Designation: E2473 – 05 (Reapproved 2011)

An American National Standard

Standard Practice for the Occupational/Environmental Health View of the Electronic Health Record[1]

This standard is issued under the fixed designation E2473; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This Practice is intended to assemble a logical occupational/environmental health view of the already defined general structure and vocabulary for the Electronic Health Record (EHR) and to suggest the ways in which this view can be used to support employee health assessments and other healthcare delivered at the work site. This view is consistent with the ANSI/ADA Clinical Concept Data Model 2005, which identified the major data entities that will need to be involved. This view would complement other views addressed in other settings of care for the employee and could logically either request other EHR data or deliver to other practitioner requester's record systems portions of occupational/environmental health data that have been recorded at the work site. This practice does not deal with the specific implementation of the content and it also does not either suggest or recommend implementation techniques. Likewise, it does not suggest standards of care. These functions are dealt with in other domains.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1239 Practice for Description of Reservation/Registration-Admission, Discharge, Transfer (R-ADT) Systems for Electronic Health Record (EHR) Systems

E1340 Guide for Rapid Prototyping of Information Systems

E1384 Practice for Content and Structure of the Electronic Health Record (EHR)

E1578 Guide for Laboratory Information Management Systems (LIMS)

E1633 Specification for Coded Values Used in the Electronic Health Record

E1714 Guide for Properties of a Universal Healthcare Identifier (UHID)

E1715 Practice for An Object-Oriented Model for Registration, Admitting, Discharge, and Transfer (RADT) Functions in Computer-Based Patient Record Systems

E1744 Practice for View of Emergency Medical Care in the Electronic Health Record

E1762 Guide for Electronic Authentication of Health Care Information

E1869 Guide for Confidentiality, Privacy, Access, and Data Security Principles for Health Information Including Electronic Health Records

E1986 Guide for Information Access Privileges to Health Information

E1987 Guide for Individual Rights Regarding Health Information (Withdrawn 2007)[3]

E1988 Guide for Training of Persons who have Access to Health Information (Withdrawn 2007)[3]

E2017 Guide for Amendments to Health Information

E2066 Guide for Validation of Laboratory Information Management Systems

E2084 Specification for Authentication of Healthcare Information Using Digital Signatures (Withdrawn 2009)[3]

E2085 Guide on Security Framework for Healthcare Information (Withdrawn 2009)[3]

E2086 Guide for Internet and Intranet Healthcare Security (Withdrawn 2009)[3]

E2145 Practice for Information Modeling

E2147 Specification for Audit and Disclosure Logs for Use in Health Information Systems

E2171 Practice for Rating-Scale Measures Relevant to the Electronic Health Record

2.2 *ANSI/IEEE Standards:*[4]

ANSI/IEEE 610.2 Standard Glossary of Computer Applications Terminology

ANSI/IEEE 610.5 Standard Glossary of Information Management Terminology

[1] This practice is under the jurisdiction of ASTM Committee E31 on Healthcare Informatics and is the direct responsibility of Subcommittee E31.25 on Healthcare Data Management, Security, Confidentiality, and Privacy.

Current edition approved May 1, 2011. Published May 2011. Originally approved in 2005. Last previous edition approved in 2005 as E2473 05. DOI: 10.1520/E2473-05R11.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

ANSI/IEEE 610.12 Standard Glossary of Software Engineering Terminology
ANSI/IEEE 729 Fundamental Terms in Software Engineering
ANSI/IEEE 830 Software Requirements Specification
ANSI/IEEE 1058 Software Project Management Plans
ANSI/IEEE 1062 Recommended Practice for Software Requirements
ANSI/IEEE 1063 Software User Documentation
ANSI/IEEE 1073 Framework and Overview
ANSI/IEEE 1073.2 Application Profile Framework and Overview
ANSI/IEEE 1073.3.1 Transport Profile
ANSI/IEEE 1073.4.1 Physical Layer-Cable Connected
ANSI/IEEE 1074 Standard for Developing Life Cycle Processes
ANSI/IEEE 1074.1 Guide for Developing Life Cycle Processes
ANSI/IEEE 1220 Standard for Application and Management of the System Engineering Process
ANSI/IEEE 1233 Guide to Preparing System Requirements Specifications
ANSI/IEEE 1320.1 Standard for Conceptual Modeling Language—Syntax and Semantics for IDEF0
ANSI/IEEE 1320.2 Standard for Conceptual Modeling Language—Syntax and Semantics for IDEF1X97 (IDEF Object)
ANSI/IEEE 1362 Guide for Information Technology—System Definition—Concept of Operations Document
ANSI/IEEE 1490 Guide to Project Management Body of Knowledge
ANSI/IEEE 1498 Trial Use Standard for Information Technology—Software LifeCycle Processes—Software Development: Acquirer—Supplier Agreement
ANSI/IEEE 12207.0 Standard for Information Technology—Software Life Cycle Processes
ANSI/IEEE 12207.1 Guide for Information Technology—Software Life Cycle Processes—Life Cycle Data
ANSI/IEEE 12207.2 Guide for Information Technology—Software Life Cycle Processes—Implementation Considerations
IEEE P1157.1 Trial Use Standard for Healthcare Data Interchange—Information Model Methods

2.3 *ANSI/HL7 Standards:*[4]
ANSI/HL7 Interface Standard v2.4
HL7 Message Development Framework v 3.0 Jan 1997

2.4 *ISO Standards:*[4]
ISO/IEC TR 9789 Information Technology—Guidelines for the Organization and Representation of Data Elements for Data Interchange—Coding Methods and Principles
ISO 12200 Computer Applications in Terminology—Machine-Readable Terminology Interchange Format (MARTIF)—Negotiated Interchange
ISO 12620 Computer Applications in Terminology—Data Categories
ISO IS 12207 Information Technology-Software Life Cycle Processes
ISO IS 15188 Project Management Guidelines for Terminology Standardization
ISO WD 15288 System Life Cycle Processes
ISO 15440 Guide for Life Cycle Processes

2.5 *Other Standards:*
ANSI X3.172 American National Dictionary for Information Systems
ANSI/ADA TR 1039 2005 Clinical Content Data Model
ANSI/ADA 1000.0 Introduction, Model Architecture, and Specification Framework
ANSI/ADA 1000.1 Individual Identification
ANSI/ADA 1000.2 Codes and Nomenclature
ANSI/ADA 1000.3 Individual Characteristics
ANSI/ADA 1000.4 Population Characteristics
ANSI/ADA 1000.5 Organization
ANSI/ADA 1000.6 Location
ANSI/ADA 1000.7 Communication
ANSI/ADA 1000.8 Healthcare Event
ANSI/ADA 1000.9 Health Materiel
ANSI/ADA 1000.10 Health Services
ANSI/ADA 1000.11 Health Service Resources
ANSI/ADA 1000.12 Population Health Facts
ANSI/ADA 1000.13 Patient Health Facts
ANSI/ADA 1000.14 Health Condition Diagnosis
ANSI/ADA 1000.15 Health Service Plan
ANSI/ADA 1000.16 Patient Health Service
ANSI/ADA 1000.17 Clinical Investigation
ANSI/ADA 1000.18 Comments Subject Area
DICOM Supplement 15 Visible Light Image, Anatomic Frame of Reference, Accession and Specimen for Endoscopy, Microscopy, and Photography
CEN ENV 1613 Medical Informatics—Messages for the Exchange of Laboratory Information
CEN ENV 1614 Healthcare Informatics—Structure for Nomenclature, Classification and Coding of Properties in Clinical Laboratory Sciences
CEN EN 12017 Medical Informatics Vocabulary (MIVoc)
CEN EN 12264 Categorical Structures of Systems of Concepts—Model for Representation of Semantics (MOSE)
Internet RFC 1521 N. Borenstein, N Freed MIME [Multipurpose Internet Mail Extensions] Purpose: Mechanisms for Specifying and Designating the Format of Internet Message Bodies Bellcore Innosoft Sep 1993
ANSI X12
CLSI AUTO1-A Laboratory Automation: Specimen Container/Specimen Carrier
CLSI AUTO2-A Laboratory Automation: Bar codes for Specimen Container Identification
CLSI AUTO3-A Laboratory Automation: Communications with Automated Clinical Laboratory Systems, Instruments, Devices and Information Systems
CLSI AUTO4-A Laboratory Automation: Systems Operational Requirements, Characteristics and Information Elements
CLSI AUTO5-A Laboratory Automation: Electromechanical Interfaces

