

*ICDR Conference: New Federal Applications of the ICF*

# LOINC®

The Master Catalog of Clinical Observations

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# Overview

- Origins of LOINC
  - Intro to LOINC
  - LOINC and ICF
-

# ICF Aims

- To provide a scientific basis for consequences of health conditions
- To establish a common language to improve communications
- To permit comparison of data across:
  - countries
  - health care disciplines
  - services
  - time
- To provide a systematic coding scheme for health information systems

# LOINC/ICF Modeling

## *Timeline*

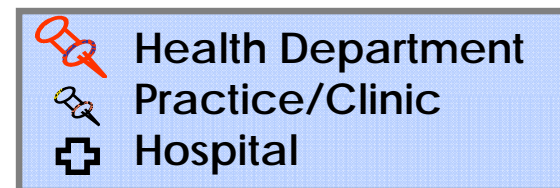
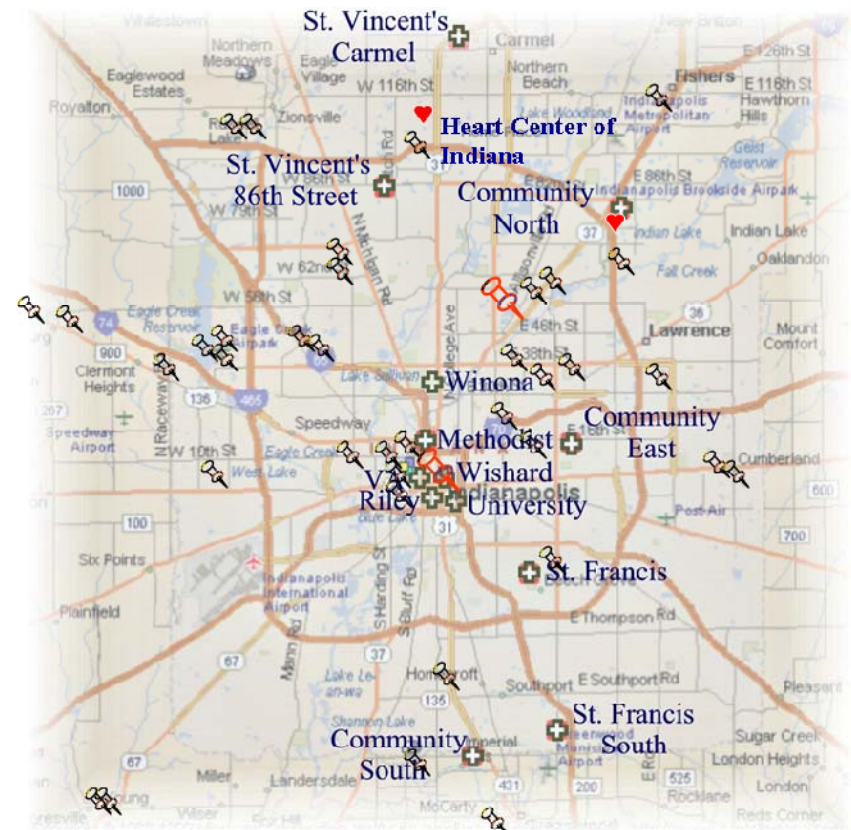
- Jan 2005 – ICF/LOINC first discussed
  - Dec 2006 – 2-day workgroup meeting
  - Dec 2006 – Preparation of exemplar LOINC modeling for each ICF component
  - Jan 2007 – Presentation, discussion, refinement of draft at Clinical LOINC Committee Meeting
  - July 2007 – ICF Conference
-

