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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]

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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E1238 Specification for Transferring Clinical Observations Between Independent Computer Systems (Withdrawn 2002)[3]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E1639 Guide for Functional Requirements of Clinical Laboratory Information Management Systems (Withdrawn 2002)[3]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F1629 Guide for Establishing Operating Emergency Medical Services and Management Information Systems, or Both (Withdrawn 2015)[3]

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

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

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[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
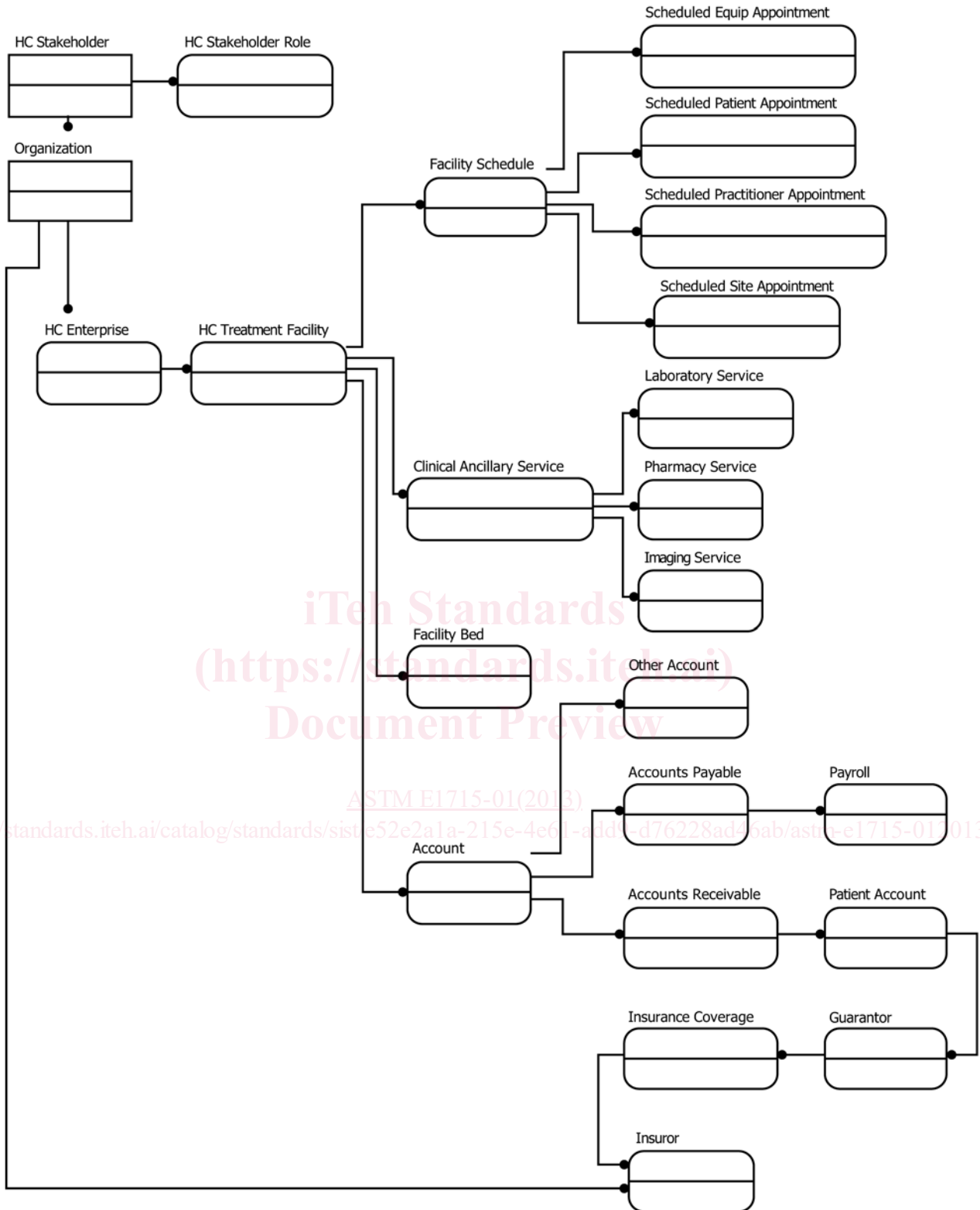
FIG. 1 RADT Object Relationships

