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Exploring the Semantic Equivalents In a NIEM and HL7 Message

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This *Technical Brief* explores the practicality of exchanging information contained in frequently used justice and healthcare information exchanges to facilitate more effective treatment, ensure continuity of care, and reduce recidivism. It also examines the content of a typical justice intake record represented in the justice community data standard NIEM (the National Information Exchange Model) with a similar message in the health community—the Admission, Discharge, or Transfer message—represented in the predominant health community data standard, HL7 (Health Level 7) to determine the degree which semantic equivalencies exist.

Background

This brief expands upon an earlier companion document¹ that compared the two commonly used information exchange data standards used by the justice and healthcare communities: NIEM and HL7. That document described the evolution, structure, and intended use of these data models and touched on their potential overlap. In general terms, NIEM and HL7 serve similar purposes: establishing consistent semantics and structures to enable automated electronic information sharing. Each of these two data models achieves this by using different technical approaches. NIEM is based on Extensible Markup Language (XML) schema; HL7's most prevalent use is based on a text delimited messaging structure. The companion document described one of several options to translate the content from one structure to the other, but it did not include a detailed assessment of the semantic equivalents of commonly used exchange documents in a given business scenario where this would be necessary.

¹ SEARCH, *Technical Brief*, "A Comparative Analysis of HL7 and NIEM: Enabling Justice-Health Data Exchange," May 2015. See http://www.search.org/files/pdf/TechBrief_HL7-NIEM_Comparative_Analysis.pdf

Business Context

In 2013, more than 11 million people were admitted to correctional facilities in the United States. Corrections populations have statistically significant higher rates of medical, substance abuse, and mental health issues (64% of local jail inmates have a mental health disorder).² In order to enhance the delivery of needed medical and treatment services, several justice and healthcare organizations collaborated to identify, define, and prioritize information exchange scenarios between their respective communities.³ The outcomes of this effort highlighted the information gaps that inhibit the business objectives among these communities and established high-level requirements for the content needed for an automated information sharing solution to these gaps. As a result of this collaborative effort, corrections and healthcare exchange of information was consistently identified as a high-volume need and critical to continuity of care and the reduction of recidivism. In particular, one of the high priorities was to establish the means by which “Correctional health records are populated with basic personal and demographic information from the facility’s offender management system to reduce the time spent asking for redundant information and to eliminate duplicate data entry.”⁴

Extrapolating from this basic information exchange scenario, a key assumption is that the content included in a NIEM-based booking or intake message could be translated into a typical HL7 Admission message structure. The remainder of this document explores the practicality of this.

NIEM Booking and Intake Messages

NIEM does not attempt to define a “standard” or authoritative message structure for a given document or exchange, but rather provides an extensible framework for information sharing partners to identify their individual requirements and develop specific messages that meet those requirements. For this discussion, SEARCH reviewed the Justice Information Exchange Modeling (JIEM) Adult Felony Reference Model⁵ and several published NIEM specifications⁶ to validate the similarity of the content typically contained in a booking or intake message across the country with the HL7 ADT message.

NIEM Booking or Intake Message

ELEMENT	DEFINITION	NIEM ELEMENT NAME
Booking Details		
Booking Date/Time	date/time booking occurred	j:Booking/nc:ActivityDate/DateTime
Booking Facility Name	name of booking facility	j:BookingAgency/nc:OrganizationName
Booking Type	description of the kind of booking	j:BookingCategoryText
Arrest Tracking Number	unique ID assigned by jail/corrections facility	j:ChargeTrackingID

² <http://www.bjs.gov/content/pub/pdf/mpp.pdf>

³ https://c.ymcdn.com/sites/ijis.site-ym.com/resource/resmgr/Docs/Opps_Info_Sharing_Enhance_He.pdf;

⁴ <http://www.it.ojp.gov/GIST/171/Aligning-Justice-to-Health-Priority-Exchanges-Task-Team-Final-Report>

⁵ <http://www.search.org/files/pdf/AdultFelonyReferenceModel.pdf>

⁶ IEPD samples reviewed include Texas Path to NIEM Booking Report, Alaska Department of Corrections Intake Message, Pima County (Arizona) Booking Report, and California Department of Justice Intake Property Inventory.

