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Position Paper ■

Standards for Medical Identifiers, Codes, and Messages Needed to Create an Efficient Computer-stored Medical Record

BOARD OF DIRECTORS OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION

Abstract A major obstacle to establishing a computer-stored medical record is the lack of "standards" that would permit government, care providers, insurance companies, and medical computer system developers to share patient data easily. In this position paper, the Board of Directors of the American Medical Informatics Association recommends specific approaches to standardization in the areas of patient, provider, and site of care identifiers; computerized health care message exchange; medical record content and structure, and medical codes and terminologies. The key concept developed in this position paper is that developers and users of computer-stored medical records must embrace existing and tested approaches, despite their imperfections, to progress quickly. This approach to standardization is being coordinated with the American National Standards Institute's Health Informatics Standards Planning Panel. The development of standards is a long-term process involving continued refinement. The proposed standards are an important step toward the goal of better and more efficient health care.

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The Need for Action

Computer information systems offer many opportunities to improve the nation's health care and reduce its costs. The universal adoption of a standard approach to electronic billing, for example, will reduce administrative costs. The analysis of clinical information derived from large populations of patients will show us the relationships of investments in health care resources and procedures to health outcomes. The opportunity to transfer medical information automatically between care facilities will speed care delivery and reduce duplicate testing and duplicate prescribing. The use of automatic reminders will reduce errors, improve efficiency, and improve patient care.

Large and fairly "immediate" opportunities exist for reaping some benefits of a computer-stored record by taking advantage of the wealth of patient information—orders, drug treatment profiles, laboratory tests, discharge summaries, surgical pathology reports, surgery reports, etc.—that is already stored in the computers of health care providers. However, such information is usually scattered across many computers (laboratory computers, billing computers, pharmacy computers, automated ECG carts, word processors) within institutions and across many in-

The members of the Board of Directors are listed at the end of the article.

Correspondence: Reed M. Gardner, PhD, Department of Medical Informatics, LDS Hospital, University of Utah, 325 8th Avenue, Salt Lake City, UT 84143.

Reprints: American Medical Informatics Association (AMIA), 4915 St. Elmo Avenue, Suite 302, Bethesda, MD 20814.

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stitutions (nursing homes, community pharmacies, hospitals, referral labs) within communities. To make this information useful, we need standards for storing tests, procedures, diagnoses, etc., as codes: standards for messages that carry the information from one computer system to another; standards for identifying patients, care providers, and care locations (so we can aggregate information from many sites); and standards for the structure and content of medical record systems that store this information.

Achieving Benefits in the Near Term

Preliminary standards for many of these subjects already exist and are in use in important sectors of the health care industry. If we are to have any hope of achieving any of the benefits listed above within the next five years, we must begin with these existing standards. While they are not perfect, nor are they suitable for all conceivable purposes, we will lose precious time if we start all over again rather than embrace the existing and tested approaches.

All interested parties should support the American National Standards Institute's (ANSI's) efforts to coordinate U.S. and international standards-development activities through the Healthcare Informatics Standards Planning Panel (HISPP). This position includes the requirement that one standard-setting group not duplicate the work of another. An appropriate division of labor will lead to quicker success.

The American Medical Informatics Association (AMIA) proposed the following specific approaches to standardization in the areas of medical identifiers, message exchange, medical record content, and codes. They will accelerate the adoption of computer-stored medical record systems and achieve some of their quality and efficiency paybacks quickly.

An Approach to Standard Patient, Provider, and Site of Care Identifiers

Universal identifiers for people and places are a prerequisite to any cross-institution sharing of patient data. The most important of these is the patient identifier. In addition, universal provider and place-of-care identifiers are also essential.

Patient Identifier

We recognize that the Social Security Number (SSN) can be criticized for the following reasons. First, SSNs are not currently assigned to infants and some noncitizens. Second, some patients have multiple SSNs and some SSNs are used by multiple patients. However, these criticisms can be answered. The procedure for assigning SSNs can be changed to accommodate younger patients and non-US citizens, and temporary numbers (John Doe numbers) could be assigned to deal with emergencies. Any identification system will be prone to the multiple-number problem. The methods that can be applied to increase the non-ambiguity of any newly constructed identifier could be applied to the SSN, as well. Furthermore, the SSN is a demonstrated success as a patient identifier in large existing systems such as that of the Veterans Affairs medical care centers. Obviously, the procedures and regulations associated with using the SSN as patient identifier would have to protect any breach of confidentiality.