ANSI/ CLSI ASTP2 Point of Care In-vitro Diagnostic Testing
ANSI/CLSI GP19 Laboratory Instruments and Data Management Systems: Design of Software User Interfaces and Software Systems Validation, Operations and Maintenance
CLSI LIS-3A (prior ASTM E792) Guide for Procurement of a Clinical Laboratory Information Management System (CLIMS)
CLSI LIS-5A (prior ASTM E1238) Specification for Transferring Clinical Observations Between Independent Computer Systems
CLSI LIS-1A (prior ASTM E1381) Specification for Low Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems
CLSI LIS-2A (prior ASTM E1394) Specification for Transferring Information Between Clinical Instruments and Computer Systems
CLSI LIS-7A (prior ASTM E1466) Specification for Use of Bar Codes on Specimen Tubes in the Clinical Laboratory
CLSI LIS-8A (prior ASTM E1639) Guide for Functional Requirements of Clinical Laboratory Information Management Systems
CLSI LIS-9A (prior ASTM E2118) Guide for Coordination of Clinical Laboratory Services Within the Electronic Health record Environment and Networked Architectures
IUPAC/IFCC Silver Book: Compendium of Terminology and Nomenclature of Properties in Clinical Laboratory Sciences
IUPAC/IFCC Properties and Units in Clinical Laboratory Sciences X Properties and Units in General Clinical Chemistry
IUPAC/IFCC Properties and Units in Clinical Laboratory Sciences XII Properties and Units in Clinical Pharmacology and Toxicology

3. Terminology

3.1 *Definitions:*

3.1.1 *case*—an Occupational/Environmental Health event in which one or more individuals and locations are found to exhibit measurements of environmental stressors that are at variance with criteria that define normative states.

3.2 *Acronyms:*

3.2.1 *CAP*—College of American Pathologists

3.2.2 *CDC*—Centers for Disease Control and Prevention, Dept. of Health and Human Services

3.2.3 *CDSS*—Clinical Decision Support Systems

3.2.4 *CLIMS*—Clinical Laboratory Information Management System

3.2.5 *CLSI*—Clinical and Laboratory Standards Institute

3.2.6 *CPR*—Computer-based Patient Record

3.2.7 *DHHS*—Department of Health and Human Services

3.2.8 *EC*—Electronic Commerce

3.2.9 *EDI*—Electronic Data Interchange

3.2.10 *EHR*—Electronic Health Record

3.2.11 *EPA*—Environmental Protection Agency

3.2.12 *HIN*—Health Information Network

3.2.13 *IDS*—Integrated Delivery Systems

3.2.14 *ISA*—Information Systems Architecture

3.2.15 *LAS*—Laboratory Automation System

3.2.16 *LIMS*—Laboratory Information Management System

3.2.17 *MDSS*—Management Decision Support System

3.2.18 *MCO*—Managed Care Organization

3.2.19 *MPI*—Master Person/Patient Index

3.2.20 *NCVHS*—National Committee on Vital and Health Statistics

3.2.21 *NIOSH*—National Institute for Occupational Safety and Health

3.2.22 *NPF*—National Provider File

3.2.23 *NPI*—National Provider Identifier

3.2.24 *NPS*—National Provider System

3.2.25 *OSHA*—Occupational Safety and Health Administration

3.2.26 *POC*—Point-of-Care

3.2.27 *POCT*—Point-of-Care Testing

3.2.28 *PPO*—Preferred Provider Organization

3.2.29 *SSAN*—Social Security Account Number (also SSN)

3.2.30 *UMLS*—Unified Medical Language System

3.2.31 *VHA*—Veteran's Health Administration

3.2.32 *VistA*—VHA Information Systems Technology Architecture

4. Significance and Use

4.1 This practice is directed at defining the application of existing conventions for the structure and content of EHR systems used to support healthcare practitioners in a workplace setting. In addition to supporting the capture of data on encounters and of periodic patient health assessments conducted during the time the employee is at work, this document also recognizes the interaction of care rendered over a lifetime and when not at work with that due to the work environment that is delivered on the work site, either for care events that have occupational significance or for surveillance of potential health conditions that may result from the work or living environment. This document recognizes not only the privacy and confidentiality of records that are kept in the work setting but also the need to be able to interchange data from the workplace record with health records in other settings in order to fully support employee and environmental health.

4.2 *Occupational Health Programs:*

4.2.1 Most occupational health programs are oriented, first, to any regular surveillance for observations associated with potentially adverse health conditions known to attend environmental stressors that may be present in either the workplace or the living environment and, second, to care and documentation of any illness or injury incurred during the workday at the work site or in other living environments. Each of these activities requires recording data for the care record that is a subset of that regularly required for care in other more extensive

ambulatory and inpatient care settings. It also requires relating the events occurring in either the work place or the living environment to those observed healthcare data.

4.2.2 This practice is intended to identify the most frequently used of the general data elements which are more completely documented in Practice E1384 and Specification E1633. Thus, this description constitutes a "view" of the more comprehensive set of data that might be captured in a general ambulatory care encounter. If the conventions given in this document are adhered to, the data will ensure a record that is portable to any other setting and the record will be interoperable with other standards conformant systems, regardless of their implementation techniques. Fig. 1 shows the interrelationships of the basic information domains that support Occupational/Environmental Health programs within healthcare. The Care Record subdomain embraces the conceptual content and structure that have been documented in Practice E1384 and associated standards. Resource Management and Epidemiology data analytic functions and subdomains are documented elsewhere in descriptions of the requirements of the HIPAA legislation and the CDC Public Health Information Network—PHIN(X). The Occupational Health Programs are generally organized in employing organizations, but healthcare enterprises need to also recognize that they too are "employers" in the same sense as any other societal business organization and that their employees, including all healthcare practitioners, as well as their associate professional discipline colleagues, are entitled to management of their occupational health information by the same principles. Thus, occupational health information management is intrinsic to management of all information in the healthcare enterprise and sets the stage for the management of information of the enterprise's "Patient" population. An occupational/environmental health "case" is defined to be that informational record that identifies a specific instance of an occupational/environmentally induced health condition and its associated attributes from the patient care and environmental assessment records that will enable resolution of both the health condition and the causal environmental factors

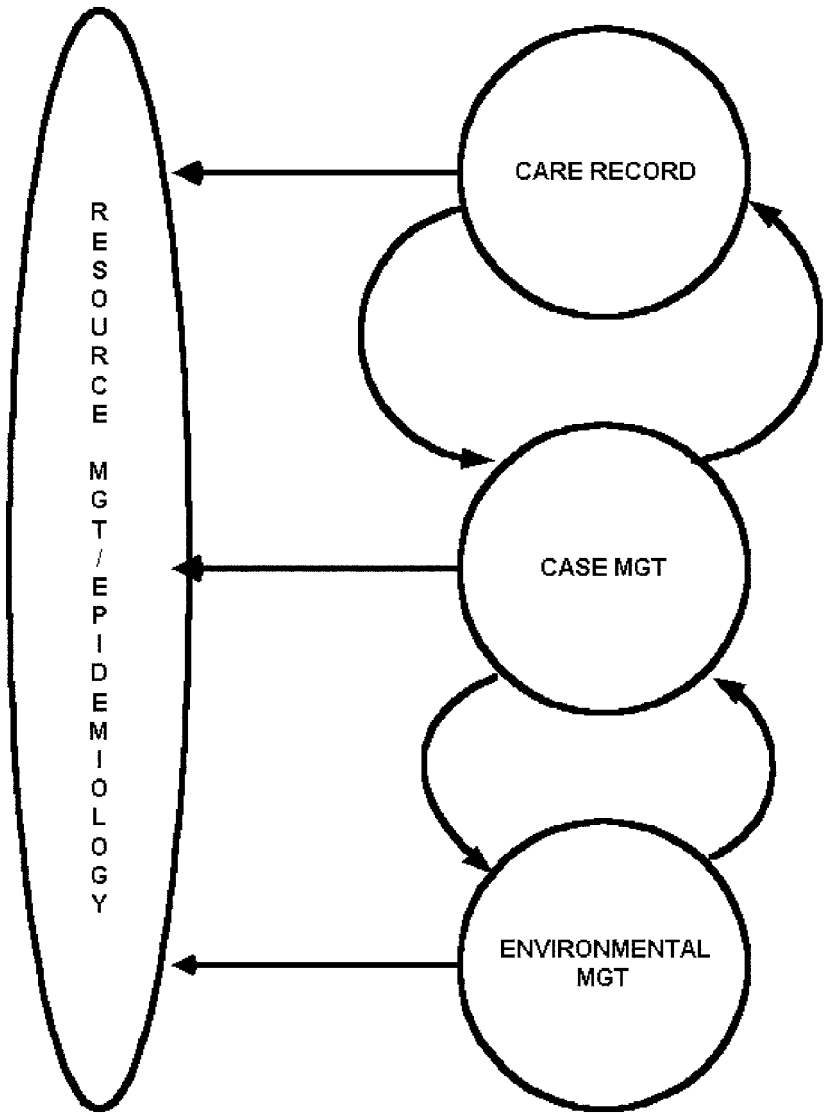

FIG. 1 Occupational/Environmental Health Information Subdomains

associated with it. The handling of "cases" relating to adverse effects of stressors in with general living environment is somewhat different since the adverse effects are usually first detected by the individual's personal practitioner and then only indirectly related to environmental events. These cases are not tracked organizationally in the same way that is used for those in the workplace. Even in workplaces for very small businesses, the environmental effects of the workplace are usually detected in this latter unstructured fashion and these "cases" are not currently formally tracked, nor is environmental monitoring performed.

