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

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Certified HL7 CDA Specialist

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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

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THAILAND'S E-HEALTH: PRESENT & FUTURE

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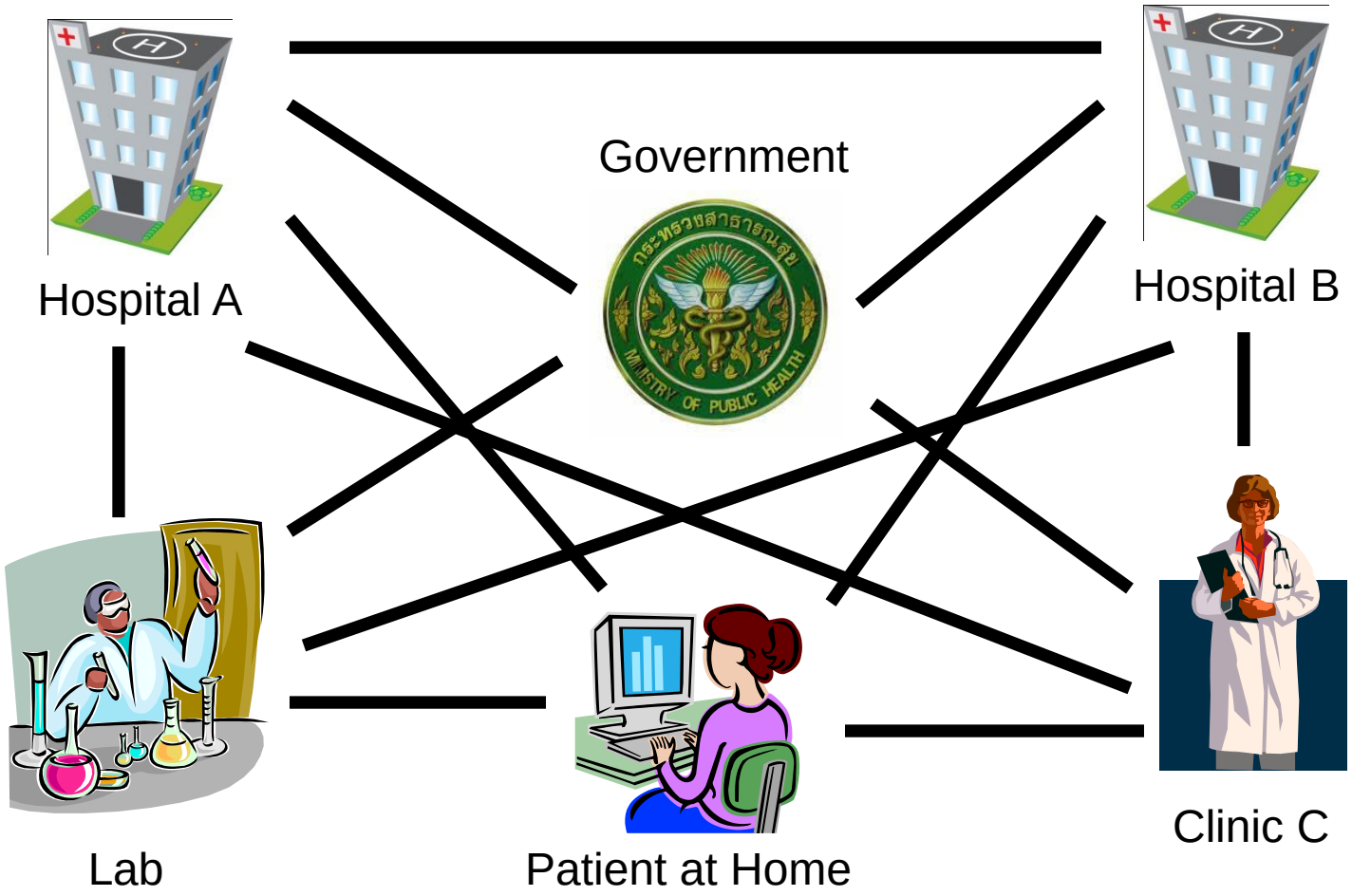
eHealth
Health Information Exchange (HIE)



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eHealth

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

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Health IT

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

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eHealth & Health IT

eHealth ≈ Health IT

Slide adapted from: Boonchai Kijsanayotin

eHealth Components
(WHO-ITU Model)

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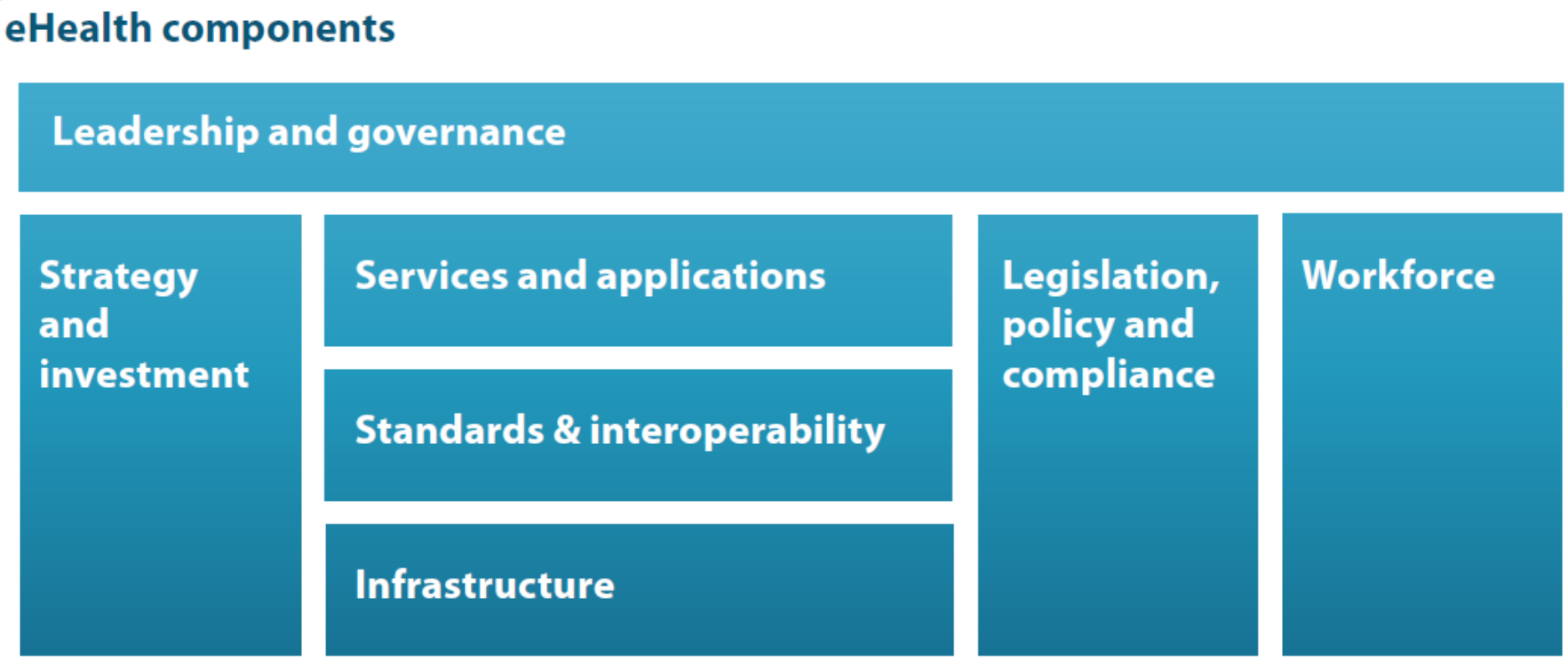
- All components are essential
- All components should be balanced



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Thailand: Unbalanced Development

