

# Introduction to LOINC and RELMA

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## Acknowledgements

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  - John Hook, Mark Fisher, Ryan Phillips, Karen Ahmad, and more!
- Kathy Mercer
- Clem McDonald
- Dan Vreeman
- The Lab LOINC Committee
- Funding Support
  - NLM, Regenstrief Institute, NCI, CDC

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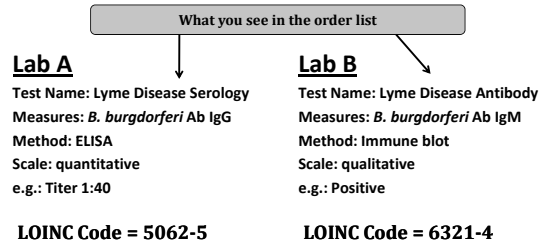
## Why LOINC?

“Within one laboratory, local jargon terms may be used which are usually well understood between colleagues, but would not be sufficiently widely known for communication with the outside world.”

U. Forsum et al., Pure Appl. Chem 72:555-745, 2000 *Properties and Units in the Clinical Laboratory Sciences Part VII. Properties and Units in Clinical Microbiology*

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## Test comparisons



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## Anatomy of a LOINC Term

5193-8:Hepatitis B virus surface Ab:ACnc:Pt:Ser:Qn:EIA

5193-8	LOINC Code
Hepatitis B virus surface Ab	Component
ACnc	Property Measured
Pt	Timing
Ser	System
Qn	Scale
EIA	Method

There are six major LOINC axes

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## What is NOT part of a LOINC Name?

- The instrument used in testing
- Specific details about the specimen
- Priority (e.g. STAT)
- Where testing was done
- Who did the test
- Test interpretation
- Anything that is not an intrinsic part of the name of the result
- Other things that are carried in;
  - The OBX segment
  - An HL7 Version 3 Observation Object

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## Component/Analyte

The substance or entity that is measured, evaluated, or observed

- Sodium
- Glucose
- Brucella sp. organism
- Influenza A Virus antigen
- Cytomegalovirus Virus antibody
- Lipids.Total

5193-8:Hepatitis B virus surface Ab:ACnc:Pt:Ser:Qn:EIA

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## Property

*the most difficult LOINC axis*

The characteristic or attribute of the analyte that is measured, evaluated, or observed

### Major Categories

- **Mass:** Observations reported with mass (milligrams, grams, etc.) in the numerator of their units of measure
- **Substance:** Observations reported with moles or milliequivalents in the numerator of their units of measure
- **Catalytic activity:** Observations that report enzymatic activity
- **Arbitrary:** Results that report arbitrary units in the numerator of their units of measure
- **Number:** Counts

5193-8:Hepatitis B virus surface Ab:ACnc:Pt:Ser:Qn:EIA

## Timing\*

The interval of time over which the observation or measurement was made

- Pt - at a point in time
- 12H - a twelve hour collection
- 24H - a twenty four hour collection

\*Public Health Lab timings are usually Pt

\*non-Pt timings are usually associated with Ratio Property

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## System

The system (context) or specimen type upon which the observation was made.

- Ser - Serum
- Bld - Whole blood (RBC)
- Ur - Urine
- BldA - Arterial blood
- Liver - Liver
- Flu - Body Fluid, unspecified
- Gast - Gastric fluid/contents
- Food - Food or feedstuff
- Tiss - Tissue
- XXX - To be specified in another part of the message

### Super System

Second subpart (^). When not included, "patient" is the default. Used to indicated blood product unit (BPU), a bone marrow donor, or a fetus.

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## Scale

- Qn - quantitative
  - Continuous numeric (real, integer, ratio)
  - Optional operator (>, ≥, ≤, <)
- Ord - ordinal
  - a ranked set of possible values (1+, 2+, 3+)
- Nom - nominal
  - an unranked collection of possible values
  - a taxonomy (e.g list of bacteria)
- Nar - narrative
  - free text narrative (e.g., visit note)

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## Method

- Methods only needed if interpretation affected
  - Different normal ranges
  - Test Sensitivity
- Listed only at the generic level
  - Agglutination
  - Immunoassay
  - Probe with target amplification
- Methods may also be sent in OBX.17

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## Mapping Terms to LOINC Things to Remember

- The thing ordered is not always the thing measured:
  - Blood Culture – live organism(s) identified
  - VDRL – *Treponema pallidum* Ab
  - Urinalysis – lots of different things
- The question (what am I measuring?) is not the answer (e.g. Pos)
  - You are mapping the question, not the answer!
- You must know the specifics of the component being tested for (what is this test actually measuring?)