The overriding advantage of the SSN is that any entirely new alternative would take much more time (three to ten years) and increase costs (possibly by billions of dollars). For example, it would cost $\$\frac{1}{2}$ billion to spend only $2.50 to assign a new number to and contact every man, woman, and child in the United States.

Thus, AMIA recommends the use of the SSN as the patient identifier at the present time.

In addition, we recommend the addition of a self-check digit to the SSN to reduce errors of identification whenever the number is hand-entered by an operator. Other options for patient identifiers should be explored for the long haul.

Provider Identification

The Health Care Financing Administration's (HCFA's) Universal Physician Identifier Number (UPIN) is an attractive option because it is already being supported by a government agency and its development costs have already been absorbed. However, it has some important deficiencies. It does not include all physicians (only those who care for Medicare patients). It does not include a self-check digit (to reduce errors where it must be keyed into a computer system), and if it were expanded to all care providers, as a purely numeric system, it might become unwieldy for direct human use (because of large number of key strokes and potential errors).

AMIA would support the use of the UPIN number as a national physician identifier if it were extended to include all physicians, a check digit were added, and the policy of never reassigning these numbers was continued. We suggest that HCFA consider using alphanumeric codes (to reduce the number of key strokes needed to enter the identifier to a practical

number), and that the UPIN number be expanded to include all health care providers for the purpose of provider identification.

One very strong alternative to the HCFA-assigned physician code is the prescribers' code being developed by the National Council of Prescription Drug Programs, Inc. (NCPDP) in collaboration with professional organizations such as the American Medical Association. Another alternative would be to use the provider's own SSN. ANSI's HISPP should solicit recommendations from groups such as the Computer-based Patient Record Institute (CPRI) and the Agency for Health Care Policy and Research (AHCPR) and use a consensus process to generate a best answer.

Site of Care Identifiers

Again, there are a few alternatives. The Health Industry Business Communications Council's (HIBCC's) assigned site identifiers each correspond to the address of a particular institution or office at a particular site. If the proper arrangement could be negotiated, this might be an alternative. If not, then the Medicare site identification might be expanded. Analysis of and recommendations for this would also be a task for groups such as the CPRI or the AHCPR.

An Approach to Standards for Computerized Health Care Message Exchange

When we use "institution" in the following, we mean any kind of care setting, including clinics, physicians' offices, hospitals, nursing homes, commercial laboratories, third-party payers, public health departments, and other care-providing organizations. When we refer to clinical data, we mean results of diagnostic studies, history and physical examinations, visit notes, nursing notes, vital signs, outcomes measures, and any other clinically relevant observations about the patient, including those used for clinical research, public health statistics, outcomes management, quality assurance, and so on.

For the next five years, all private and government care agencies should use published health care informatics message standards as a starting point for all new applications involving applicable internal and external health care information transmissions. Different published standards would apply to different kinds of communications, depending upon the subject matter and kind of communication as described below.

This approach would result in convergence around the standard where possible and identify areas where divergence exists. The latter areas would indicate where the standard must be expanded or changed.

Health Level 7 (HL7)

HL7 is being used in more than 150 U.S. health care institutions, including most leading university hospitals. It is being used in Japan, Germany, Sweden, and Holland, and has been adopted by Australia and New Zealand as their national standards. It is also supported by most of the large health care system vendors. It will not serve every communication need in a health care institution, and continued development is needed to obtain a message standard that will track and control all of the processes within a hospital or health care institution. (See proposal below.) However, the HL7 standard will serve the immediate purpose outlined above. Thus, AMIA recommends that HL7 be used for *within*-institution transmission of orders, clinical observations, and clinical data (including test results); admission, transfer, and discharge records; and charge and billing information.

American Standards for Testing and Materials (ASTM) E1238 Clinical Data Interchange Standard

ASTM E1238 is being used by most of the largest commercial laboratory vendors in the United States to transmit laboratory results. It is also used by many public health departments to transmit patient data required for health statistics, by pharmaceutical manufacturers to transmit clinical trial data, and by the Outcomes Management Institute (see Table 1) to transmit outcomes data. Furthermore, it has been adopted by a consortium of 25 French laboratory system vendors called Harmonization et Promotions des Informatiques Medicales (H.PR.I.M.). It should be used for most interchanges of clinical data between institutions. HL7, which is a practical superset of ASTM E1238, is an alternative when tighter linkages are desired.