# Origins of LOINC

The Lingua Franca of Clinical  
Observation Exchange

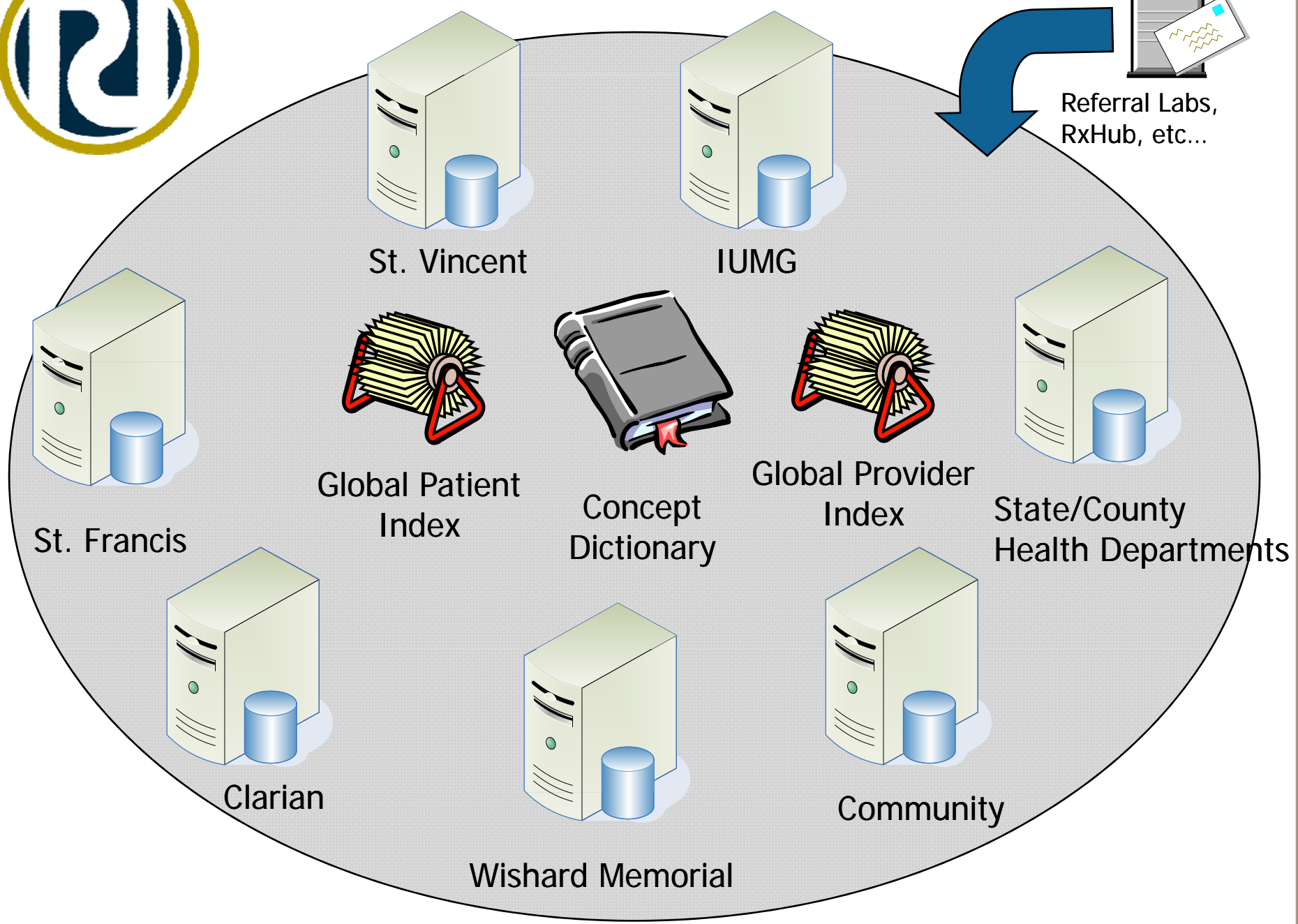
# Introduction

- Regenstrief's 30-year history
- The Indiana Network for Patient Care
  - A working Health Information Exchange for 10 years
  - 100 source systems
  - 1 billion discrete results
- Local systems have idiosyncratic ways of identifying similar concepts
- Controlled terminologies provide the *lingua franca*





# Indiana Network for Patient Care



# From whence comes LOINC?

- LOINC®
  - Logical Observation Identifiers Names and Codes
  - A universal code system for laboratory and other clinical observations
  - The **lingua franca** of information exchange for clinical observations

# LOINC Purpose

To facilitate the exchange and pooling of results for clinical care, outcomes management, and research

- Specifically, to provide a universal ID for the OBX-3 field in HL7 ORU messages
- LOINC codes “questions”, not answers
  - Orders/Panels (OBR-4)
  - Questions (OBX-3)
  - **NOT** Values (OBX-5)
    - Numbers, organisms (*E. coli*)