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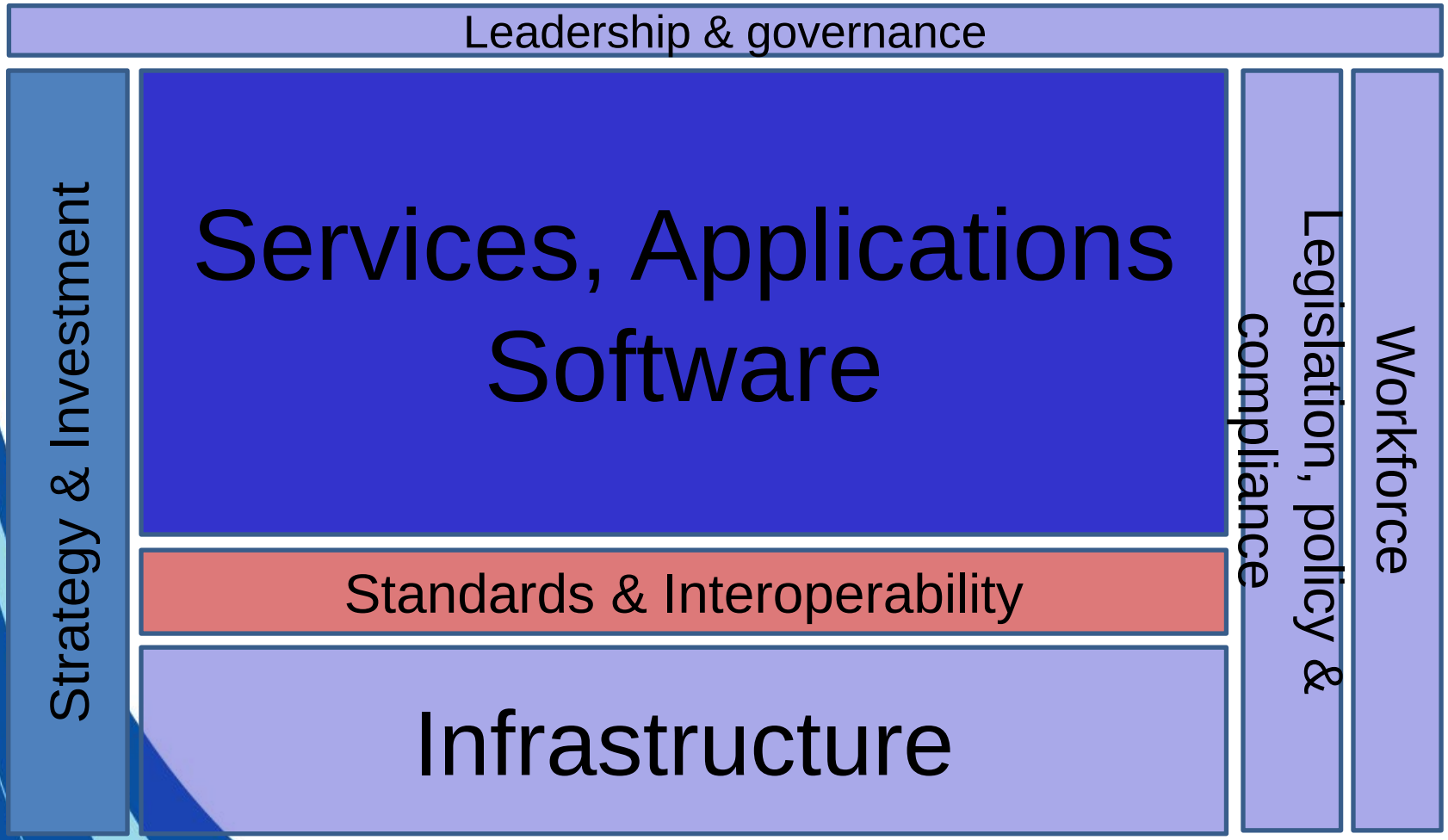

Slide adapted from: Boonchai Kijsanayotin

eHealth Development Model

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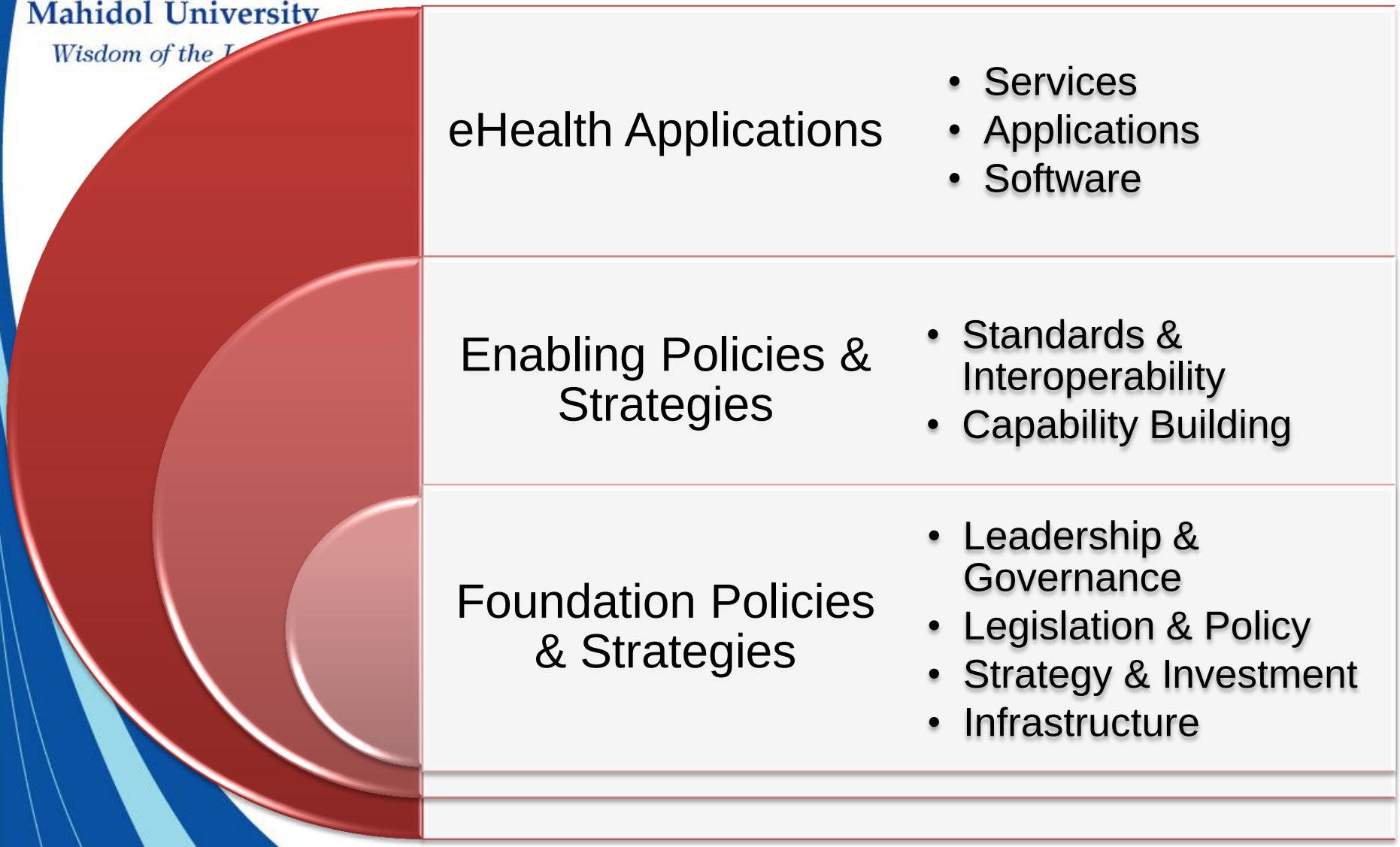

