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I. INTRODUCTION

This Systematized Nomenclature of Dentistry (SNODENT) Guide is intended as a starting point from which anyone interested in oral health information can learn about SNODENT. The SNODENT User Guide’s audience includes dentists, academics, researchers, public health professionals, consultants, analysts, students, Electronic Dental Records (EDR) vendors, and other dental clinical technology vendors that may be involved in managing and interpreting information created with SNODENT. The Guide should prove helpful in the conduct of activities such as clinical content definition, implementation, and use of the resulting clinical information for research, public health, system design, and quality management.

The SNODENT User Guide will cover:

- SNODENT and its Benefits
- SNODENT and Interoperability in Dentistry
- SNODENT Basics
- SNODENT Model
- Releases
- Mapping
- Implementation

As an official subset of SNOMED CT*, SNODENT is a standard terminology that used effectively may provide new and exciting opportunities for interdisciplinary research including:

- Benefits to public oral health
- Benefits to patients, dentists and other healthcare providers
- Providing support research for evidence based oral health

Understanding the intended benefits of SNODENT will enable development of effective strategies for adoption, implementation, and use of this oral health terminology. As an official subset of SNOMED CT, SNODENT is a standard terminology that may be used in connection with the HITECH Meaningful Use incentives program. It also enables a platform-independent, language-independent, cross-cultural, oral health care record. SNODENT allows precise, highly detailed recording of oral health information.

By using many descriptions for a single clinical concept, it allows tailoring for individual care settings and locations while maintaining consistency. The recording of clinical data through SNODENT also enables the consistent retrieval, transmission, and analysis of data from patient records across healthcare systems. SNODENT is maintained and updated in collaboration with oral health subject matter experts to represent current oral health knowledge.

SNODENT enables the capture of information at a level of detail appropriate for the provision of oral healthcare. It enables patient data to be recorded by different people in different locations, and to be combined into simple information views within the patient record. It provides a standardized way to represent clinical oral health descriptions captured by dentists and enables automated interpretation of their observations.

* SNOMED CT® and SNOMED® are registered trademarks of the IHTSDO.
ELECTRONIC DENTAL RECORDS AND SNODENT

An Electronic Health Record is often defined as a complete longitudinal history of an individual’s health care across all settings and encounters as well as the data types and relationships that would enable it to be created, stored, and managed electronically. This notion of the Electronic Health Record carries with it no prescriptions regarding technologies or display formats such as the layout of a chart or screen. As for the terms “Electronic Medical Record” and “Electronic Dental Record,” they are bodies of patient data arranged to present information to the provider, other authorized users, and in some cases the patient, and may include non–EHR data such as reference values for clinical laboratory tests. Another way to think of the EMR or EDR concepts is that they present extracts of the data contained in the EHR with other relevant information. EHR systems offer the potential to improve care quality and patient safety by enhancing both the quantity and quality of information available to providers for decision making. An EHR system’s ability to capture detailed clinical information in a highly structured manner can enable analysis for quality assessment, identification of areas for improvement, and the design of decision support tools like allergy alerts, medication alerts, and other prompts.

Figure 1. The Benefits of SNODENT
SNODENT enabled oral health records benefit individuals by:

- Enabling information to be recorded consistently during office visits
- Enabling analysis of patient care services and outcomes
- Enabling interoperability of clinical details and patient characteristics between providers
- Allowing identification of patients who need follow up for specific conditions and improved coordination of care

EDRs that have adapted SNODENT benefit public health by:

- Identifying and monitoring oral health issues
- Reducing errors and ensuring a high quality of recording of demographic and clinical data
- Enabling point of care decision support and patient treatment
- Enhancing oral health care efficiency by enabling electronic sharing of detailed clinical information

SNODENT enabled clinical health records benefit evidence-based oral healthcare by:

- Providing standardized terms for describing dental disease
- Permitting analysis of patient care services and outcomes
- Improving the cost-effectiveness and quality of care delivered to populations
II. SNODENT AND INTEROPERABILITY IN DENTISTRY

SNODENT enables the capture of information at a level of detail appropriate for the provision of oral healthcare and the interoperability of electronic dental records.

As part of SNOMED CT, oral health information in SNODENT is recorded using standard identifiers that refer to concepts. The structure of SNODENT, through synonyms allows the recording of the information to be entered in a consistent fashion. The hierarchical nature of SNODENT allows the recording of the clinical information granularity and with different levels of detail (e.g. “dental caries”, is a “bacterial oral infection” or “disorder of hard tissues of teeth”).

The nature of SNODENT hierarchies allows the clinical information to be retrieved and used in order to meet the requirements at various levels (e.g. retrieval of subtypes of “disorder of mouth” or “oral infection” would both include “dental caries”). The SNODENT concepts allow more specificity to be taken into account when retrieving clinical data. The SNODENT concept model also allows additional details to be taken into account when retrieving data.

SNODENT IMPLEMENTATION

SNODENT may be implemented in different ways that are dependent on the design of existing systems prior to the introduction of SNODENT, available technology, and support for the health informatics standards.

