Improving documentation of HL7 FIAB standard based on UML diagrams

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1. Methods

One aiming to apply UML diagrams to HL7 standards needs to know about the various parts of the HL7 standards, its methodology, and so on.

2-1 HL7 v3 Methodology

HL7 v3 uses a methodology called Message Development Framework (MDF). It contains four artifacts such as Storyboard, Trigger Event, Interaction, and Application roles based on a reference information model (HL7 RIM). HL7 RIM contains UML class diagrams. Figure 1 shows these models.

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• **Application roles**: “Application roles represent a set of communication responsibilities that might be implemented by an application. Thus they describe system components or sub-components that send and/or receive interactions.

• **Trigger Events**: A trigger event is an explicit set of conditions that initiate the transfer of information between system components (application roles). It is a real-world event such as the placing of a laboratory order or drug order. The trigger event must be systematically recognizable by an automated system.

• **Storyboard**: A storyboard consists of a short description of its purpose and an interaction diagram that shows the progression of interactions between the application roles. A storyboard narrative is a description of a real-life event that provides the necessary context for the development of a specific interaction described in the storyboard. The process of storyboarding lays the foundation for describing HL7 messages and their content.

• **Interactions**: They are at the heart of messaging. The formal definition of an interaction is: A unique association between a specific message type (information transfer), a particular trigger event that initiates or "triggers" the transfer, and the Receiver Responsibilities (in terms of response interactions) associated with the receipt of the Interaction.

• A single Interaction explicitly answers the questions:

  • What the particular message type is?
  • What caused the message to be sent?
  • How a receiving system knows when it has to send a particular type of response message” (8).
2-2 HL7 Financial Management and Patient Administration Standards

Financial Management is one of the chapters in the HL7 standards dealing with managing a patient billing account. “This domain area covers the basic interactions needed to manage patient billing accounts”.

In this standard, the main subject is the “patient”. To know about all occurrences in a patient’s billing account, studying the other chapters is necessary (i.e. Patient Administration). “Patient Administration transaction set provides for the transmission of new or updated demographic and visit information about patients”.

2-3 Simplified Scenario for FIAB Standard

We studied the two above-mentioned chapters of the HL7 standard. Thus, this study led to the design of a simplified scenario in which a patient arrives at one hospital. This general scenario was extracted from Storyboard examples, the corresponding Trigger Event, and the Interaction between sender and receiver of a message in this standard.
The steps of the proposed method are:

- When a patient is admitted by a hospital, an account will be created for him.
- The patient is referred to the hospital’s units such as laboratory according to his physical situation.
- Charges for his given services will be sent to financial systems. Consider that this account has various statuses, such as close, create, delete and merge account.
- The patient’s billing account is prepared.

Thus, we are able to extract the actors and the use cases from this standard. The procedure of this work is shown in Figure 2.

Figure 2: The steps for designing UML models For HL7 FIAB standard
2-4 Use Cases for the HL7 FIAB Standard

In this step, we found the actors and the main use cases in the FIAB standard. Then we designed a use case diagram for it. The use cases based on a patient’s account status may occur in this standard. Figure 3 shows this use case diagram. The actors of this diagram were the accounting system and the registrar of patient administration. These actors were extracted from Storyboard examples in the HL7 FIAB standards.

![Use case diagram for FIAB standard](image)

**Figure 3:** Use case diagram for FIAB standard

2-5 Sequence Diagrams for HL7 FIAB

Tim Benson stated in his book (11) that, although HL7 v3 Application Roles are useful in theory, practically they are confusing. Figure 4 shows the Interaction (“create billing account”) between sender and receiver by a Trigger Event. This diagram is unable to show which objects are sending a message. Moreover, it is unable to show which real actors are on the sender or receiver side of a message.
“Use cases are often refined into one or more sequence diagrams. In addition to their use in designing new systems, sequence diagrams can be used to document how objects in an existing (call it "legacy") system currently interact. This documentation is very useful when transitioning a system to another person or organization”(12). Furthermore, sequence diagrams can address the problems by indicating the objects which communicate to actors in order to send a message. Figure 5 shows the boundary, entity, and control objects in UML models. The registrar gets the patient information and sends it to the financial system to create an account.

![Manage Patient Account Diagram](image)

**Figure 4:** The Interactions in FIAB standard (8)
2. **Results**

According to “HL7 creating billing account”, we designed UML models to the other interactions in the FIAB standards. Table 1 shows that a use case diagram can indicate all concepts in the HL7 FIAB standard. In fact, UML diagrams can reduce the number of HL7 concepts. For example, we can consider a use case “create account” for three concepts in HL7 (i.e., Storyboard examples, Interaction, and Trigger Event in the first row of Table1). Moreover, they can reduce the volume of HL7 documentation which will ease understanding of HL7 documentation for software engineers.

![Sequence diagram for “creating account”](image)
Table 1: Comparison between UML Models and HL7 concepts

<table>
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<th>UML concepts</th>
<th>HL7 Concepts</th>
</tr>
</thead>
<tbody>
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<td>Sequence Diagram In UML</td>
</tr>
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<td>FIAB_SN000101</td>
</tr>
<tr>
<td>Merge Account</td>
<td>FIAB_SN000104</td>
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<td>5</td>
<td>5</td>
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</table>

3. Conclusion and Future Work

Today, HL7 standards are widely used in health services around the world. These standards are specific to the health care industry. The difficulty of HL7 documentation encourages researchers to transform or correspond HL7 models to UML models.

UML is an ISO standard known by most software engineers. This standard can solve the drawbacks in complexity of software design texts such as HL7 standard documentation.

We designed use case and sequence diagrams for the HL7 FIAB standard based on a study of HL7 v2 and HL7 v3 documentation standards. We are working to extend our results to other HL7 products. This way we will be able to design a main method with UML diagrams for most HL7 documentation.