Slide adapted from: Boonchai Kijsanayotin

Thailand's eHealth Development

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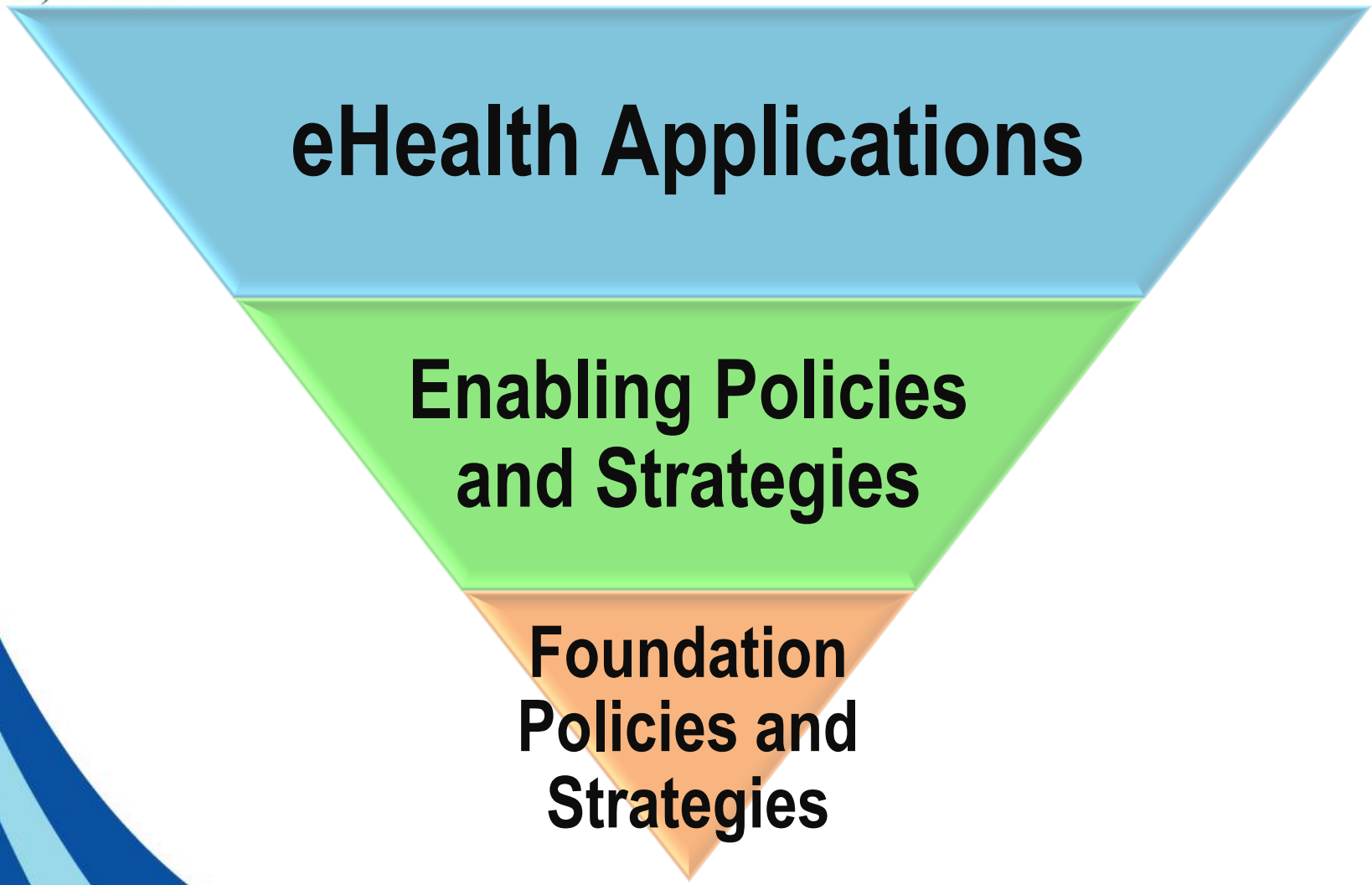

Slide adapted from: Boonchai Kijsanayotin

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STANDARDS FOR E-HEALTH

Standards Are Everywhere

Nutrition Facts

Serving Size: 2 oz. (60 ml)
Servings Per Container 1

Amount Per Serving	
Calories 68	Calories from Fat 0
	% Daily Value*
Total Fat <1g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 30mg	1.5%
Total Carbohydrate 17g	4%
Dietary Fiber 0g	0%
Sugars 7g *(from natural fruit juices)*	
Protein 1g	2%

Vitamin A 45 IU <1%	Vitamin C 2mg <1%
Vitamin B-12 6mcg 100%	Calcium 0%
Iron 0%	Niacin 20mg 100%

*Percent Daily Values are based on a 2,000 calorie diet.

Ingredients: Purified Water, Organic Agave, Proprietary blend of the following concentrates: Cranberry, Pomegranate, Passion Fruit, Aronia Berry, Lime, Orange, Ginger, Rose, Ylang Ylang, Neroli, Geranium, Frankincense, Tulsi, Turmeric, Peppermint, Nutmeg and Astaxanthin, Guarana Powder, Rosemary Antioxidant, Niacin, Vitamin B-12, Ionic Sea Trace Minerals.

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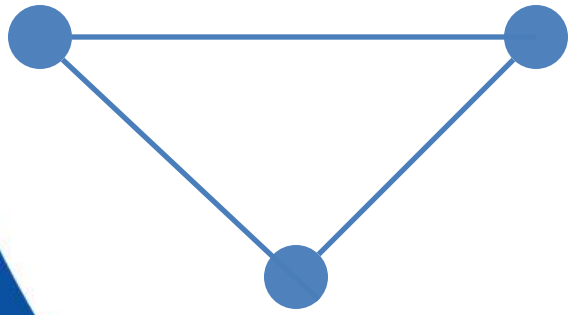
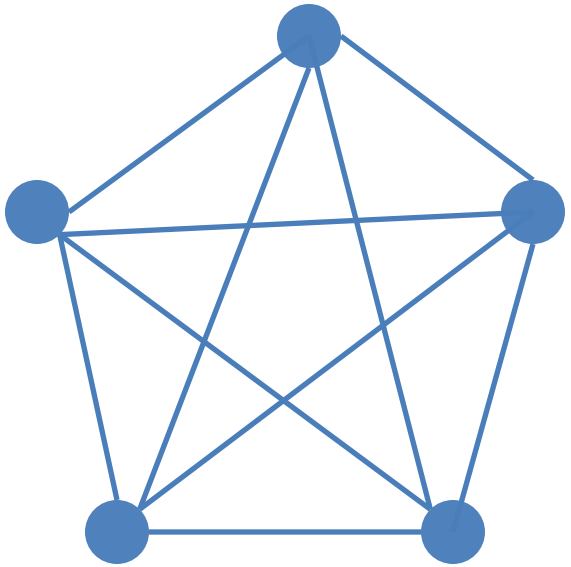
Standards: Why?

- The Large N Problem

N = 2, Interface = 1

N = 3, Interface = 3





N = 5, Interface = 10

Interfaces = N(N-1)/2

N = 100, Interface = 4,950

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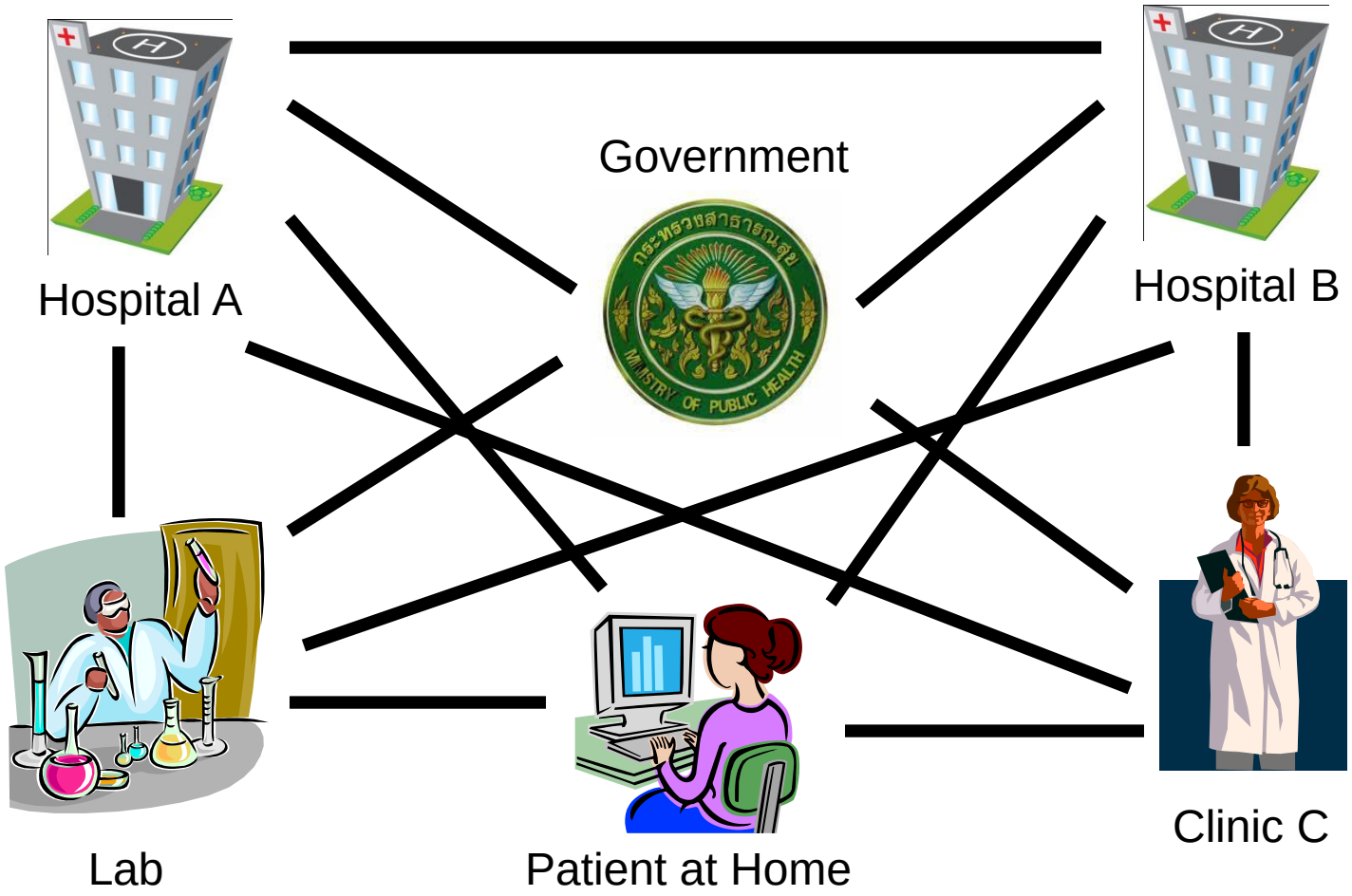
Health Information Exchange (HIE)