4.3 *Reportable Data*—Certain data about care events are required to be regularly reported to public authorities, state or federal. These include occupational illness or injury. These reportable data constellations are subsets of the occupational health "view" described here and do not include all of the attributes of the "view." Such "Reportable Data" are explicitly defined. These data can be composed into electronic messages for transmission to reporting authorities. While this "view" does not deal with the format of such messages, its constituent data elements provide the fields needed to compose such messages. For discussion of reportable data, consult Refs. (**1, 2**).[5]

4.4 *Health Surveillance Processes*—Health Surveillance processes supporting Occupational/Environmental Health begin with the Basic Patient Care Scenario given in Practice E1384. In occupational/environmental healthcare, the "patient" must first be registered and have updated demographic data available to the sites who give care for the illnesses and injuries resulting from either the occupations or the general living environment. Likewise, periodic environmental assessment measurements must be posted to the susceptible individuals' patient record. When a health event occurs, provoking the individual to visit a healthcare enterprise, the individual demographic information must be easily accessible during the event encounter's Receipt Phase. Attributes of that phase denote potential occupational or environmental involvement in the health condition(s) assessed during the Activities Phase of the Encounter. The care data is captured during the encounter and is related to the individual's recorded environmental exposure measurements. These observations become the source of reportable data that supports surveillance. Those encounter attributes also control the data that flows to all of the various other (for example, public health) information domains at the completion of the encounter. For best followup, the data captured in the EHR need to identify either the living or the work locations and associated activities that produce the adverse health events that may potentially be related either to the living or the work environment.

4.5 *Occupational/Environmental Healthcare Processes*—The individual's "Employer," if there is one that has a healthcare facility and staff to service the health problems of individuals employed by the organization, will have a different approach than that for small businesses who rely on the individual employee's private practitioner, regardless of the healthcare payer arrangements. "Workman's Compensation" arrangements primarily address the financial management functions rather than the health condition issues and the situations that led to them, particularly if these illnesses or injuries might have been caused by the work environment. Worker's Compensation does not presently fully address the reasons for the inability to return to work due to the health condition, but rather provides limited stipends for a specified period. Particularly when the employer relies solely on the individual's practitioner, the mechanisms are not yet well defined by which the employee can progressively return to work in an healthcare-supervised fashion and by which the work environment situations leading to the injury or illness are actively addressed in order to remedy their causes. These mechanisms should include such functions as steps to identify the environmental causes of stressors in either general living or small business settings and the causes of injury in all settings. In industrial or large businesses, there may be specific staff responsible for monitoring the work environment, but in small businesses these capabilities should be also available via other arrangements that are triggered by the nature of the documented health conditions and a tracking of their source to the specific work or living environment settings. The business organization structures, the functional responsibilities and the associated data and data flows need documentation based upon common specific arrangements that can be made by the employer organization. Other arrangements regarding environmental health conditions associated with the non-employed should also be possible with respect to the individual's private practitioner, and these arrangements should relate to patient-centered care issues. It is these processes that characterize what may be termed the "Occupational/Environmental Healthcare Processes" as differentiated from the specific "Patient Care Processes."

4.6 *Environmental Assessment Processes*—The "Occupational/Environmental Healthcare Processes" are complemented by the "Environmental Assessment Processes," which include the familiar monitoring of elements such as air and water for environmental contaminants. What is needed for a comprehensive treatment of occupational and environmental health, either within the workplace or outside of it, is a description of the flow of information among the environmental and health care professional disciplines, such that each role is clearly defined and the contribution of each role in specified situations is recognized with regard to a healthy population in and out of the workplace. It is critical to define how information about the environment to which individuals are exposed, both during the workday and outside of it, is made available to the documented healthcare practitioners serving those individual "patients" through being posted to appropriate patient records. The present kinds of environmental assessment information are well known, but how they are used to create integrated multidisciplinary care process relationships that lead to "Patient-Centered Care" is not presently well documented. Section 5 will address this need.

[5] The boldface numbers in parentheses refer to the list of references at the end of this standard.

5. An Occupational/Environmental Health Information Model

5.1 *Conceptual Model of Relationships of Occupational/Environmental Health within Healthcare*—As noted in 4.2, looking at the overall four information subdomains, these breakdown into conceptual entities which must be related to those data that are maintained in the Care Record now referred to as the Electronic Health Record (EHR), which has a much more specific structure than the commonly stated unspecific "Clinical Data Repository" term. The general implications of the points made in Section 4 are that the occupational/environmental health usages of the EHR data elements depend upon the particular needs of the individual work/living setting. If these data elements are used, then they are common to their usage by other practitioners, such as the employees personal family practitioner(s). Thus they complement the data in the "Case Management" subdomain of Fig. 1 in the sense that the "Case" is a problem/health condition that results from an environmental situation in the workplace that must be concurrently managed in order to ensure that the environment no longer causes such problems/health conditions identified in either the specific individual or in other individuals in that work/living environment setting. For that reason, the conceptual objects involved in the individual enterprise information architecture need to be approached in a unified way from an "Enterprise View." Fig. 2 presents the key conceptual objects that should be considered. This diagram should also be considered in the context of the Model for the Registration, Admitting and Discharge core model that underpins not only the EHR but also all supporting ancillary services used in healthcare, as documented in Practices E1239 and E1715, and extended for the clinical laboratory ancillary service domain by Practice CLSI LIS-8A. Fig. 2 also notes those conceptual objects that deal with those attributes of the occupational/environmental health domains dealt with by the Environmental Health Laboratories which post information to EHR components within the healthcare enterprise information architecture that support both the "Case Management" and the "Environmental Management" functions of the defined "Enterprise." For healthcare providers that deliver healthcare services to a variety of "Employers," careful definition of these information subdomains will be required if an effective information architecture for supporting these functions is to be achieved. Both the process and data models associated with these conceptual entities are dealt with below in 5.2 and 5.3 respectively. The data objects used for each function is given in Table 3.

5.2 *Process Model for Occupational/Environmental Health Functions*—The processes discussed in Section 4 can be represented in the general model shown in Fig. 3. These functions, given in Table 1, reflect those given in the basic Core EHR Functional Model given in Table 2 (see also Practice E1239). The relationship of the processes to the EHR functions given in the public health perspective and HL7 EHR functional model described in Ref (**1**) is not yet clear because the conceptual linkages between the various public health agencies involved in environmental issues and the patient care settings for occupational/environmental care has not yet been described. Such linkages will need to clearly depict how environmental data would transparently aid in clinical decision support of occupational/environmental care by practitioners, in addition to its epidemiologic and environmental policy roles.

5.2.1 *Functional Model Scenarios*—Two key Scenarios, Occupational and Environmental, can be described to illustrate how these functions might be applied within these basic situations. These will now be described.

