HL7 & HL7 CDA: The Implementation of Thailand’s Healthcare Messaging Exchange Standards

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Certified HL7 CDA Specialist
A Bit About Myself...

2003  M.D. (First-Class Honors) (Ramathibodi)
2009  M.S. in Health Informatics (U of MN)
2011  Ph.D. in Health Informatics (U of MN)
2012  Certified HL7 CDA Specialist

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Outline

• A Vision
• HL7 & HL7 CDA Standards
• Ramathibodi’s Experience

Acknowledgments

• Some of these slides are reproduced/adapted from those of Dr. Supachai Parchariyanon, Miss Sireerat Srisiriratanakul, and Mr. Chaiwiwat Thongtaveechaikit at Ramathibodi
THAILAND’S E-HEALTH: PRESENT & FUTURE
eHealth

Health Information Exchange (HIE)

Hospital A

Government

Hospital B

Lab

Patient at Home

Clinic C
Use of information and communications technology (ICT) for health; Including

- Treating patients
- Conducting research
- Educating the health workforce
- Tracking diseases
- Monitoring public health.

Sources: 1) WHO Global Observatory of eHealth (GOe) (www.who.int/goe)
2) World Health Assembly, 2005. Resolution WHA58.28
Use of information and communications technology (ICT) in health & healthcare settings

Source: The Health Resources and Services Administration, Department of Health and Human Service, USA
eHealth & Health IT

Slide adapted from: Boonchai Kijsanayotin
- All components are essential
- All components should be balanced

eHealth components

- Leadership and governance
  - Strategy and investment
  - Services and applications
  - Standards & interoperability
  - Infrastructure

- Legislation, policy and compliance
- Workforce

Slide adapted from: Boonchai Kijsanayotin
Thailand: Unbalanced Development

Services, Applications Software

Legislation, policy & compliance

Workforce

Leadership & governance

Strategy & Investment

Standards & Interoperability

Infrastructure

Slide adapted from: Boonchai Kijsanayotin
Health Development Model

- eHealth Applications
  - Services
  - Applications
  - Software
- Enabling Policies & Strategies
  - Standards & Interoperability
  - Capability Building
- Foundation Policies & Strategies
  - Leadership & Governance
  - Legislation & Policy
  - Strategy & Investment
  - Infrastructure

Slide adapted from: Boonchai Kijsanayotin
Thailand’s eHealth Development

Slide adapted from: Boonchai Kijsanayotin
STANDARDS FOR E-HEALTH
Standards Are Everywhere
Standards: Why?

• The Large N Problem

\[ \text{# Interfaces} = \frac{N(N-1)}{2} \]

- \( N = 2, \text{Interface} = 1 \)
- \( N = 3, \text{Interface} = 3 \)
- \( N = 5, \text{Interface} = 10 \)
- \( N = 100, \text{Interface} = 4,950 \)
eHealth
Health Information Exchange (HIE)
### Objectives

- Interoperability
- Inter-operable systems

### Ultimate Goals

- Continuity of Care
- Quality
  - Safety
  - Timeliness
  - Effectiveness
  - Equity
  - Patient-Centeredness
- Efficiency

**Why Health Information Standards?**
Levels of Interoperability

- Functional
- Semantic
- Syntactic
Various Kinds of Standards in Health Care

- Unique Identifiers
- Standard Data Sets
- Vocabularies & Terminologies
- Exchange Standards
  - Message Exchange
  - Document Exchange
- Functional Standards
- Technical Standards: Data Communications, Encryption, Security
How Standards Support Interoperability

Functional Standards (HL7 EHR Functional Specifications)

- Vocabularies, Terminologies, Coding Systems (ICD-10, ICD-9, CPT, SNOMED CT, LOINC)
- Information Models (HL7 v.3 RIM, ASTM CCR, HL7 CCD)
- Standard Data Sets
- Unique ID

Some may be hybrid: e.g. HL7 v.3, HL7 CCD

Exchange Standards (HL7 v.2, HL7 v.3 Messaging, HL7 CDA, DICOM)

Technical Standards (TCP/IP, encryption, security)
Exchange Standards

Message Exchange

- Goal: Specify format for exchange of data
- Internal vs. external messages
- Examples
  - HL7 v.2
  - HL7 v.3 Messaging
  - DICOM
  - NCPDP

Document Exchange

- Goal: Specify format for exchange of “documents”
- Examples
  - HL7 v.3 Clinical Document Architecture (CDA)
  - ASTM Continuity of Care Record (CCR)
  - HL7 Continuity of Care Document (CCD)
## Exchange Standards