ELEMENT	DEFINITION	NIEM ELEMENT NAME
Offender Information		
Offender Identification	unique ID assigned by jail/corrections facility	j:SubjectIdentification
First Name	offender first name	nc:PersonGivenName
Middle Name	offender middle name	nc:PersonMiddleName
Last Name	offender last name	nc:PersonSurname
Alias Name	alternate name	j:PersonAliasIdentityAssociation/nc:Person/PersonName
Address	offender address	nc:PersonLocationAssociation/nc:Address
Birth Date	date of birth	nc:PersonBirthDate
Driver License Number	offender DL number	j:DriverLicenseCardIdentification
Home Phone Number	offender phone	nc:FullTelephoneNumber
Social Security Number	SSN	nc:PersonSSNIdentification
State Identification Number	SID	nc:PersonStateIdentification
FBI Identification Number	FBI	j:PersonFBIIdentification
Scars, Marks, Tattoos	offender scars, marks, tattoos	j:PersonPhysicalFeatureDescriptionText
Sex	gender	nc:PersonSexText
Race	offender race	nc:PersonRaceText
Hair Color	offender hair color	nc:PersonHairColorText
Eye Color	offender eye color	nc:PersonEyeColorText
Height	offender height	nc:PersonHeightDescriptionText
Weight	offender weight	nc:PersonWeightDescriptionText
Language	language spoken by offender other than English	nc:PersonPrimaryLanguage/LanguageName
Complexion	description of offender's skin complexion	nc:PersonComplexionText
Build	description of offender's build	nc:PersonBuildText
Glasses	description of glasses, if applicable	nc:PersonEyewearText
Facial Hair	description of any facial hair, if applicable	nc:PersonFacialHairText
Birth City	city where offender was born	nc:PersonBirthLocation
Citizenship	citizenship of offender	nc::PersonCitizenshipText
Offender Employment		
Employer Name	name of the offender's employer	nc:Employer/nc:OrganizationName
Occupation	offender's occupation	nc:EmployeeOccupationText
Employer Address	address of the employer	nc:Employer/OrganizationLocation/AddressFullText
Arrest Details		
Date/Time	date of arrest	j:ActivityArrestAssociation/nc:Activity/nc:DateTime
Location	location where arrest occurred	j:PersonArrestLocationAssociation/Location
Agency Report Number	arresting agency record number	j:ArrestAgencyRecordIdentification
Arresting Officer ID	arresting officer ID number	j:EnforcementOfficialBadgeID
Arresting Officer Name	arresting officer name	j::ArrestOfficerAssociation/PersonName
Arresting Agency Name	arrest agency name	j:ArrestAgencyAssociation/OrganizationName

ELEMENT	DEFINITION	NIEM ELEMENT NAME
Offense Details		
Statute Identification	statute number of offense	j:StatuteCodeIdentification
Statute Name	common name of the offense	j:StatuteDescriptionText
Class	severity of the offense	j:ChargeSeverityDescriptionText
Date/Time	date and time when the offense occurred	j:Offense/Activity/ActivityDate
Bond Amount	bond amount	j:bailbondamount
Offense Code	Description of charge	j:ChargeDescriptionText
Custody Details		
Custody Status	description of the kind of custody assigned by correctional facility	j:SupervisionCustodyStatus/j:StatusDescriptionText
Current Body Location	location of the offender within the facility	nc:SupervisionFacility/j:SupervisionAugmentation/Area/cell/bed
Release Date	anticipated date of offender's release	j:SupervisionRelease/nc:Date
Security Cautions	description of any officer safety concerns	j:SupervisionCautionText
Custody Level	description of required supervision level	nc:Supervision/SupervisionAugmentation/SupervisionLevelText

Table 1

Example ADT message type 1 – Admission

Unlike the NIEM approach to defining an individual information exchange, the HL7 specification includes more than 80 distinct message types that correspond to a given healthcare event. HL7 version 2.3, which has the highest usage of all HL7 versions,⁷ defines 16 “sub-types” of the patient Admission/Discharge/Transfer (ADT) message. For the purposes of this assessment, this document focuses on the ADT01 message: *admission of a new patient into a facility*. The HL7 approach to defining message structure and content is an over-inclusive process; this means that in practice, the typical ADT01 message is a subset of the “standard” message. The published ADT specification for v2.3⁸ includes 13 message segments, as listed in the following table. However, only four are required for any ADT implementation (segments 1, 2, 3, and 6, as noted with an asterisk).