5.2.1.1 *Occupational*—In occupational settings, the employer would offer occupational care facilities and maintain an EHR to capture health data with respect to the workplace, including capturing stressor data for workplace locations; these stressor exposure data would be located in the EHR as described in Practice E1384 and would be accessible to appropriate occupational health practitioners. Such data would be obtained as part of a designated environmental monitoring protocol for identified work locations. At designated times environmental samples would be taken and subsequently analyzed by a designated environmental laboratory. The environmental measurement data for each date-time and location would be posted to a posting file. The occupational health facility for each employee (whose work location and appropriate dates would be known in the EHR) would, on a designated schedule, access this posting file and copy the appropriate measurement entries to the employee stressor exposure segment of the EHR. When the employee has an encounter (either scheduled or ad hoc), this updated segment is viewed by the practitioner during the assessment phase, clued by entries in the Health Condition/Problem List segment that the employee is at risk for identified environmental stressors. These alerts may stimulate requested clinical lab services for biomarkers in patient specimens and specific examination observations potentially related to exhibited adverse effects of environmental stressors. Presence or absence of appropriate observations would trigger appropriate statements to be recorded in the record of such encounters. These recorded encounter entries will provide clues to the occupational health service practitioners for early detection and characterization of adverse effects of identified environmental stressors and, if such adverse effects are detected, develop both a care treatment plan and an environmental remediation plan to deal with both the effects and the cause respectively. In addition, identified reportable data sets can be electronically prepared and sent from the recorded EHR data to designated public health agencies. Additional analytical data sets for the employer can also be abstracted from the EHR and used in the occupational health management process. If the care process requires coordinated activities by the employee's private practitioner, appropriate EHR abstracts can be electronically forwarded (with appropriate privacy/confidentiality caveats) to that practitioner as directed by the occupational health practitioner staff. These steps should ensure patient-centered, multidisciplinary, evidences-based and quality care in the workplace.

5.2.1.2 *Environmental*—In general living settings where, for example, there may be exposure by residents of a given community to such stressors as arsenic, lead, selenium or organic industrial pollutants that enter the air or drinking water that subsequently show up in exhibited health conditions that

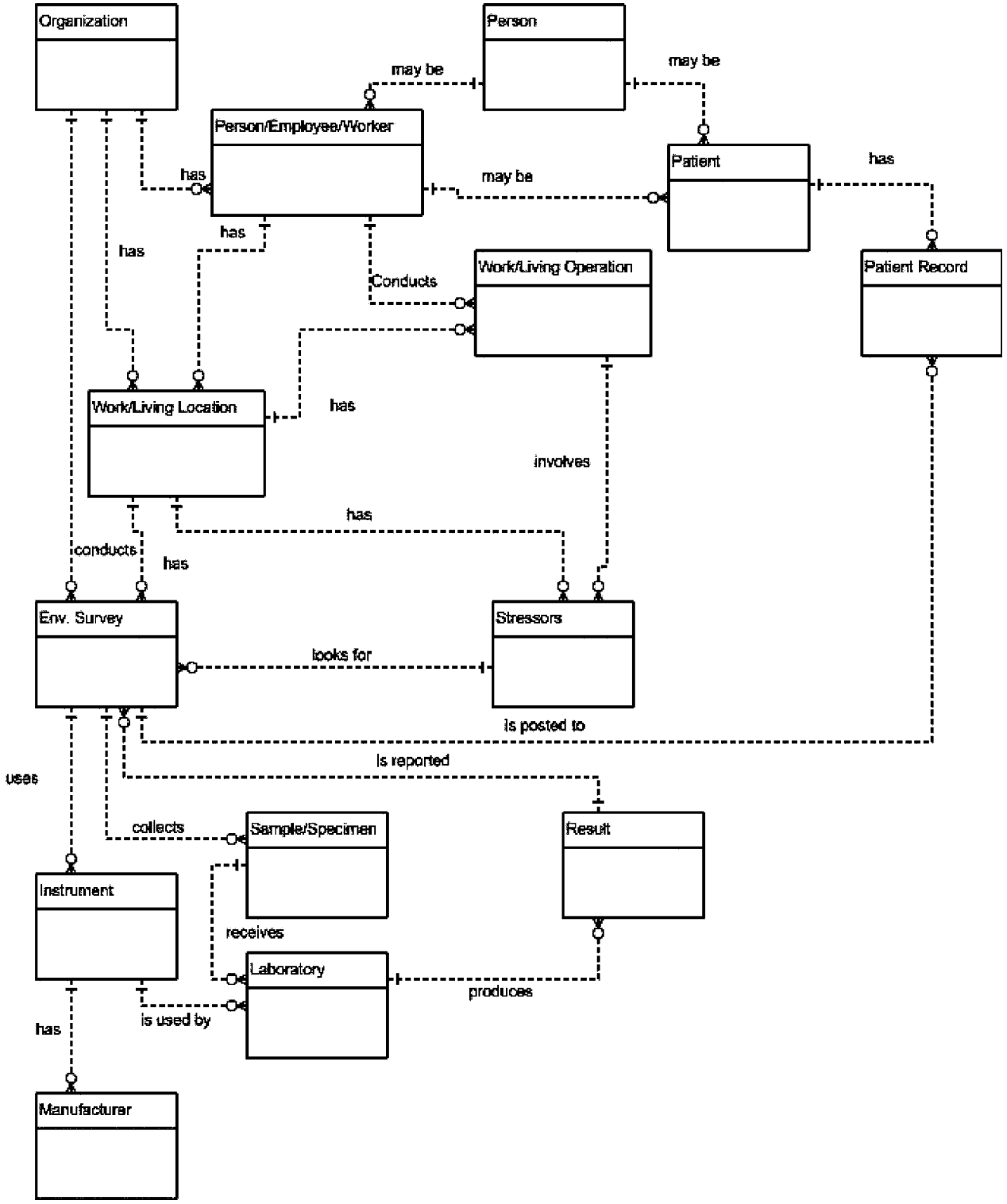

FIG. 2 Conceptual Occupational/Environmental Health Data Model

could be detected by the private practitioners of those residents, if given sufficient clues about potential exposures. This situation will require appropriate health professional specialty education and alerting that is supported by effective and convenient data sources. The environmental information needed by the practitioners can be supplied by an appropriate information architecture that contains components not only for the EHR but also for collecting and posting to the EHR those data applicable to specific patients. This data posting mechanism will be more complex than that for occupational healthcare settings because of the breadth and diversity of the geographic and social settings; different regions may have

TABLE 1 Functions Supporting the Occupational/Environmental Health View of the EHR

NOTE 1—Basic Core Functional Model Functions are in **bold** .

Occupational:

Employer
Employ Workers
Assign Workers
Manage Work Activities
Plan Surveillance Protocol
Post Occupational Activities
Evaluate Work Activities

Care:

Patient
Categorize Living Activities
Register Patients **REG**
Post Patient Environmental Assignments
Practitioner Assignment **ASSGN**
Conduct Encounter **ENOT**
Make Assessment: Health History **HIST**
Make Assessment: Examination **EXM**
Make Assessment: Health Condition/Problem **HCPL**
Make Clinical Laboratory Patient Measurements
Coordinate Patient and Environmental Measurements
Evaluate Occupational/Environmental Factors
Interpret Environmental Measurements
Plan Treatment **TPL**
Issue Clinical Orders **CCO**
Make Disposition: Report Environmental Factors to Relevant Public Health Agencies
Make Disposition: Develop Followup Plan
Report Adverse Living/Workplace Factors

Healthcare Provider
Monitor List of Employers
Monitor List of Environmental Locations
Monitor List of Public Health Agencies

Public Health:

Plan Environmental Surveillance
Plan Environmental Monitoring
Monitor Environment with Measurements
Post Environmental Data to Healthcare Enterprises
Plan Environmental Remediation
Interpret Environmental Measurements

TABLE 2 EHR Core Model Patient Care Functions

Abbrev.	Function Name
	Administrative
MPI	Patient/Person Indexing [EHR03MPI]
PRREG	Register Practitioners/Staff [EHR031]
REG	Register Patient [EHR031]
ASSGN	Assign Practitioner [EHR032]
PSAC	Patient Screening/Acceptance[EHR03222]
APPTS	Create Patient Appointments [EHR032]
	Assessment
ENOT	Enter Encounter Data [EHR03224]
HIST	Get Patient Health History [EHR03222]
ESTR	Document Exposure to Environmental Stressors [EHR03222]
EXM	Record Patient Examination[EHR03222]
HSTAT	Assess Patient Health Status[EHR03222]
HCPL	Input Health Condition/Problem List[EHR03222]
	Treatment Planning
TPL	Prepare Treatment Plans [EHR03223]
CCO	Create Clinical Orders [EHR03223]
PEDC	Patient Education/Communication Capability [EHR03223]
RCON	Request Patient Referral/Consult [EHR03223]
	Infrastructure
CHAUD	Conduct Chart Audits [EHR01]
CHTR	Track Paper Charts [EHR01]
PCQA	Patient Care Quality Assurance [EHR02]
REFDM	Referential Data Maintenance [EHR01]
PRT	Patient Record Transfer [EHR01]