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Why Health Information Standards?

Objectives

- Interoperability
- Inter-operable systems

Ultimate Goals

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

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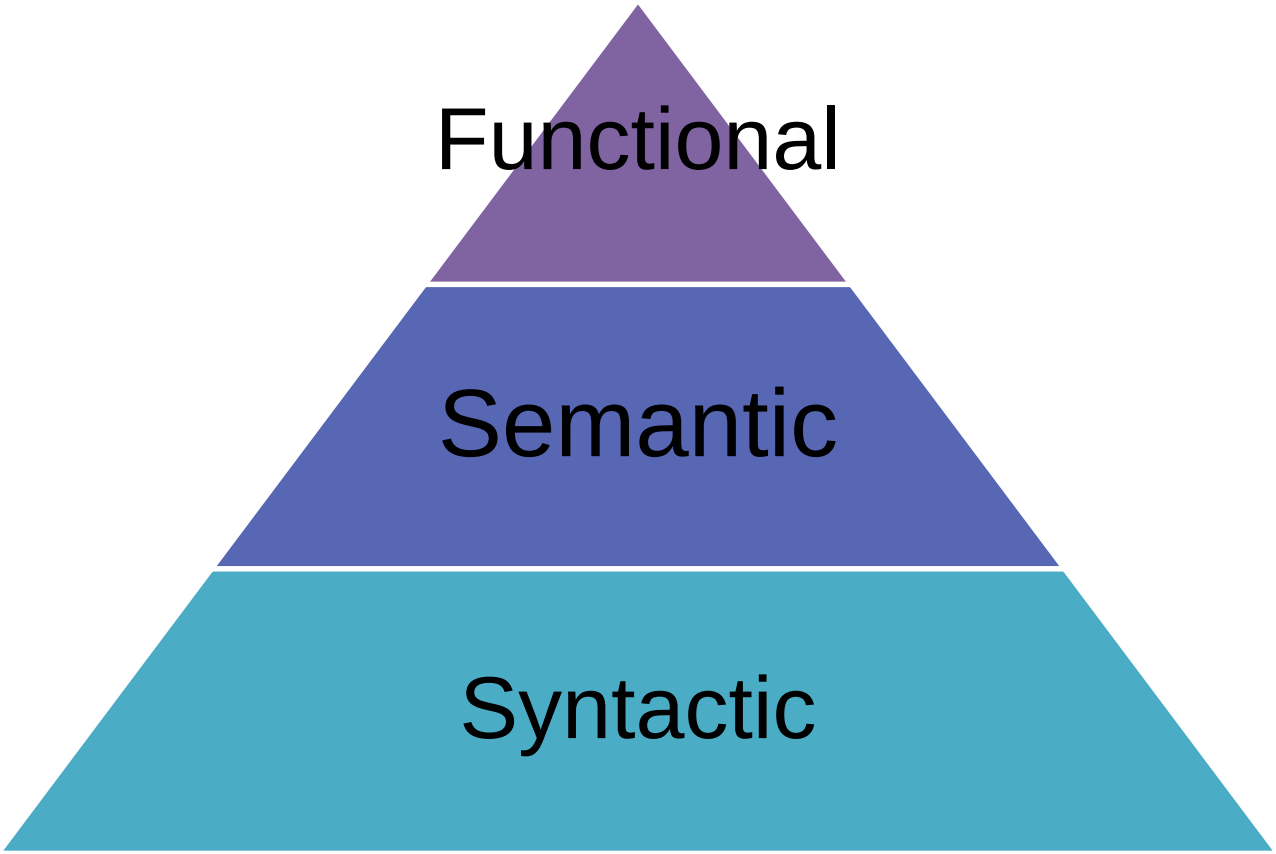
Levels of Interoperability



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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

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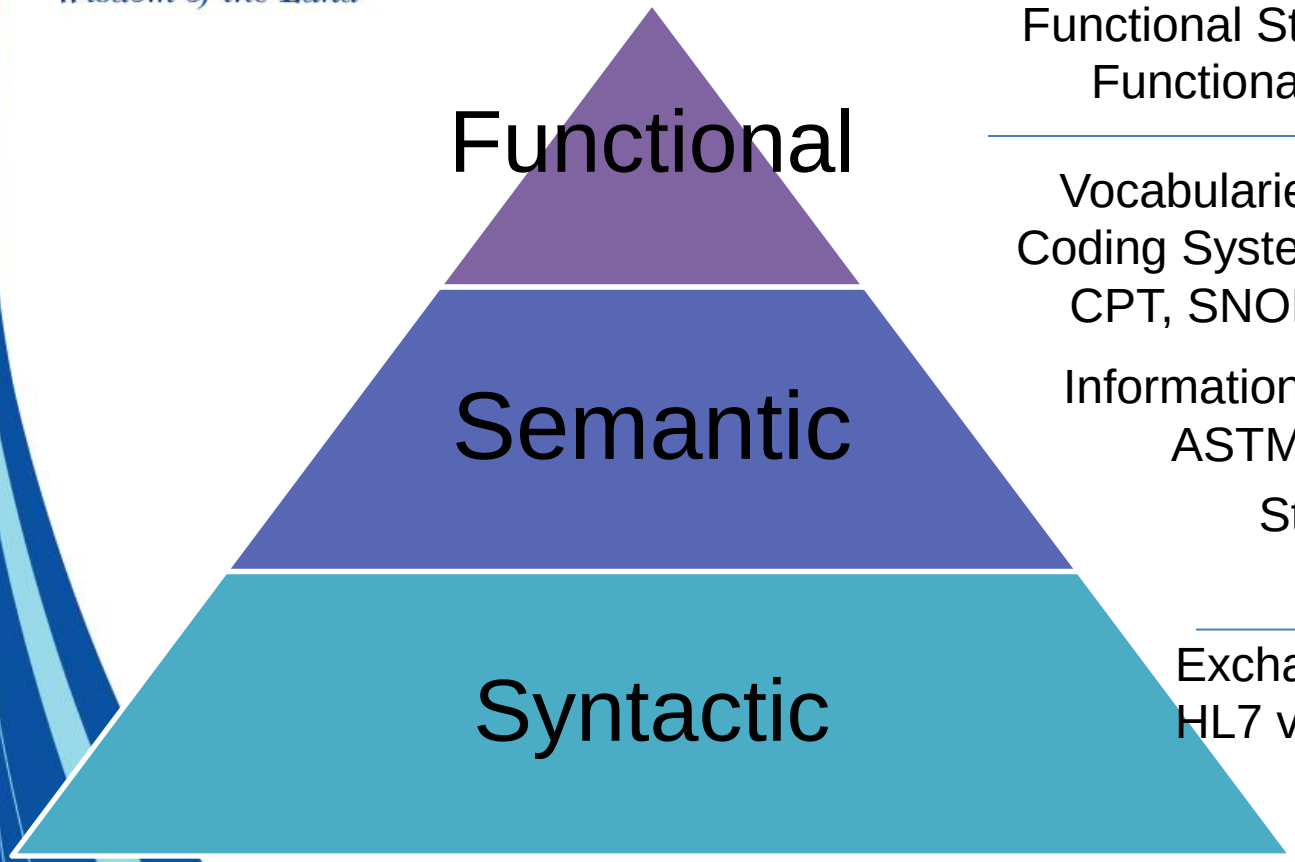
How Standards Support Interoperability