Segments:		
1. MSH – Message Header*	6. PV1 – Patient Visit*	11. GT1 – Guarantor
2. EVN – Event Type*	7. PV2 – Patient Visit – Additional demographics	12. IN1 – Insurance
3. PID – Patient Identification*	8. AL1 – Allergies	13. ACC – Accident
4. PD1 – Additional Demographics	9. DG1 – Diagnosis	
5. NK1 – Next of Kin	10. PR1 – Procedures	

Table 2

⁷ <http://www.corepointhealth.com/sites/default/files/whitepapers/hl7-v2-v3-evolution.pdf>

⁸ See Appendix A for a full analysis of all optional ADT01 content for the four required segments.

The following table lists the 10 required elements within the four required segments⁹ needed to produce a valid instance of the ADT01 message. The table contains the element name, sample values, and simple descriptions. The remaining, optional segments in the ADT Message do not contain any equivalent data concepts that align with a typical booking or intake message.

MSH Segment			
1	Field Separator*		default HL7 delimiter
2	Encoding Characters*	^~\&	default HL7 encoding characters
9	Message Type*	ADT^A01	patient admission
10	Message Control ID*	unique identifier per message	GUID format
11	Processing ID*	D for debugging or P for production mode	second component is not used
12	Version ID*	2.3.1	
EVN Segment			
2	Recorded Date/Time*		date/time of admission
PID Segment			
2	Patient ID – External ID*	integer	assigned authority issued ID #
5	Patient Name*		full name of patient
PV1 Segment			
2	Patient Class*	I	patient/inmates defined as “inpatient”

Table 3

This table shows how NIEM elements could map to these basic required HL7 elements:

Segment	HL7-ADT Element	NIEM Element
MSH	Field Separator	XML addresses this requirement
MSH	Encoding Characters	Defined within each schema document
MSH	Message Type	IEP document name addresses this requirement/Defined in WSDL
MSH	Message Control ID	Addressed by Web Services WS-Addressing
MSH	Processing ID	Handling via web service end-point
MSH	Version ID	Defined in namespace name
EVN	Recorded Date/Time	j:Booking/nc:ActivityDate/nc:DateTime
PID	Patient ID	j:SubjectIdentification
PID	Patient Name	nc:PersonName/PersonFullName
PV1	Patient Class	j:BookingCategoryText

Table 4

NIEM does not include all of the MSH segment data within the message itself. As illustrated in Table 4 above, NIEM has mechanisms to cover all of the required elements although it may

⁹ The asterisk symbol (*) symbol denotes a required segment and element.

handle them in different ways. The **Field Separator** is defined by XML, itself. Elements such as **Encoding Characters** and **Version ID** are defined in the schema. Elements such as **Message Type**, **Message Control ID** and **Processing ID** are handled by web services or in the Web Service Definition Language (WSDL) file. Where exact NIEM equivalents may not exist, such as **Patient ID**, these elements can be defined using generic NIEM constructs, such as `SubIdentificationID`, or can be defined in an extension schema.

This minimum information set in the ADT message satisfies the basic use case described previously—that of populating an electronic health record system (EHR) with a patient name, ID, and class to create a new patient chart or record. However, the typical NIEM Booking message contains additional data that could be included to reduce the amount of data entry into the EHR. The following table lists the more complete content that could be included in an ADT message.