different governmental or private organizational participants, but these will operate very similarly to the situation in occupational settings. Thus the common conventions for environmental health business operations will parallel the informatics common conventions for the EHR and data exchange. The individual's private practitioner would maintain an EHR to capture health data with respect to the living environment, including capturing stressor data for community locations; these stressor exposure data would be located in the EHR as described in Practice E1384 and would be accessible to appropriate private practitioners. Such data would be obtained as part of a designated environmental monitoring protocol for identified community locations. At designated times, environmental samples would be taken and subsequently analyzed by a designated environmental laboratory. The environmental measurement data for each date-time and location would be posted to a posting file. The health facility for each patient (whose residential location and appropriate dates would be known in the EHR) would, on a designated schedule, access this posting file and copy the appropriate measurement entries to the patient stressor exposure segment of the EHR. When the patient has an encounter (either scheduled or ad hoc), this updated segment is viewed by the practitioner during the assessment phase, clued by entries in the Health Condition/Problem List segment that the patient is at risk for identified environmental stressors. These alerts may stimulate requested clinical lab services for biomarkers in patient specimens and specific examination observations potentially related to exhibited adverse effects of environmental stressors. Presence or absence of appropriate observations would trigger appropriate statements to be recorded in the record of such encounters. These recorded encounter entries will provide clues to the private practitioners for early detection and characterization of adverse effects of identified environmental stressors and, if such adverse effects are detected, develop both a care treatment plan and help develop a community environmental remediation plan to deal with both the effects and the cause, respectively, of community environmental stressors. In addition, identified reportable data sets can be electronically prepared and sent from the recorded EHR data to designated public health agencies. These steps should ensure patient-centered, multidisciplinary, evidences-based, and quality environmental health care in the community.

5.3 *Data Model for Occupational/Environmental Health*—The Core EHR Data model, given in Fig. 4, and the Data Model for the Occupational/Environmental Health View of the EHR, which is an extension of that core and is given in Fig. 5, represent how the data needed for integrated occupational/environmental patient care draw on the defined structure for the basic EHR. The mapping of data objects to the functional activities given in 5.2 is given in Table 3. The attributes of the data objects are given in 5.3.2.

TABLE 3 Function/Data Relationships

Function	Data Objects
Employ Workers	Organization, Employer, Worker
Assign Workers	Location, Work Location
Manage Work Activities	Location, Work Location, Work Operation
Evaluate Work Activities	Location, Work Location, Work Operation
Plan Surveillance Protocol	Survey, Location
Post Occupational Activities	Work Operation
Categorize Living Activities	Living Activity
Register Patients	Person, Patient, Healthcare Enterprise
Post Patient/Environmental Assignments	Health History
Conduct Encounter	Patient, Encounter
Make Assessment: Health History	Health History
Make Assessment: Examination	Exam, Diagnostic Tests
Make Assessment: Health Condition/Problem	Health Condition
Make Clinical Laboratory Patient Measurements	Diagnostic Test, Clinical Orders, Laboratory, Clinical Laboratory
Coordinate Patient and Environmental Measurements	Diagnostic Test, Environmental Measurement
Evaluate Occupational/Environmental Factors	Health Condition
Plan Treatment	Treatment Plan
Issue Clinical Orders	Clinical Order, Patient
Make Disposition: Report Environmental Factors to Relevant Public Health Agencies	Person, Patient, Environmental Measurement, Environmental Location
Make Disposition: Develop Followup Plan	Patient, Encounter
Report Adverse Living/Workplace Factors	Environmental Location, Environmental Measurement
Monitor List of Employers	Employer
Monitor List of Environmental Locations	Location, Work Location, Environmental Location, Instrument, Environmental Specimen
Monitor List of Public Health Agencies	Organization
Plan Environmental Monitoring	Organization, Environmental Measurement
Monitor Environment with Measurements	Environmental Measurement, Environmental Laboratory, Laboratory
Post Environmental Data to Healthcare Enterprises	Patient, Environmental Specimen
Plan Environmental Remediation	Organization
Interpret Environmental Measurements	Environmental Measurement, Stressor

5.3.1 *Business Process Correlates of the Data Model*—The data object relationships implied in Fig. 5 are that, by identifying the Work Operations and the Work/Environmental Locations associated with the Employee/Patient and by documenting the environmental sampling regimen associated with that location, the specimens taken for analysis will yield environmental measurements for that work/living location. These environmental measurements can be posted to individual patient records with sufficient identifying attributes for the analyzing laboratory, and its associated environmental scientist, so that, should the Patient's Healthcare Practitioner find an association of the environmental measurement with a Patient's Health Condition and need further information about the Work/Environmental Location and its associated population, then an expeditious contact with the Environmental Scientist can be made to arrive at an appropriate interpretation of the Environmental Measurement. The implemented specific healthcare enterprise and regional information architectures would determine how such specific communications would occur but could be achieved by use of standards defined message formats.

