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Laboratory Management

LOINC, a Universal Standard for Identifying Laboratory Observations: A 5-Year Update

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The Logical Observation Identifier Names and Codes (LOINC®) database provides a universal code system for reporting laboratory and other clinical observations. Its purpose is to identify observations in electronic messages such as Health Level Seven (HL7) observation messages, so that when hospitals, health maintenance organizations, pharmaceutical manufacturers, researchers, and public health departments receive such messages from multiple sources, they can automatically file the results in the right slots of their medical records, research, and/or public health systems. For each observation, the database includes a code (of which 25 000 are laboratory test observations), a long formal name, a "short" 30-character name, and synonyms. The database comes with a mapping program called Regenstrief LOINC Mapping Assistant (RELMA™) to assist the mapping of local test codes to LOINC codes and to facilitate browsing of the LOINC results. Both LOINC and RELMA are available at no cost from http://www.regenstrief.org/loinc/. The LOINC medical database carries records for >30 000 different observations. LOINC codes are being used by large reference laboratories and federal agencies, e.g., the CDC and the Department of Veterans Affairs, and are part of the Health Insurance Portability and Accountability Act (HIPAA) attachment proposal. Internationally, they have been adopted in Switzerland, Hong Kong, Australia, and Canada, and by the German national standards organization, the Deutsches Instituts für Normung. Laboratories should include LOINC codes in their outbound HL7 messages so that clinical and research clients can easily integrate these results into their clinical and research repositories. Laboratories should also encourage instrument vendors to deliver LOINC codes in their instrument outputs and demand LOINC codes in HL7 messages they get from reference laboratories to avoid the need to lump so many referral tests under the "send out lab" code.

Today most laboratory and diagnostic systems in the US deliver their results electronically via Health Level Seven (HL7)[12] *(1)* messages to their hospital, office practice, health maintenance organizations (HMOs), public health departments, and other clients. The HL7 message carries one record for each separate test observation. Within this record is one field that identifies the test, e.g., serum sodium, and another that reports its value, e.g., 142. These observations records carry other fields for reporting the units of measure, the reference interval, normal flag, and other information. In the HL7 nomenclature, the field that

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[12] Nonstandard abbreviations: HL7, Health Level Seven; HMO, health maintenance organization; LOINC, Logical Observation Identifier Names and Codes; RELMA, Regenstrief LOINC Mapping Assistant; EKG electrocardiogram; HIPAA, Health Insurance Portability and Accountability Act; ASIG, Attachment Special Interest Group; DEEDS, Data Elements for Emergency Department Systems; NLM, National Library of Medicine; LIS, laboratory information systems; and AMIA, American Medical Informatics Association.

carries the observation identifier is called OBX-3, and the field that carries the observation value is called OBX-5. Until recently, most laboratories would send their own local and idiosyncratic codes in OBX-3 to identify the observation. One laboratory would identify serum sodium with the code "C1231" and another with the code "SNA". Every laboratory had its own unique code for every test observation. This extreme degree of variation is a huge barrier to the development of clinical repositories and research databases for office practices, hospitals, HMOs, and public health departments because mapping these local laboratory codes (thousands of them per laboratory) to the codes used in the receiving systems requires large labor investments. If we had a universal code system for tests and everyone used this system, this barrier probably would vanish, and receiving systems could "understand" and recognize all results that flow to them in HL7 and other electronic messages *(2)* and efficiently store these results in their medical record or repository system.

Before 1994, no universal pre-coordinated code system for laboratory test names existed, although considerable background work had been done within organizations such as the IFCC/IUPAC Committee/Commission on Properties and Units in Clinical Chemistry *(3, 4)*, and EUCLIDES *(5)*. In 1994, a group of researchers met in Indianapolis at the Regenstrief Institute to begin the development of such a system, which they called the Logical Observation Identifiers Names and Codes (LOINC®) code system. The initial release, in the spring of 1995, included a 70-page Users' Guide and identifiers and names for more than 6000 laboratory test results *(6, 7)*.

Since this first release, the Regenstrief Institute and the LOINC Committee have delivered 17 releases, increased the size of the database fivefold, added codes for many clinical subjects beyond the laboratory, added short names for laboratory tests, developed and enhanced a free browsing program, the Regenstrief LOINC Mapping Assistant (RELMA™) *(8)*, and watched adoption of the LOINC coding system grow. Here we report this progress.

