If Two Do the Same Thing... Comparing IHE Profiles PIX/PDQ Based On HL7 2.x And HL7 Version 3

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Abstract

Background: IHE integration profiles for managing patient identification, PIX and PDQ, exist in two alternative forms: on the one hand using HL7 2.x, on the other hand based on HL7 Version 3. **Objective:** Knowing differences between the competing integration profiles shall assist the user to choose the one better suitable for their specific deployment. **Methods:** Differences in the set of interactions, the information model, the vocabulary and the required behavior of individual interactions were analyzed. **Results:** A list of specific features and constraints for each of the integration profiles was compiled. **Conclusions:** Not all of the identified deltas originate in the inherent incompatibility between HL7 2.x and 3.0, they also result from the specific constraints imposed by the IHE profile. Identified disparities include the communication pattern, constraints to identifier schemas and pseudonymization capabilities.

Keywords

health communication; medical records linkage; HL7; IHE

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1 Introduction

The international interoperability initiative Integrating the Healthcare Enterprise (IHE) employs standards authored by Health Level Seven International (HL7) throughout all of its technical frameworks. The IHE domain IT Infrastructure (ITI) and its technical framework make use of various HL7 technologies, including HL7 2.x (HL7v2) and HL7 version 3 (HL7v3) messaging.

The profiles Patient Identifier Cross-Referencing (abbreviated as PIX or PIXv2) and Patient Demographics Query (PDQ or PDQv2) are based on HL7 versions 2.3.1 and 2.5 [1]. They describe the management of patient identification information. In the IHE season 2011-2012, two other profiles with the very same purpose have achieved the final status, being referred to as PIXv3 and PDQv3. These profiles depend on HL7v3 (Normative Edition 2008) [2]. The obvious redundancy invites to explore the differences between the old and the new profiles more closely.

A short overview of the profiles within the ITI technical framework [3] is provided here for readers not familiar with the IHE process or the particular integration profiles.

An IHE integration profile typically covers a specific healthcare scenario (use case) by defining roles of the participating systems (actors) as well as the message transmissions or service calls among them (transactions). Transactions defined within the ITI domain are identified by their number of the form "ITI-<integer>" (cf. IHE ITI [3], TF-1, 1.1).

The profiles PIX and PIXv3 specify the communication with a central application, the PIX Manager, which is capable to aggregate multiple identifiers belonging to the same patient person. This actor receives patient information from individual PIX Source actors in form of Patient Identity Feeds (transaction ITI-8/ITI-44). A PIX Consumer actor may subsequently use a locally known patient identifier to obtain associated identifiers from the s (transaction PIX Query, ITI-9/ITI-45). Optionally, PIX Manager may notify the Consumer about changes in an association between two identifiers (transaction PIX Update Notification, ITI-10/ITI-47). The „Patient Identity Feed" transaction is re-used by a related profile Cross-Enterprise Document Exchange (XDS.b) for maintaining

a patient record in a central document index (actor Document Registry).

Demographics queries (transaction ITI-21/ITI-47) are directed from a peripheral client system (PDQ Consumer) to the central PDQ Supplier actor. The latter is often coupled (grouped) with a PIX Manager. Unlike PIX queries, PDQ supports comprehensive patient demographics both as query parameter and in the query result. The scope of the demographics may include pediatric information (Pediatric Option) or visit information (transaction ITI-22, subprofile Patient Demographics & Visit Query).

As incomplete information is allowed as query criteria in PDQ, responses with a large number of matching records may occur, which requires adequate technical means. PDQv2/v3 allows a querying client to explicitly limit the size of the response and to fetch the result in multiple smaller pieces. The complete result set is obtained by incrementally iterating over all fragments. This mechanism is referred to as incremental response or query continuation.

2 Objectives and Methods

Integration profiles PIXv2 and PIXv3 are not in complete alignment, the same is true for PDQv2 and PDQv3. The objective of the work at hand is to identify the differences and their impact on the practical usability of the respective profile.

To achieve the goal, the aforementioned specifications of the ITI technical framework were analyzed. Differences in the set of interactions, the information model and the vocabulary were explored, with consideration of the previous work. The main focus was put on differences in the definition of the relevant IHE transactions „Patient Identity Feed“, „PIX Query“, „PDQ Query“.

3 Results

3.1 Interactions

Both PIX and PIXv3 manage the patient information object through basic life cycle actions: create, read, update and delete (CRUD) [4]. Both PIX and PIXv3 use multiple transaction subtypes: initial query, continuation query, query cancellation. Refer to Figre 1 for an overview of the interactions and their correlation with each other.