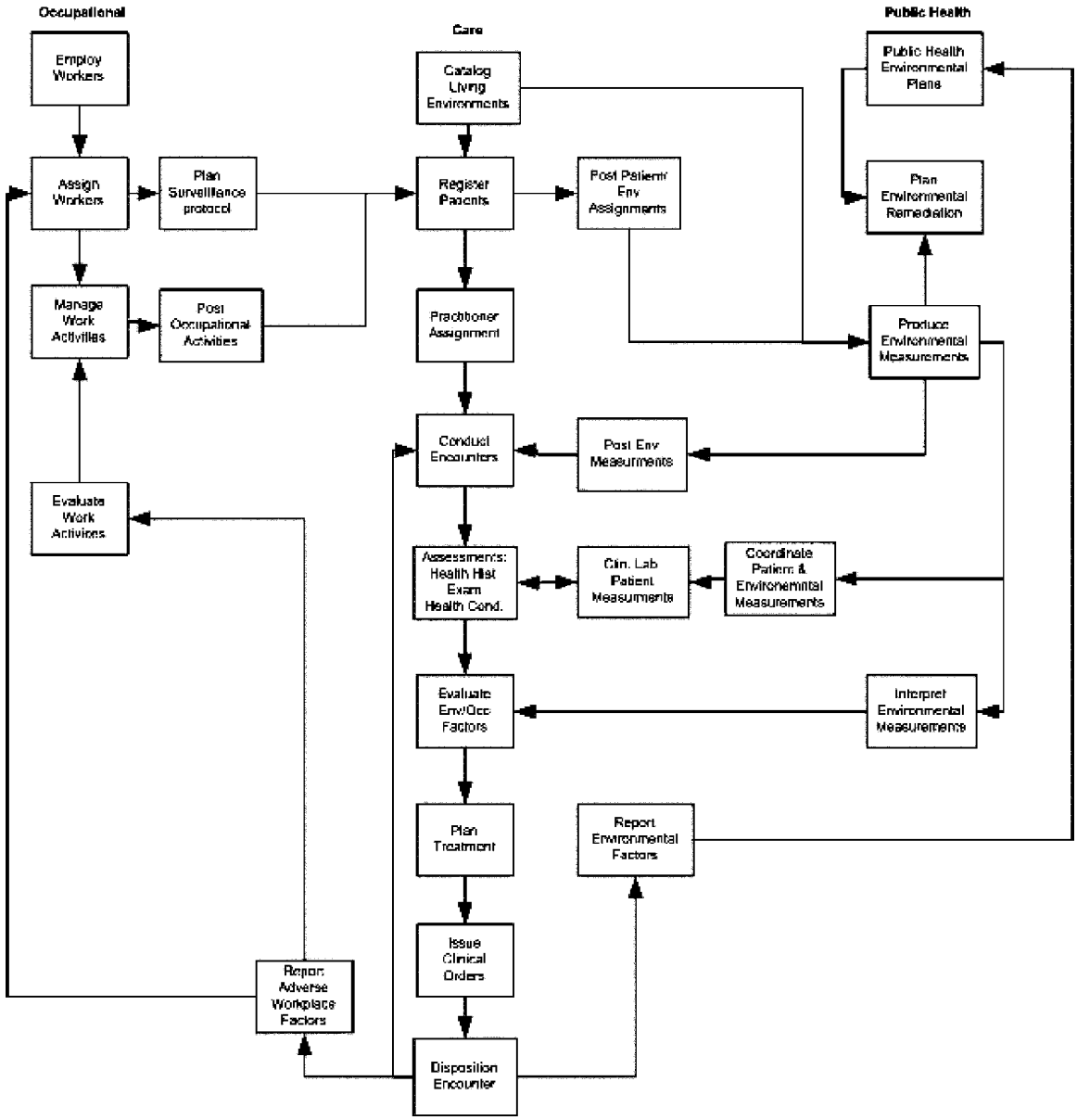

FIG. 3 Occupational/Environmental Health Functional Model

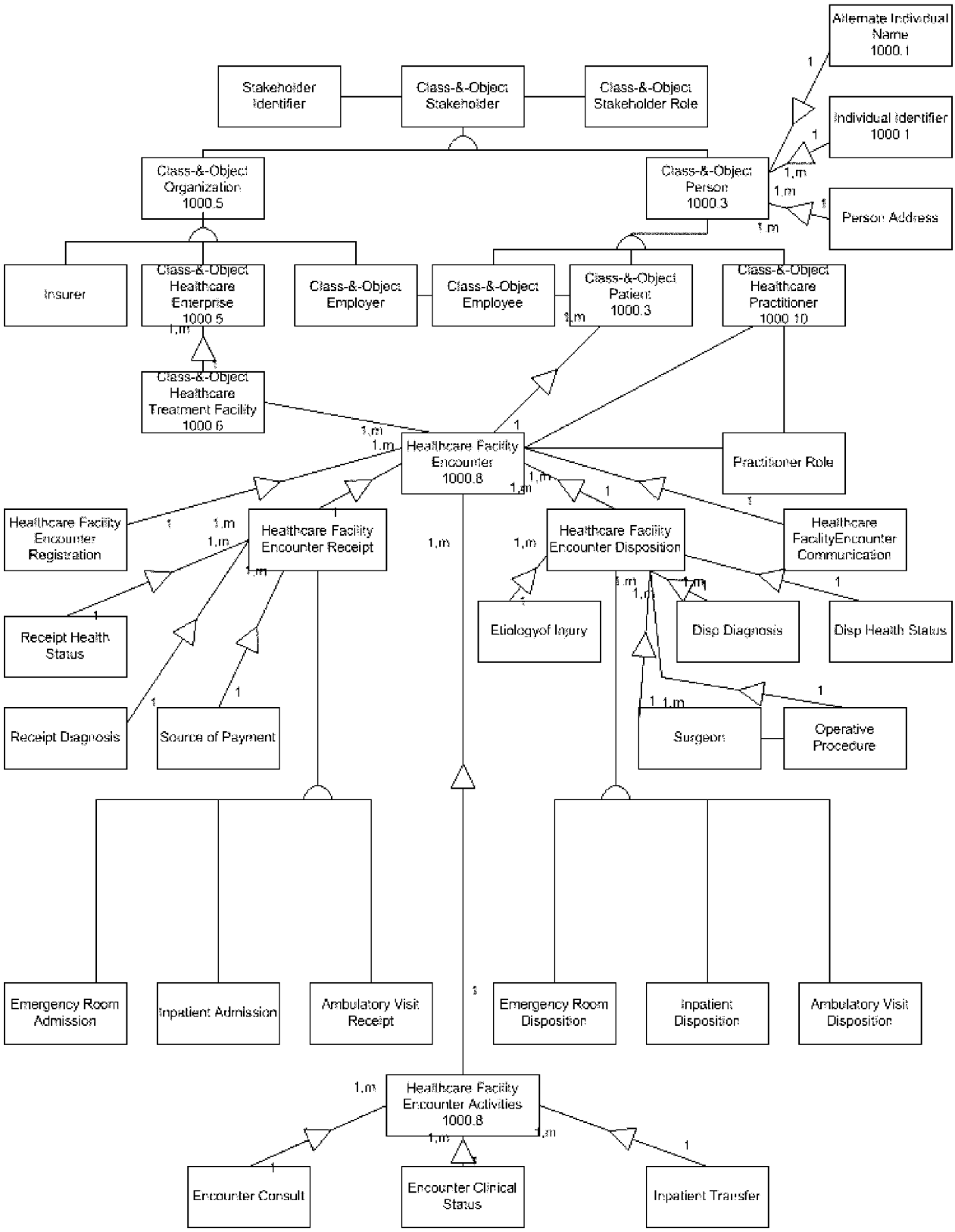

FIG. 4 Common Core EHR Model (with ADA Object IDs)

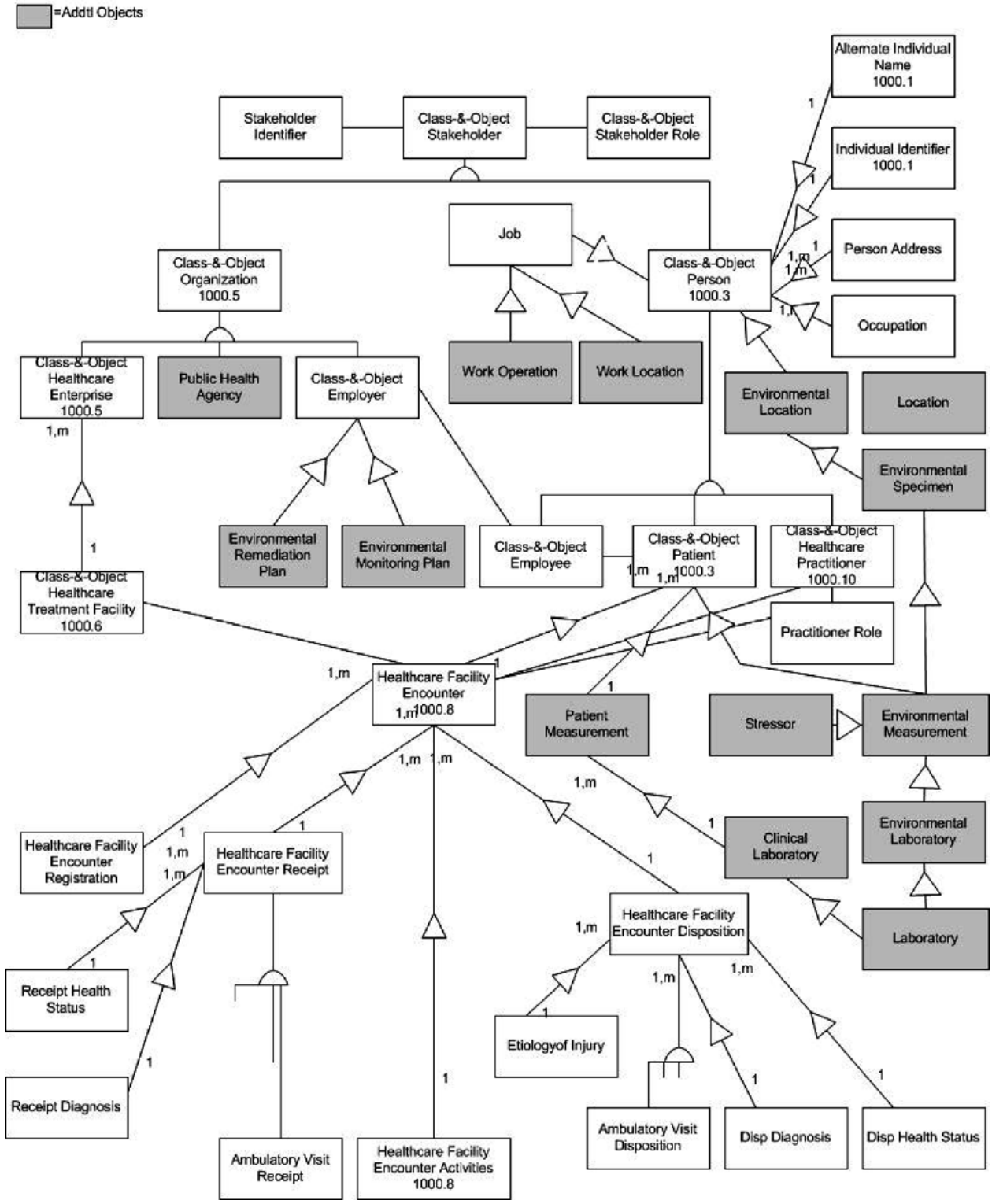

FIG. 5 Common Core Occupational/Environmental Health EHR Model (with ADA Object IDs)

5.3.2 *Data Objects:*

NOTE 1—National Committee Vital and Health Statistics Core Data Set are in *italics*.

NOTE 2—ASTM E1384 Minimal Data Set are underlined.

NOTE 3—HIPAA data elements are in **bold**.

NOTE 4—ADA 1000 series objects are so noted.