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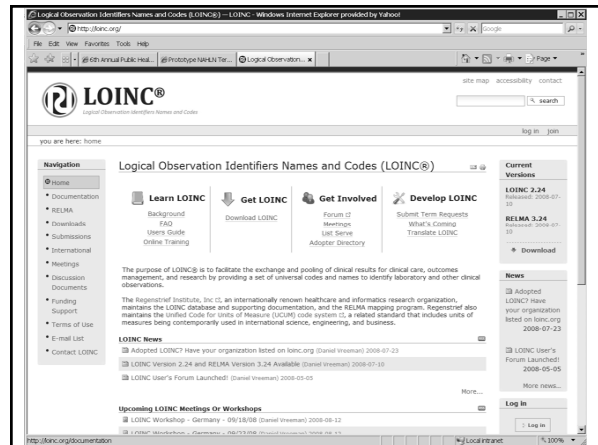
## RELMA® Regenstrief LOINC Mapping Assistant



## RELMA Functions

- Manual and automated mapping assistant
- Same free use as LOINC (see license)
- Comes with the LOINC files and indexes
- RELMA tools transform local words in local file
  - User creates file of local term/name and codes
- Assigns LOINC term to local test/battery code

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## RELMA Search logic

For a given test:

- User can select LOINC records containing:
  - A set of words connected by ANDs or ORs
  - Additional keyed in words
  - A particular category of test (e.g. microbiology)
  - Wild cards of ? and \*
  - Selected classes, systems, components,
  - Any intersection of the above

Note:

RELMA assumes *exact match* on word unless user adds terminal "\*" to indicate wild card.

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## RELMA Logic

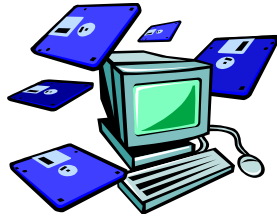
Not → #<word A>

Or → <word A> | <word B>

And → <word B> <word A>

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# Importing Local Terms into RELMA



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# 4 Ways to Load Local Master Observation Files

- Direct entry into LMOF from within RELMA (painful)
- Create an Access table that mimics the LMOF structure (less painful but tedious)
  - Appendix A: RELMA Manual
- Create a delimited ASCII file from your local test catalog (good choice)
- Load directly from HL7 v2.x messages (best? choice)
  - Pulls data from OBR and OBX segments

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## Example Delimited File

#1	#2	#3	#4	#5
312370	MIC	309651	Nafillin	
312370	MIC	708007	Moxifloxacin	
665670	Basic Metabolic Panel	754689	Anion Gap	mmol/L
665670	Basic Metabolic Panel	755363	Creatinine SerPl QN	mg/dL
665670	Basic Metabolic Panel	755364	Sodium SerPl QN	mmol/L
665670	Basic Metabolic Panel	755365	Potassium SerPl QN	mmol/L
665670	Basic Metabolic Panel	755366	Chloride SerPl QN	mmol/L
665670	Basic Metabolic Panel	755367	Carbon Dioxide SerPl QN	mmol/L
665670	Basic Metabolic Panel	755368	Glucose SerPl QN	mg/dL
665670	Basic Metabolic Panel	755369	BUN SerPl QN	mg/dL
665670	Basic Metabolic Panel	755370	Calcium Total SerPl QN	mg/dL
667682	Factor VIII(B) Assay	755177	Factor VIII-C Assay	%
667685	Factor XI(II) Assay	755179	Factor XI Assay	%
667688	Factor XII(II) Assay	755181	Factor XII Assay	%
684308	ABO and Rh	810892	Anti-A	%
684308	ABO and Rh	810893	Anti-B	%
685703	Coostmety Panel Bld QN	755435	Carboxyhemoglobin Bld QN	%
685703	Coostmety Panel Bld QN	755474	Methemoglobin Bld QN	%
685703	Coostmety Panel Bld QN	755475	Oxyhemoglobin Bld QN	%
685753	CRP SerPl QN	755479	C-Reactive Prot SerPl QN	mg/dL
685796	Drug Scn SerPl QL	755372	Benzoziaz Scn SerPl QL	
685796	Drug Scn SerPl QL	755498	The cyclic Antidepressants Scn SerPl QL	
685796	Drug Scn SerPl QL	755497	Salicilate SerPl QN	mg/dL
685796	Drug Scn SerPl QL	755498	Ethanol Pl QN	mg/dL
684849	Hgb A1C HPLC Bld QN	755572	Hemoglobin A1C HPLC Bld QN	%
685823	Hgb A1C POC	755573	"Hemoglobin A1C POC"	%
686283	PTH Intact Ser QN	755577	PTH Intact Ser QN	pg/mL
693154	B Cell Subsets	755895	B Cells- Igg	%
693154	B Cell Subsets	755896	B Cells- Igm	%
693154	B Cell Subsets	755897	B Cells- Igd	%
693154	B Cell Subsets	755898	B Cells- Iga	%
693154	B Cell Subsets	755906	Flow Cytometry Interpretation	
693154	B Cell Subsets	773454	B Cell Subset	
693154	B Cell Subsets	7124661	Flow Cytometry ASB Comment	