Structure and Purpose of LOINC Codes

The initial purpose of the LOINC database was to provide universal identifiers for observations in HL7 messages. Specifically, LOINC provides a code system for the observation identifier field (OBX-3) of the HL7 observation-reporting message *(1)*. However, LOINC is now being used in Digital Imaging and Communication in Medicine (DICOM) ultrasound *(9)* messages and in Clinical Data Interchange Standards Consortium (CDISC) pharmaceutical industry *(10)* messages to identify clinical and laboratory observations, respectively, and could well be used in clinical and research databases for the same purpose. LOINC codes exist for laboratory observations such as partial pressure of arterial blood oxygen (Po_2) and percentage lymphocytes; electrocardiogram (EKG) measurements, such as PR interval; vital signs, such as pulse, body weight, and height; and for many other clinical domains. Laboratory result values (which are stored in the HL7 field OBX-5) are often reported as numbers, but depending on the nature of the test observation, they may also be reported as free text or as codes. Some laboratory systems report blood types, for example, as codes. The scope of the LOINC Committee includes the codes that identify the test observation per se, e.g., serum glucose or blood culture, not the codes that might be reported in the values of some test observations. If we consider the observation as a question and the observation values as answers, LOINC provides codes for the questions. Other code systems, e.g., International Classification of Diseases (ICD)-9 *(11)*, International Classification of Diseases for Oncology (ICDO)-3 *(12)*, Systemized Nomenclature in Medicine (SNOMED) *(13)*, MEDCIN *(14)*, and the Medical Dictionary for Regulatory Activities (MedDRA) *(15)*, provide codes for the answers.

Our initial emphasis was on developing codes for single test observations, not the batteries, panels, or packages that might contain multiple test readers. However, the LOINC code used to report a single observation, e.g., serum potassium (LOINC code 2823-3) can also be used to order that observation. Similarly, in clinical domains, the LOINC code for reporting a "chest x-ray PA & lateral" result could also be used to order a chest x-ray study. The LOINC database now also includes codes for some test packages (panels) such as arterial blood gases, differential count, and hemogram, but only the most common and standardized ones. We will expand the LOINC coverage for order packages over time.

As of July 2002, the LOINC database carried records for more than 30 000 different observations. Each record carries the formal six-part LOINC name; the LOINC code, a number with a check digit (see Table 1); the observation class (e.g., chemistry, hematology, and radiology); related names (to assist searches of the database); and other attributes. For most classes of laboratory observations, the database also includes a "short" report name that is <30 characters, is less formal, and is more readable. Short names have not yet been finalized for the nonlaboratory LOINC concepts.

LOINC follows good coding system practices *(16)*. LOINC codes carry no embedded meaning, and they are never reused or deleted. If a LOINC term happens to be identified as a duplicate of a coding record previously entered into the LOINC database, it will be flagged as "deprecated" but not removed from the database.

We used many sources for constructing the original LOINC database as described in the original *Clinical Chemistry* article *(6)*. The development of LOINC codes has been an empirical process, based on the examination of existing laboratory master test files and the contents of millions of HL7 messages, as well as requirements discovered during the adoption of LOINC codes by individ-

Table 1. Examples of laboratory LOINC codes and formal LOINC names.

LOINC code	LOINC name (component:property:timing:specimen:scale)
2951-2	SODIUM:SCNC:PT:SER/PLAS:QN
2955-3	SODIUM:SCNC:PT:UR:QN
2956-1	SODIUM:SRAT:24H:UR:QN
2164-2	CREATININE RENAL CLEARANCE:VRAT:24H:UR:QN
1514-9	GLUCOSE^2H POST 100 G GLUCOSE PO:MCNC:PT:SER/PLAS:QN
3665-7	GENTAMICIN^TROUGH:MCNC:PT:SER/PLAS:QN
17863-2	CALCIUM.IONIZED:MCNC:PT:SER/PLAS:QN
2863-9	ALBUMIN:MCNC:PT:SNV:QN:ELECTROPHORESIS

ual laboratories and the development of new testing technology.

LOINC clinical observation names (including laboratory test results, clinical measurements, and results of other diagnostic studies) are defined in terms of six major, and up to four minor, axes. The formal LOINC name must include entries for the first six major axes (shown in Table 2). The method axis is included only when the method distinction makes an important difference to the clinical interpretation of the result. Examples of LOINC terms are shown in Table 1.

The minor axes include challenge information; adjustments; supersystem, e.g., fetus, blood product; and time operators (maximum, minimum, last, first). The challenge axis is the most complex and includes the amount, route, and timing (e.g., oral glucose tolerance test). The details about these other axes can be found in the LOINC Users' Guide *(17)*.

Examples of clinical LOINC terms and names are shown in Table 3, in which each of the axes is separated into a separate column for easier reading.

Scope of the Current LOINC Database

The LOINC Committee divides the LOINC development into three divisions; the first of these is laboratory LOINC.

Table 2. LOINC axes.

Number	Description
1	Component (analyte): e.g., potassium, hemoglobin, hepatitis B antigen
2	Property measured: e.g., a mass concentration, enzyme activity (catalytic rate)
3	Timing: i.e., whether the observation applies to a moment in time or is an average or amount taken over a period of time, as is the case for a 24-h urine sodium concentration
4	System: i.e., type of sample or organ examined: e.g., urine, blood, chest
5	Scale: e.g., whether the measurement is quantitative (a true measurement), ordinal (a ranked set of options), nominal, or narrative (e.g., dictation results from x-rays)
6	Method used to produce the observation, but only when different methods give clinically significant different results

The early years of the LOINC development were focused exclusively on laboratory observations, and large adopters of LOINC laboratory continue to stimulate expansion of the laboratory terminology. Hence, the laboratory content, which is the focus of this report, is the best developed and largest of the three divisions.

