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An American National Standard

Standard Practice for An Object-Oriented Model for Registration, Admitting, Discharge, and Transfer (RADT) Functions in Computer-Based Patient Record Systems[1]

This standard is issued under the fixed designation E1715; 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 amplify Practice E1239 and to complement Practice E1384 by detailing the objects that make up the reservation, registration, admitting, discharge, and transfer (RADT) functional domain of the computer-based record of care (CPR). As identified in Practice E1239, this domain is seminal to all patient record and ancillary system functions, including messaging functions used in telecommunications. For example, it is applicable to clinical laboratory information management systems, pharmacy information management systems, and radiology, or other image management, information management systems. The object model terminology is used to be compatible with other national and international standards for healthcare data and information systems engineering or telecommunications standards applied to healthcare data or systems. This practice is intended for those familiar with modeling concepts, system design, and implementation. It is not intended for the general computer user or as an initial introduction to the concepts.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1238 Specification for Transferring Clinical Observations Between Independent Computer Systems (Withdrawn 2002)[3]

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

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

E1633 Specification for Coded Values Used in the Electronic Health Record

E1639 Guide for Functional Requirements of Clinical Laboratory Information Management Systems (Withdrawn 2002)[3]

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

F1629 Guide for Establishing Operating Emergency Medical Services and Management Information Systems, or Both

2.2 *ANSI Standard:*

ANSI X3.172 Dictionary of Information Systems[4]

2.3 *IEEE Standard:*

IEEE 1157.1 Trial Use Standard for Healthcare Information Interchange—Information Modelling (6 June 1994)[5]

2.4 *Other Document:*

HL-7 v2.4 Data Communication Standard[6]

3. Terminology

3.1 *Definitions*—General terms are defined in accordance with ANSI X3.172.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *functional domain, n*—that area of activity that encompasses a given function. **(HL-7, v2.4)**

3.2.2 *healthcare domain, n*—that functional domain encompassing all aspects of the delivery of health care, both preventive and corrective, to patients, and the management of resources enabling that care to be delivered. **(HL-7, v2.4)**

4. Background

4.1 *Object Representation of RADT Processes*—Practice E1239 provides the experiential background of the functions in RADT. These functions are common to all systems that deal with patient data. The minimal essential data elements for

[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.

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[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.

[5] Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331, http://www.ieee.org.

[6] Available from Health Level Seven, 900 Victors Way, Suite 122, Ann Arbor, MI 48108.

RADT were identified and characterized partly in Practice E1239. Table 1 of that guide identifies a logical data structure for the data elements, but it does not relate these elements to constituent "entities" or "objects" in the sense that they are now used in analysis. Entity-relationship modeling is one major technique used (**1**)[7] to establish the conceptual" things" and their relationships involved in this overall functional domain. "Objects" (**2, 3**) is another term for these things, and the object concept involves very specific characteristics associated with a defined object such as encapsulation and inheritance. Common ground exists between entity and object representations of models. However, the object terminology is still evolving into a clearly established dictionary associated with object modeling at the analysis (**2**), design (**3**), and implementation (**3**) levels of information systems engineering.

4.1.1 At the analysis level, which is most relevant to implementation-independent standards creation, the static level is first in importance since it identifies the involved objects and their static characteristics, such as definitions, relationships, and inheritance. Subsequently, the service/messages communication properties constitute the second level of importance, because they specify the dynamics of system behavior. However, messages are more difficult to define since system behavior patterns are more complex. This secondary domain also involves the telecommunications aspects that are the focus of other standards bodies. Because of the distributed and networked architectures of the newest systems, telecommunications may be of prime importance in qualifying the definitions of system behavior identified in Practice E1239. For all of these reasons, it is of special importance to initially establish an object-oriented static model for the RADT functional domain that can be the basis for definitions of healthcare data management and standards setting and serve as a foundation for modeling telecommunications standards.

4.1.2 While this practice was being developed, a joint working group (JWG) on data modeling of the then American National Standards Institute (ANSI) Healthcare Informatics Standards Planning Panel (HISPP), now Health Informatics Standards Board (HISB), began work on a common data model (CDM) for the healthcare information domain. A JWG data modeling convention document (IEEE 1157.1) guides the conventions to be used, and this practice reflects those conventions as they are currently known. It is intended that this practice contribute to establishing the RADT core of the CDM. The exact boundaries of the RADT functional domain have not yet been agreed on formally. The objects included here are those that involve data generally associated with administrative and demographic functions in patient care but that may also be linked with other functional domains involved with health care.

4.2 *Inclusion of Emergency Medical Systems Functions*—This practice also takes note of the recent work of the emergency medical systems (EMS) standards ASTM Subcommittee F30.03.03 on Data Management Systems in defining the pre-hospital and associated emergency room data (Guide F1629) required for emergency medical service system management. The hospital and emergency room data are a subset of that identified in Practice E1384 and is consistent with the statement of Steen and Dick (**4**) that EMS data are part of the primary record of care. This concept has already been recognized in several state statutes that are part of the implementation of an injury control plan by the Centers for Disease Control (see Practice E1744). This RADT object model practice extends those data elements already defined in Practice E1384 by associating them with common RADT objects, as defined here, that form the basis for a predictable system behavior for trauma data. The behavior of clinical data will be defined subsequently in following standards.