## Open File in RELMA

Name your working set. RELMA allows multiple sets in LMOF database

Select your delimiter

Import Button

## Fields Segregated

Assign LMOF Attribute

## Ready to Import

Minimum assignments

Now you can click this button!

## Alternative (best) Way

- Use large set of HL7 messages
- Automatically make dataset of:
  - OBR ID
  - OBR description
  - OBX ID
  - OBX description
- Sample of results with
  - Real values
  - Units
  - Abnormal flags
  - Normal ranges

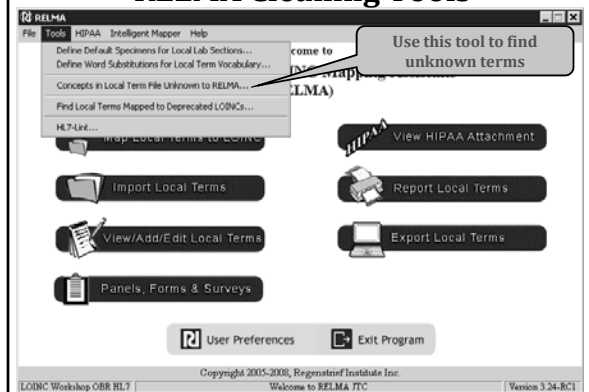
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## Preparing your Data for Mapping

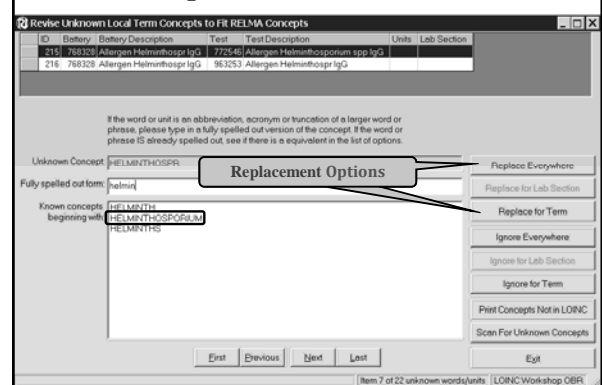
- Improve mapping success by:
  - Expanding abbreviations
  - Standardizing colloquial terms
  - Ignoring “administrative” terms
  - Standardizing time references
- Can be done prior to importing
- Better to use tools built into RELMA

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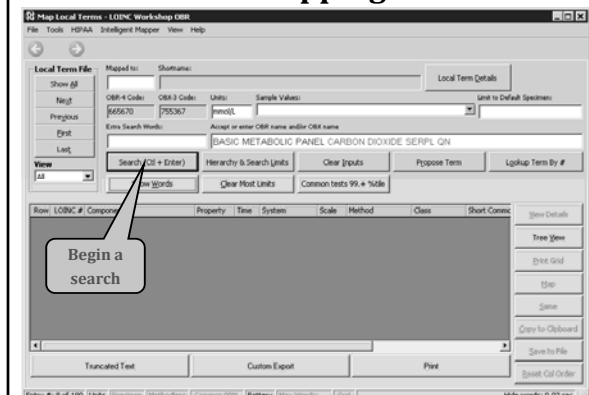
## RELMA Cleaning Tools