# LOINC's General Role

- If an observation is a question, and the observation value an answer:
  - LOINC provides codes for the *questions* {*OBR-4, OBX-3*}
  - Other systems (eg SNOMED) provide codes for the *answers*

*What is my patient's hemoglobin level?*

718-7:Hemoglobin:MCnc:Pt:Bld:Qn

*How fast does my patient usually walk?*

41959-8:Walking speed:Vel:1W^mean:^Patient:Qn:Calculated



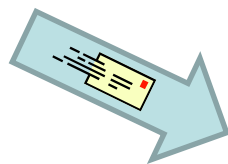
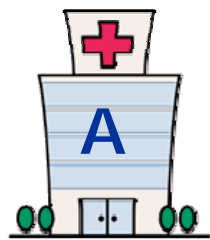
# HL7 Version 2.X ORU

- HL7 is a multi-faceted standards organization
- HL7 version 2.x Observation reporting message is our focus
  - ASCII Text
  - Messages composed of segments, which is like a data base record
- Used world wide to deliver clinical observations from the source system to systems that need the data

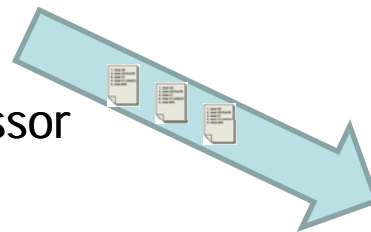
# Indiana Network for Patient Care

## HL7 v.2.X Message

```
MSH|^~\&|HOSPITAL_A|SAMPLE_HOSPITAL_A|||$YearMonthDay|||  
PID|||$patientId$||$patientName$|||  
PV1|||$$attendingDoctor$||$consultingDoctor$|||  
OBR|1||44249-1^PHQ-9 Quick Depression Assessment Pnl^LN||$requestDate|||  
OBX|1|ST|44250-9^Little interest or pleasure in doing  
things:Find:Pt:^Patient:Ord:Reported.PHQ-9^LN|1|3^More than half the days^LN|||  
OBX|2|ST|44255-8^Feeling down, depressed, or hopeless^LN|1|2^Several days|||  
...  
OBX|10|ST|44261-6^PHQ-9 Total Score^LN|1|11|||
```



Message Processor



Institutional Repository

# Brief Digression About Data Models...

# Flat Data Model

Pat ID	Name	ObsDate	Anemic	HBP	# units	ByPass	Chol
1234-5	Doe Jane	12May07	Yes	Yes	3	80	180
9999-3	Jones Ted	1Aug07	No	No	2	90	230
8888-3	Doe Sam	4June07	No	Yes	0	80	205

One record per patient

# E-A-V or “Stacked” Data Model

Pt ID	Date	ObsCode	Observation ID	Value	Units	NormRan	Place	Observer Responsible
Doe J	12-May-07	1234-5	Hemoglobin	13	mg/dl	12.5-15	St Francis	Dr Smith
Doe J	13-May-07	1234-5	Hemoglobin	11.5	mg/dl	12.5-15	St Francis	Dr Smith
Doe J	12-May-07	1235-6	Dias BP	95	mm/Hg	80-140	St Francis	Dr Smith
Doe J	13-May-07	1235-6	Dias BP	110	mm/Hg	80-140	St Francis	Dr Smith
Doe J	13-May-07	1236-7	Time on bypass	80	min		St Francis	Dr Sleepwell
Doe J	13-May-07	1237-8	Serial # of blood unit	351			St Francis	Dr Bloodbank

One record per observation

# Back to LOINC®...

Naming Conventions for  
Clinical Observations

# LOINC Background

- Organized by Regenstrief Institute in 1994
  - Development housed at Regenstrief
    - Support from Regenstrief, NLM, CDC, VA
  - Two LOINC Committees
    - Laboratory LOINC
      - Tests/Measurements done on specimens
    - Clinical LOINC
      - Tests/Measurements done on patients
  - LOINC and RELMA are available **freely**
    - Unrestrictive license
  - LOINC development is a highly ‘open source’ model
    - Much work is done by volunteers
    - Encourages end-user suggestions
-