American College of Radiology (ACR)/National Electrical Manufacturers Association (NEMA) Imaging Standards, ACR–NEMA Standards Publications

ACR–NEMA is supported by most radiology picture archiving and communication system (PACS) vendors, and has been incorporated into the Japanese Image Store and Carry (ISAC) optical disk system, as well as Kodak's Photo CD. Thus, ACR–NEMA should be used for the transmission of radiologic images and for message transmissions within PACS.

Table 1 ■

Suggested Code Systems for Some Subject Domains

Subject Matter	Preferred Code System	Description–Justification
Drugs	WHO drug record codes	Supported and maintained by the World Health Organization. Includes all drugs marketed internationally—an advantage to U.S. pharmaceutical manufacturers. Includes links to a hierarchical indications code (ATC) and to the American Chemical Society chemical codes for the drugs. We propose that it be added as an identifier to all drugs manufactured in the United States.
Drugs	NDC	Produced by the FDA and applied to all packages. Widely used, but not as comprehensive as the WHO codes and has no internal structure. We propose that it continue to be supported, and that the choice of use of WHO or NDC would depend upon the application.
Diagnoses	ICD9-CM	Would continue to be used where required by law and international treaty.
Diagnoses	SNOMED III	A much richer diagnostic structure than ICD9, and has a mapping to ICD9-CM.
Symptoms and findings + modifiers	SNOMED III	A quite rich catalogue of symptoms and findings.
Microbes and etiologies	SNOMED III	A rich catalogue of microbes and other etiologies.
Anatomic locations	SNOMED III	A very rich hierarchical definition of body locations.
Patient observations	ASTM (1384 & 1238-91, app A)	Provides codes for common clinical variables such as temperature, pulse, intake and output, the major components of history and physical
Patient outcome variables	Medical Outcomes Institute	A set of codes that defines all of the outcome variables used by a consortium of 30 large group practices.
Units of measure, ISO + units	ASTM 1238-91	Defines the ISO single-case abbreviations as the codes for units of measure and extends to units not covered by ISO.
ECG machine diagnoses	CEN PT007	A quite comprehensive set of codes (abbreviations) and descriptions for ECG diagnoses published as a pre-standard by CEN TC251 based on a collaboration with most of the ECG cart makers.

ASTM E1394 Clinical Laboratory Instruments to Computers

This standard, developed by a consortium consisting of most U.S. manufacturers of clinical laboratory instruments, is being implemented in the current generation of laboratory instruments. Thus, AMIA recommends the use of ASTM E1394 for communication of information from laboratory instruments to computer systems.

NCPDP Telecommunications Standard Format for Transmission of Community Pharmacy Information

This standard, which has been in use since 1985, serves almost 90% of the community pharmacies in the United States and 60% of the prescription volume. Thus, AMIA suggests that the NCPDP be used for communication of prescription billing information and eligibility information between the community pharmacies and third-party payers.

Institute of Electrical and Electronics Engineers, Inc. (IEEE) P1073 Medical Information Bus (MIB), for Control of and Linking with Critical Care Instruments

This standard has been under development and testing for almost a decade. It has the most promise for communications and control of critical care instruments.

Billing and Insurance Transmissions—Accredited Standards Committee (ASC) X12

ASC X12 has developed message standards, X12 834

Benefit Enrollment Transactions, X12 835 Health Care Payment Transactions, and X12 837 Health Care Claim Transactions. The X12 standards for billing information have been adopted by HCFA. Thus, AMIA suggests the use of ASC X12's standards for billing and remittance transactions between a health care provider and a third-party payer.

The X12N insurance and casualty group is composed almost entirely of insurance companies. It should not develop the content of standards for clinical data messages. Standards groups with existing experience and expertise should be the primary developers. X12 should also adopt the clinical content needed for insurance billing purposes.

ASTM E1460 (Arden Syntax) Standard Specification for Defining and Sharing Modular Health Knowledge Bases

The Arden syntax provides a standard format and syntax for representing medical logic for writing reminder rules and guidelines that can be automatically executed by computer systems. Thus, AMIA recommends its use for the transmission of medical logic modules.