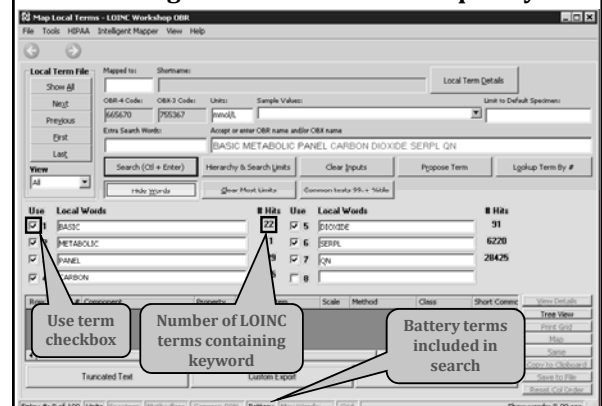
## Replace Local Terms



## Standard Mapping Screen



## Showing Search Terms and Frequency



## Mapping Results

Map Local Terms - LOINC Workshop OBR

Local Term File: Mapped to: Show all Local Term Details

Next: OBR-4 Code: OBR-3 Code: Units: Sample Values: Unit to Default Specimen: 65670 75536 Penicill

Extra Search Words: Accept or enter OBR name and/or OBR name

View: Search (Ctrl + Enter) Hierarchy & Search Limits Clear Inputs Propose Terms Lookup Term by #

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Codes	View Details
1	2075-0	Chloride	MCnc	PT	Sev/Pas	Qn		CHEM	Chloride InH	Tree View

Entry # 7 of 190 | 7 records found: 0.38 sec

## Ad hoc term search

Map Local Terms - LOINC Workshop OBR

Local Term File: Mapped to: Show all Local Term Details

Next: OBR-4 Code: OBR-3 Code: Units: Sample Values: Unit to Default Specimen: 65670 75536 Penicill

Extra Search Words: Accept or enter OBR name and/or OBR name

View: Search (Ctrl + Enter) Hierarchy & Search Limits Clear Inputs Propose Terms Lookup Term by #

Enter keywords here

Entry # 7 of 190 | 6 records found: 0.16 sec

## Ad hoc term search

Map Local Terms - LOINC Workshop OBR

Local Term File: Mapped to: Show all Local Term Details

Next: OBR-4 Code: OBR-3 Code: Units: Sample Values: Unit to Default Specimen: 65670 75536 Penicill

Extra Search Words: Accept or enter OBR name and/or OBR name

View: Search (Ctrl + Enter) Hierarchy & Search Limits Clear Inputs Propose Terms Lookup Term by #

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Codes	View Details
1	20742-3	Canine distemper virus Ag	ACnc	PT	Ord	IF	MCRO	CDV Ag Col		Tree View

Entry # 7 of 190 | 7 records found: 0.34 sec

## Assigning a LOINC Map

Map Local Terms - LOINC Workshop OBR

Local Term File: Mapped to: Show all Local Term Details

Next: OBR-4 Code: OBR-3 Code: Units: Sample Values: Unit to Default Specimen: 65670 75536 Penicill

Extra Search Words: Accept or enter OBR name and/or OBR name

View: Search (Ctrl + Enter) Hierarchy & Search Limits Clear Inputs Propose Terms Lookup Term by #

Highlight correct term

Click "Map" Button (or doubleclick)

Entry # 7 of 190 | 6 records found: 1.34 sec

## Assigning a LOINC Map

Map Local Terms - LOINC Workshop OBR

Local Term File: Mapped to: Show all Local Term Details

Next: OBR-4 Code: OBR-3 Code: Units: Sample Values: Unit to Default Specimen: 65670 75536 Penicill

Extra Search Words: Accept or enter OBR name and/or OBR name

View: Search (Ctrl + Enter) Hierarchy & Search Limits Clear Inputs Propose Terms Lookup Term by #