The categories of laboratory test procedures that are included in the LOINC database are identified in Table 4 along with the number of LOINC terms defined for each category.

The clinical LOINC division is concerned with nonlaboratory diagnostic studies, critical care, and nursing measures, as well as the history, physical, and survey instruments. The clinical LOINC division, chaired by Stan Huff, MD, includes several new projects for defining clinical notes, report titles, and dental observations.

The categories and numbers of clinical LOINC terms per categories that are available in the LOINC database are described in Table 5.

The third division focuses on proposals for the Health Insurance Portability and Accountability Act (HIPAA) *(18)* attachments. HIPAA mandates the promulgation of 10 administrative standards. The first nine deal with payment, enrollment, and other purely administrative functions. These have already been delivered *(19)*. More time was provided under the law for developing the tenth administrative standard, the one for claims attachments. The draft rule for claims attachments proposes a HL7, unsolicited observational report message as the attachment "structure" and uses LOINC codes to identify the individual observations within the attachment. A payer who wanted a specified set of results, e.g., chemistry tests, obtained at a given encounter would request the set of codes by sending a request for LOINC code 18719-5, the LOINC code for all chemistry tests. The care provider's system would use LOINC codes to identify the chemistry test results that it included in its query response.

The content of HIPAA attachments is developed by the HL7 Attachment Special Interest Group (ASIG), not by the LOINC Committee. Members of the LOINC Committee provide technical advice to the HL7 ASIG, and the Regenstrief Institute constructs the attachment set and adds new LOINC codes as required. Six HIPAA attachments have been drafted, including (*a*) laboratory reports, (*b*) nonlaboratory clinical reports, (*c*) ambulance transport, (*d*) emergency room visits, (*e*) medications, and (*f*) rehabilitation. These can be found at http://www.hl7.org/Special/committees/claims/claims_attachments.htm#Publications. New LOINC terms had to be developed for some of these attachments, but existing LOINC codes were adequate for most of the laboratory and clinical reports attachments. Work is underway in the HL7 ASIG to add attachments and associated LOINC codes for durable medical equipment, home healthcare, and other subject matter.

Table 3. Example of clinical LOINC terms and names (with axes emphasized by separation into columns).

Code	Component	Property	Time	System	Scale	Method
8302-2	BODY HEIGHT:	LEN	PT	^PATIENT	QN	
3140-1	BODY SURFACE:	AREA	PT	^PATIENT	QN	DERIVED
8331-1	BODY TEMPERATURE:	TEMP	PT	MOUTH	QN	
8632-2	QRS AXIS:	ANGLE	PT	HEART	QN	EKG
8642-1	PUPIL DIAMETER:	LEN	PT	EYE.RIGHT	QN	AUTO
21611-9	AGE:	TIME	PT	^PATIENT	QN	ESTIMATED
19867-1	CAPACITY.VITAL:	VOL	PT	RESPIRATORY SYSTEM	QN	
9279-1	BREATHS:	NRAT	PT	RESPIRATORY SYSTEM	QN	
11882-8	GENDER:	FIND	PT	^FETUS	NOM	US

RELMA

The Regenstrief Institute provides RELMA, a program for browsing the LOINC database and for mapping local test codes to LOINC codes. The mapping effort can be difficult for laboratories because their test catalogs are so large (from 2000 to 5000); we therefore have put special effort into RELMA's laboratory mapping capabilities.

Most users will explore the capabilities of RELMA and the content of the LOINC databases by entering the individual words that make up a test name into the RELMA mapping screen. RELMA will then search the LOINC database and display a grid showing all of the LOINC terms that include the entered words. When mapping large numbers of local laboratory tests, users can create an import file that carries information about their local tests. This import file includes fields for the local test name and code (both required) as well as the units of measure, the producing laboratory section, and the code and name of the local battery under which the test is ordered (all optional). RELMA takes advantage of these optional fields to make the mapping process more precise and efficient. The LOINC manual *(17)* gives details about the structure and formats required for creating an import file.

When an import file is used, the first step in the mapping process is to run a special program to find words and units within the import file that RELMA does not understand. The user then corrects typographical errors and maps these unrecognized words into words that RELMA does understand before starting the mapping process.

Once the local test field has been edited, the user can map each local test to its corresponding LOINC code. RELMA parses the local test names into separate "words", using blanks and special characters as word boundaries, and places these words in the fields of the RELMA mapping screen (see far left column of five input fields in Fig. 1). The user can add further search specifications and add or remove words to facilitate the search.

Table 4. Laboratory LOINC scope.