ASTM E1467 Standard Specification for Transferring Digital Neurophysiological Data between Independent Computer Systems

ASTM 1467 is very similar in structure to ASTM E1238 and to HL7. It defines codes and structures needed to transmit the signals and results produced by electroencephalograms (EEG) and electromyograms (EMG). It is being adopted by most of the EEG and EMG systems manufacturers. Thus, AMIA recommends its use for the transmission of such EEG and EMG signals.

Messages from Applications to Bibliographic Retrieval Systems

ANSI Z39.50 is a draft standard for transmitting requests for bibliographic information to bibliographic retrieval systems. AMIA recommends that it be considered for all such communications.

European Committee for Standardization (CEN) Technical Committee for Medical Information (TC251 Project Team 007) Message Standard for Transmitting Content of Electrocardiogram Carts

CEN PT007 has developed a pre-standard for transmitting electrocardiogram (ECG) tracings, computed values, and diagnoses from ECG carts in central computer systems. AMIA recommends the use of this standard for the transmission of ECG data to clinical computer systems.

General

Transactions produced in the syntax of one standard could be sent in the syntax of another standard (e.g., from HL7 to ACR-NEMA at the option of the vendors) so long as the translated messages were direct translations of the source standard, and the translation capabilities were widely provided.

AMIA recommends that during the initial five years of standards development, the federal government invest in efforts to integrate and extend these standards to all health care messages. Furthermore, we suggest that the federal government build public-domain translators between the current message systems to permit future integration of systems. The translators should be submitted as ANSI and/or ISO standards, and would be based on the object modeling framework being developed by the joint working group created by the HISPP Message Standards Developers Subcommittee (MSDS) and coordinated by IEEE MEDIX for modeling.

An Approach to Standards for Medical Record Content and Structure

ASTM E31.12 has been working on standards for the content and structure of medical records for more than four years. They have published a consensus standard on some aspects of the problem. They represent the only standards group that has focused on this issue. With advice from AHCPR and CPRI, and in coordination with ANSI HISPP and the message standards developers, they should have the formal responsibility for developing these standards.

An Approach to Standards Codes and Terminology

Patient data are of many different kinds: laboratory information, radiology information, hospital discharge reports, operative reports, admissions and physicals, just to name a few. And they come from many sites: doctor's offices, hospitals, nursing homes, public health departments, etc. Moreover, for each kind of data and site of care, thousands of different providers exist. Consequently, standards for codes/terminology are an essential requirement for a computer-stored medical record that spans more than one provider's domain.

Table 2 ■

Other Subject Domains

Subject Matter	Preferred Code System	Description–Justification
Devices	To be established	Classifications for all major kinds of devices, Universal Medical Device Nomenclature System, available from Emergency Care Research Institute (ECRI), and the Classifications Names for Medical Devices and in Vitro Diagnostic Products, available from the FDA.
Diagnostic study identifiers (e.g., blood glucose, chest x-ray, cardiac MUGA)	To be established	This is a sorely needed category with available alternatives for some diagnostic procedures. In the United States, CPT4 defines most diagnostic procedures for professional billing. It is already in use so could be used as a first approximation. However, it creates codes for combined procedures in a non-uniform and inelegant manner. It lacks codes for most special serologic tests. It does not have codes for the observations that are components of some batteries (e.g., differential count, urinalyses—but those can be obtained from ASTM 1239-91, Appendix A). A possible choice for laboratory testing only is Euclides. At present it is a multiaxial code and may be difficult to adapt to existing laboratory systems. It is very elegant and complete, however. ASTM E31.12 is working on an alternative that is compatible with Euclides codes. SNOMED has developed but not yet published codes for diagnostic procedures.
Procedure codes	To be established	The same can be said about CPT4 here as above. CPT4 does have the advantage of current production usage. ICD-9 procedure codes are a bit more elegant (if three different procedures are performed they are not combined, but reported as separate atomic codes). SNOMED III is coming out with new codes. ICCS has a proprietary, but widely used, set of procedure codes. The READ codes include procedure codes.