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

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

Technical Standards (TCP/IP, encryption, security)

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

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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)

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Exchange Standards

Messages	Clinical Documents
• Human Unreadable • Machine Processable	• Human Readable • (Ideally) Machine Processable

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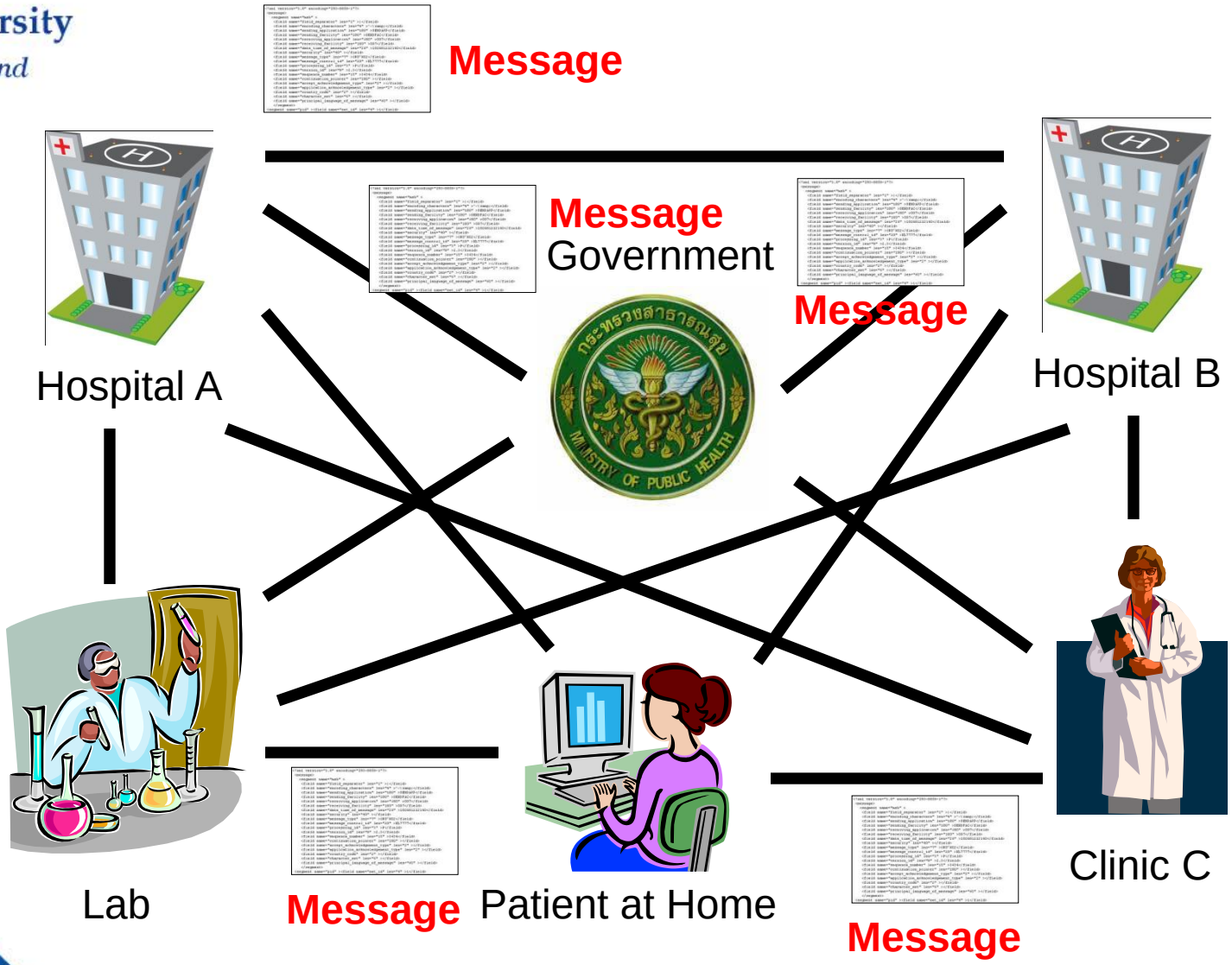
Message Exchange



Clinical Document Exchange

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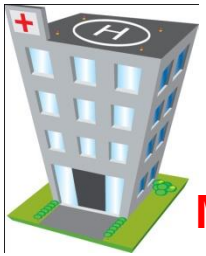
Message containing Referral Letter

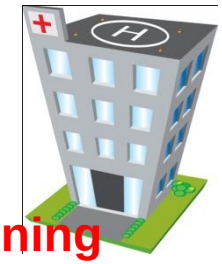


Hospital A

Message containing Claims Request

Government

Message containing Communicable Disease Report



Hospital B

Lab

Patient at Home

Clinic C

Message containing Lab Report

Message containing Patient Visit Summary

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HL7 & HL7 CDA STANDARDS

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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.

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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)

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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…

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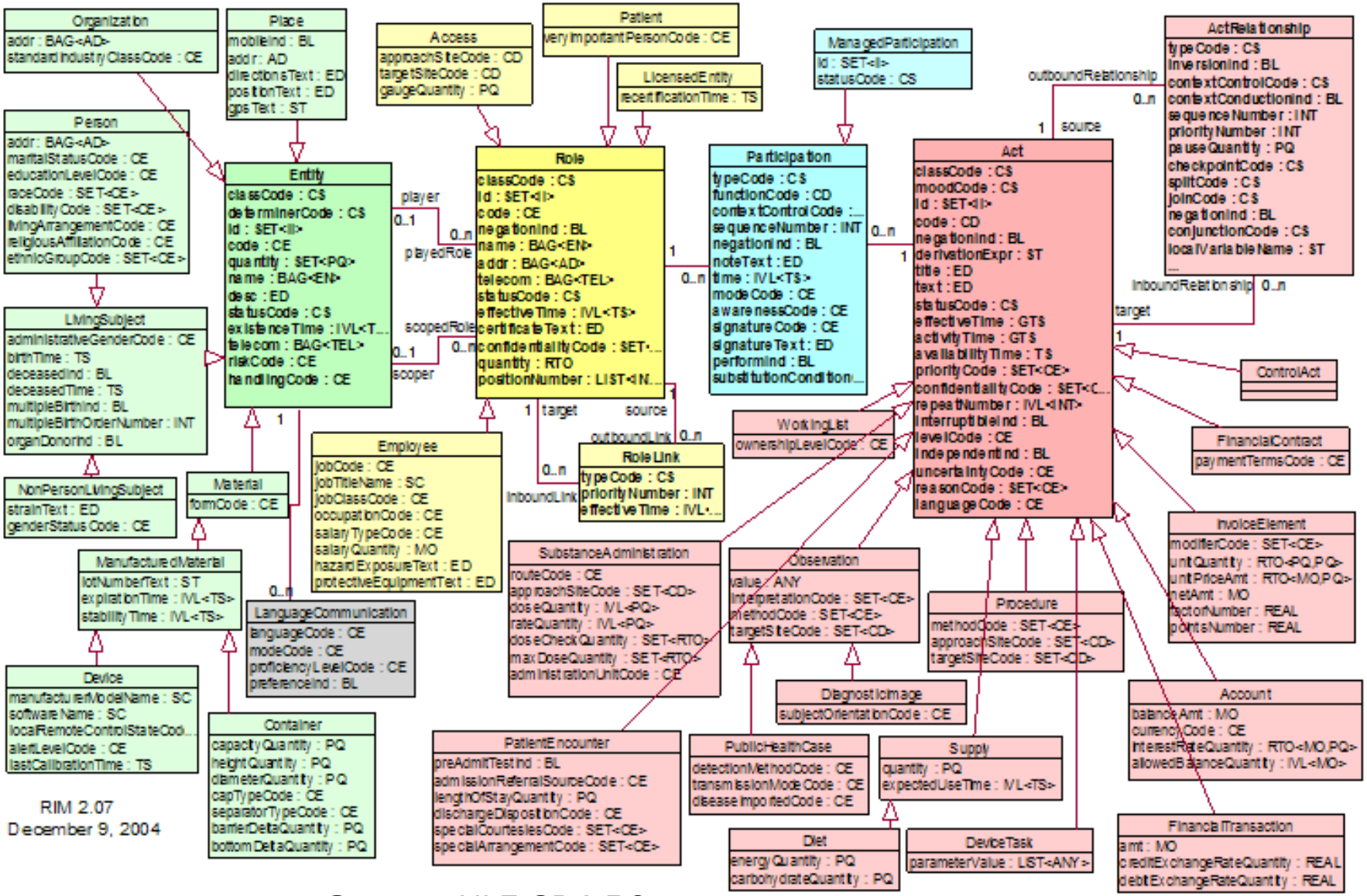
Sample HL7 v.3 Message (Patient Registration)

```
<?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>
```

Message source adapted from Ramathibodi HL7 Project by Supachai Parchariyanon, Kavin Asavanant, Sireerat Srisiriratanakul & Chaiwiwat Tongtaweechaikit

HL7 Reference Information Model (RIM)



Source: HL7 CDA R2

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HL7 V3 Messaging

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

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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**

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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!!

