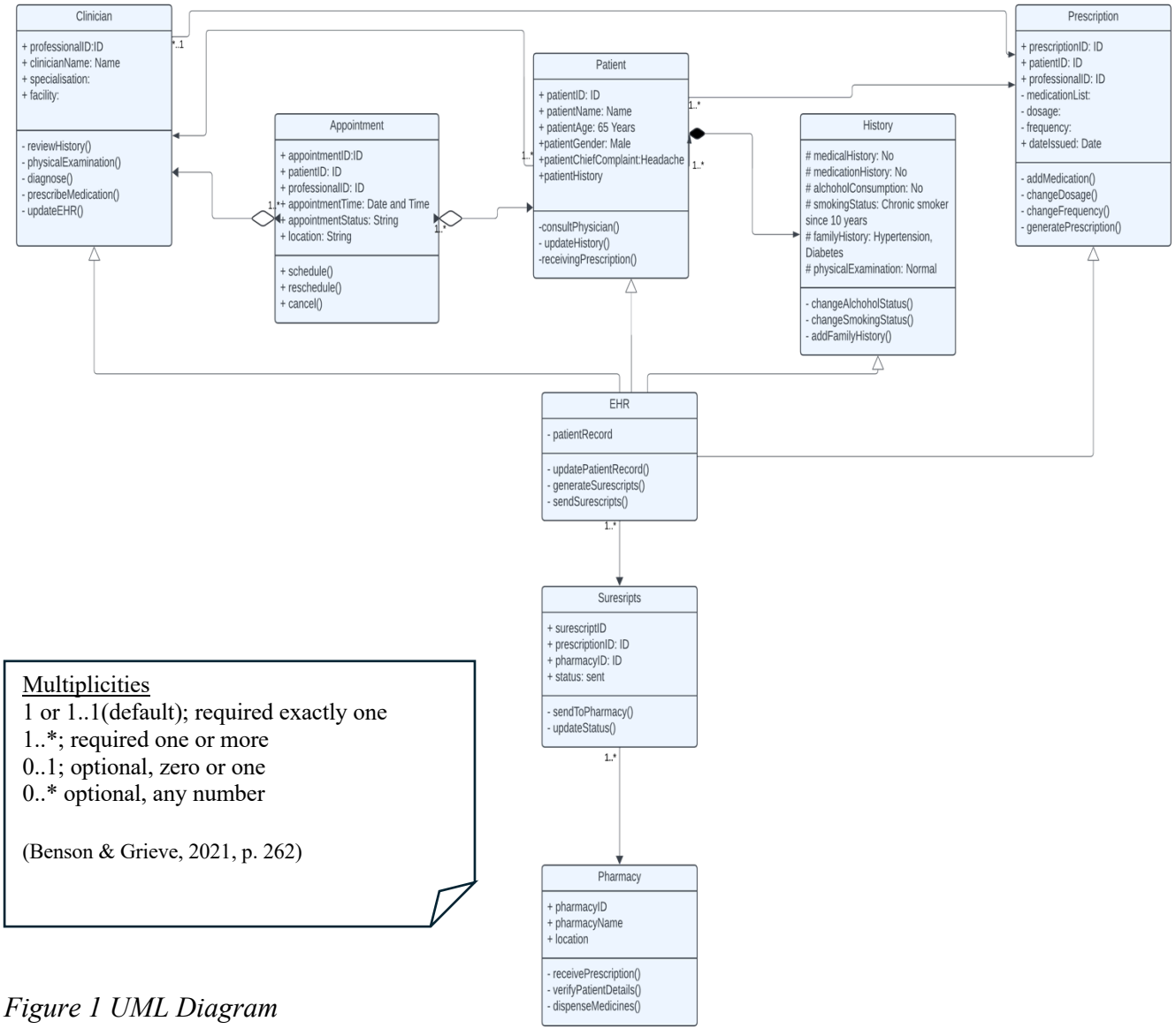
PS2 Problem Analysis & Modelling-Revised

Sprint 2 focuses on the event of an electronic prescription. The linked entities include the clinician entering prescriptions through the electronic health record (EHR) by generating an electronic prescription (e-prescription) with Surescripts and transmitting it to a pharmacy network for dispensing. A unified modeling language (UML) and business process model notation (BPMN) are modeled for the event.

Use Case

"A male patient aged 65 years consulted a 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 to be normal. The patient has been prescribed Atenolol 50mg, Telmisartan 40mg. All information was updated in the electronic health records. Surescripts should be generated from EHR and sent to pharmacy network for dispensing."