<table>
<thead>
<tr>
<th>Messages</th>
<th>Clinical Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Human Unreadable</td>
<td>• Human Readable</td>
</tr>
<tr>
<td>• Machine Processable</td>
<td>• (Ideally) Machine Processable</td>
</tr>
</tbody>
</table>

---

22
Message Exchange
Clinical Document Exchange

- Hospital A
  - Message containing Referral Letter
- Hospital B
  - Message containing Claims Request
  - Message containing Communicable Disease Report
- Clinic C
  - Message containing Patient Visit Summary
- Lab
  - Message containing Lab Report
- Patient at Home
HL7 & HL7 CDA STANDARDS
HL7 Standards

- **HL7 V2.x**
  - Defines electronic messages supporting hospital operations
- **HL7 V3**
- **HL7 Clinical Document Architecture (CDA) Releases 1 and 2**
- **HL7 Arden Syntax**
  - Representation of medical knowledge
- **HL7 EHR & PHR Functional Specifications**
- **Etc.**
HL7 V3 Standards

• A family of standards based on V3 information models and development methodology

• Components
  – HL7 V3 Reference Information Model (RIM)
  – HL7 V3 Messaging
  – HL7 Development Framework (HDF)
Sample HL7 v.2 Message (Lab Result)

OBX|1|NM|10839-9^TROPONIN-I^LN||5|ng/ml|
0-1.3|H||H|F|19980309…
Sample HL7 v.3 Message
(Patient Registration)

<?xml version="1.0" encoding="UTF-8"?>
<PRPA_IN101311UV02 xmlns="urn:hl7-org:v3"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   ITSVersion="XML_1.0" xsi:schemaLocation="urn:hl7-org:v3
   ../schemas/PRPA_IN101311UV02.xsd">
   ...
   <name use="SYL">
      <given>นวนรรน</given>
      <family>ธีระอัมพรพันธุ์</family>
   </name>
   <name use="ABC">
      <given>Nawanan</given>
      <family>Theera-Ampornpunt</family>
   </name>
   <administrativeGenderCode code="M"/>
   ...
</PRPA_IN101311UV02>
HL7 Reference Information Model (RIM)

Source: HL7 CDA R2
HL7 V3 Messaging

- V3 provides messaging standards for
  - Patient administration
  - Medical records
  - Orders
  - Laboratory
  - Claims & Reimbursement
  - Care provision
  - Clinical genomics
  - Public Health
  - Etc.
How HL7 V3 Works

- Message sent from sending application to receiving application
- Message in XML with *machine-processable* elements conforming to messaging standard
- Data elements in message conform to RIM
- Not designed for human readability
What Is HL7 CDA?

• “A document markup standard that specifies structure & semantics of “clinical documents” for the purpose of exchange” [Source: HL7 CDA Release 2]

• Focuses on document exchange, not message exchange

• A document is packaged in a message during exchange

• **Note:** CDA is not designed for document storage. Only for exchange!!
A CDA document is a defined & complete information object that can include

- Text
- Images
- Sounds
- Other multimedia content

Source: HL7 CDA R2
Key Aspects of CDA

• CDA documents are encoded in XML
• CDA documents derive their machine processable meaning from HL7 RIM and use HL7 V3 Data Types
• CDA specification is richly expressive & flexible
  ▪ Templates can be used to constrain generic CDA specifications

Source: HL7 CDA R2
Scope of CDA

Lab Technician

Create document

Lab Report

Physician

Process & Store document

Transmit document

CDA
CDA & HL7 Messages

- Documents complement HL7 messaging specifications
- Documents are defined and complete information objects that can exist outside of a messaging context
- A document can be a MIME-encoded payload within an HL7 message

Source: “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
CDA & Message Exchange

- CDA can be payload (or content) in any kind of message
  - HL7 V2.x message
  - HL7 V3 message
  - EDI ANSI X12 message
  - IHE Cross-Enterprise Document Sharing (XDS) message

- And it can be passed from one kind to another

Source: “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
CDA & Message Exchange

Clinical Document (Payload)

HL7 V3 Message (Message)

HL7 V2 Message (Message)

Source: Adapted from “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
CDA As Payload

Relationship to HL7 messages
Documents can be encapsulated within HL7 messages as MIME packages

**HL7 V2.x**

MSH | ...  
EVN | ...  
PID   |   ...  
PV1   |   ...  
TXA   |   ...  
OBX | 1 | ED | ...