IHE Transaction PIXv3/PDQv3	HL7 Ver. 3 Interaction	IHE Transaction PIXv2/PDQv2	HL7 2.x Message
ITI-44 (Patient Identity Feed)	PRPA_IN201301UV02	ITI-8	ADT^A01^ADT_A01, ADT^A04^ADT_A01 ADT^A05^ADT_A05
	PRPA_IN201302UV02		ADT^A08^ADT_A01
	PRPA_IN201304UV02		ADT^A40^ADT_A39
	MCCI_IN000002UV01		ACK^Axx^ACK
ITI-45 (PIX Query)	PRPA_IN201309UV02	ITI-9	QBP^K23^QBP_K21
	PRPA_IN201310UV02		RSP^K23^RSP_K21
ITI-46 (PIX Update Notification)	PRPA_IN201302UV02	ITI-10	ADT^A31^ADT_A05
	MCCI_IN000002UV01		ACK^Axx^ACK
ITI-47 (PDQ Query)	PRPA_IN201305UV02	ITI-21	QBP^K22^QBP_K22
	PRPA_IN201306UV02		RSP^K22^RSP_K22
	QUQI_IN000003UV01		QCN^J01^QCN_J01
	MCCI_IN000002UV01		ACK^J01^ACK

Figure 1: Comparison of PIX/PDQ interactions [3].

4 Information Model And Vocabulary

In the approach of both HL7 2.x and HL7 Version 3 semantic concepts in its implementable form are represented by a combination of an information model element and a vocabulary value. However, each of the standards may use a unique combination and not every concept is expressible in both standards.

This gap is obvious already at the level of data types. See Figure 2 for an example concerning the patient's mobile phone number. Another example of different representation are the specialized patient/person identifiers such as Social Security Number or Driver's License Number. These are modeled as individual elements (fields) in HL7 2.x (PID-19, PID-20), whereas in HL7 3.0 based profiles they are uniformly represented by a single element ("Other ID") with varying values of the assigning authority - i. e. through differentiation by the means of vocabulary.

	HL7 Ver. 2.5	HL7 Ver. 3 (XML)	
Data type used	XTN (Extended Telecommunication Number)	TEL (Telecommunication Address)	
Data element(s) used	XTN-3 (Telecommunication Equipment Type)	telecom/@value (scheme)	telecom/@use (use)
Vocabulary used	Table 0202 (Telecommunication equipment type)	URLScheme (2.16.840.1.113883.1.11.14866)	TelecommunicationAddressUse (2.16.840.1.113883.1.11.201)
Vocabulary value	CP (Cellular Phone)	tel (Telephone)	MC (Mobile Contact)

Figure 2: Representation of the mobile phone number in HL7 2.5 and Version 3.

In general, the information model of a HL7 Ver. 3 domain, based on the Reference Information Model (RIM), is richer and more powerful than the corresponding (implicit) model under HL7 2.x. The scope of the chronologically newer profiles is essentially the minimal coverage of elements required in the „old“ profiles, including profile

options. This approach is reflected in the constraints imposed on the HL7v3 Reference Information Model (RIM) by PIXv3 and PDQv3. Within this narrowed scope, IHE offers an approximate mapping of both data types and higher semantic units between HL7 2.x and 3.0 ([3], TF-2x, Appendix R).

A semantic mapping between the v2 and v3 representation is only achievable within a constricted scope and with limitations [5]. While PIXv3/PDQv3 strives for semantic alignment with PIX/PDQ, this effort influences the profile design. For example, both PIXv3 and PDQv3 impose a restriction on the scoping organization of a patient identifier, requiring it to be identical with the assigning authority of the patient identifier ([3], TF-2b, sections 3.45.4.2.2.1, 3.45.4.1.2.2, 3.46.4.1.2.1, 3.47.4.1.2.1). This does not fully comply with the common practice for assigning ISO object identifiers (OID) and restricts the OID assignment policy within the user's organization. Obviously this approach is a compromise to avoid more complicated technical solutions, such as an externalized mapping of object identifiers.

4.1 PIXv2 Versus PIXv3: Patient Identity Feed

The recipient of a PIXv2 ITI-8 transaction is explicitly required to respond with an application acknowledgement. In conjunction with the use of the original acknowledgement mode ([3], TF-2x, Appendix C.2.3) and the synchronous Minimal Lower Layer Protocol MLLP ([3], TF-2x, Appendix C.2.1) this implies that the response shall be generated immediately after the receiving application has fully completed the processiong of the message. The requirement for immediate application response conflicts with the asynchronous processing approach of most interface engines. This issue could only be resolved with an additional implementation effort, such as a asynchronous-to-synchronous converter being a part of the interfaces.

Opposed to this, for PIXv3 a commit acknowledgement (MCCI_IN000002UV01) is sufficient ([3], TF-2b, sections 3.44.4.1.2, 3.44.4.2.2, 3.46.4.1.2), which allows for responses with a simple transport receipt. In this case, message transmission over asynchronous intermediaries is IHE compliant.

As the PIXv2 profile specification references to the generic HL7 2.x guideline within the ITI technical framework ([3], TF-2x, Appendix C), its error handling is more specific than in PIXv3.