ADT Segment & Sequence #	ADT Field	Notes	NIEM Equivalent
EVN – 2	Recorded Date/Time*	date/time admission occurred	j:Booking/nc:ActivityDate/DateTime
PID – 2	Patient ID – External ID*	assigned authority issued ID #	j:SubjectIdentification
PID – 5	Patient Name*	full name of patient	nc:PersonFullName
PID – 7	Date/Time of Birth	birth date of patient	nc:PersonBirthDate
PID – 8	Sex	gender of patient	nc:PersonSexText
PID – 9	Patient Alias	alternate name of patient	j:PersonAliasIdentityAssociation/ nc:Person/PersonName
PID – 10	Race	race of patient	nc:PersonRaceText
PID – 11	Patient Address	current address of patient residence	nc:PersonLocationAssociation/nc:Address
PID – 13	Phone Number – Home	patient personal phone number	nc:FullTelephoneNumber
PID – 15	Primary Language	patient primary language	nc:PersonPrimaryLanguage/LanguageName
PID – 19	SSN Number – Patient	patient social security number	nc:PersonSSNIdentification
PID – 20	Driver’s License Number – Patient	patient driver license number	j:DriverLicenseCardIdentification
PID – 23	Birth Place	location of patient birth	nc:PersonBirthLocation
PID – 26	Citizenship	patient county of citizenship	nc:PersonCitizenshipText
PV1-2	Patient Class*	patient/inmates defined as “inpatient”	j::BookingCategoryText
PV1-3	Assigned Patient Location	facility is just the name of the facility (i.e., is not a compound field)	nc:SupervisionFacility/ j:SupervisionAugmentation/Area/cell/bed
PV1-44	Admit Date/Time	admission date/time	j:Booking/nc:ActivityDate/DateTime
PV1-45	Discharge Date/Time	discharge date/time	j:SupervisionRelease/nc:Date

Table 5

Clearly, both the justice and health communities have a need to adequately identify and describe many different personal characteristics about the people they interact with. Both NIEM and HL7 provide elements to describe many of these common characteristics as illustrated in Table 5. In addition to describing individuals, both communities track contact information for the individual

(e.g., address and phone number). Lastly, certain event dates are tracked in both data systems. While the magnitude of these data is relatively small, the value is significant, as the accurate sharing of offender/patient identification and contact information is very important to both communities—especially in the context of ensuring continuity of care. While the focus of this use case and analysis has been on the sharing of data from the corrections environment to the health environment, the exchange could be equally valuable in the opposite direction. This is because many people who are receiving treatment can have their continuity of care disrupted should they become involved in the justice process and be detained in a jail.

Conclusion

This *Technical Brief* analyzes how a typical booking or intake message produced by a correctional facility using NIEM can semantically align with a similar message within an Electronic Health Record system that uses the HL7 ADT01 message to create a new patient record. As illustrated in the various tables herein, there is semantic equivalency between these two standards for basic person-related (demographic) information. Certainly, the degree of commonality between the two typical message types is quite limited, considering they each have distinct and diverse intended uses. However, the common elements are sufficient to produce a useful amount of sharable information to further the continued collaboration among healthcare providers and corrections communities. This exchange scenario represents one of many instances where each information-sharing partner can leverage existing information exchange content and data standards to more effectively deliver the appropriate medical and rehabilitative services to increase public safety and patient care.

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Appendix A: Complete ADT01 Message with NIEM Equivalents

Segment: Message – MSH				
Sequence #	Field	Value	Notes	NIEM Equivalent
1	Field Separator*		default HL7 delimiter	
2	Encoding Characters*	^~\&	default HL7 encoding characters	
3	Sending Application	user-defined table	identifier of sending application or system	
4	Sending Facility	user-defined table	identifier for sending facility	
5	Receiving Application	user-defined table	identifier for the receiving application or system	
6	Receiving Facility	user-defined table	identifier for the receiving facility	
7	Date/Time of Message	00:00:00:zz	time zone is defined as offset of UTM	
8	Security		used to implement security features	
9	Message Type*	ADT^A01	patient admission	
10	Message Control ID*	unique identifier per message	GUID format used for sending acknowledgment	
11	Processing ID*	D for debugging or P for production mode	used to determine processing rules	
12	Version ID*	2.3.1	HL7 version number	
13	Sequence Number	1,2,3, etc.	incremented by one for each instance	
14	Continuation Pointer		used for application-specific continuations	
15	Accept Acknowledgement	user-defined table; AL = always	indicates expected acknowledgement	
16	Application Acknowledgement	user-defined table; AL = always	indicates expected application acknowledgement	
17	Country Code		3-character code of message origin	
18	Character Set		7-bit ASCII set	
19	Principal Language of Message		code for the language of message	

