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# CPT Data Model

National Committee on Vital and Health Statistics

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My name is Michael Beebe and I am the Director of CPT and the AMA.

I don't need to tell you that CPT is new to the realm of structured semantic definitions and formal description logic. CPT has grown -up, since 1966, as a working terminology designed to accurately describe health care services and procedures. As such, little thought was given to issues of hierarchy, relationships between codes, or to computer interfaces. The AMA and the CPT Editorial Panel is aware of the need to enhance CPT and the development of this data model is one very important step.

# Presentation Goals

- ➔ Why is the AMA Developing a CPT Data Model
  - ◆ CPT-5 Project
  - ◆ CPT interoperability
- ➔ How will the model be developed?
  - ◆ Process
- ➔ What will the model look like?
  - ◆ Codes
  - ◆ Products

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I would like to provide a brief overview of the changes we are making to CPT to facilitate computer processing and interoperability with various computer systems.

# CPT-5 Project Goals

- Enhance use by practicing physicians
- Address non-MD professionals' needs
- Supply tools for researchers and managed care
- Improve maintenance and editorial processes
- Improve structure
  - ◆ greater specificity
  - ◆ hierarchical information
  - ◆ standardized language
  - ◆ “fix” problem sections
  - ◆ facilitate correct coding

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## Interoperability Objective

CPT will be inherently structured to support easy electronic interface and coordination with other computer-interpretable healthcare terminology systems, electronic medical and health records, other fields on the administrative record, and analytical databases of varying levels of detail

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This was one of the elements in the CPT-5 Project statement of purpose. As you can tell it was written by committee, but the general sentiment is evident.

# CPT<sup>®</sup> Data Model

- Effort to make CPT computer processible
  - ◆ Hierarchical organization
  - ◆ Structured semantic definitions
- Incorporate CPT guidelines and rules
- Facilitate integration with electronic health records
- Assist users with tools to find the appropriate code more quickly
- Assist researchers

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# Machine-processible structure

- ⇒ Directly supports computerized functions
  - ◆ Searching
  - ◆ Sorting
  - ◆ Indexing
  - ◆ Aggregation
  - ◆ Abstraction
  - ◆ Autocoding

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## CPT Data Model Process

- Development of explicit CPT hierarchy
- Incorporation of CPT into database to allow interface with taxonomies from MeSH or UMLS
- Use of description logic to define and inter-relate concepts
- Formalize hierarchy; leverage inheritance
- Develop files and software to allow users to take advantage of model

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In a very broad sense these are the steps we are going through to model CPT. We are working with Apelon who developed the initial Oracle integration and supplied the TDE modeling tool.

# Implicit Hierarchy

➔ CPT book contains an implicit hierarchy:

Surgery

Integumentary System

Repair (Closure)

Repair-Simple

Repair-Intermediate

Repair-Complex

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Based on the general structure of the CPT book

# Implicit Hierarchy

➡ CPT conventions such as the use of the semicolon for indented codes also imply a hierarchy:

- 43651 Laparoscopy, surgical; transection of vagus nerves, truncal
- 43652           transection of vagus nerves, selective or highly selective
- 43653           gastrostomy, without construction of gastric tube (e.g., Stamm procedure)

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Occasionally this convention causes problems through inconsistent and ill defined concepts. We are working to resolve this issue.

# Example of Explicit Hierarchical Structure

Surgery on Musculoskeletal System [G23E5]

Surgery on the Shoulder [C43Y9]

Treatment of fracture or dislocation of Shoulder [VF567]

Treatment of fracture of the Clavicle [BRT56]

\_\_\_\_\_ Open Treatment of fracture of the Clavicle [23515]

\_\_\_\_\_ Closed Treatment of fracture of the Clavicle  
[M3E5R]

\_\_\_\_\_ With Manipulation [23505]

\_\_\_\_\_ Without Manipulation [23500]

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Illustration of hierarchical structure. Each of the levels will be uniquely coded with a random alphanumeric code to facilitate computer searching, aggregation and advance functions such as record abstraction.

# Population of CPT Database

- CPT hierarchy imported as XML files into Oracle database
- Use of Ontylog description logic to:
  - ◆ define concepts, assign semantic categorization (I.E. procedure kind),
  - ◆ First pass at relationships between concepts:
    - ⚡ Reference Concepts
    - ⚡ CPT terminology concepts
    - ⚡ CPT hierarchy concepts

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# Modeling Activities

- ⇒ Model reference concepts as taxonomies
- ⇒ Model CPT concepts
  - ◆ Roles between CPT concepts
  - ◆ Roles between CPT concepts & reference concepts
  - ◆ Automatic classification to infer taxonomic (hierarchical) relationships

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This is what AMA CPT staff have been doing for the last several months

We need to modify the reference taxonomies to establish correct hierarchy (subsumption or partonomy), relationships, and functionality for CPT.

- Occasionally too much detail or specificity for CPT

The Apelon TDE was the tool used to develop the taxonomies and to classify

# Modeling Activities

- Assign concept properties (non-definitional)
  - ◆ Long descriptors
  - ◆ CPT guidelines
  - ◆ Life stage information (birth/revision/death)

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A variety of other information can be stored a properties and associated with CPT codes or hierarchical levels.

# Semantic Categorization

## “Kinds”

- ⇒ Procedure (CPT taxonomy)
- ⇒ Anatomy (MeSH taxonomy)
- ⇒ Substance (UMLS semantic classes)
- ⇒ Device (UMLS semantic classes)
- ⇒ Disorder (UMLS semantic classes)
- ⇒ Etc. (List of misc. concepts)

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# CPT Surgery Model

## Roles

- ◆ Anatomic\_Site - Anatomy kind
- ◆ Approach - Anatomy kind
- ◆ Method - Procedure kind
- ◆ Primary Procedure - Procedure kind
- ◆ Procedure Included - Procedure kind
- ◆ Procedure Excluded - Procedure kind
- ◆ Disorder -Disorder kind
- ◆ Device - Device kind
- ◆ Extent - Etc kind
- ◆ Sequence - Etc kind
- ◆ Laterality - Etc kind
- ◆ Difficulty Level - Etc kind
- ◆ Quantifier - Etc kind
- ◆ Qualifier - Etc kind

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# Modeling Problems

- ➔ Use of ambiguous terms such as “with or without”
- ➔ Ambiguous concepts
- ➔ Inconsistent use of “unlisted codes”
- ➔ Inconsistent use of semicolons

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# CPT Data Model

## ⇒ XML File

- ◆ CPT model DTD specifications
- ◆ Incorporate into applications

## ⇒ Browser Products

- ◆ Searching
- ◆ Aggregation
- ◆ coding assistance

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A version of a machine readable version of CPT that we intend to produce is XML tagging applied to CPT.

Applications using the CPT model will allow users to aggregate on, for example, all services on the bladder using a laproscope. It will also permit user to create their own code books by rearranging codes in say cardiovascular surgery. Eventually it can be used in record abstraction and to support an electronic health record in conjunction with other code sets.

# Further Information

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