4.2 PIXv2 Versus PIXv3: PIX Query

PIXv2 query constraints itself strictly to dealing with patient identifiers (PID-3). Returning other data is explicitly precluded ([3], TF-2b, section 3.9.4.2.2.5). While the motivation of this measure is avoiding inconsistency issues with multiple unequal sets of demographics, its side effect is that the PIXv2 query response becomes de-identified. While the users of an IHE compliant PIX implementation can expect the query response to contain no personal data of the patient whatsoever, in a PIXv3 interface such behavior is not requried and has to be addressed explicitly. Since patient name is a required element in a PIXv3 query response (PRPA_IN201310UV02), the implementer would have to supply an adequate NullFlavor value to achieve de-identification.

4.3 PIXv2 Versus PIXv3: Update Notification

It is to note that on the Patient Identity Consumer side this functionality is expressed as an optional transaction in PIXv3 but represented as a separate profile option „PIX Update Notification“ in PIXv2 (ITI TF-1, table 5.2-1). The practical significance of the transaction is limited, as most implementations favor the query-response communication pattern of the PIX query over the data push approach of the notification.

While PIXv2 update notification ITI-10 is free of patient's personal data ([1]), the analogue PIXv3 transaction ITI-46 is generally not, on the same background as discussed for PIXv2 Query in section 4.4.

Furthermore, recipients of PIXv2 Update Notification are required to support a subscription mechanism with a defined configuration structure ([3], TF-2a, section 3.8.4.1.3.1). Requirement in PIXv3 are substantially less demanding ([3], TF-2b, section 3.46.4.1.2), leaving more freedom to the implementor.

4.4 PDQv2 Versus PDQv3: PDQ Query

PDQv2 only supports the combination of multiple query parameters with logical AND ([3], TF-2a, section 3.21.4.1.2.2.1). Logical OR has to be achieved executing multiple queries and subsequently combining results.

Also, PDQv3 is more specific about partial matches ([3], TF-2b, section 3.47.4.2.2.1). It describes how to specify a particular matching algorithm or how to quantify the alignment of the result with the parameters using a metric (quality of match).

A major difference appears in the specification of the continuation. Continuation is optional in PDQv3. HL7 2.x represents the response increments basically as linked list, using the continuation pointer of the DSC segment ([3], TF-2a, section 3.21.4.2.2.7) as a pointer to the next element. In opposite to this, the generic mechanism of HL7 Version 3 allows to be retrieve any fragment of the result, using the QUQI_IN000003UV01 interaction ([3], TF-2b, 3.47.4, 3.47.4.3). The fragment has an arbitrary position within the result set (parameter startResultNumber) and an arbitrary size (parameter continuationQuantity).

PDQv3 does not possess any counterpart to the optional Visit Information of PDQv2: the corresponding parameters such as Assigned Patient Location or Consulting

Doctor ([3], TF-2a, 3.22.4.1.2.2.1) are not supported.

5 Discussion And Conclusion

Comparing HL7 2.x with HL7 Ver. 3 with respect to the scope, methodology and information model down to the message structures has been subject to both theoretical research and practice driven work since the first Version 3 Normative Edition in 2005. To avoid redundancy, this paper refers to existing publications ([5, 6], [7, 8]) and addresses this aspect only in a limited depth.

It is to note that not all deltas between PIXv3/ PDQv3 abd PIXv2/PDQv2 can be attributed to the incompatibilities between the underlying information models. One reason why PIXv2 and PDQv2 are more restrictive than their HL7v3 counterparts is a higher re-use of the technical framework, e. g. of the framework-wide HL7 2.x guidelines ([3], TF-2x, Appendix C). Also, the HLv3 re-edition of the integration profiles was taken as opportunity for a purposeful re-adjustment of profile features, while maintaining downwards compatibility.

As HL7v3 and HL7v2 will continue to co-exist, the probability of PIXv2/PDQv2 and v3 interfaces being deployed in parallel to each other is likely to increase and technical availability will cease to be the major selection criterion. In such a setting, when deciding on the interface, special traits beyond the implementation technology can be taken into account. Based on the comparison results above, a few recommendations regarding the deployment can be articulated. PIX/PDQ HL7 2.x is to be preferred under the following pre-conditions:

- easy administration is a priority - immediate response and specific error handling increase the maintainability of the interface;
- for privacy reasons, patient demographics data must not occur in PIX query and PIX update notification;
- PDQ continuation must be supported;
- in the local deployment, organizations are not identified by a pure object identifier, instead a combination of an OID and an additional (non-OID) identifier is used.

PIXv3/PDQv3 is to be preferred under the following pre-conditions:

- asynchronous intermediaries (e. g. hospital interface engines) are employed for Patient Identity Feed transactions;
- rich PDQ queries are required, supporting the logical OR and result filtering based on the quality of match;
- comfortable continuation functionality is needed: random access to result fragments (w/ Continuation option).

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