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A Clinical Document (3)

- A CDA document is a defined & complete information object that can include
  - Text
  - Images
  - Sounds
  - Other multimedia content

Source: HL7 CDA R2

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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

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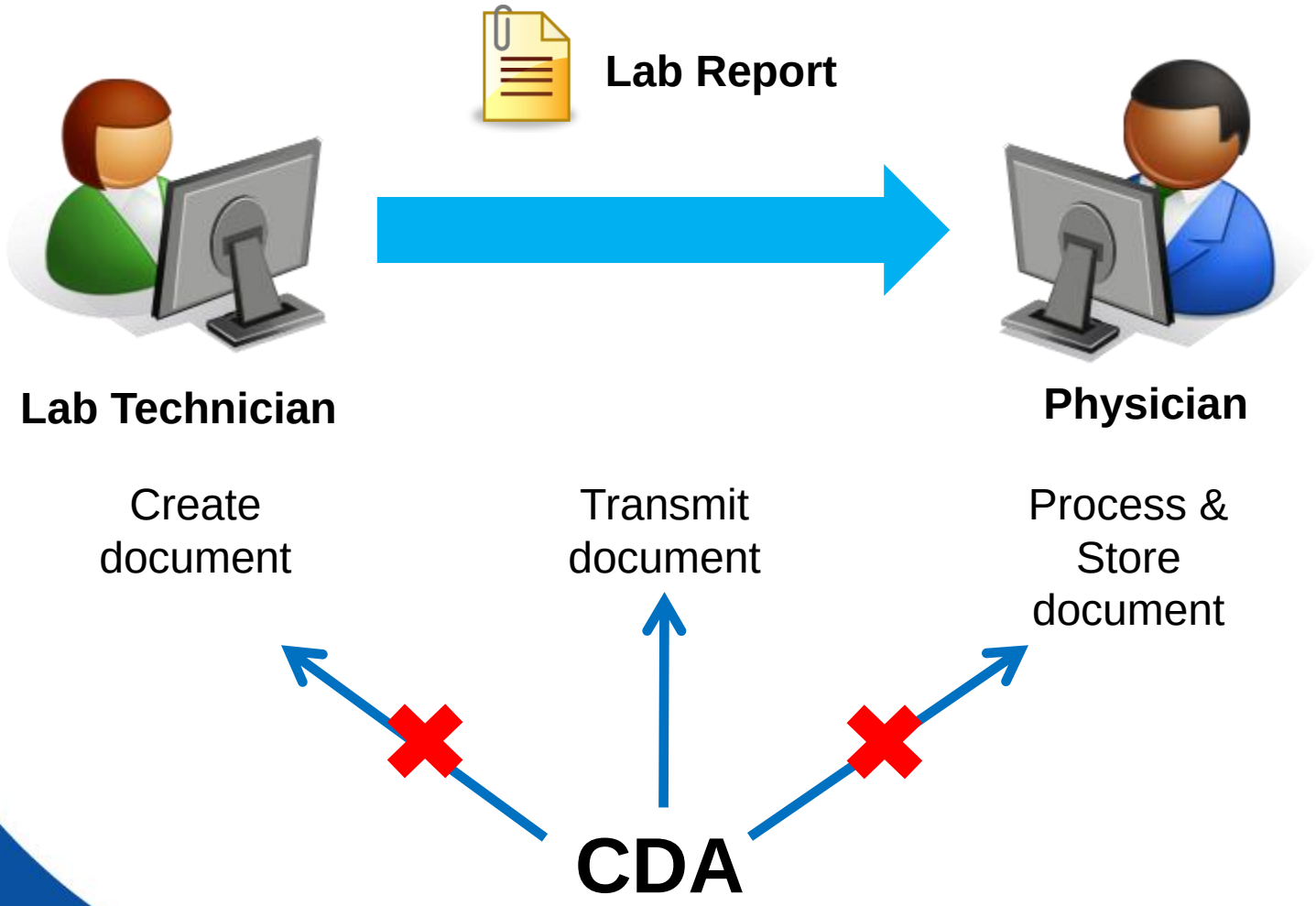
Scope of CDA



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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

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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

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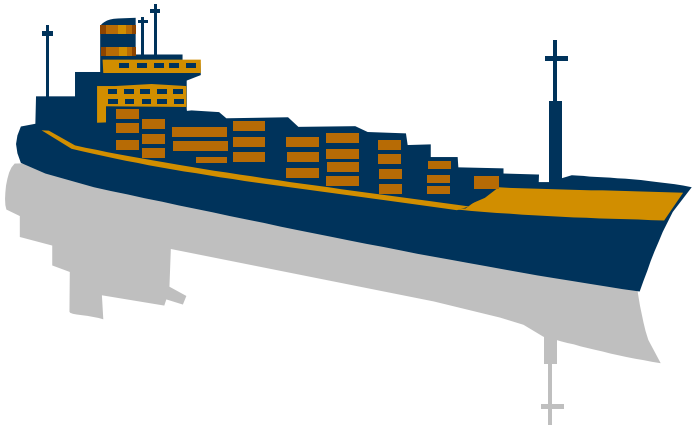
CDA & Message Exchange

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

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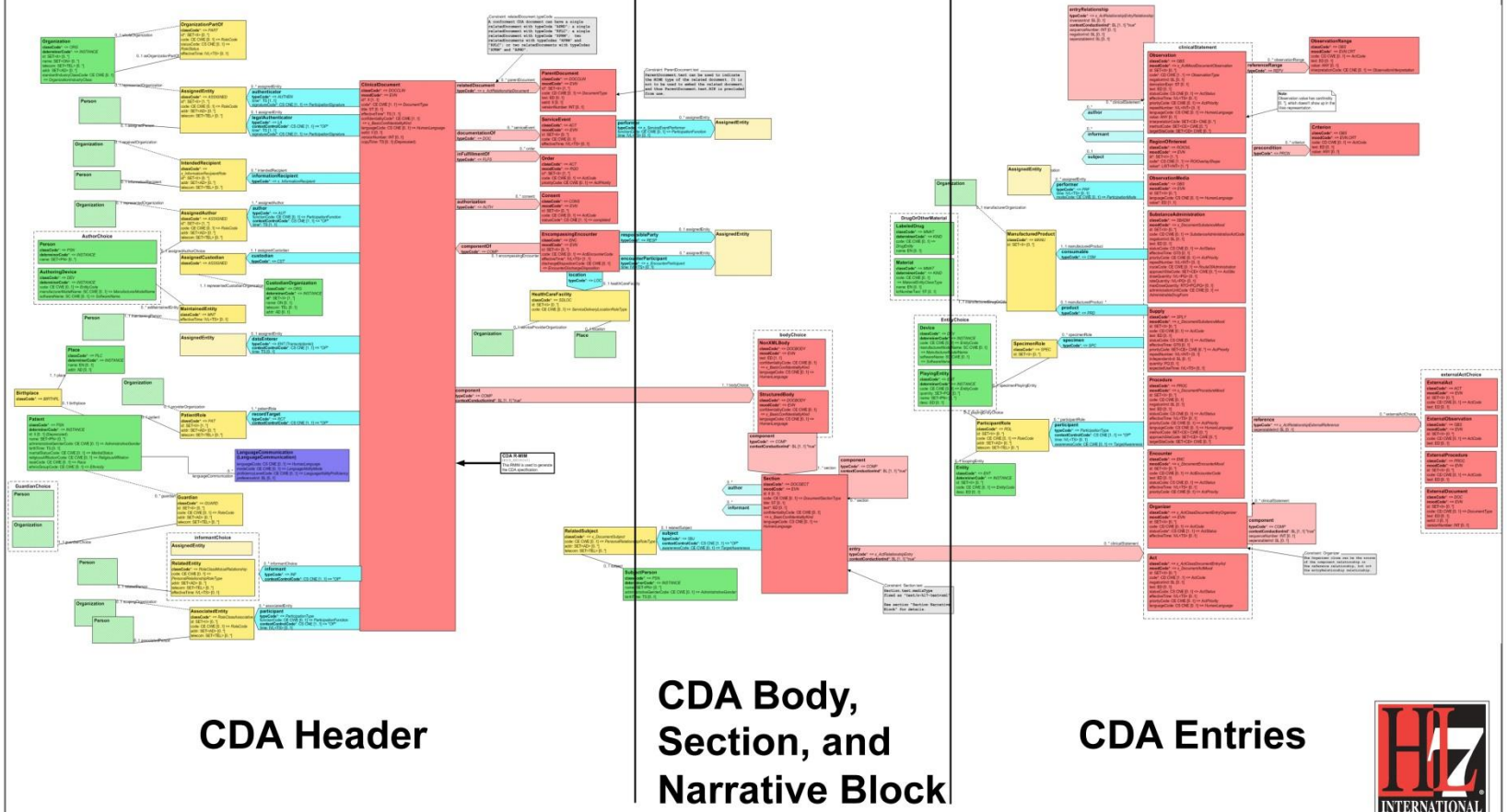
Components of CDA Document