Unified Modeling Language (UML)



Multiplicities
1 or 1..1(default); required exactly one
1..*; required one or more
0..1; optional, zero or one
0..* optional, any number

(Benson & Grieve, 2021, p. 262)

Figure 1 UML Diagram

Definitions

Patient class:
Id = Patient identification number

Clinician Class:
NPI = National Provider Identifier

Specialty = Healthcare specialty of which the clinician has received specialized training (e.g. Internal Medicine, Cardiology, Family Medicine)

Facility = Outpatient primary care or specialty practice clinic owned by a hospital system or a privately owned practice.

Pharmacy, Surescripts and Prescription classes:
prescriptionID= Snomed drug code

patientId = Patient identification number

professionalID = NPI of clinician

medicationList = Snomed description of drug

EHR = Electronic Health Record
Diagnosis = Description of diagnosis with ICD-10 code

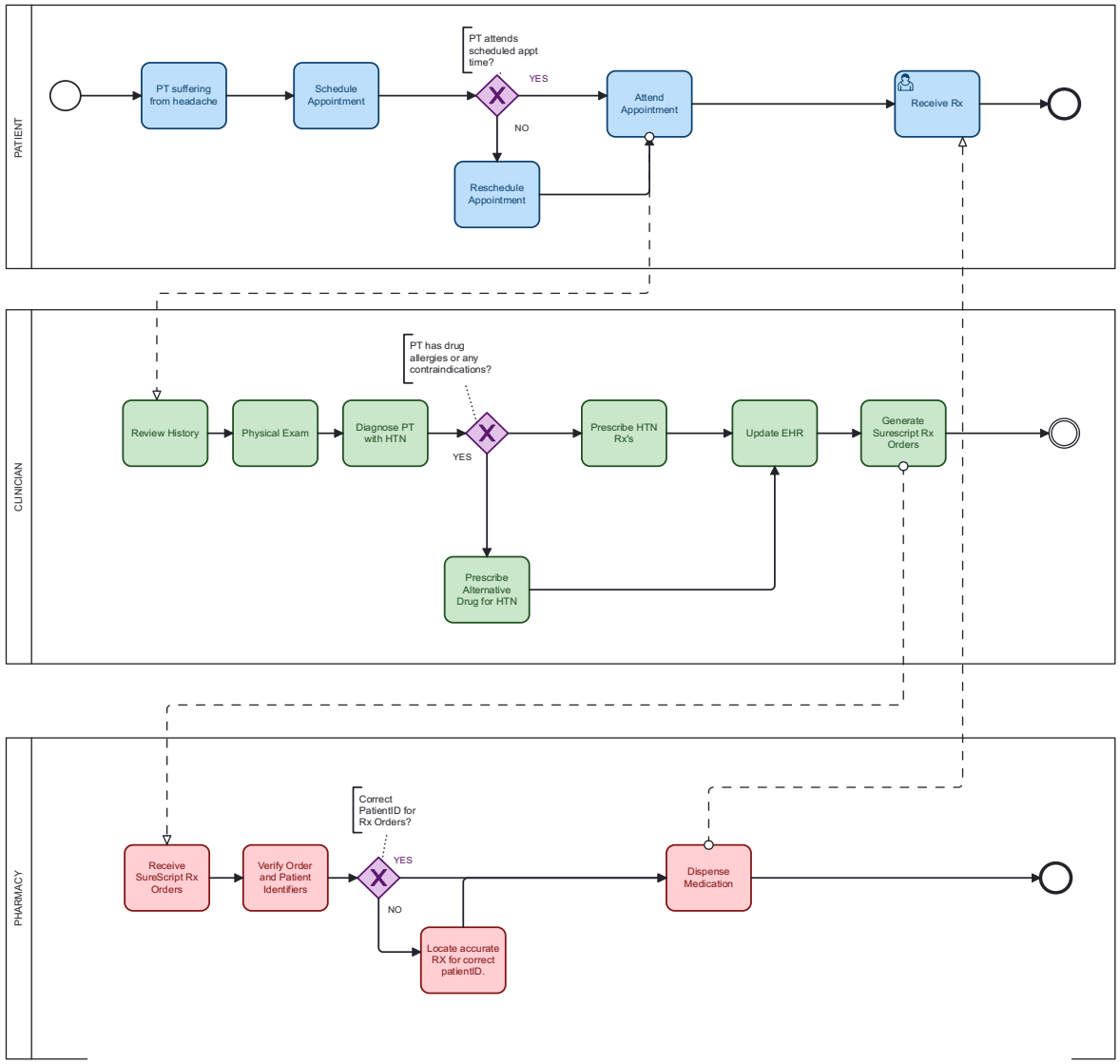
Layer of Interoperability

The UML represents semantic interoperability. The Class Diagram represents eight classes and associated attributes of the use case. The relationships between the classes represent a transfer of meaningful information between each class. The Clinician class enters information into a prescription and transmits that to the Pharmacy class to order the processing of a prescription. The Clinician class also transmits information into the EHR class for documentation and to the Patient class to receive and begin administering the medication. The transmission of information includes diagnosis codes, drug codes, patient data, clinician details and health data.