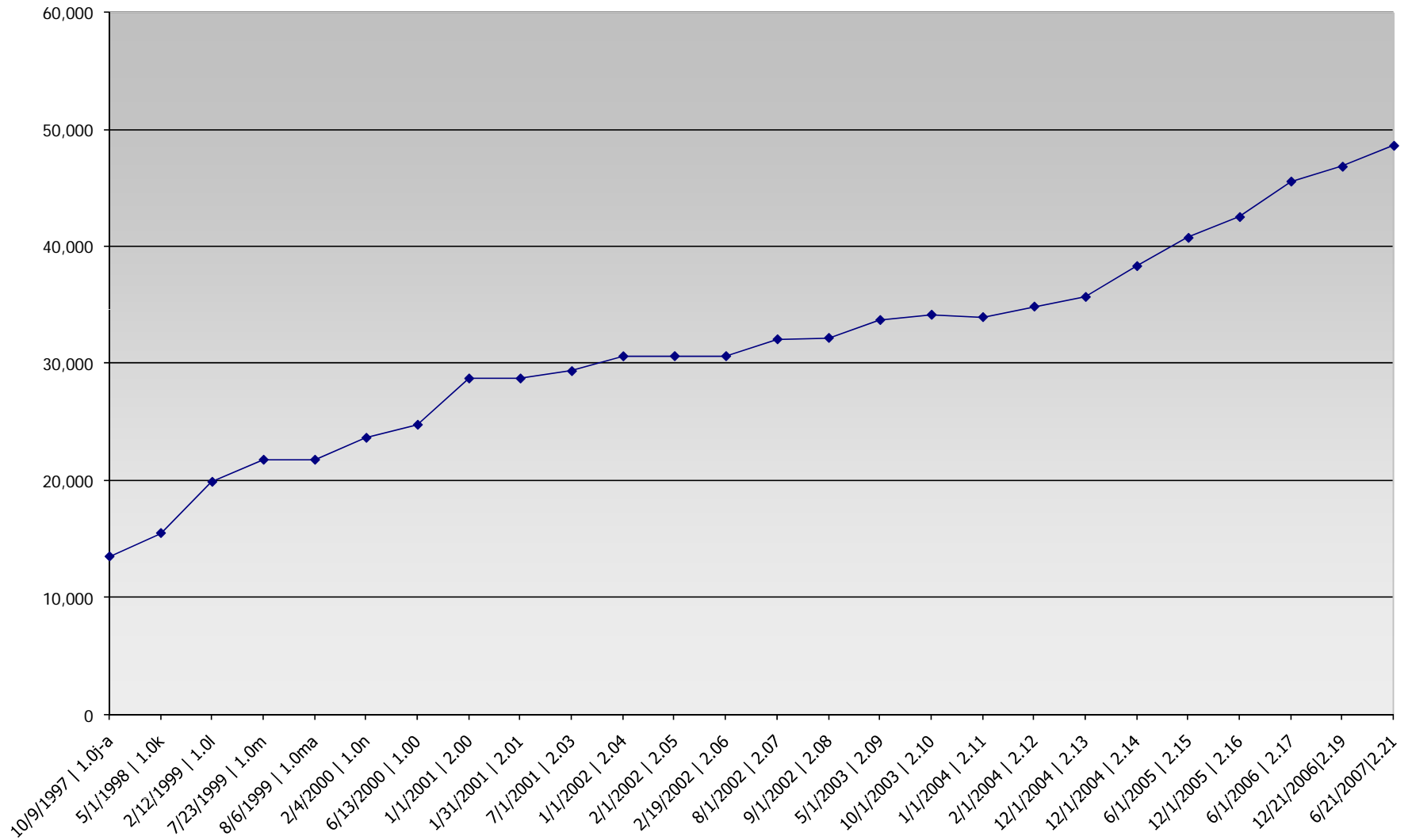
# Laboratory LOINC

- Chemistry
  - Urinalysis
  - Toxicology
  - Hematology
  - Microbiology
  - Antibiotic Susceptibilities
  - Immunology/Serology
  - Molecular Genetics
  - Cell Counts
  - Allergy Testing
  - Blood Bank
  - Cell Markers
  - Skin Tests
  - Coagulation
  - Cytology
  - HLA Antigens
  - Surgical Pathology
-