4.3 *Relationships to Other Systems*—This practice also identifies those objects in the RADT functional domain that are required by clinical laboratory information management systems (CLIMS) (Guide E1639), radiology information systems (RIS), and other ancillary systems. This model also forms the core for a basic ambulatory record system, and specialized variants, in support of clinical specialties in medicine and dentistry. The object models for these ancillary and specialized electronic health record (EHR) systems are defined in other standards that constitute the "family of models" that extend the RADT function.

5. Significance and Use

5.1 *RADT Object Model as a Basis for Communication*—The RADT object model is the first model used to create a common library of consistent entities (objects) and their attributes in the terminology of object analytical models as applied to the healthcare domain. These object models can be used to construct and refine standards relating to healt care information and its management. Since the RADT object model underpins the design and implementation of specific systems, it provides the framework for establishing the systematics of managing observations made during health care. The observations recorded during health care not only become the basis for managing an individual's health care by practitioners but are also used for research and resource management. They define the common language for abstracting and codifying observations. The inconsistency and incompleteness of the data recorded in paper records is well known and has been noted by the Institute of Medicine's study (**4**). The ability to build the recommended EHR begins with RADT, as noted in Practice E1239. A more detailed specification of the RADT process and its specific functional domain shall begin with a formal model. Furthermore, following agreement on the initial model, that model shall evolve as knowledge accumulates and the initial view of the healthcare domain extends to other social

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

TABLE 1 Data Element Datatypes

Type	Standard Tag/ Mnemonic
Name	Name
Number	Num
Code	Code
Datetime	Dtm
Signature	Sig
Text	Text
Quantity	Qty

and psychologic processes that link healthcare with other functional domains of society. The management of lifelong cases of care, such as those of birth defects in newborns, will involve interactions with social work and educational functional domains of experience. It has been recognized for some time (**5**) that a "healthcare team," in the broader sense, is involved in dealing with these complex cases. The RADT model is the core to linking these functional domains together in a transparent way. For that reason, the object terminology is used to enable the most global view and vernacular that will facilitate communication among technical specialties that participate in managing some aspect of health care or that build systems to manage the required information.

5.2 *Common Terminology as a Basis for Education*—The use of models and their associated terminology implies that education of the healthcare practitioners shall incorporate this view to a significant extent. While a detailed specification of systems requires extensive lexicons of carefully defined terms, a more understandable terminology shall evolve for the process of educating practitioners during their formal education as well as continuing to educate current practioners concerning how this new technology can be integrated with their existing practices. This challenge has yet to be met, but the objects and modeling concepts presented here are intended to be named with the most intuitive titles in order to promote clear understanding during their use in instruction. Nevertheless, relating these objects and their properties to everyday practice remains a significant challenge, for both the implementors of systems and educators. The perspectives cataloged here can be used in the creation of system documentation and curricula represented in a variety of media.

6. Graphic Representation

6.1 The graphic representation in Figs. 1-4 of the relationships among the objects depicts the static inheritance properties of the constituent objects. These properties and others, such as definitions, are given in tabular form in Section 7. Graphic depiction provides a more comprehensive overview of the global structure of this functional domain, thus enabling the reader to appreciate all of the parts of the model at a glance. This depiction also aids the reader when probing the specific attributes and other properties of the objects given in the tabular section. There are five object groups/subject areas (**2**) , or subaggregates of objects with certain common characteristics. These relationships are more easily understood graphically. The notation is from Coad and Yourdon (**2**). Two main concepts are involved. The first, represented by separate lines and arrowheads, is the "is a component of" relationship, which implies the parts of a whole. The second concept, represented by a branching tree, is the "is a special case of" relationship, which implies encapsulation of the special attributes that differentiate the individual characteristics of a more general object. The combination of these two relationships permits all of the complexities in the static interrelationships of the constituent objects comprising the RADT model to be represented. Instance connections are a weaker form of relationship that have not been included in the basic framework for this model. Instance connections show references to master system tables of context-insensitive entities. These same terms appear in the tabular representation. The sequential application of these relationships, visually from the top down in Figs. 1-4, depict the inheritance properties since the objects later in the sequence of the relationships inherit the attributes from those earlier in the sequence. These concepts are all explained by Coad and Yourdon (**2**).

7. Tabular Representation

7.1 Tables 1 and 2 and Annex A1 provide the detailed attributes of the objects and should be compared with Table 1 of Practice E1239 and Annex A1 of Practice E1384, which show the integrated logical structure of the computer-based primary record of care. The latest revision of Practice E1384 associates each data element with an index that uniquely identifies its segment location in Annex A1 and provides a definition and references its representation. Certain data elements with coded values have their value sets, which are also identified in that specification by its specific index contained in Practice E1384 and point to Specification E1633. The definitions, mnemonics, and associated attributes of the objects in the RADT object model are given in Table A1.1 of Annex A1 of this practice. The object mnemonics that are used in the construction of standardized short names for the data elements indexed and characterized in Practice E1384 are given as attributes in this practice. A standardized short name begins with the object mnemonic and ends with a datatype substring given in Table 1. The object mnemonics are given in Table 2. Each substring begins with a sequence of uppercase letters followed by a sequence of lowercase letters. The beginning object mnemonic and ending datatype substrings are required. These characterizations provide the static properties of the RADT object model. The operational global implications of the dynamic properties of the RADT functional domain will be detailed in future versions of Practice E1239, while the specific attributes comprising messages involving RADT objects will be specified in other standards, such as Specification E1238, HL-7 v2.4, IEEE 1157.1, and others. The interrelationship of the objects defined here to other objects in ancillary or