**HL7 V3**

<Act.Code code="11488-4" codeSystem="2.16.840.1.113883.6.1" displayName="Consultation note"/>

<Act.text type="multipart/related"> MIME-Version: 1.0  
Content-Type: multipart/related; boundary="HL7-CDA-boundary"; type="text/xml";  
start="10.12.45567.43" Content-Transfer-Encoding: BASE64

**Source:** From “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
Components of CDA Document

- Header
- Body
  - Section
  - Entry (machine processable)
  - Narrative Block (human readable)

Source: HL7 CDA R2
CDA Model

Source: From “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
A Closer Look at a CDA Document

`<ClinicalDocument> ... CDA Header ...`  
`<structuredBody> <section> <text>... Single Narrative Block ...</text> <observation>...</observation> <substanceAdministration> <supply>...</supply> </substanceAdministration> <observation> <externalObservation>...</externalObservation> </observation> </section> <section> <section>...</section> </section> </structuredBody> </ClinicalDocument>`

Source: HL7 CDA R2
History of Present Illness section

-->

    <component>
        <section>
            <code code="10164-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"/>
            <title>History of Present Illness</title>
            <text>
                <content styleCode="Bold">Henry Levin, the 7<sup>th</sup> is a 67 year old male referred for further asthma management. Onset of asthma in his <content revised="delete">twenties</content> 
                <content revised="insert">teens</content>. He was hospitalized twice last year, and already twice this year. He has not been able to be weaned off steroids for the past several months.
            </text>
        </section>
    </component>

Past Medical History section

-->
Rendering CDA Documents (2)

Good Health Clinic Consultation Note

Patient: Henry Levin, the 7th  
Birthdate: September 24, 1932  
Consultant: Robert Dolin, MD

MRN: 12345  
Sex: Male  
Created On: April 7, 2000

History of Present Illness

Henry Levin, the 7th is a 67 year old male referred for further asthma management. Onset of asthma in his teens. He was hospitalized twice last year, and already twice this year. He has not been able to be weaned off steroids for the past several months.

Past Medical History

- Asthma  
- Hypertension (see HTN.cda for details)  
- Osteoarthritis, right knee

Medications

- Theodur 200mg BID  
- Proventil inhaler 2puffs QID PRN

Source: From “What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012
CDA Releases

- CDA Release 1 (ANSI-approved in 2000)
  - First specification derived from HL7 RIM
- CDA Release 2 (2005) - Current Release
  - Basic model essentially unchanged from R1
    - Document has a header & a body
    - Body contains nested sections
    - Sections can be coded using standard vocabularies and can contain entries
  - Derived from HL7 RIM Version 2.07

Source: HL7 CDA R2
Some Possible Use Cases of CDA

- Intra-institutional
  - Exchange of parts of medical records (scanned or structured electronic health records)
  - Lab/Imaging requests & reports
  - Prescriptions/order forms
  - Admission notes
  - Progress notes
  - Operative notes
  - Discharge summaries
  - Payment receipts
  - Other forms/documents (clinical or administrative)
Some Possible Use Cases of CDA

- Inter-institutional
  - Referral letters
  - Claims requests or reimbursement documents
  - External lab/imaging reports
  - Visit summary documents
  - Insurance eligibility & coverage documents
  - Identification documents
  - Disease reporting
  - Other administrative reports
Achieving Interoperability

- CDA is a general-purpose, broad standard
- Use in each use case or context requires implementation guides to constrain CDA
- Examples
  - Operative Note (OP)
  - Consultation Notes (CON)
  - Care Record Summary (CRS)
  - Continuity of Care Document (CCD)
  - CDA for Public Health Case Reports (PHCRPT)
  - Quality Reporting Document Architecture (QRDA)
CDA Summary (1)

- CDA is a markup standard for document exchange
  - Not message exchange
  - Not document storage or processing
- CDA is a general-purpose standard
  - Use in specific context requires Implementation Guides (and possibly Extensions)
CDA Summary (2)

- CDA is XML-based and RIM-based
- CDA documents can be exchanged as encapsulated data (payload) in any message (HL7 V2, HL7 V3, etc.)
- CDA is not dependent on using HL7 V3 messages
- Most likely early use cases for CDA
  - Referrals
  - Claims & Reimbursements
  - Lab/imaging Reports
  - Electronic Health Records Documents
RAMATHIBODI EXPERIENCE
Overall