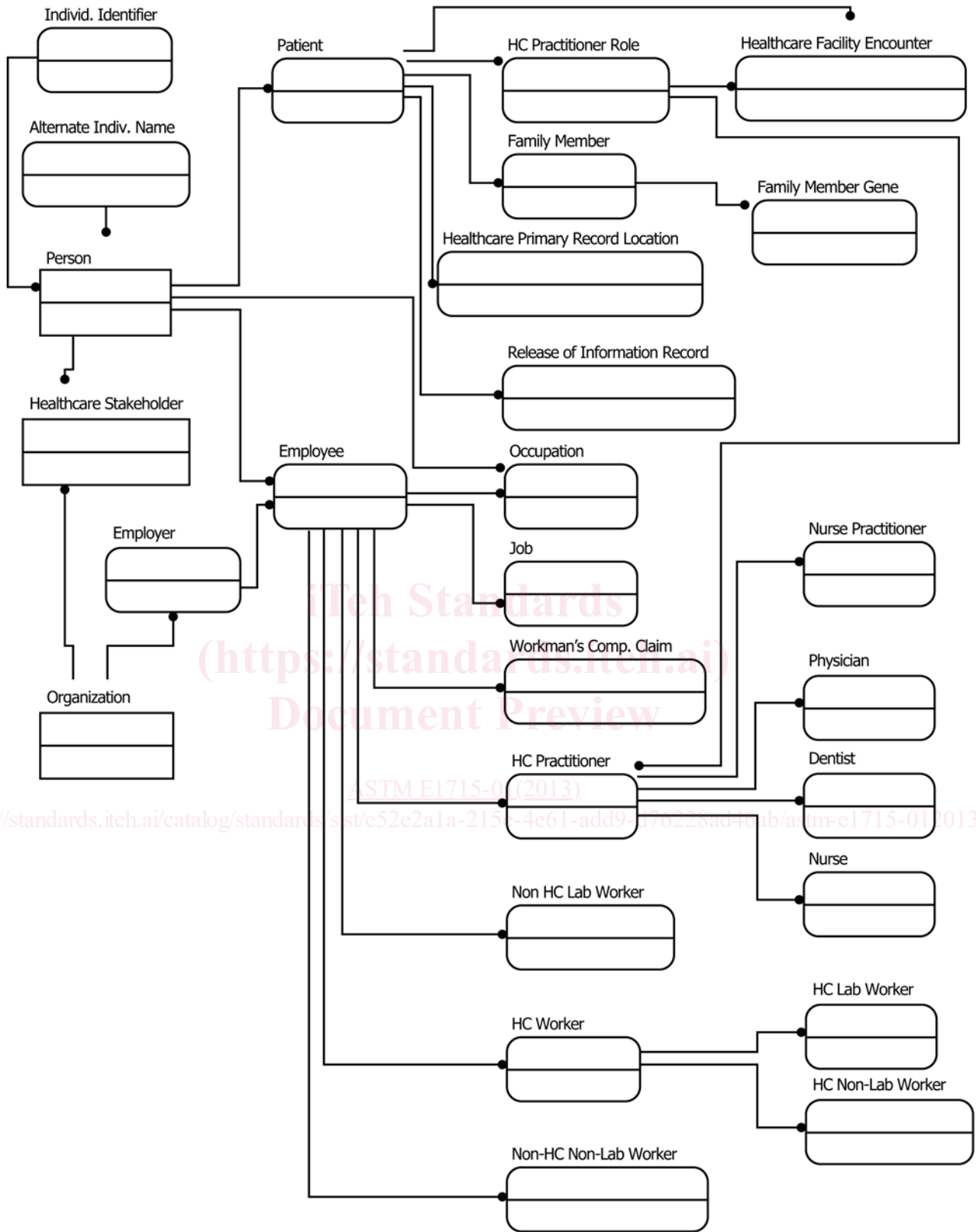FIG. 2 Fiscal and Facilities Relationships

FIG. 3 People and Organization Relationships

FIG. 4 Clinical Activity and Encounter Relationships

specialized EHR systems will be found in the standards focused on those specialty systems, such as Guide E1639.