# Clinical LOINC

- Vital signs
  - Hemodynamic Measurements
  - Fluid Intake/Output
  - Body Measurements
  - Emergency Department
  - Respiratory Therapy
  - Document Sections
  - Patient Assessment Instruments
  - Ophthalmology Measurements
  - Radiology Reports
  - EKG
  - Cardiac Ultrasound
  - Obstetrical Ultrasound
  - Discharge Summary
  - History and Physical
  - Pathology Findings
  - Colonoscopy/Endoscopy
  - Clinical Documents
  - Tumor Registry
-

# LOINC Codes Over Time By Release



# LOINC Adoption

- Public and private sector
  - CHI recommendations, HIPAA, HL7, eLINC<sup>s</sup>, CDSIC
  - Care institutions, referral laboratories
- US and internationally
  - Many countries
  - Translations: Simplified Chinese, Spanish, German, French

LOINC Users' Guide translated to Simplified Chinese—June 1, 2005

观测指标标识符逻辑命名与编码系统 (LOINC<sup>®</sup>)  
Logical Observation Identifier Names and Codes (LOINC<sup>®</sup>)  
用户指南  
Users' Guide

编写: Clem McDonald, M.D., Stan Huff, M.D., Daniel J. Vreeman, PT, DPT, Kathy Mercer

2005年6月1日更新

您如果有任何问题、意见及建议, 敬请告知, 联系地址如下:

LOINC  
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Indianapolis, IN 46202

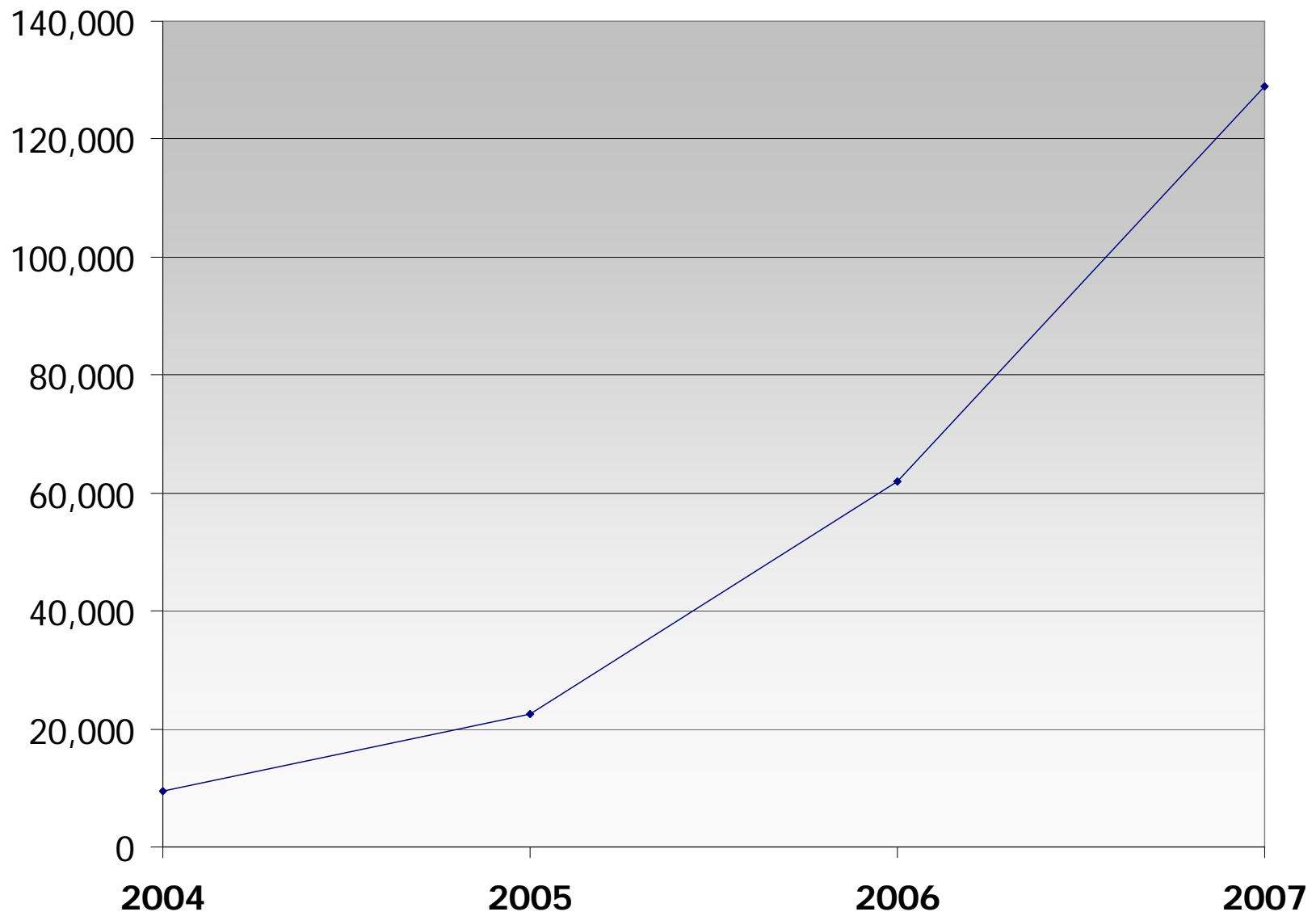
或者发送电子邮件 (email) 至:  
loinc@regenstrief.org