Class	No. of terms	Class	No. of terms
Antibiotic susceptibilities	1010	Hematology cell count	1082
Blood bank	658	Microbiology	5786
Chemistry	4817	Molecular pathology	245
Coagulation	346	Skin tests	25
Cytology	31	Pathology	124
Fertility	123	Drug & toxicology	3919
Flow cytometry cell markers	580	Urinalysis	136

Fig. 1 shows the search screen for a local test that has "SNA" for its code and "Sodium" for its name. This example test is ordered under the electrolytes panel. RELMA automatically restricts the search to tests that are consistent with the local name and the local units (the local units field contains "mmol/dl" in the field at the top left of Fig. 1). In Fig. 1 the RELMA program has retrieved the 14 LOINC terms that contain the word sodium and are consistent with the units of mmol/dl. The search is very fast, less than 0.1 s on a 600 MHz personal computer for most searches. In this example, the local laboratory uses "Sodium" as shorthand for "Serum Sodium", so the user would have to click on row 11 to link the LOINC code for serum sodium to their local serum sodium test.

The user can adjust the search by adding or removing words within the fields labeled "local words" in Fig. 1 and by relating the words by logical NOTs or ORs. The user can reorganize the grid column order by dragging the field labels and can resort the grid according to the content of any column by clicking on the column header. In the example (Fig. 1), the test name does not include any hint that it is a serum sodium, so RELMA returns sodium tests for the many different specimens. If the name had included some string, e.g., "ser", that indicated this was a serum sodium or if the user had typed "serum" in the second search word field, RELMA would have returned just one test, serum sodium, in its grid.

The second tab on this screen (see Fig. 2) permits the user to set global search options. For example, the user could request that RELMA find only molar measurements, as preferred in most European countries, or the mass measurements that are more commonly preferred in the US by clicking on "favor substance property" or "favor mass property". The radio buttons are at the bottom of this form. This screen also has an option to control the search based on the number of words in the analyte name, which is useful for excluding the more unusual forms of analytes, such as hemoglobin Chesa-

Table 5. Clinical LOINC scope.

Class	No. of terms	Class	No. of terms
Body measurements	61	History and physical	324
Cardiac ultrasound	487	Obstetrical ultrasound	562
Clinical documents headers	19	Ophthalmology measurements	477
Colonoscopy/Endoscopy	72	Radiology reports	1177
EKG (ECG)	411	Respiratory therapy	33
Emergency department	34	Standard survey instruments *(41)*	460
Fluid intake/output	400	Tumor registry	246
Hemodynamic measures	142	Vital signs	335

peake or hemoglobin Seattle, when looking for the blood hemoglobin.

The other tabs permit users to restrict the search to broad categories of classes, systems (specimens), and components, respectively. When these tabs are opened, they display a tree of concepts. Fig. 3 shows the component tree with the virus branch of microbiology opened, and below that the hepatitis viruses subtree is opened and hepatitis viruses are selected. This choice would restrict the search to tests for hepatitis viruses. The same kind of selection capability is available for test classes (e.g., chemistry test or hematology tests) and systems (specimens).

When all terms are mapped, the user can recover the "import file", which will now carry links to the corresponding LOINC codes, and import this mapping table into their laboratory system or interface engine.

RELMA has options for importing and exporting the local mapping file, for reporting the contents of the local mapping file and LOINC database, for finding words and units in the local system that LOINC does not recognize