TABLE 2 Names of Objects Contained in the RADT Model

Object Name	Tag/Mnemonic
Clinical Activities	
Care agreement	Cagrmnt
Clinical order/service request	Cord
Clinical order result	Cordres
Clinical admission order	CADOrd
Clinical disposition order	CDOrd
Clinical transfer order	CTOrd
Death certificate	Dcert
Emergency room admission	ERAdm
Emergency room activities	ERAct
Emergency room disposition	ERDisp
Facility schedule	FACSch
Healthcare ambulatory visit receipt	HCAVRec
Healthcare ambulatory visit activities	HCAVAct
Healthcare ambulatory visit disposition	HCAVDisp
Healthcare communication encounter	HCCEnc
Healthcare encounter activities	HCEAct
Healthcare encounter followup	HCEFup
Healthcare episode	HCEpi
Healthcare facility encounter	HCFEnc
Healthcare facility encounter activities	HCFEAct
Healthcare facility encounter consult	HCFECon
Healthcare facility encounter disposition	HCFEDisp
Healthcare facility encounter disposition diagnosis	HCFEDispdiag
Healthcare facility encounter disposition health status	HCFEDisphthst
Healthcare facility encounter receipt	HCFERec
Healthcare facility encounter receipt diagnosis	HCFERecdiag
Healthcare facility encounter receipt health status	HCFERechthst
Healthcare facility encounter payment source	HCFEPaysrc
Healthcare facility encounter procedure	HCFEProc
Healthcare encounter followup	HCFoll
Healthcare primary record location	HCPriRecLoc
Healthcare registration	HCReg
Healthcare Registration Change	HCRegCh
Healthcare visit	HCVis
Inpatient activities	Iact
Inpatient admission	IAdm
Inpatient transfer	Itrns
Inpatient disposition	Idis
Inpatient disposition surgeon	Idissurg
Organ/tissue donor agreement	Urg
Pre-hospital run	PREHosp
Pre-hospital run crew action	PREHospcract
Pre-hospital run equipment	PREHospeq
Pre-hospital run observation	PREHospobs
Research Study agreement	RSCHAgr
Scheduled patient appointment	SCHPIAppt
Scheduled equipment appointment	SCHEQAppt
Scheduled practitioner appointment	SCHPRAppt
Scheduled site appointment	SCHSITAppt
Facilities	
Healthcare treatment facility	HCTFac
Facility bed	FACBed
Clin/ancillary service	CANSvc
Laboratory organizational service	CLAB
Pharmacy ancillary service	PHARANSvc
Imaging ancillary service	IMANSvc
Fiscal	
Account	Acc
Account payable	ACCPay
Account receivable	ACCRec
Patient account	ACCPt
Other account	ACCOth
Guarantor	Guar
Healthcare claim	HCClm
Insurer	Insr
Insurance coverage	INSCov
Workman's compensation claim	WCClm
Organization	
Organization	Orgn
Employer/company	Emplr

TABLE 2 *Continued*

Object Name	Tag/Mnemonic
Healthcare enterprise	HCPrv
Healthcare stakeholder	HCStkh
Healthcare stakeholder role	HCStkhRol
People	
Alternate Individual Name	ALTINam
Person	Pers
Employee/worker	Emply
Family member	FAMMbr
Patient	Pt
Release of information record	REINRcd
Healthcare practitioner	HCPract
Healthcare practitioner role	HCPractRole
Healthcare practitioner, physician	HCPPhy
Healthcare practitioner, dentist	HCPDent
Healthcare practitioner, nurse	HCPNur
Healthcare practitioner, nurse practitioner	HCPNPr
Individual Identifier	IndIdentifier
Job	Job
Occupation	Occ
Professional specialty	ProfSpec
Worker, healthcare	WkrHC
Worker, healthcare, nonlab	WkrHCNonLab
Worker, healthcare, lab	WkrHCLab
Worker, nonhealthcare, lab	WkrNonHCLab
Worker, nonhealthcare, nonlab	WkrNonHCNonLab

8. Explanation of Subject Areas

8.1 *People Subject Area*—This group of objects characterizes the properties of individuals in the RADT functional domain. The top level in this hierarchy is the person object. The generic attributes of all persons are contained in that object. The employee/worker object is included because it encapsulates attributes of the employee properties of not only patients but also those of workers in health care, including those generally skilled in addition to those skilled in ancillary as well as practitioner skills, in order to deal with the occupational illness and injury of these workers in an entirely consistent fashion. The guarantor status of each recipient is thus dealt with in a consistent manner, whether or not the individual works for the healthcare organization. The employee/worker object also inherits from the "organization" subject area because he/she works for an "employer." The "occupation" object is a component multiple attribute of person objects because it is context insensitive, but "job" objects relate to the "employee/worker" object since their attributes are a function of the work environment, tasks, and potential hazards.