Organization
ORGANIZATION ADA 1000.5 ADA CONCEPT MODEL: ORGANIZATION
Organization Identifier
Organization Name
Address
Telephone number
FAX Number
E-mail address

Employer
EMPLOYER
Employer ID----------→ORGANIZATION
Number of Employees
Commercial Segment----------→STANDARD INDUSTRIAL CODE

Healthcare Enterprise
HEALTHCARE ENTERPRISE ADA 1000.5
Healthcare Enterprise Identifier ----------→ORGANIZATION
Healthcare Identifier (NPI)
Healthcare Enterprise Name
Healthcare Category----------→HEALTHCARE CATEGORY

Worker (Employee)
EMPLOYEE
Employee Name----------→PERSON
Employee Identifier
Employer----------→EMPLOYER
Functional Title
Category
Risk Code
Pay Plan
Job ID
Job Title
Hire date
Occupation Code----------→OCCUPATION
Supervisor----------→PERSON
Primary Worksite----------→WORK LOCATION
Primary Work Operation----------→WORK OPERATION
Personal Protective Equipment----------→STOCK ITEM
Applicable Safety program (M)

Individual (Person)
PERSON ADA 1000.3 ADA CONCEPT MODEL: INDIVIDUAL
Person name
Previously Registered Name
Universal Patient Identifier
Date-time of Birth
Birthplace
Sex ----------→SEX
Race ----------→RACE
Ethnic Group----------→ETHNIC GROUP
Religion ----------→RELIGION
Marital Status
Education Level
Occupation ----------→OCCUPATION
Work Phone
Work Address
Citizenship Status
Home Address
Home Address Location Code
Home Address County/Census tract
Temporary Address
Temporary Address Phone
Foreign Residence

Patient
PATIENT ADA 1000.3
Patient Name (Multiple) ----------→PERSON

Adoption status
Patient Number
Universal Patient Health Number
Archive Data
Location of Chart
Multiple Birth Marker
Birth Order
School name
Military Service/Veteran Status
Current Work Status
Current Vocational Status
Previous Occupations (M)----------→OCCUPATION
Date Completed Occupation
Number in Household
Family Member Name (M) ----------→FAMILY MEMBER
Emergency Contact (relation/friend) Name
Emergency Contact Relationship
Emergency Contact Address
Emergency Contact Home phone
Emergency Contact Business phone
Patient Guardian Name----------→PERSON
Patient Guardian Address
Patient County/Census tract
LNOK Name
LNOK Relationship
LNOK Address
Parental Marital Status
Patient's Language
Interpreter Required
Usual Living Arrangement

Family Member
FAMILY MEMBER ADA 1000.3
Family Member Name----------→ **PERSON**
Family Member Relationship
Family Member Name
Family Member SSAN
Family Member Male Parent
Family Member Female Parent
Family Member Spouse
Family Member Sex
Family Member DOB
Family Member Date of Death
Family Member Head of Household Status
Family Member Caregiver Status
Family Member Location
Family Member Occupation----------→OCCUPATION
Family Member Major Diagnosis (M)

Segment II: Legal Agreements
Consent Signed/Admit Agreement
Patient Rights Acknowledgement
Directive to Physician

RECORD RELEASE INSTANCE
Release of Information Datetime
Type of Information Released
Person Releasing

Segment III: Financial
Payment Source
Payer Group No
Payment Sponsor
Address of Sponsor

Living Activity/Operation
LIVING ACTIVITY
Living Activity Name
Living Activity Risk Assessment Code
Associated Stressor (M)----------→STRESSOR
Activity Description

Location
LOCATION ADA CONCEPT MODEL: LOCATION
Location ID
Location Name

Environmental Location ADA CONCEPT MODEL: ENVIRONMENT

ENVIRONMENTAL LOCATION
Environmental Location ID----------→LOCATION
Location Coordinates

Work Location
WORK LOCATION
Work Location ID Code----------→LOCATION
Work Location Name
Worker Type (M)
Contact Name
Supervisor
Worksite (M)----------→WORK LOCATION
Work Operation (M)----------→WORK OPERATION
Building
Floor
Phone

Work Activity/Operation
WORK OPERATION
Work Operation Name
Exposure Protection Code
Operation Risk Assessment Code
Associated Stressor (M)----------→STRESSOR
Engineering Control (M)
Operation Description

Work Location/Environmental Survey
SURVEY
Survey ID
Environmental Survey Name
Survey Date Time
Surveyor
Engineering Controls Required (M)
Engineering Controls Evaluated (M)
Survey Sample (M)----------→ENVIRONMENTAL SURVEY SAMPLE

Environmental Survey Sample
ENVIRONMENTAL SURVEY SAMPLE ADA CONCEPT MODEL: SAMPLE
Sample ID----------→ENVIRONMENTAL SPECIMEN
Survey ID----------→SURVEY
Sample Datetime
Sample Collector ID----------→PERSON
Analyzing location----------→ENVIRONMENTAL LABORATORY

Environmental Specimen
ENVIRONMENTAL SPECIMEN
Sample ID
Sample Collection Datetime
Sample Location----------→ENVIRONMENTAL LOCATION
Sample Subject
Sample Collection Equipment ID----------→INSTRUMENT
Sample Collection Method
Sample Period Duration
Sample Size
Sample Unit
Sampling Conditions
Analyzing Laboratory----------→LABORATORY

Instrument
INSTRUMENT
Instrument ID
Instrument Name
Instrument Model
Instrument Manufacturer----------→MANUFACTURER
MF Recommended Calibration Method
Instrument Description

Instrument Calibration
Instrument ID----------→INSTRUMENT
Instrument Manufacturer----------→MANUFACTURER
Calibration Date
Calibration Method
Calibrator ID
Calibrator Measurement Name----------→MEASUREMENT NAME
Calibrator Value
Calibrator Unit of Measure----------→UNIT OF MEASURE

Manufacturer

MANUFACTURER
Manufacturer Name----------→ORGANIZATION
Manufacturer Industrial Classification

Laboratory
LABORATORY
Laboratory ID----------→ORGANIZATION
Lab Name
Laboratory Category
Laboratory Address
Laboratory Telephone
Laboratory URL

Clinical Laboratory
CLINICAL LABORATORY
Clinical Lab ID----------→LABORATORY
Healthcare Enterprise----------→HEALTH CARE ENTERPRISE

Environmental Laboratory
ENVIRONMENTAL LABORATORY
Environmental Lab ID----------→LABORATORY

Measurement
MEASUREMENT NAME
Measurement Name
Measurement ID
Measurement Usual Unit of Measure-------→UNIT OF MEASURE

Environmental Measurement
ENVIRONMENTAL MEASUREMENT
Measurement Name----------→MEASUREMENT NAME
Analyte Measured----------→STRESSOR
Measured Value
TWA
Peak Value
Standard Unit of Measure----------→UNIT OF MEASURE
Measurement Datetime
Measurement Specimen Datetime
Specimen ID----------→ENVIRONMENTAL SPECIMEN
Environmental Location----------→ENVIRONMENTAL LOCATION
Related Stressor----------→STRESSOR
Measuring Laboratory----------→ENVIRONMENTAL LABORATORY
Interpretive Code

Patient Environmental Stressor
STRESSOR EXPOSURE ADA CONCEPT MODEL: EXPOSURE
Stressor Type (M)----------→STRESSOR
Stressor Total Lifetime Exposure
Stressor Unit of Exposure
Stressor Lifetime Milestone Date
Stressor Exposure Period (M)----------→STRESSOR EXPOSURE PERIOD

Patient Environmental Stressor Exposure
STRESSOR EXPOSURE PERIOD
Stressor Exposure begin date-time
Stressor Exposure termination date
Stressor Employer----------→EMPLOYER
Stressor Exposure Setting
Stressor Route of Exposure
Stressor Exposure Interval Dose
Stressor Plant Process Code
Stressor Plant Location Code
Stressor Work Performed
Stressor Personal Protection used (M)

Patient Environmental Stressor Measurement
Stressor Measurement Date
Stressor ID----------→STRESSOR
Form of Measured Agent
Environmental Specimen ID----------→ENVIRONMENTAL SPECIMEN
Units of Stressor Sample Collected
Stressor Sample Unit of Measure----------→UNIT OF MEASURE
Stressor Sample Collection Datetime
Stressor Sample Collection Device
Stressor Test Sample Method
Stressor Type of Determination
Stressor Peak Measurement Value
Stressor Peak Measurement Unit

Stressor
STRESSOR
Stressor ID
Stressor Name
Trade Name (M)
CAS No
RTECS Code
Description
MSDS Availability Code
STEL
STL Sampling Duration
Hazard Class