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Codes	View Details
4	2075-0	Chloride	MCnc	PT	Sev/Pas	Qn		CHEM	Chloride InH	Tree View

LOINC Term Assigned

Entry # 7 of 190 | 6 records found: 1.34 sec

## Setting Search Limits

- Narrows search to specific subset of LOINC terms
- Reduces number of candidate terms
- Limits can be applied to all components
- Component attribute can be further restricted by number of words
- Tree structure allows for hierarchical constraints

## RELMA - Search Constraints

- Controls general search constraints including:
  - Limit to LOINC terms compatible with submitted units
  - Force match with any specimen contained in name
  - Methodless terms only (*now enhanced*)
  - Limit to components with N or fewer words in their name
  - Pop up search timing statistics after each search
- Use carefully or search may not be successful  
(Note parallel control switches at bottom of screen)

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## Terms Consistent with Specimen

The screenshot shows the 'Map Local Terms - LOINC Workshop OBR' window. The search criteria are set to 'ASPERGILLUS FLAVUS'. The results table displays the following data:

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Code	View Details
1	13173-0	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus Ab C	View Details
2	16415-2	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus Ab C	View Details
3	21004-9	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	Immune diffusion	MICRO	A Ruvus Ab C

## Setting Search Limits

The screenshot shows the 'Search Constraints' dialog box. The 'Restrict Search' section has several options checked, including 'Terms consistent with local units', 'Terms consistent with local laterality', 'Pharma Tests Only', and 'Methodless Terms Only'. A callout box points to the 'Methodless Terms Only' checkbox with the text 'Methodless Terms Restriction'. Another callout box points to the 'Override Methodless Terms Restriction' checkbox with the text 'Override Methodless Terms Restriction'.

## Limit to Methodless Terms

The screenshot shows the 'Map Local Terms - LOINC Workshop OBR' window with the search criteria set to 'ASPERGILLUS FLAVUS'. The results table displays the following data:

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Code	View Details
1	13173-0	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus F	View Details
2	16415-2	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus F	View Details
3	19725-1	Aspergillus Ruvus Ab IgG	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus F	View Details
4	21004-9	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	Immune diffusion	MICRO	A Ruvus F
5	23023-4	Aspergillus Ruvus Ab	ACnc	PI	Ser	Qn	Qn	Immune diffusion	MICRO	A Ruvus F
6	27309-4	Aspergillus Ruvus Ab	Tit	PI	Ser	Qn	Qn	Immune diffusion	MICRO	A Ruvus F
7	27377-1	Aspergillus Ruvus Ab	ACnc	PI	Body/fl	Qn	Qn	MICRO	A Ruvus F	View Details
8	31229-0	Aspergillus Ruvus Ab	ACnc	PI	Body/fl	Qn	Qn	MICRO	A Ruvus F	View Details
9	31230-6	Aspergillus Ruvus Ab	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus F	View Details
10	43090-0	Aspergillus Ruvus Ab	Tit	PI	Ser	Qn	Qn	MICRO	A Ruvus F	View Details

## Limit to Methodless Terms

The screenshot shows the 'Map Local Terms - LOINC Workshop OBR' window with the search criteria set to 'ASPERGILLUS FLAVUS'. The results table displays the following data:

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Code	View Details
1	13173-0	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus F	View Details
2	16415-2	Aspergillus Ruvus Ab	ACnc	PI	CSF	Qn	Qn	MICRO	A Ruvus F	View Details
3	19725-1	Aspergillus Ruvus Ab IgG	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus F	View Details
4	31229-0	Aspergillus Ruvus Ab	ACnc	PI	Body/fl	Qn	Qn	MICRO	A Ruvus AB F	View Details
5	31230-6	Aspergillus Ruvus Ab	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus AB F	View Details
6	43090-0	Aspergillus Ruvus Ab	Tit	PI	Ser	Qn	Qn	MICRO	A Ruvus AB F	View Details
7	47421-3	Aspergillus Ruvus AB	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus AB AL	View Details
8	47422-1	Aspergillus Ruvus H Ab	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus H Ab	View Details
9	60244	Aspergillus Ruvus Ab IgE	ACnc	PI	Ser	Qn	Qn	ALLERGY	A Ruvus IgE	View Details
10	94004	Aspergillus Ruvus Ab	ACnc	PI	Ser	Qn	Qn	MICRO	A Ruvus AB C	View Details