Segment: Event – EVN				
Sequence #	Field	Value	Notes	NIEM Equivalent
1	Event Type Code	user-defined table	contains the corresponding triggering event code	
2	Recorded Date/Time*		date/time admission occurred	j:Booking/nc:ActivityDate/DateTime
3	Date/Time Event Planned		date/time when event is planned to occur	
4	Event Reason Code	user-defined table; 01 – patient request, etc.	reason for the event	
5	Operator ID	user-defined table	identifier for person responsible for event	
6	Event Occurred	(if ADT02 – transfer date, etc.)	date/time when event occurred	

Segment: Patient ID – PID				
Sequence #	Field	Value	Notes	NIEM Equivalent
1	Set ID – Patient ID		not used	
2	Patient ID – External ID*	integer	assigned authority-issued ID #	j:SubjectIdentification
3	Patient ID – internal ID	integer	e.g., medical record number	
4	Alternate Patient ID	patient ID	unique name-based identifier	
5	Patient Name*		full name of patient	nc:PersonFullName
6	Mother's Maiden Name		maiden name of patient's mother	
7	Date/Time of Birth		birth date	nc:PersonBirthDate
8	Sex		gender	nc:PersonSexText
9	Patient Alias		alternate name of patient	j:PersonAliasIdentityAssociation/nc:Person/PersonName
10	Race	patient ethnicity	race of patient	nc:PersonRaceText
11	Patient Address	Street Address^ Address Line 2^ City^State^Zip	current address of patient residence	nc:PersonLocationAssociation/nc:Address
12	Country Code	user-defined table	code for patient's country	
13	Phone Number – Home	patient home phone number	patient personal phone number	nc:FullTelephoneNumber
14	Phone Number – Business	patient work phone number	patient work phone number	

15	Primary Language	user-defined table; E = English, S = Spanish	patient primary language	nc:PersonPrimaryLanguage/LanguageName
16	Marital Status	user-defined table; M = Married, D = Divorced, etc.	patient marital status	
17	Religion	user-defined table	patient-identified religion	
18	Patient Account Number	A-account~2 A-account	patient account number for financial transactions	
19	SSN Number – Patient		patient social security number	nc:PersonSSNIdentification
20	Driver’s License Number – Patient		patient driver license number	j:DriverLicenseCardIdentification
21	Mother’s Identifier		ID number used to link individuals (newborns)	
22	Ethnic Group	user-defined table	patient ancestry	
23	Birth Place		location of patient birth	nc:PersonBirthLocation
24	Multiple Birth Indicator	Y/N	indicates patient was part of multiple birth	
25	Birth Order	1,2,3, etc.	number for the order of patient birth (if multiple birth is Y)	
26	Citizenship	user-defined table	patient county of citizenship	nc:PersonCitizenshipText
27	Veterans Military Status	user-defined table	military status of veteran patient	
28	Nationality	user-defined table	patient-identified national group	
29	Patient Death Date and Time		date/time in which patient death occurred	
30	Patient Death Indicator	Y/N	indicates a patient is deceased	

Segment: Patient Visit Information – PV1

Sequence #	Field	Value	Notes	NIEM Equivalent
1	Set ID – PV1	1,2,3, etc.	transaction occurrence identification	None
2	Patient Class*	I for Inpatient, E for emergency, O for outpatient, etc.	patient/inmates defined as “inpatient”	J:BookingCateoryText
3	Assigned Patient Location	^Wing^Bed^Facility^^ Unit^Area	facility (just the facility name; i.e., is not a compound field)	nc:SupervisionFacility/ j:SupervisionAugmentation/Area/cell/bed
4	Admission Type	A = accident, E = emergency, R = routine, etc.	circumstance for admission	
5	Preadmit number		pre-admit account #	