Important Elements Not Modeled

The UML diagram focused only on the event of an e-prescription. Important elements not modeled included scheduling an appointment, scheduling a follow-up appointment, reviewing prescription insurance drug coverage, submitting prior authorizations to insurance providers, and reviewing drug effectiveness or monitoring for adverse drug reactions. The UML did not model all attributes of the EHR class including attributes for diagnosis coding since this sprint focused on the process of an e-prescription. When completing a full model, a complete and accurate EHR is important for successful interoperability between health entities.

Business Process Modeling Notation (BPMN)



All the gateways are exclusive.
Process flows from the patient swim lane through the clinician and pharmacy swim lanes. Process then flows from pharmacy swim lane back to patient with the patient receiving the medications.

Figure 2 BPMN Diagram

Definitions:

PT = patient

Rx = Prescription

HTN =Hypertension

EHR = Electronic Health Record

PatientID = patient identifiers number

Clinician = a healthcare provider who is licensed to prescribe medications, such as a physician or advanced practice nurse

Important BPMN Elements Not Modeled

The BPMN follows the UML Case model and incorporates those attributes and behaviors into a BPMN Activity model. Like the UML, this model focuses only the event of an e-prescription, and important elements were not modeled. These included scheduling a clinic visit and assessing medication cost.

While a history and physical examination is included in the BPMN for the clinician visit, this model did not detail the full review of pertinent history and a complete physical exam. The patient's initial complaint and the hypertension diagnosis demonstrate the key tasks for these medication prescriptions. It is important to complete a physical examination and a comprehensive history review in any future model.

The number of interactions and decisions that can occur in the U.S. health system between a healthcare provider, patient, pharmacy, office staff and insurance provider can be extensive depending on the type and number of insurance providers a patient has. Due to this complexity, this model is only showing the simple “happy path” of a clinician writing a prescription and that prescription being covered by the insurance at the pharmacy for which it was sent and that cost being acceptable to the patient. It is recommended in the future to fully cover this use case, that another model be added that addresses the authorization and reimbursement process for insurance for which these situations would need to be considered.

Some other processes that have not been included in the diagram are:

- scheduling initial and follow-up appointments,
- prescription refills,
- monitoring adverse drug reactions,
- ongoing review of drug effectiveness,

- medication errors management, and
- processes for prior authorizations and submitting billing claims.

Layer of Interoperability

The BPMN represents syntactic, process and semantic interoperability. The output is executable in Business Process Execution Language (BPEL), which is XML structured (Benson & Grieve, 2021, p. 410) and represents syntactic interoperability. Within the BPMN diagram, the actors (patient, clinician, pharmacy) are represented with swim lanes and the connector lines represent the flow between processes (Benson & Grieve, 2021). This can be visually seen in the BPMN diagram as the clinician diagnoses the patient with hypertension and decides to prescribe Atenolol and Telmisartan.

The dotted connector lines represent message flows between the actors which is semantic interoperability. This can be seen as messages cross the pools between the clinician and the pharmacy. Finally, the annotations of the BPMN add details for the business process, which provide semantic meaning of the relationships between the actors.

Conclusion

The project group investigated interoperability within a healthcare use case using BPMN and UML. The BPMN diagram showcased syntactic, process, and semantic interoperability. It achieved syntactic interoperability through BPEL, a language for executing business processes. Process interoperability was achieved using swim lanes, which represent different actors involved. Finally, annotations provided details, enabling semantic interoperability.

The UML class diagram, on the other hand, focused on semantic interoperability. It depicted the flow of data and relationships between classes representing healthcare entities like clinicians,

patients, pharmacies, and medical records. This flow highlighted how meaningful information is exchanged, enabling semantic interoperability. In conclusion, both diagrams, working together, provided valuable insights into the data flow, process flow, and clear communication of meaning within the healthcare system, offering a comprehensive understanding of interoperability in this context.

References

Benson, T., & Grieve, G. (2021). *Principles of health interoperability* (Fourth ed.). Springer International. https://doi.org/10.1007/978-3-030-56883-2