## More on Methodless Terms

- Some LOINC categories do not have methodless terms
- Checking methodless only will remove these from view on results grid
- Checking additional box allows these to be seen

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### Methodless Only Checked

Only Methodless terms returned

Differ in one or more components

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Code	View Details
1	2573-0	Viral hemorrhagic disease virus	ACnc	A	Qn	Qn	Out	MICRO	RHDV Ag Te	
2	2575-4	Viral hemorrhagic disease virus	ACnc	PI	Qn	Qn	Out	MICRO	RHDV Ag Te	
3	2575-2	Viral hemorrhagic disease virus	ACnc	PI	Ser	Qn	Out	MICRO	RHDV Ag Te	

### Conditional Methodless

More terms returned

No methodless term; all shown

Row	LOINC #	Component	Property	Time	System	Scale	Method	Class	Short Code	View Details
1	2573-0	Viral hemorrhagic disease virus	ACnc	A	Qn	Qn	Out	MICRO	RHDV Ag Te	
2	2575-4	Viral hemorrhagic disease virus	ACnc	PI	Qn	Qn	Out	MICRO	RHDV Ag Te	
3	2575-2	Viral hemorrhagic disease virus	ACnc	PI	Ser	Qn	Out	MICRO	RHDV Ag Te	
4	2575-4	Viral hemorrhagic disease virus	ACnc	PI	Ser	Qn	Out	MICRO	RHDV Ag Te	
5	2575-2	Viral hemorrhagic disease virus	ACnc	PI	Yes	Qn	Out	EIA	MICRO	RHDV Ag Te
6	2575-4	Viral hemorrhagic disease virus	ACnc	PI	Yes	Qn	Out	IF	MICRO	RHDV Ag Te
7	2575-6	Viral hemorrhagic disease virus	ACnc	PI	Yes	Qn	Out	IF	MICRO	RHDV Ag Te
8	2575-0	Viral hemorrhagic disease virus	ACnc	PI	Yes	Qn	Out	Immune stan	MICRO	RHDV Ag Te

### Setting Search Limits

Limit to Lab Tests Only (No Clinical LOINC Terms)

### Navigating through the Mapping Process

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### LOINC Mapping Tactics

- Try using method-less terms first
  - Specific methods (if needed) can be transmitted in:
    - OBX-17 (v2.x)
    - Observation.methodCode (v3.0)
- If specimen type is transmitted in the message (OBR or SPM), limit system to "XXX"
- Examine local units or real results to verify correct properties
  - Properties are rarely distinguishable in tests
- With every release - Update previous mappings to identify deprecated terms

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### Common Mapping Issues

- Locally Defined Test Name Ambiguity
  - Reuse of local test code
- "Analyte-free" Local Test Names
- Incongruent Value sets (Scale ambiguity)
- Result vs. Interpretation
- Available LOINC Terms too Specific
- Available LOINC Terms too General
- Panel vs. Discrete Test
  - Common in Microbiology

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### Search Hints and Tips

- Keywords with zero frequency are ignored
  - May need to rephrase – use synonym
- Some causes for no returned terms
  - Too many keywords in search – uncheck some
  - Limits applied that don't make sense
    - E.g. Method-less tests plus Method tree set to EIA
  - Did not find and revise words not in RELMA
    - Local units not in RELMA
- Units are GREAT discriminators
- You may have tests that need to be added to LOINC

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### Using LOINC and SNOMED Together



### Where do LOINC and SNOMED Fit?

#### Remember:

- LOINC represents the question:
  - Is there any Botulism toxin in my specimen? (33708-9)
  - Organisms identified in specimen? (634-6)
- SNOMED represents the answer:
  - Negative (SCTID 260385009)
  - *E. coli* O157:H7 (SCTID 103429008)

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### Where do LOINC and SNOMED Fit?

- In an HL7 message, LOINC may be used:
  - In OBR-4 (Universal Service Identifier)
  - In OBX-3 (Observation Identifier)
  - In Version 3 - Observation.code
- SNOMED may be used:
  - In OBX-5 (where nominal values are needed)
  - Almost anyplace else in an HL7 message where coded values are needed

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