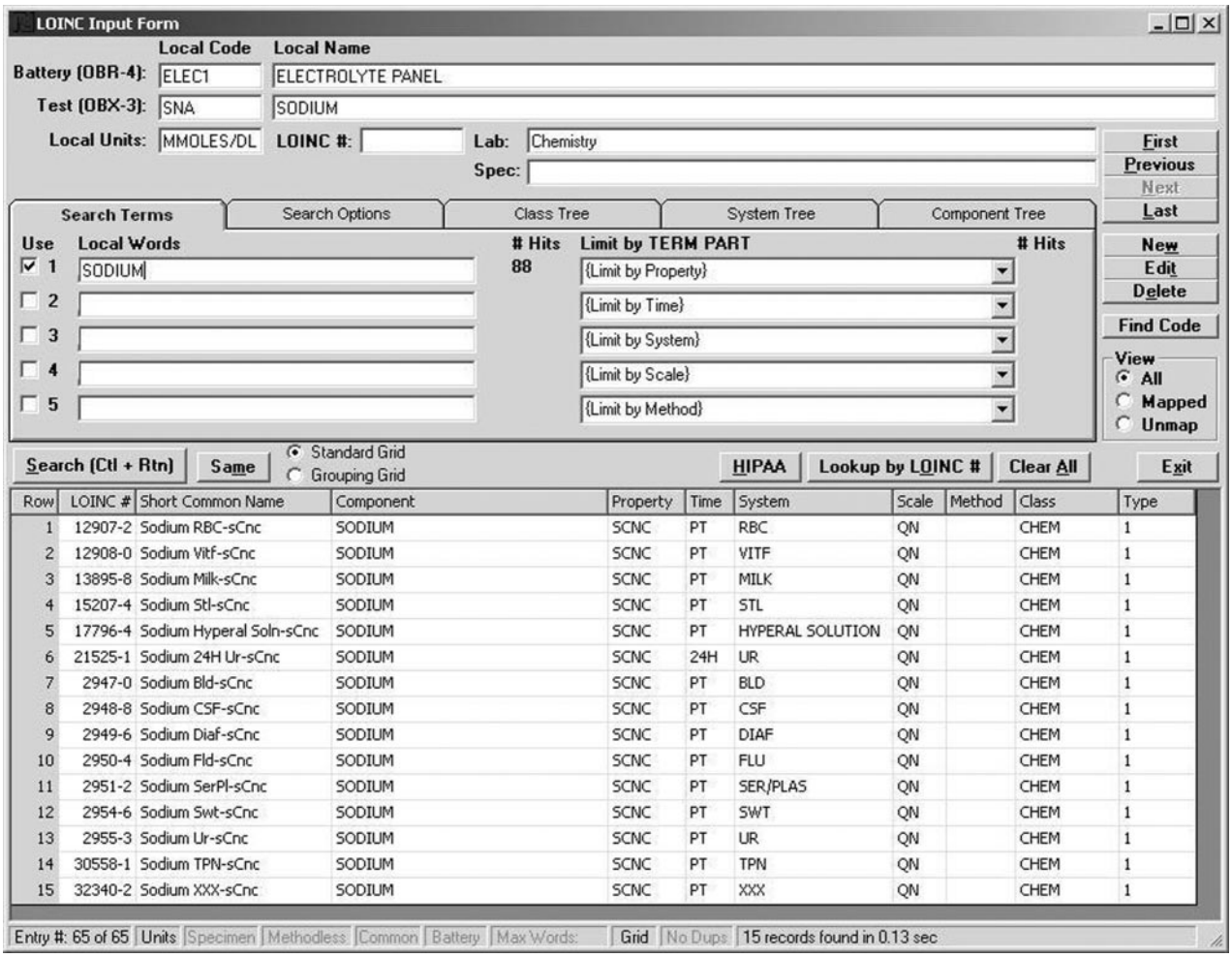

Fig. 1. RELMA mapping tab 1, showing successful search for sodium tests that could have units = mmol/dl.