本指南及其他相关文档与计算机文件可以从如下网址获得:  
<http://www.regenstrief.org/loinc>

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Translation to Simplified Chinese by Lin Zhang at Bethune International Peace Hospital, Shijiazhuang, People's Republic of China on behalf of Regenstrief Institute, Inc. Copyright 1995-2004, Regenstrief Institute, Inc. and LOINC<sup>®</sup> Committee. All rights reserved. This LOINC Popularization and Promotion Project was initially supported by Professor Xing Chen, Director of the Department of Laboratory Medicine, Bethune International Peace Hospital. Currently it is supported by Professor Xing Yang, Director of the Department of Nuclear Medicine, Bethune International Peace Hospital. Technical support for the document proofreading and word processing was provided by Yingjie Zhao, one of the Top Ten Outstanding Adobe China Certified Instructors (ACCI) in 2003. Ms. Zhao is an instructor of the Department of Computer Science at Information Management College of Shijiazhuang.

# Google™



# LOINC® Naming

**41959-8:Walking speed:Vel:1W^mean:^Patient:Qn:Calculated**

41959-8

LOINC Code

Walking speed

Component

Vel

Property Measured

1W^mean

Timing

^Patient

System

Qn

Scale

Calculated

Method

*There are six major LOINC axes*

# Panels/Forms in LOINC

- Representing Panels in LOINC
    - Set of observations
    - Relatively sophisticated semantics
    - CBC, survey instruments, etc
    - Can include nested structures
  - Consistent with the HL7 message structure previously described
  - Evolved significantly to represent the attributes of patient assessment instruments
-

# What's in the Master Question File?

- Question name/text
  - Data type
  - Description and/or help text
  - For numeric values: units of measure, range checks
  - For categorical answers in an answer list
  - Consistency checks
  - Required field (Y/N)
  - More than one answer allowed
  - Copyright notices
  - Skip logic
  - ... and more
-

# 46102-0 MDS quart assess form

## NAME

Component	Property	Time	System	Scale	Method
MDS quarterly assessment form	-	Pt	^Patient	-	

## COPYRIGHT NOTICE

[interRAI Copyright notice;](#)

## BASIC PROPERTIES

Class/Type: PANEL.SURVEY.MDS/Survey  
 Order vs. Obs.: ORDER  
 Units Required: N

## PANEL CHILDREN

LOINC#	Component	Property	Time	System	Scale	Method	Submitters Code	Datatype	R/O
46102-0	MDS quarterly assessment form	-	Pt	^Patient	-				
45965-1	Name	-	Pt	^Patient	Set				
45394-4	Last name	Pn	Pt	^Patient	Nom		AA1c		TX
45392-8	First name	Pn	Pt	^Patient	Nom		AA1a		TX
45393-6	Middle initial	ID	Pt	^Patient	Nom		AA1b		TX
45395-1	Name suffix	Pn	Pt	^Patient	Nom		AA1d		TX
45403-3	Room number	Loc	Pt	^Patient	Nom		A2		TX
45983-4	Assesment reference date	-	Pt	^Patient	Set				
45453-8	Date of last day of observation period	TmStp	Pt	^Patient	Qn	MDS	A3a		DT
45454-6	Original or corrected copy of form	Num	Pt	^Patient	Ord	MDS	A3b		NM
45455-3	Date of reentry to facility	TmStp	Pt	^Patient	Qn	MDS	A4a		DT
46106-1	Medical record no.	ID	Pt	^Patient	Nar	MDS			
45482-7	Comatose	Find	Pt	^Patient	Ord	MDS	B1		CE
45988-3	Memory	-	Pt	^Patient	Set				