- 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

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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>
```

Human Readable Part

Machine Processable Parts

Source: HL7 CDA R2

Rendering CDA Documents (1)

```
<!--
**********************************************************
  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>
                                                </content> 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
**********************************************************
-->
                        <component>
                                <section>
```

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

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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

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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

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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)

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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

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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)

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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**)

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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

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RAMATHIBODI EXPERIENCE

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Overall

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

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2010

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

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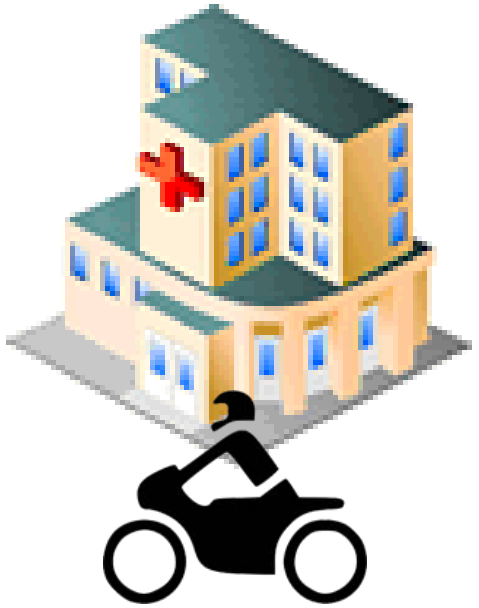
RAMA-SCG: Existing Process

SCG
SIAM CEMENT GROUP



Exchange Interoperability

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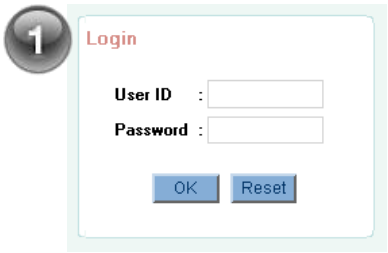
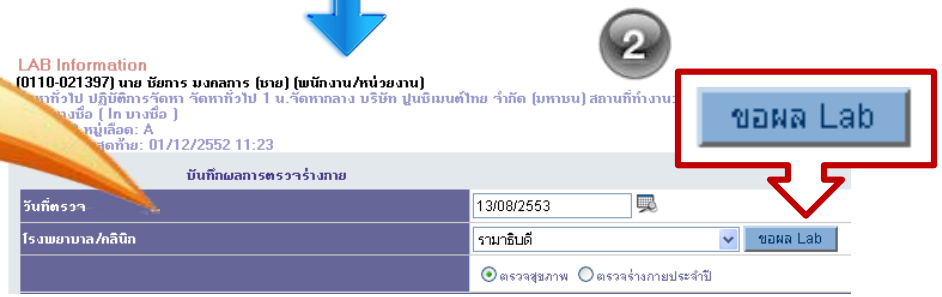
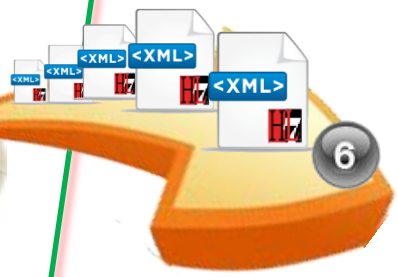
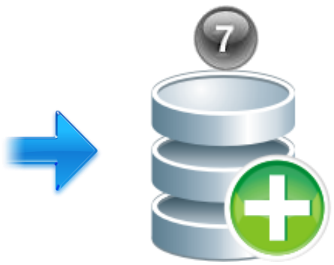
SCG
SIAM CEMENT GROUP









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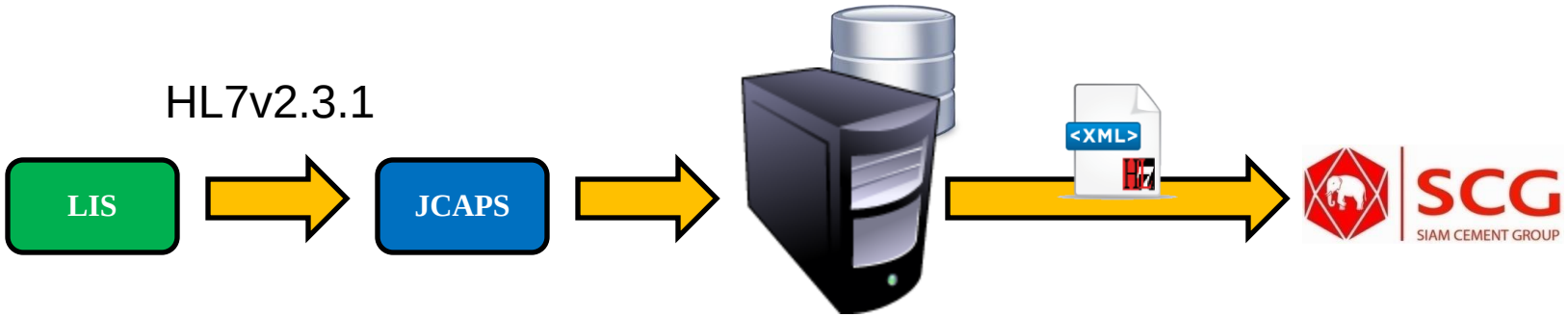
Message Exchange



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HL7 V3 Message