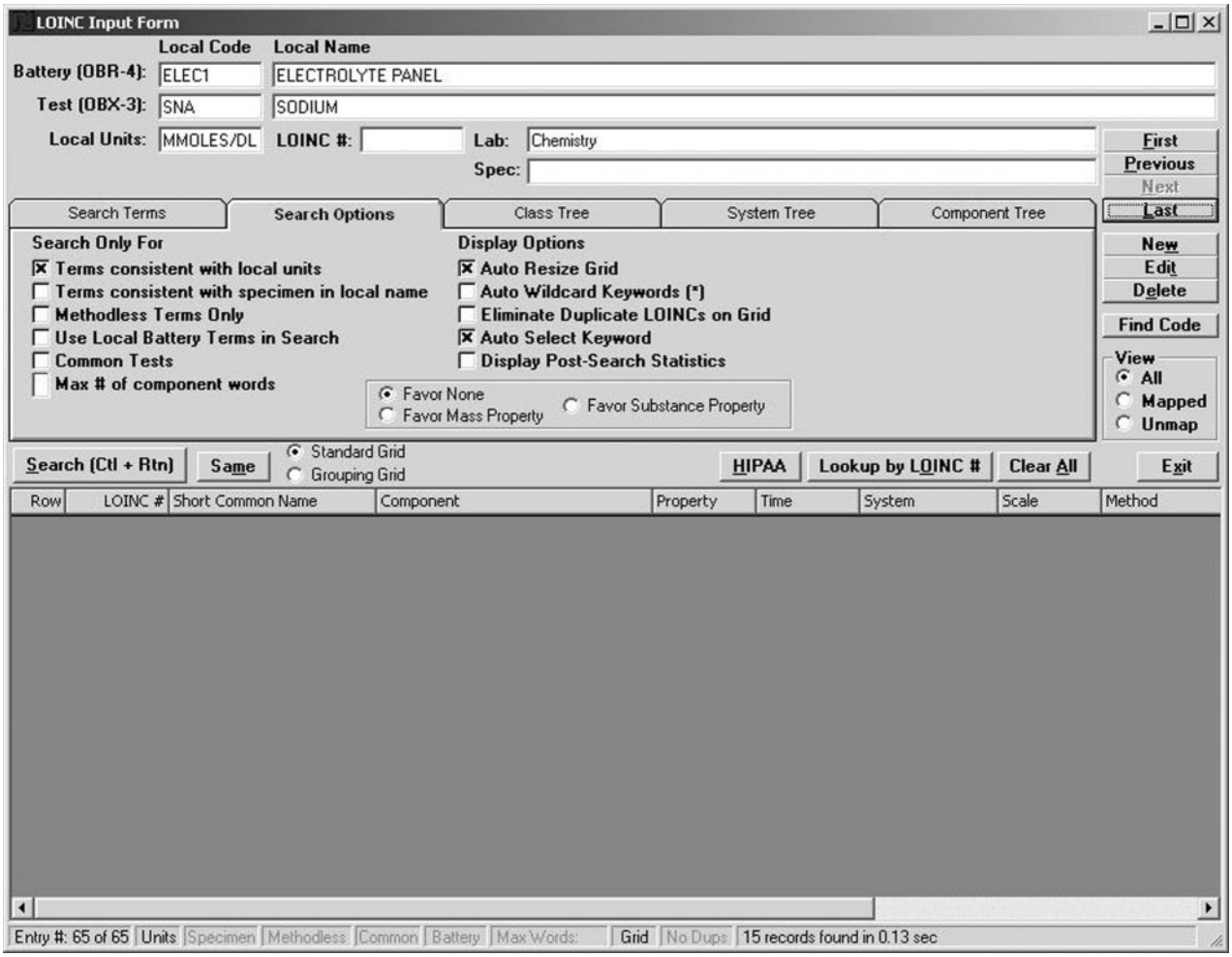

Fig. 2. RELMA mapping tab 2, showing strategy specification screen.

(often typographical errors or irrelevant words), and for converting these into words and units, respectively, that RELMA understands.

RELMA is provided at no cost from the Regenstrief Institute *(8)*. Users can also run RELMA via the Web and a Citrix client (available at http://www.regenstrief.org/loinc).

LOINC has been adopted widely. In the US, most federal agencies with healthcare interests have adopted LOINC. The CDC recommends HL7 messages with LOINC codes for delivering laboratory results that identify cases of reportable conditions to public health departments *(20–23)*. The New York State Public Health Department, Indiana State Department of Health, and Washington State Public Health Laboratories are among the public health departments now using this approach *(24)*. The CDC is also proposing a LOINC- and HL7-based *(25)* standard for tumor registry reporting and emergency encounter reporting [Data Elements for Emergency Department Systems (DEEDS)] *(26)*. The National Library of Medicine (NLM) has included LOINC as one of the source vocabularies in the Unified Medical Language System (UMLS) Metathesaurus.

The Veterans Administration is mapping the test codes in all of its hospital laboratories to LOINC codes to facilitate clinical care and research *(27)* across Veterans Administration hospitals. We have already mentioned the Department of Health and Human Service's *(28)* involvement in LOINC for use in electronic claims attachments. The Clinical Data Interchange Standards Consortium, which includes all of the major pharmaceutical manufacturers and the Food and Drug Administration as a liaison participant, uses LOINC codes for identifying laboratory tests and EKG results in new drug submissions *(10)*. The American Clinical Laboratories Association, which includes many of the large referral laboratories, endorsed LOINC from its beginning.

Large reference laboratories, including the largest, Quest *(29)* and LabCorp *(30)*, have mapped their internal codes to LOINC and will include the LOINC codes along with their local codes in HL7 result messages. For Quest, this endeavor required the mapping of more than 200 000 local codes from the many laboratories that are now part of Quest. Other large laboratories and the 26 veterinary medicine laboratories in the US are also currently mapping their local test codes to LOINC.