Display - Details

Text Size-Medium

Print

Print All

Previous

46102-0

Next

OK

1	No	0
2	Yes	1
3	UTD	-

45988-3 Memory - Pt ^Patient Set

45483-5 Short-term memory OK Find Pt ^Patient Ord MDS B2a CE

CONSISTENCY CHECKS: \*1. Value must be blank if B1 = 1; value must be 0 (zero), 1, or - if B1 not = 1.

RELEVANCE EQUATION: B1 != 1

ANSWER LIST: Memory / MDS\_399

SEQ#	Answer	Global ID	Code	System
1	Memory OK		0	
2	Memory Problem		1	

CONSISTENCY CHECKS: \*1. Value must be blank if B1 = 1; value must be 0 (zero), 1, or - if B1 not = 1.

RELEVANCE EQUATION: B1 != 1

ANSWER LIST: Memory / MDS\_399

SEQ#	Answer	Global ID	Code	System
1	Memory OK		0	
2	Memory Problem		1	

45490-0 Makes decisions regarding tasks of daily life Find Pt ^Patient Ord MDS B4 CE

CONSISTENCY CHECKS: \*1. Value must be blank if B1 = 1; value must be 0 (zero) thru 3 or - if B1 not = 1.

RELEVANCE EQUATION: B1 != 1

ANSWER LIST: Makes Decisions Regarding Tasks of Daily Life / MDS\_428

SEQ#	Answer	Global ID	Code	System
1	INDEPENDENT-decisions consistent/reasonable		0	
2	MODIFIED INDEPENDENCE-some difficulty in new situations only		1	
3	MODERATELY IMPAIRED-decisions poor,cues/supervision required		2	
4	SEVERELY IMPAIRED-never/rarely made decisions		3	

45990-0 Indicators of delirium - periodic disordered - Pt ^Patient Set

Display - Details

Text Size-Medium

Print

Print All

Previous

46102-0

Next

OK

# Advantages of the Master Catalog


- Single database contains the details about individual observations and sets
    - In the database, all forms (sets) look the same
    - Automatic standardization
  - Separates the form structure, question details, the rendered version (paper or screen), and the program that manages it
  - Can easily reuse observations (and attributes) in different forms/sets
-

# OASIS: Outcome and assessment information set (OASIS) form

Agency medicare provider number:  ⓘ  
Agency medicaid provider number:  ⓘ  
State location of agency branch:  ⓘ  
Branch number:  ⓘ  
★ Patient number:  ⓘ

...

## Grooming

Prior: grooming:  ⓘ   
Current: grooming:  ⓘ

## Ability to dress upper body

Prior: dress upper body:  ⓘ  
Current: dress upper body:  ⓘ

## Ability to dress lower body

Prior: dress lower body:  ⓘ  
Current: dress lower body:  ⓘ

## Bathing ability

Prior: bathing:  ⓘ  
Current: bathing:  ⓘ

## Toileting

Prior: toileting:  ⓘ  
Current: toileting:  ⓘ




## Transferring

Prior: transferring:  ⓘ  
Current: transferring:  ⓘ

## Locomotion

Prior: ambulation:  ⓘ  
Current: ambulation:  ⓘ

Horizontal Split

http://swdef.nlm.nih.gov - OASIS Input Help - Mozilla F...   



### OASIS Input Help

Question:  
Prior

Instructions:  
Definition:  
Identifies the patient's ability to tend to personal hygiene needs, excluding bathing. The prior column should describe the patient's ability 14 days prior to the start (or resumption) of care visit. The focus for today's assessment - the "current" column - is on what the patient is able to do today.