8.2 *Fiscal Subject Area*—This subject area characterizes the most basic properties of the claims and benefits properties. It is included to contain those data needed by the practitioners in devising treatment plans that are within the means of the individual as well as those data that characterize the resources allocated to the staff. It is an initial framework for understanding the management of resources within health care.

8.3 *Organization Subject Area*—The objects in this subject area characterize the general properties of organizations and the responsibilities they have for the individuals they employ, including the elected or mandated benefits and workplace health and safety responsibilities. These properties are inherent in healthcare-providing organizations (Healthcare Enterprises), in addition to their clients to whom they provide services. The "organization" object encapsulates the most general attributes of an organization without employees, while the employer

function is represented by the employer object. A healthcare enterprise in the facilities subject area characterizes the highest level business functions of a healthcare organization while Healthcare T is at the facility level treatment facilities.

8.4 *Facilities Subject Area*—This subject area is intended to characterize the properties of each facility and healthcare worksite, both from the contribution to resource management as well as support of care to individual patients at the time of clinical encounters. The inheritance of these attributes into the primary record of care still requires study. The common designation of specialty and subspecialty subunits of a healthcare provider ("clinical service") is dependent on a yet-to-be-agreed-on naming rules convention that would define the special cases and their attendent unique attributes. Some commonality in these designations would aid health service and outcomes research that identify the best recommended services for identified populations and problems.

8.5 *Clinical Activities Subject Area*—This subject area is the important core to all aspects of the primary record of care and the supporting ancillary services. The healthcare facility encounter, and the immediate hierarchy of objects under it that characterize the properties of the range of healthcare settings outlined in Practice E1384, provides the partitioning of attributes that enable the characterization of all situations of encounter and settings of care. They encapsulate the attributes of such situations and settings that we enumerate currently but do not restrict any further partitioning or identification of new attributes. All encounters have been recognized to have three major phases, with registration review an implicit fourth component and communication situations still assigned provisionally in the hierarchy.

9. Keywords

9.1 electronic health record (EHR); object modeling; registration, admitting, discharge, and transfer (RADT) ; reservation

ANNEX

(Mandatory Information)

A1. PROPERTIES OF RADT OBJECTS

A1.1 The definitions, mnemonics, and associated attributes of the objects in the RADT object model are given in Table A1.1.

TABLE A1.1 Properties of RADT Objects

General Subject/Object Group: Clinical Activities	
Care Agreement	Object and Class
	Relationships:
	Is a component of: inpatient admission
	Inherits from:
	Inpatient admission
	Healthcare facility encounter
	Healthcare facility encounter receipt
	Patient
	Person
	Healthcare facility encounter
	Healthcare enterprise
	Organization
	Healthcare stakeholder
	A legal document detailing the conditions that the patient consents to care during residency in this facility.
	Attributes:

02001	consent signed/admit agreement
02005	patient rights acknowledgment
02010	authority for autopsy
02015	release of body to morgue
02020	consent for videotp/observ
02030	directive to physician
02040	organ donor type
02045	court-ordered care

Clinical Admission Order	Object and Class
	Relationships:
	Is a special case of: clinical order/service request
	Inherits from:
	Clinical order/service request
	Healthcare facil encounter
	Healthcare facil encounter activities
	Person
	Patient
	Healthcare stakeholder
	Healthcare treatment facility
	Healthcare enterprise
	Organization
	This object characterizes the special properties of the action to induct a patient into a resident status in a healthcare treatment facility.
	Attributes:

Clinical Disposition Order	Object and Class
	Relationships:
	Is a special case of: clinical order/service request
	Inherits from:
	Clinical order/service request
	Person
	Patient
	Healthcare facility encounter
	Healthcare facility encounter activities
	Healthcare encounter activity
	Inpatient activities
	Organization
	Healthcare provider
	Healthcare treatment facility
	Healthcare stakeholder
	This object characterizes the special properties of the action to release a resident patient from the responsibility of a healthcare treatment facility.
	Attributes:

Clinical Order Result	Object and Class
	Relationships:
	Is a result of: Clinical order/service request
	Inherits from:
	Healthcare stakeholder
	Organization
	Healthcare enterprise
	Healthcare treatment facility
	Healthcare facility encounter activities
	Clinical order/service request
	Recorded observation or action that is the direct result of a clinical order/service request
	Attributes:
10001.120	CLIN order result acknowl datetime
10001.120.01	CLIN order result shiftcare plan date
10001.120.02	CLIN order result return flag
10001.120.03	CLIN order result return status
10001.120.04	CLIN order result return datetime
10001.120.05	CLIN order result return acknl by
10001.120.06	CLIN order result return comment

Clinical Order/Service Request	Class
	Relationships:
	Is a component of: emergency room activities
	Is a component of: healthcare ambulatory visit activities
	Is a component of: inpatient activities
	Inherits from:
	Person
	Patient
	Healthcare encounter activity
	Healthcare treatment facility
	Healthcare enterprise
	Organization
	Healthcare facility encounter
	Healthcare facility encounter activities
	Inpatient activities

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This object encompasses the general properties of a clinical action message, or "clinical order." It characterizes the properties common to all types of clinical orders by identifying the addressee, subject, circumstances, and control properties of the action ordered. It does not include those special properties of the addressee specialty.

Attributes:

10001	CLIN order ID number
10001.002	CLIN order patient status
10001.009	CLIN order date-time of order
10001.010	CLIN order type
10001.013	CLIN order action
10001.015	CLIN order priority
10001.017	CLIN order pre-admit status
10001.019	CLIN order origin
10001.021	CLIN order parent order
10001.022	CLIN order multiple seq status
10001.023	CLIN order related orders
10001.025	CLIN order user
10001.027	CLIN order user sig
10001.029	CLIN order nurse ID
10001.031	CLIN order nurse sig
10001.033	CLIN order ordering practitioner name
10001.035	CLIN order ordering practitioner sig
10001.037	CLIN order countersigning practitioner name
10001.039	CLIN order countersigning practitioner sig
10001.041	CLIN order nurse sig needed status
10001.043	CLIN order nurse sig needed datetime
10001.045	CLIN order practitioner sig needed status
10001.047	CLIN order practitioner sig needed datetime
10001.049	CLIN order countersig needed status
10001.051	CLIN order countersig needed by datetime
10001.052	CLIN order discontinued by practitioner name
10001.053	CLIN order discontinued practitioner sig
10001.055	CLIN order confirmation recd datetime
10001.057	CLIN order active/pending flag
10001.059	CLIN order active status
10001.061	CLIN order pending status
10001.063	CLIN order inactive status flag
10001.065	CLIN order start status
10001.067	CLIN order execution frequency
10001.069	CLIN order duration of service
10001.071	CLIN order latest status chg datetime
10001.073	CLIN order reactivation datetime
10001.075	CLIN order req fm ancillary
10001.077	CLIN order ancillary activ datetime
10001.079	CLIN order result expectation datetime
10001.081	CLIN order telephone result flag
10001.083	CLIN order telephone to request destination
10001.085	CLIN order request scheduled flag
10001.087	CLIN order requested appt time
10001.089	CLIN order appt type
10001.091	CLIN order appt transport status
10001.093	CLIN order appt status
10001.095	CLIN order assigned appt time
10001.097	CLIN order health service ordered
10001.099	CLIN order principal problem
10001.100	CLIN order full text
10001.102	CLIN order location of service
10001.104	CLIN order freq ordered SVC
10001.106	CLIN order modify status
10001.108	CLIN order modification reason
10001.110	CLIN order non-modify flag
10001.112	CLIN order instructions
10001.114	CLIN order secondary orders
10001.116	CLIN order message
10001.118	CLIN order date-time completed
10001.123	CLIN order date-time order completed
10001.140	CLIN order Q-A warning datetime
10001.140.1	CLIN order Q-A warning text
10001.140.2	CLIN order Q-A warning disposition
10001.140.3	CLIN order Q-A warn override practitioner
10001.140.4	CLIN order Q-A warn authorized by practitioner
10001.140.5	CLIN order Q-A warning override justification
10001.160	CLIN order Q-A review date
10001.160.01	CLIN order Q-A review event type

Clinical Transfer Order	Object and Class

Relationships:

Is a special case of: clinical order/service request