6	Prior Patient Location	^Wing^Bed^Facility^^^ Unit^Area	patient location if transferred	
7	Attending Doctor	ID#^Last Name^First Name	attending physician information	
8	Referring Doctor	ID#^Last Name^First Name	referring physician information	
9	Consulting Doctor	ID#^Last Name^First Name	consulting physician information	
10	Hospital Service	user-defined table	treatment to be provided	
11	Temporary Location	user-defined table	location other than assigned	
12	Preadmit Test Indicator	Y/N	pre-admission testing required or not	
13	Readmission Indicator	user-defined table; R = readmit	indicates readmission to facility	
14	Admit Source	8 = court/law enforcement, 1 = physician referral, etc.	indicates where patient was admitted	
15	Ambulatory Status	A0 = no limitations, A2 = wheelchair, etc.	handicapped conditions	
16	VIP Indicator		type of VIP	
17	Admitting Doctor	ID#^Last Name^First Name		
18	Patient Type	user-defined table	identification for site-specific patient type	
19	Visit Number	user-defined table	unique number for each patient visit	
20	Financial Class	user-defined table	type of class for reimbursement	
21	Charge Price Indicator	user-defined table	code for room/bed price schedule	
22	Courtesy Code	user-defined table	special courtesies for patient	
23	Credit Rating	user-defined table	determine past credit experience	
24	Contract Code	user-defined table	type of contract for settling of balances	
25	Contract Effective Date		contract effective start date	
26	Contract Amount		amount to be paid	
27	Contract Period		contract duration	
28	Interest Code	user-defined table	amount of interest to be paid	
29	Transfer to Bad Debt Code	user-defined table	indicates account and reason for transfer to bad debt status	
30	Transfer to Bad Debt Date		date account transferred to bad debt status	

31	Bad Debt Agency Code	user-defined table	agency code that received bad debt account	
32	Bad Debt Transfer Amount		amount transferred to bad debt status	
33	Bad Debt Recovery Amount		amount recovered from guarantor	
34	Delete Account Indicator	user-defined table	reason account was deleted from file	
35	Delete Account Date		date which account was deleted	
36	Discharge Disposition	user-defined table-01 = Discharged to home, etc.	disposition information at time of discharge	
37	Discharged to Location	e	facility in which patient was discharged	
38	Diet Type	user-defined table	special diet for patient	
39	Servicing Facility	user-defined table	used in multiple facility environments	
40	Bed Status	user-defined table; C = closed, O = occupied, I = isolated	status of patient bed	
41	Account Status	user-defined table	status of account	
42	Pending Location	user-defined table	point of care, status where patient may be moved	
43	Prior Temporary Location	user-defined table	patient location prior to transfer to temporary location	
44	Admit Date/Time	CCYYMMDDHHMM	admission date/time	j:Booking/nc:ActivityDate/DateTime
45	Discharge Date/Time	CCYYMMDDHHMM	discharge date/time	j:SupervisionRelease/nc:Date
46	Current Patient Balance		visit balance due	
47	Total Charges		total visit charges	
48	Total Adjustments		total visit adjusted charged	
49	Total Payments		total payments for visit	
50	Alternate Visit ID	user-defined table	temporary, pending visit ID	
51	Visit Indicator	user-defined table; A = account, V = visit	defines data as visit information	
52	Other Healthcare Provider	user-defined table	contains other care provider information	

Sample Message format for ADT01 – Admission:

```
MSH|^~\&|XYZJMS|XYZFacility|ABCEHR|ABCHealthcareFacility|200601121115||ADT^A01|693
8a24d-1d54-3256-b2ee-3e75274ec396|P|2.3.1||AL|AL
EVN||200601121115
PID||00000000|142127|253763|LastName^FirstName^M||19720430|M|||||||123-45-6789
PV1|||3^49^CorrectionalFacility^^C^C1
```