```
<subject typeCode="SUBJ" contextConductionInd="false">
- <observationEvent classCode="OBS" moodCode="EVN">
    <id extension="701" assigningAuthorityName="A unique identifier of Test" />
    <id extension="เคมีคลินิก" assigningAuthorityName="Ramathibodi Lab Name" />
    <id extension="384" assigningAuthorityName="SID" />
  - <code code="14647-2" codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"
      displayName="Cholesterol">
      <originalText>SCG:Cholesterol|RAMA:CHOL|Lab:เคมีคลินิก
        |value:6.39|unit:mmol/L</originalText>
    </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" />
  - <recordTarget typeCode="RCT" contextControlCode="OP">
    - <patient classCode="PAT">
        <id extension="[redacted]" assigningAuthorityName="Hospital Number" />
        <statusCode code="active" />
        <effectiveTime value="[redacted]" />
      - <patientPerson classCode="PSN" determinerCode="INSTANCE">
          <id extension="[redacted]" assigningAuthorityName="Identifier Person" />
        - <name use="ABC">
            <given>[redacted]</given>
            <family>[redacted]</family>
          </name>
          <telecom nullFlavor="NA" />
          <administrativeGenderCode code="M" />
          <birthTime value="[redacted]" />
          <addr />
        </patientPerson>
      </patient>
    </recordTarget>
  - <inFulfillmentOf typeCode="FLFS">
    - <placerOrder classCode="ACT" moodCode="RQO">
        <id extension="2.16.840.1.113883.3.568" assigningAuthorityName="OID SCG" />
      </placerOrder>
    </inFulfillmentOf>
  </observationEvent>
</subject>
```

Lab Results

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LAB Information

[redacted] (พนักงาน/หน่วยงาน)

[redacted] สถานที่ทำงาน:

[redacted] อายุ [redacted] ปี หมู่เลือด: A

วันที่ตรวจครั้งสุดท้าย: [redacted]

จำนวนครั้ง : เปรียบเทียบ

บันทึกผลการตรวจร่างกาย

วันที่ตรวจ	[redacted]
โรงพยาบาล/คลินิก	รามาธิบดี
	ตรวจสุขภาพ / ตรวจร่างกายประจำปี

Physical Examnation	หน่วยวัด	ค่าปกติ	ผล LAB
Weight	kg		0
Height	cm		0
Pulse		40-100	-
BMI	kg/m2	20-25	-
BP		140/90	-/-
Waist Circum		gm/dl	-
Complete Blood Count			
HB		14-18	-
HCT	vol%	37-47	-
RBC Morphology		Normal	-
WBC	ul	4900-10000	-
Platelet	ul	150000-450000	-
Neutrophil	%	55-75	-
Lymphocyte	%	20-35	-
Monocyte	%	3-10	-
Basophil	%	0-2	-
Eosinophil	%	1-5	-
Blood Chemistry			
Sugar	mg/dl	60-110	109.8
HbA1C	%	4.2-6	6.4
Cholesterol	mg/dl	<200	246.7
Triglyceride	mg/dl	<150	146.0
HDL	cm	40-70	39.4
LDL	mg/dl	<130	183.3
Uric Acid	mg/dl	2-8	4.9
Liver			
SGOT (AST)	u/l	8-40	-

Sugar
HbA1C
Cholesterol
Triglyceride
HDL
LDL
Uric Acid

Thailand's HL7 Certified Specialists

- HL7 V3 Reference Information Model (RIM)
  - Kavin Asavanant — Kyoto, Japan — May 14, 2009
  - Sireerat Srisiriratanakul — Atlanta, GA — May 9, 2013
- HL7 CDA
  - Supachai Parchariyanon — Durham, NC — Mar 25, 2010
  - Nawanan Theera-Ampornpunt — St. Louis, MO — Jul 19, 2012

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SEARCH RESULTS

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Certified User	Country *	Certification Type	Certification Location	Date
Sireerat Srisiriratanakul	Thailand	Certified HL7 V3 RIM Specialists	Atlanta, GA	May 9, 2013
Nawanan Theera-Ampornpunt	Thailand	Certified HL7 CDA Specialists	St. Louis, MO	Jul 19, 2012
Supachai Parchariyanon	Thailand	Certified HL7 CDA Specialists	Durham, NC	Mar 25, 2010
Kavin Asavanant	Thailand	Certified HL7 V3 RIM Specialists	Kyoto, Japan	May 14, 2009

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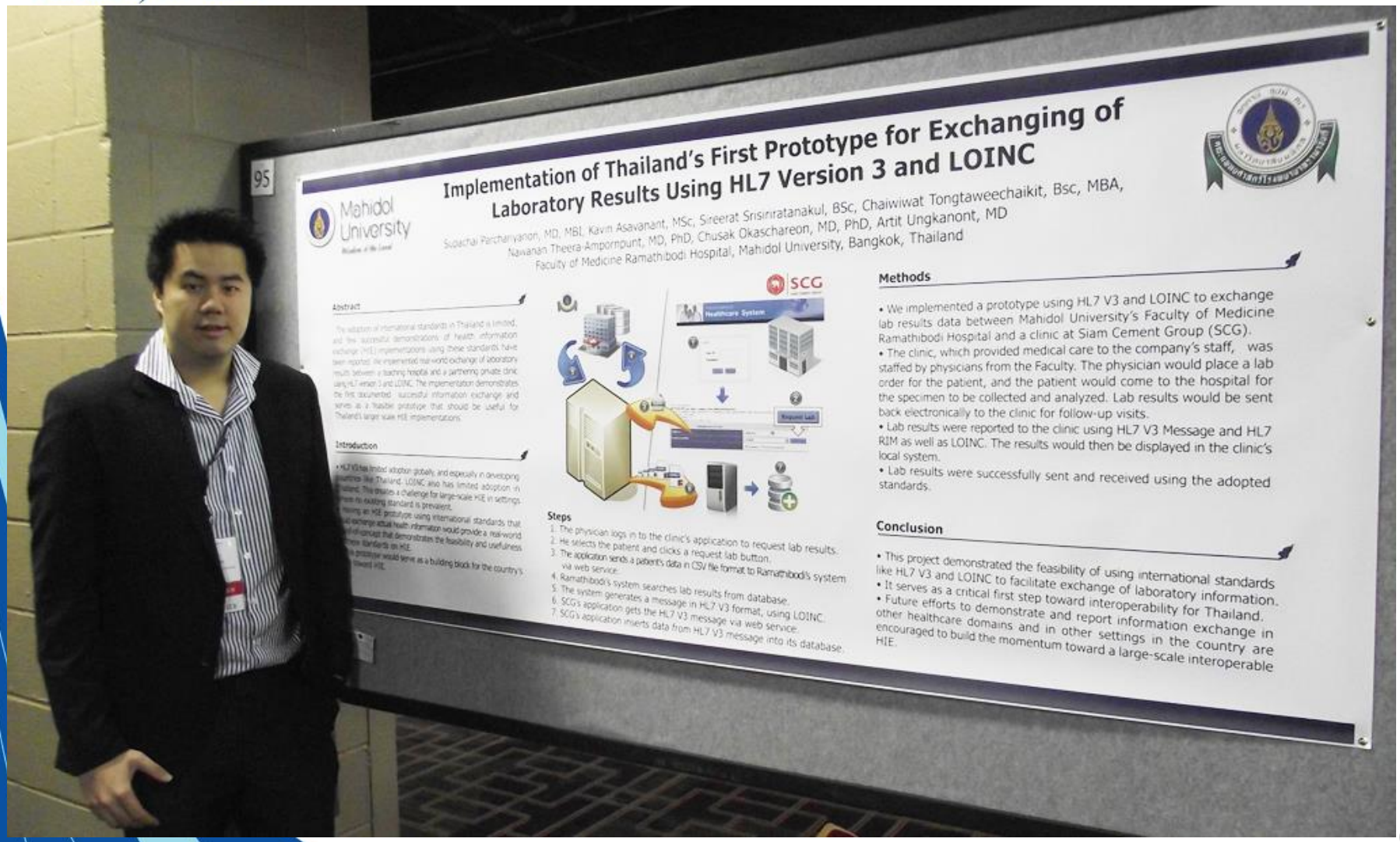
** Address information is only available for users certified after 2009 and where an address was supplied.*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Implementation of Thailand's First Prototype for Exchanging of Laboratory Results Using HL7 Version 3 and LOINC
Mahidol University
Subachai Parcharivanon, MD, MBI, Kavin Asavanant, MSc, Sireerat Srisiriratanakul, BSc, Chaiwiwat Tongtaweechaikit, Bsc, MBA,
Nawanan Theera-Ampornpunt, MD, PhD, Chusak Okascharoen, MD, PhD, Artit Ungkanont, MD
Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
Abstract
Introduction
SCG
Steps
1. The physician logs in to the clinic's application to request lab results.
2. He selects the patient and clicks a request lab button.
3. The application sends a patient's data in CSV file format to Ramathibodi's system via web service.
4. Ramathibodi's system searches lab results from database.
5. The system generates a message in HL7 V3 format, using LOINC.
6. SCG's application gets the HL7 V3 message via web service.
7. SCG's application inserts data from HL7 V3 message into its database.
Methods
• 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 Siam Cement Group (SCG).
• The clinic, which provided medical care to the company's staff, was staffed by physicians from the Faculty. The physician would place a lab order for the patient, and the patient would come to the hospital for the specimen to be collected and analyzed. Lab results would be sent back electronically to the clinic for follow-up visits.
• Lab results were reported to the clinic using HL7 V3 Message and HL7 RIM as well as LOINC. The results would then be displayed in the clinic's local system.
• 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 HIE.

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Next Steps

Encourage adoption of HL7 CDA at Ramathibodi and in other hospitals

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Q/A