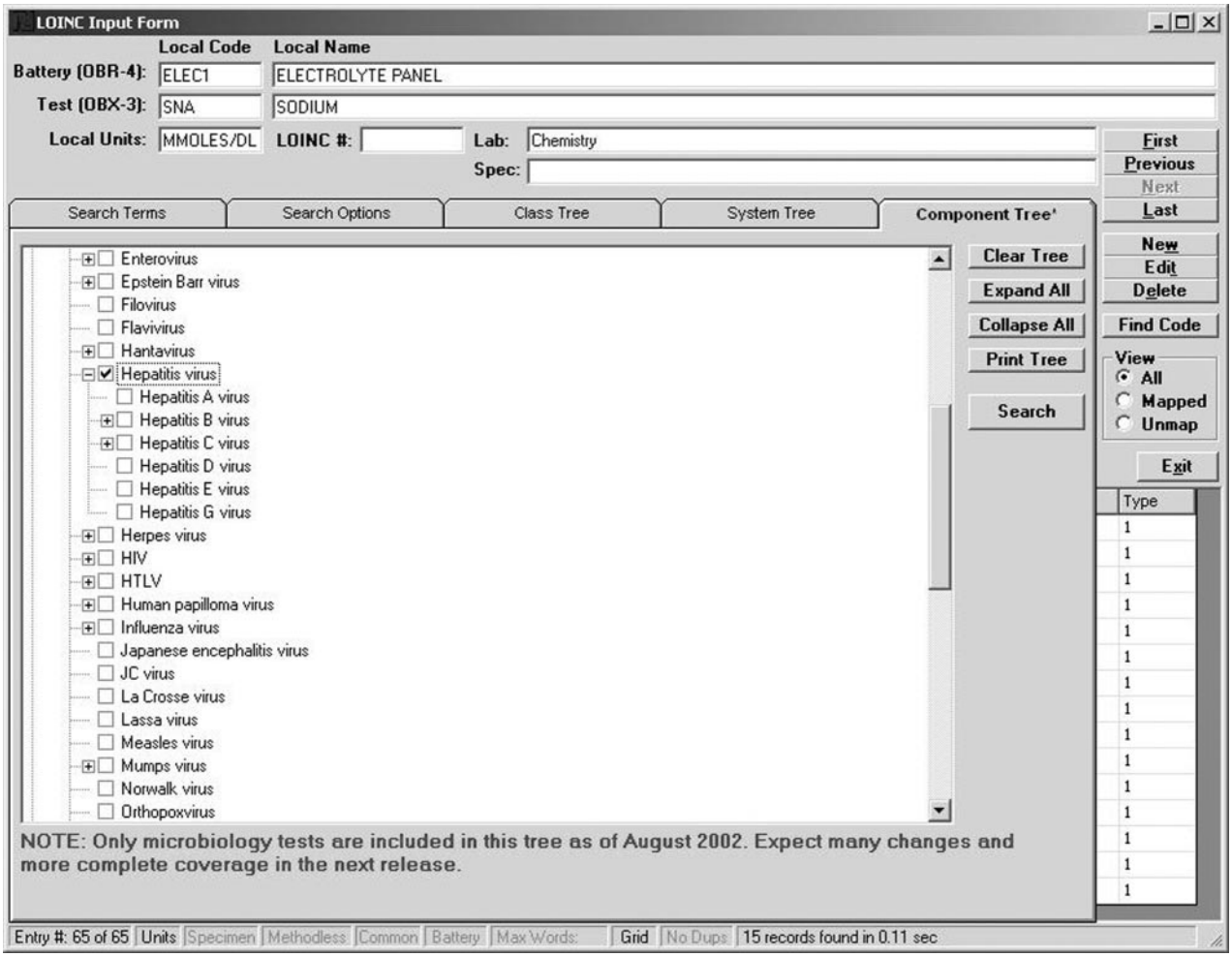

Fig. 3. RELMA mapping tab 4, showing specimen tree.

Large healthcare institutions have taken advantage of LOINC to standardize the information coming from many different sources. Notable users include Partners HealthCare of Boston, Intermountain Health Care, Kaiser Foundation Health Plan, the Hospital for Sick Children in Toronto, all of the major hospitals in Indianapolis, New York-Presbyterian, and the University Hospitals of Columbia and Cornell. Many health insurance companies require their laboratory vendors to supply them with LOINC-coded laboratory HL7 messages so that they can pool these results for clinical management purposes. LOINC is being adopted internationally as well. In Germany, the Deutsches Institut für Normung has specified LOINC as a national standard for laboratory reporting *(31)*. In Switzerland, the Swiss Center for Quality Control introduced a LOINC-based service *(32, 33)* for clinical laboratorians worldwide, CUMUL, which has contributed their French, German, and Italian names for close to 3000 of the most common laboratory tests to the LOINC database. The CUMUL project is now endorsed by European Laboratory Medicine as "a platform to develop co-ordination between European societies of all laboratory disciplines", thereby spreading interest for LOINC across Europe. LOINC is part of a province-wide laboratory information standardization in Ontario and British Columbia and is used in Australia, Korea, Estonia, Brazil, and New Zealand.

Some instrument vendors, including Dade MicroScan's antibiotic susceptibility and Beckman Coulter's cell counting instruments, have been mapping each of their distinct instrument measurements to LOINC codes for years, and interest in having laboratory instruments deliver LOINC codes with the results they produce has recently increased. Roche Diagnostics now has mapped all of the distinct test measurements produced by their large-scale chemistry analyzers to their corresponding LOINC codes. Table 6 lists the vendors who indicate ability to transmit LOINC codes as identifiers of results they deliver in outbound messages to laboratory information systems (LIS) *(34–39)*. We are particularly pleased to see the number of vendors of immunoassay instruments who can provide LOINC codes because immunoassays are one of the more challenging areas for assignment of LOINC codes because of methodology-specific coding differences

and unusual analytes. The Department of Veterans Affairs has been considering making instrument delivery of LOINC codes a requirement in future system-wide bids for laboratory instruments.

The adoption by instrument vendors is welcome for two reasons. Instrument manufacturers have the most knowledge about the tests they produce and are best positioned to identify the appropriate LOINC code and/or to argue for new LOINC codes when required by new testing technology. In addition, when instrument vendors provide LOINC codes as part of the result output message, they decrease the need for mapping work at the hundreds of laboratories that use their instruments.