Mahidol University
Wisdom of the Land

2009
- **Study**
  - HL7v3 RIM
  - HL7v3 Tools
- **Implement**
  - Prototype: Patient Registration

2010
- **Study**
  - HL7v3 Laboratory
  - HL7v3 CDA
- **Implement**
  - Prototype CDA
  - Data Exchange (RAMA-SCG)

2011
- **Study**
  - Mirth
  - DICOM
  - Distributors
  - JCAPS
  - Observation Results
- **Implement**
  - CDA Referral
  - JCAPS LIS to HIS

2012
- **Study**
  - Distributors
  - JCAPS
  - Admit / Discharge / Transfers
- **Implement**
  - JCAPS
  - ADT

2013
- **Next Step**
• **Study**
  – HL7v3
    • Laboratory
  – HL7v3 CDA

• **Implement**
  – Data Exchange (RAMA-SCG)
  – Prototype CDA
RAMA-SCG: Existing Process
Exchange Interoperability
Message Exchange

HL7v2.3.1

LIS -> JCAPS -> SCG
<subject typeCode="SUBJ" contextConductionInd="false">
  <observationEvent classCode="OBS" moodCode="EVN">
    <id extension="701" assigningAuthorityName="A unique identifier of Test" />
    <id extension="Ramathibodi Lab Name" assigningAuthorityName="Ramathibodi Lab Name" />
    <id extension="SID" />
  </observationEvent>
  <code code="14647-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC" displayName="Cholesterol">
    <originalText>SCG:Cholesterol|RAMA:CHOL|Lab:Ramathibodi:marker</originalText>
    <value value="6.39" unit="mmol/L" />
  </code>
  <statusCode code="completed" />
  <effectiveTime value="20100808" />
  <priorityCode code="CR" codeSystem="2.16.840.1.113883.5.7" codeSystemName="ActPriority" displayName="Callback Result" />
  <confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25" codeSystemName="Confidentiality" displayName="Normal" />
  <value xsi:type="PQ" unit="mmol/L" value="6.39" />
</subject>

- <recordTarget typeCode="RCT" contextControlCode="OP">
  - <patient classCode="PAT">
    <id extension="" assigningAuthorityName="Hospital Number" />
    <statusCode code="active" />
    <effectiveTime value="" />
    <patientPerson classCode="PSN" determinerCode="INSTANCE">
      <id extension="" assigningAuthorityName="Identifier Person" />
      <name use="ABC">
        <given>"</given>
        <family>"</family>
      </name>
      <telecom nullFlavor="NA" />
      <administrativeGenderCode code="M" />
      <birthTime value="" />
    </patientPerson>
  </patient>
</recordTarget>

- <inFulfills typeCode="FLFS">
  - <placerOrder classCode="ACT" moodCode="RQO">
    <id extension="2.16.840.1.113883.3.568" assigningAuthorityName="OID SCG" />
  </placerOrder>
</inFulfillsOf>
</observationEvent>
</subject>
## Lab Results

### Physical Examination

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value 1</th>
<th>Value 2</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Pulse</td>
<td>40-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>20-25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>140/90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist Circum</td>
<td>g/m/l</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Complete Blood Count

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value 1</th>
<th>Value 2</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>14-18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCT</td>
<td>37-47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RBC Morphology</td>
<td>Normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC</td>
<td>4900-10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelet</td>
<td>150000-450000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutrophil</td>
<td>% 55-75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocyte</td>
<td>% 20-35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocyte</td>
<td>% 3-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basophil</td>
<td>% 0-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eosinophil</td>
<td>% 1-5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Blood Chemistry

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value 1</th>
<th>Value 2</th>
<th>LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>mg/dl 60-110</td>
<td>109.8</td>
<td></td>
</tr>
<tr>
<td>HbA1C</td>
<td>% 4.2-6</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Cholesterol</td>
<td>mg/dl &lt;200</td>
<td>246.7</td>
<td></td>
</tr>
<tr>
<td>Triglyceride</td>
<td>mg/dl &lt;150</td>
<td>146.0</td>
<td></td>
</tr>
<tr>
<td>HDL</td>
<td>cm 40-70</td>
<td>39.4</td>
<td></td>
</tr>
<tr>
<td>LDL</td>
<td>mg/dl &lt;130</td>
<td>183.3</td>
<td></td>
</tr>
<tr>
<td>Uric Acid</td>
<td>mg/dl 2-8</td>
<td>4.9</td>
<td></td>
</tr>
</tbody>
</table>