Occupational/Environmental Case
OCCUPATIONAL/ENVIRONMENTAL CASE
Occupational/Environmental Case ID
Case Patient ID----------→PATIENT
Healthcare Enterprise----------→HEALTHCARE ENTERPRISE
Case Establishment Date
Case Description
Case-related Health Conditions (M)----------→HEALTH CONDITION
Associated Environmental Location----------→ENVIRONMENTAL LOCATION
Involved Stressor(s) (M)----------→STRESSOR
Associated Environmental Surveys (M)-----→ENVIRONMENTAL SURVEY
Associated Encounter Dates (M)----------→ENCOUNTER
Case Status
Case Resolution Date

Appointments
Segment XIII: Appointments ADA 1000.15
Date-time (M)
Treatment Facility
Expected Duration 00868
Clinic Name
Previous Encounter datetime----------→ENCOUNTER
Provider ID----------→PRACTITIONER
Requestor----------→PRACTITIONER
Purpose/Chief Complaint 00866
Remarks
Appointment Status
Expected Services (M)
Type 00867
Urgency
Cancellation Reason
Cancellation Datetime
Overbook status
Encounter Disposition

Encounter
ENCOUNTER ADA CONCEPT MODEL: HEALTHCARE EVENT
HEALTHCARE FACILITY ENCOUNTER ADA 1000.8
Datetime of Encounter
Name of Facility of Encounter----------→HEALTHCARE ENTERPRISE
Encounter status
Comments
Type of Encounter
Patient Chief Complaint
Reason for Visit

HEALTHCARE ENCOUNTER RECEIPT
SubSegment XIVA: Encounter Receipt
Facility Type
Type of Encounter
Confidentiality Status
Episode ID
Mode of Injury
Nature of Injury
Chief Complaint
Health Condition/Problem ID (M)----------→HEALTH CONDITION/PROBLEM
Receipt Diagnosis
Practitioner ID

RECEIPT HEALTH STATUS
Receipt Health Status Measure Name
Receipt Health Status Measure Total Value
RECEIPT DIAGNOSIS
Encounter Receipt Diagnosis

Encounter Receipt Health Status

SOURCE OF PAYMENT
Source of Payment

HEALTHCARE ENCOUNTER ACTIVITIES

HEALTHCARE ENCOUNTER DISPOSITION
SubSegment XIVF/G: Encounter Disposition & Charges
Disposition
Disposition Date time
Disposition Destination
Patient Instructions
Disposition Note
Disposition Note Signature
Encounter Charges
Disposition Type
Followup Action
Followup target date

DISPOSITION DIAGNOSIS: ADA CONCEPT MODEL: DIAGNOSIS
Disposition Diagnosis Name--→DIAGNOSIS
Diagnosis Type

DISPOSITION HEALTH STATUS
Disposition Health Status Measure Name
Disposition Health Status Measure Total Value

Health History
Segment VIII: Health History ADA 1000.13
Date of Health History
History Source Contact Name
History Source Relationship
History Present Health Text
Past History Social Text
Current Habits Text
Health History Item (Multiple)

Segment VI: Immunizations
Immunization Name (Multiple)
Immunization Date (M)

Exam
Segment IX: Examinations ADA 1000.12
Date of Examination
Source of History Present Illness/status Present Health
Review of Systems
Exam Finding (Multiple)
Exam Finding Comment
Exam Health Status Total Measure Name
Exam Health Status Total Measure Value
Exam Summary

Patient/Environmental Measurement
Segment XI: Diagnostic Tests ADA 1000.13 ADA CONCEPT MODEL: HEALTH FACT
Datetime of Test (Multiple)
Clinical Order ID
Name of Requested Test----------→MEASUREMENT
Test Ordering Facility
Test Ordering Practitioner
Test Performing Facility
Test Performer
Datetime Result Reported
Test Report Text (for Textual Reports)
Analyte/Measurement/Observation Name (M)→MEASUREMENT
Analyte/Measurement/Observation Value
Interpretation
Microorganism Requested (M)
Microorganism Attribute (M)
Microorganism Comments
Test Comments

Health Condition
Segment V: Health Condition/Problem ADA 1000.14 ADA CONCEPT MODEL: HEALTH CONDITION
Health Condition/Problem ID
Health Condition/Problem Name----------→HEALTH CONDITION
Health Condition/Problem Time of Onset
Health Condition/Status

Etiology----------→ETIOLOGY

Treatment Plan
Segment X: Treatment Plans ADA 1000.15 ADA CONCEPT MODEL: TREATMENT PLAN
Treatment Plan ID
Treatment Plan Description
Health Condition/Problem ID----------→HEALTH CONDITION/PROBLEM
Treatment Plan Phase (M)

Clinical Order
Segment X: Clinical Orders ADA CONCEPT MODEL: COMMUNICATION
Clinical Order ID
Clinical Order Datetime
Clinical Order Full Text

Manufacturer
Manufacturer ID----------→ORGANIZATION
Manufacturer Name
Product ID (M)

Public Health Agency
Public Health Agency Organizational ID----→ORGANIZATION

Environmental Monitoring Plan
Environmental Monitoring Plan ID
Environmental Monitoring Plan Name
Environmental Monitoring Plan Description

Environmental Remediation Plan
Environmental Remediation Plan ID
Environmental Remediation Plan Name
Environmental Remediation Plan Description

Stock Item
Stock Item Product ID
Stock Item Name

VOCABULARIES and REFERENTIAL CONTEXT-INSENSITIVE DATA: ADA 1000.2

Measurement Name
MEASUREMENT NAME
Measurement Name
Measurement LOINC ID
Measurement Payment Code

Observation
OBSERVATION
Observation Identifier
Observation Name

Unit of Measure
UNIT OF MEASURE [ADA 1000.14]
Unit of Measure ID
Unit of Measure Name/Unit of Measure Term
Unit of Measure Abbreviation
Unit of Measure Code
Unit of Measure System

Occupation
OCCUPATION [ASTM/ADA]
Occupation ID
Occupation Name
Occupation Identifier

Race
RACE
Race/Biologic Population ID
Race/Biologic Population Name

Religion
RELIGION RELIGION [ADA 1000.3]
Religion ID
Religion Name
Religion Code
Sect Name

Sex Characteristic
SEX CHARACTERISTIC [ADA 1000.3]

Sex Characteristic Code
Sex Characteristic description

Sex
SEX
Sex ID
Sex Name

Ethnic Group
ETHNIC GROUP
Ethnic Group ID
Ethnic Group Name

Language
LANGUAGE [ADA 1000.3]
Language Code
Language Name
Dialect Name

Marital (Pair-Bond) Status
MARITAL STATUS [ADA]
Marital Status Code
Marital Status description

Healthcare Category
HEALTHCARE CATEGORY
Healthcare Category ID
Healthcare Category Name

Health Condition
HEALTH CONDITION/PROBLEM [ADA 1000.10]
Health Condition/Problem Identifier
Health Condition/Problem Name

Diagnosis
DIAGNOSIS [ADA 1000.10]
Diagnosis Identifier
Diagnosis Term

Procedure
PROCEDURE [ADA 1000.10]
Procedure Identifier
Procedure Term
Procedure Type
Procedure mnemonic
ADA Procedure code
Base value
Procedure Description

Materiel
MATERIEL [ADA 1000.9] ADA CONCEPT MODEL: MATERIEL
Materiel Identifier
Materiel Name

Outcome
OUTCOME [ADA 1000.10]
Outcome Identifier
Outcome Term code
Outcome description

Population
POPULATION [ADA 1000.12]
Population Identifier
Population Name

Quantitative Measure
QUANTITATIVE MEASURE [ADA 1000.14]
Quantitative Measure Term
Quantitative Measure Description

Taxonomy
TAXONOMY [ADA 1000.3]
Taxonmy Identifier
Taxonomy Name

Etiology ADA CONCEPT MODEL: ETIOLOGY
ETIOLOGY [ADA 1000.14]
Etiology Code

Etiology type

Service ADA CONCEPT MODEL: TREATMENT
SERVICE [ADA 1000.16]
Service Identifier
Service Term
Service Type
Service Description

Location
LOCATION [ADA 1000.6]
Location Identifier
Location Name

Anatomic Location ADA CONCEPT MODEL: ANATOMIC LOCATION
ANATOMIC LOCATION [ADA]
Anatomic Code
Anatomic Location Type

Laboratory Procedure
LABORATORY PROCEDURE [ASTM]
Laboratory Procedure Identifier
Laboratory Procedure Name
ICD-10 PCS Code

REFERENCES

(1) Public Health Data Standards Consortium: PHDSC Ad Hoc Task Force on Electronic Health Records—Public Health "White Paper Electronic Health Records: Public Health Perspectives," 8 March 2004, Baltimore, MD.

(2) PHIN Standards Specification v1.2 (http://cdc.gov/phin/index.htm).