Some LIS vendors, including Compromed, M/Mgmt, McKesson, Northern, Soft Computer, and Sysware, provide the full LOINC database with each new installation. Many LIS vendors (25 vendors in the November 2001 *CAP Today* survey) now include an indexed field for the LOINC code in their test database *(40)*. (As an aside, we do not recommend that laboratories use LOINC as the primary internal identifier in their LIS; rather that every test defined in the LIS include a field for carrying the appropriate LOINC code so that it can be included as the alternative observation identifier, along with the local test code, within outbound HL7 messages.)

Distribution and Copyright, Communications and Meetings

The LOINC database can be obtained from the Regenstrief LOINC website (http://www.regenstrief.org/loinc/), as a PDF report sorted alphabetically by class, as a tab-delimited ASCII text file, and/or as an Access database. The same web site also provides the 85-page LOINC Users' Guide (PDF); the free RELMA program, which downloads with full LOINC access to the database; and the RELMA Users' Manual.

The LOINC database and associated documents and programs are copyrighted, but the copyright permits all commercial and noncommercial uses in perpetuity at no cost. If the LOINC database or its contents are distributed as a database, such distributions must include all parts of the formal LOINC term, the LOINC short name, the LOINC code, the deprecated flag, and the copyright. The copyright notice is needed to prevent variants, which would defeat the purpose of this standard. No such notice is required when LOINC codes are used in messages to report test results.

LOINC has four to six committee meetings per year, one-half clinical and one-half laboratory. At least one laboratory and one clinical meeting are open to the public. New releases of the LOINC database and/or RELMA program occur three to four times per year. We announce new releases and public meetings to all who subscribe to our e-mail list. Interested parties can subscribe to the LOINC e-mail news and mailing announcements by going to http://www.regenstrief.org/loinc/mlist/. Public meetings are also announced through the NLM UMLS listserv, the American Medical Informatics Association (AMIA) monthly electronic newsletter list (ACCESS AMIA), and the HL7 Calendar of Events website.

We welcome suggestions about observation terms that have not yet been included in the LOINC database. The LOINC Users' Guide defines the structure and format required for new submissions.

Table 6. Clinical laboratory instrument vendors who transmit LOINC codes with results.

Type of analyzer	Vendors	As of	Reference
Mid- and high-volume chemistry	Bayer	July 2001	*(34)*
Blood gas analyzers	Abbott	September 2001	*(35)*
	Bayer		
	Radiometer		
Hematology cell counters	Abbott	December 2001	*(36)*
	Abx		
Coagulation analyzers	None as yet	January 2002	*(37)*
Immunoassay analyzers	Abbott	April 2002	*(38)*
	Awareness Technology		
	Bayer		
	Beckman Coulter		
	Diamedix		
	Grifols-Quest		
	Nichols		
	Ortho		
	Tosoh		
Low-volume chemistry	Abbott	June 2002	*(39)*
	ACT		
	Alfa Wasserman		
	Awareness Technology		
	Careside		

Conclusions

The use of LOINC codes to identify laboratory (and other) observations could provide major benefits to the organizations that receive such messages because it allows them to organize, pool, and analyze results from many HL7 sources without manual labor. Office practice systems will be able to import test results into their office medical record automated systems when their source laboratories include LOINC codes in their HL7 messages. Similarly, hospitals will be able to share results with the office practice systems of their attending physicians (in both directions), and hospitals and other primary systems will be able to import reference laboratory results without having to lump them under the "send out" or "miscellaneous lab test" codes.

To facilitate the mapping of local test codes to LOINC codes, we encourage laboratories to be more specific in their naming conventions for tests. In particular, laboratories should always include an indication of the specimen type (e.g., Ser for serum, Ur for urine) and the scale (e.g., QL for ordinal tests and QN for quantitative tests) in their test names. With that additional specification, laboratories with semiautomatic methods could map most of their routine tests to universal LOINC codes in a few days.

Laboratories should adopt LOINC codes internally, include them in their outbound HL7 messages, and demand LOINC codes from their reference laboratories and instrument vendors. Practices and HMOs should demand LOINC codes in the HL7 results messages they receive from laboratories so that they can collate and analyze results from many independent sources automatically.

The work of maintaining the Users' Guides, laboratory- and HIPAA-specific LOINC codes, and some of the clinical LOINC codes as well as distribution of the LOINC database and maintenance of the LOINC web site is done at the Regenstrief Institute for Health Care (Indianapolis, IN). We wish to thank Henrik Olesen, Chairman of IUPAC and the Commission on Quantities & Units in Clinical Chemistry, for very helpful comments and insights over the year about laboratory test coding. LOINC work has been supported in part by the NLM (representing the Department of Health and Human Services), the Department of Defense, and the Department of Veterans Affairs (Contracts NO1-LM-4-3510, N01-LM-6-3546, and N01-LM-9-3517), the Agency for Healthcare Research and Quality (Grants HL08750 and HS07719), and The John A. Hartford Foundation, Inc. This endeavor was also supported in part by Grants R13/CCR517099-01 and H75/CCH520501-01 from the CDC. The contents of this report are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

Appendix

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