The goal is to have an acceptable code system for each kind of data. It is not necessary (it may not even be desirable) to have all of the codes come from a single master code system, because computers can integrate multiple code systems easily while avoiding collisions among assigned codes by adding a code source designation. Consequently, we can create a suitable first-phase set of codes for the computer-based medical record by borrowing from many different existing code systems. Codes are needed to address (at least the following) subject domains:

- Drugs (e.g., penicillin V)
- Diagnoses (e.g., pneumonia, heart failure)
- Symptoms and findings (e.g., fatigue, swollen ankle)
- Anatomic sites (e.g., right lower lobe of lung)
- Microbes and etiologic agents (e.g., *E. coli*)
- Clinical observations (e.g., blood pressure, oral intake, physical examination of heart)
- Patient outcome variables and functional status (e.g., SF-36, Hamilton depression score, InterStudy TyPE variables)
- Medical devices (e.g., hip implant, tongue blades)
- Units of measure
- Diagnostic study results (e.g., blood glucose, chest x-ray, cardiac MUGA)
- Procedures (e.g., triple bypass surgery, endoscopy, skin care)

AMIA proposes that a first-stage medical record code system be created by borrowing from existing code systems in order to cover most of the above subject domains. In Table 1 we recommend specific code systems for some subject domains. We suggest that the federal government seek to purchase or license these code systems at a reasonable cost. In case such arrangements cannot be reached, bids should be obtained from the proprietary alternatives with advice from the HISPP and appropriate federal agencies such as the NLM, the AHCPR, and the National Center for Vital and Health Statistics. In addition to choosing coding systems, there must be a common "language"

of combining data structures and grammar so that meaningful "coded" messages can be sent between medical computer systems.

From some subject domains (Table 2), the choice of best code system is not as clear, because developments are still under way, available information is insufficient, or further development is required. Research on the available code system and/or further enhancements when necessary should be undertaken in consultation with ANSI HISPP. The maintenance and the translation of these code systems and funding their development would best be accomplished by the NLM within the context of the Universal Medical Language System (UMLS), and by the Food and Drug Administration (FDA) for medical device codes.

The members of the Board of Directors of AMIA at the time these positions were adopted were:

Michael J. Ackerman, PhD, Bethesda, MD
Marion J. Ball, EdD, Baltimore, MD
Paul D. Clayton, PhD, New York, NY
Mark E. Frisse, MD, St. Louis, MO
Reed M. Gardner, PhD, Salt Lake City, UT
Robert A. Greenes, MD, PhD, Boston, MA
William E. Hammond, PhD, Durham, NC
Lawrence C. Kingsland III, PhD, Bethesda, MD
Clement J. McDonald, MD, Indianapolis, IN
Daniel R. Masys, MD, Bethesda, MD
Perry L. Miller, MD, PhD, New Haven, CT
Randolph A. Miller, MD, Pittsburgh, PA
Joyce A. Mitchell, PhD, Columbia, MO
Judy G. Ozbolt, PhD, RN, Charlottesville, VA
William W. Stead, MD, Nashville, TN

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Sources for Standards and Code Systems

ACR-NEMA	National Electrical Manufacturers Association, 2101 L St. NW, Washington, DC
ASC X12	X12 DISA, 1800 Diagonal Road, Suite 355, Alexandria, VA
ASTM	American Society of Testing and Materials, 1916 Race Street, Philadelphia, PA
CEN PT007	European Committee for Standardization Central Secretariat: rue de Stassart 36, B-1050, Brussels, Belgium
ECRI	Emergency Care Research Institute, 5200 Butler Pike, Plymouth Meeting, PA
EUCLIDES TC251	Euclides Foundation International, Excelsiorlaan 4A, B-1930 Zaventem, Belgium
HL7	Health Level Seven, 900 Victors Way, Ann Arbor, MI
ICD9-CM	Commission on Professional and Hospital Activities, 1968 Green Road, Ann Arbor, MI [includes all procedures and diagnostic tests]
IEEE MIB and MEDIX	IEEE Standards Dept., 445 Hoes Lane, Piscataway, NJ
Medical Outcomes Institute	2001 Killebrew Drive, Suite 122, Bloomington, MN
NCPDP	National Council for Prescription Drug Programs, 4201 North 24th Street, Phoenix, AZ
NDC	National Drug Code Director, FDA, Rockville, MD
SNOMED III	College of American Pathologists, 325 Waukegan Road, Northfield, IL 60093-2750
WHO drug codes	INTDIS, P.O. Box 26, S-751 03 Uppsala, Sweden