Time Points Item(s) Completed:  
- Start of care - prior and current ability  
- Resumption of care - prior and current ability  
- Follow-up - current ability  
- Discharge from agency - not to an inpatient facility -- current ability

Response-Specific Instructions:  
- Grooming includes several activities. The frequency with which selected activities are necessary (i.e., washing face and hands vs. fingernail care) must be considered in responding. Patients able to do more frequently-performed activities but unable to do less frequently-performed activities should be considered to have more grooming ability.

Done   0:194

# LOINC and ICF

Creating a Computer-Interpretable  
Representation of ICF

# General Points

- No computer-interpretable version of ICF
  - Ideal to send a person's ICF classifications with existing clinical electronic machinery/infrastructure
  - HL7 messaging

# ICF Panels/Sets

- Original publication details 2 Versions
    - Full Version
    - Short Version (Two-levelsystem)
  - Others are on the way
    - ICF-CY
    - ICF Core Sets
    - More...
  - Would be nice to
    - Define these sets in a computable format
    - Re-use the items
-

# ICF as a Clinical Observation

- ICF is not an assessment/measurement tool
    - But...An ICF classification can be thought of like any other clinical observation
      - d410 | Changing basic body position
        - **Question:** Does this person have a problem changing basic body position?
        - **Answer:** Mild problem (d410.1 for problem in performance)
  - **Challenge:** shifting the view that blends the question and answer(s) into 1 code
-

# Creating a LOINC Representation of ICF

- The simplest approach:
  - XXXXX-X:Functioning Classification:Imp:^Patient:Pt:Ord:ICF

```
OBX|1|ST|XXXXX-X:Functioning Classification:Imp:Patient:Pt:Ord:ICF^LN  
|1|d5101.1_1^Mild difficulty with bathing the whole body with the use of  
assistive devices that are available to the person in his or her current  
environment^ICF|||||||||||  
OBX|2|ST|XXXXX-X:Functioning Classification:Imp:Patient:Pt:Ord:ICF^LN  
|1|d5101._2^Moderate difficulty with bathing the whole body without the use of  
assistive devices or personal help^ICF|||||||||||  
...
```

- Problems with the simple approach
  - No ‘item bank’ of observations
  - No explicit representation of sets
  - OBX-5 contains both question and answer
    - Problematic for storage/retrieval in EHRs

# Full LOINC Modeling

## *Body Functions*

- b28013 - Pain in back

<u>Component</u>	<u>Prop</u>	<u>Time</u>	<u>System</u>	<u>Scale</u>	<u>Method</u>
Pain	Imp	Pt	Back	Ord	Observed.ICF

### Answer List:

- #.0 - NO Problem
- #.1 - MILD Problem
- #.2 - MODERATE Problem
- #.3 - SEVERE Problem
- #.4 - COMPETE Problem
- #.8 - not specified
- #.9 - not applicable

- Compare to 38214-3:
  - Pain severity:Find:Pt:^Patient:Qn:Reported.visual analog score

# Full LOINC Modeling

## *Activities and Participation*

- d420 – Transferring oneself

Component	Prop	Time	System	Scale	Method
Transferring oneself	-	-	^Patient	Set	-
Transferring oneself.Performance	Imp	Pt	^Patient	Ord	Observed.ICF
Transferring oneself.Capacity	Imp	Pt	^Patient	Ord	Observed.ICF

### Support Provided Answer List:

- 0 - No setup or physical help from staff
- 1 - Setup help only
- 2 - One person physical assist
- 3 - Two+ persons physical assist
- 8 - ADL activity itself did not occur during entire 7 days

- Compare to 45590-7 and 45591-5:
  - Transfer - self-performance:Find:Pt:^Patient:Ord:MDS
  - Transfer - support provided:Find:Pt:^Patient:Ord:MDS

# Concluding Points

- LOINC semantic model works for a broad range of clinical observations
  - Some details of ICF LOINC modeling need to be worked out
    - No unsolvable problems
    - Collaboration between LOINC/ICF
    - Based on anticipated use in systems
  - Want to enable on HL7 messaging
  - Make it easy to build interface, data collection, and retrieval tools
-

# Acknowledgements

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- John Hough
- Clem McDonald
- Clinical LOINC Committee

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-