### Liver

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGOT (AST)</td>
<td></td>
<td>8.40</td>
</tr>
</tbody>
</table>
Thailand’s HL7 Certified Specialists

- **HL7 V3 Reference Information Model (RIM)**
  - Kavin Asavanant
  - Sireerat Srisiriratanakul

- **HL7 CDA**
  - Supachai Parchariyanon
  - Nawanan
  - Theera-Ampornpunt

Kyoto, Japan  May 14, 2009
Atlanta, GA   May 9, 2013
Durham, NC   Mar 25, 2010
St. Louis, MO Jul 19, 2012
# Certification Directory

### Search Certification Directory

**Certified User:**

**Country of Origin:** Thailand

**Certification Type:** All Certifications

**Certification Location:**

**Certified Between:**

Search Tips

- Try searching for just the last name, or any part of the name of the person you wish to find. The certification location input will also search on partial strings.
- You can also view a list of HL7 Organizational Members with CNC certified EHR Products.
- Learn more about Training and Certification.

Search

### Search Results

**1-1 of 4**

<table>
<thead>
<tr>
<th>Certified User</th>
<th>Country</th>
<th>Certification Type</th>
<th>Certification Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sirarat Sririratanakul</td>
<td>Thailand</td>
<td>Certified HL7 V3 RIM Specialists</td>
<td>Atlanta, GA</td>
<td>May 9, 2013</td>
</tr>
<tr>
<td>Nawanan Theera-Ampampun</td>
<td>Thailand</td>
<td>Certified HL7 CDA Specialists</td>
<td>St. Louis, MO</td>
<td>Jul 19, 2012</td>
</tr>
<tr>
<td>Supachai Pocharajphon</td>
<td>Thailand</td>
<td>Certified HL7 CDA Specialists</td>
<td>Durham, NC</td>
<td>Mar 25, 2010</td>
</tr>
<tr>
<td>Kavin Asavanant</td>
<td>Thailand</td>
<td>Certified HL7 V3 RIM Specialists</td>
<td>Kyoto, Japan</td>
<td>May 14, 2009</td>
</tr>
</tbody>
</table>

*Address information is only available for users certified after 2009 and where an address was supplied.*
Implementation of Thailand’s First Prototype for Exchanging of Laboratory Results Using HL7 Version 3 and LOINC

Saopial Chuchaiwara, MD, MBA; Antawan, MSc; Sireerat Srininiratnakul, BSc; Chanvivat Tongtaveechakit, BSc, MBA; Nawanin Thierra-Ampornsut, MD, PhD; Chulay Okeachareon, MD, PhD; Arit Ungkanont, MD

Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Abstract

The adoption of international standards in Thailand is limited, and the standardization of healthcare information exchange (HIE) implementations using these standards have been reported for improved patient-handling, quality of clinical results, and research outcomes. This system is designed for the exchange of clinical results between medical facilities and a central repository. The proposed implementation demonstrates a successful exchange of healthcare data. The developed system is scalable and can be replicated in settings with similar clinical needs.

Introduction

Thailand is a rapidly developing country, and it is essential to develop a standardized healthcare system for clinical decision support. The Mahidol University's School of Medicine (MUSOM) has partnered with the National Health Security Office (NHSO) in Thailand to develop a national health information exchange (HIE) system. This project aims to establish a secure, scalable, and interoperable framework for healthcare providers to exchange patient information.

Methods

1. We implemented a prototype using HL7 V3 and LOINC to exchange lab results data between Mahidol University’s Faculty of Medicine Ramathibodi Hospital and a clinic at SCG (Siam Cement Group).
2. The clinic, which provided medical care to the company’s staff, was staffed by physicians from the Faculty. The physician would place a label for the specimen, and the patient would come to the hospital for the specimen to be collected and analyzed. Lab results would be sent electronically to the clinic for follow-up visits.
3. Lab results were reported to the clinic using HL7 V3 Message and HL7 R2R as well as LOINC. The results would then be displayed in the clinic's system.
4. Lab results were successfully sent and received using the adopted standards.

Conclusion

This project demonstrated the feasibility of using international standards like HL7 V3 and LOINC to facilitate exchange of laboratory information. It serves as a critical first step toward interoperability for Thailand. Future efforts to demonstrate and report information exchange in other healthcare domains and in other settings in the country are encouraged to build the momentum toward a large-scale interoperable health information exchange (HIE).
Next Steps

Encourage adoption of HL7 CDA at Ramathibodi and in other hospitals
Q/A