Key determinants include:

- **Stored Clinical Information**
  In order to facilitate the effective use of clinical information, SNODENT should be used within a well-designed data repository that stores information consistently.

- **Data Entry**
  The clinical data entry should not result in inconsistent representations of the same information. The most efficient approaches constrain the choice of available concepts for data entry that is specific to the clinical context.

- **Communication**
  SNODENT may be used in standard electronic clinical documents and messaging for improved communications.

- **Retrieval and Analysis**
  Data repositories can be designed to optimize use of SNODENT for selective data retrieval and to support analysis. Possible analytical uses of SNODENT data includes data mining for epidemiological studies, identifying trends in the public’s oral health, and clinical research.
III. SNODENT BASICS

This section provides an introduction to:

- SNODENT Components and Hierarchies
- SNODENT Releases

SNODENT components and characteristics provide the base on which to build a higher level of understanding. It also aids in making decisions related to adoption, implementation, and use of this terminology.

SNODENT features include:

- An oral health resource with a granular clinical content
- Provides consistent oral health content for use in electronic dental records
- Is mapped to other standard terminologies

When implemented in software applications, SNODENT can be used to represent clinical oral health information consistently, reliably and comprehensively.

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Figure 2. SNODENT Components, Hierarchies and Outputs
SNODENT COMPONENTS

SNODENT content is represented through the following components:

- **Concepts** — Representing clinical phrases that are organized into hierarchies
- **Descriptions** — Link appropriate, human readable terms to concepts
- **Relationships** — Link each concept to other related concepts

**Concepts**

SNODENT concepts represent clinical phrases. Every concept has a unique numeric concept identifier. Within each hierarchy, concepts are organized from the general to the more detailed.

**Descriptions**

SNODENT descriptions link appropriate, human readable terms to concepts. A concept may have more than one description and they may represent synonyms describing that very same concept.

**Relationships**

SNODENT relationships link each concept to other concepts that have a related meaning. One type of link is the “is a” relationship which relates a concept to more general concepts. The “is a” relationship defines the hierarchies of SNODENT concepts.

SNODENT HIERARCHIES

SNODENT concepts are organized in hierarchies. Within a hierarchy, concepts range from the more general to the more detailed. Related concepts are linked with the “is a” relationship.

Examples of some of the hierarchies include “clinical finding”, “body structure”, “observable entity” and “organism”.

SNODENT CHARACTERISTICS

SNODENT has a broad coverage of oral health-related topics. It can be used to describe a patient’s oral health history, the details of a periodontal procedure, the spread of epidemics, and much more. At the same time, the terminology enables clinicians to record data at the appropriate level of granularity.

Specific applications tend to focus on specific subsets of SNODENT, for example concepts related to dental caries, periodontal diseases or pediatric conditions. These subsets can be used to present relevant parts of the terminology, depending on the clinical context. This means for example, that a drop down list to select diagnoses in a dental electronic health record in a pediatric facility can be tailored to that particular clinical setting.

SNODENT maps work to provide explicit links to health related classifications and coding schemes used in the United States such as ICD-9 CM, ICD-10 CM, and CDT.

Maps facilitate use of SNODENT based clinical data for other purposes, such as reimbursement or statistical reporting.
SNODENT RELEASES
The American Dental Association may, as part of a license agreement, provide a range of products and services, including:

- SNODENT terminology files consisting of:
  - Concepts
  - Descriptions
  - Relationships
- Derivative works that assist with the use of SNODENT
  - Identification of subsets of SNODENT content
  - Maps to other code systems and classifications
- Implementation guidance for successful use of SNODENT, including:
  - Participation in the ADA community through the meetings of special interest groups

SNODENT MODEL
Figure 3 depicts the relationship between the various SNODENT components and represents the relationships between SNODENT components. It clearly identifies SNODENT’s structure, detailing the components management during SNODENT implementation.

Figure 3. The Components of SNODENT
DESCRIPTIONS

Human readable descriptions are assigned to each concept. One description is the Fully Specified Name (FSN) and Synonym.

The FSN represents a unique description of a concept and is not displayed in the clinical records. The FSN purpose is to differentiate concepts that may be referred to by the same word or phrase. This name includes a semantic tag that appears in parenthesis at the end of the name, e.g. “disorder”.

For example, “cold” could be “common cold (disorder)” or “cold sensation quality (qualifier value)”.

<table>
<thead>
<tr>
<th>SNOmed CT ID</th>
<th>FSN</th>
<th>SYNONYM</th>
</tr>
</thead>
<tbody>
<tr>
<td>82272006</td>
<td>COMMON COLD (DISORDER)</td>
<td>COLD</td>
</tr>
<tr>
<td>84162001</td>
<td>COLD SENSATION QUALITY (QUALIFIER VALUE)</td>
<td>COLD</td>
</tr>
</tbody>
</table>

Figure 4. Example of Semantic Tag

A synonym is a term that can be used to select a concept. A concept may have many than one synonyms and users may select the terms applicable to specific clinical meaning. In addition, concepts can have the same synonym and one of them is marked as ‘Preferred’.
RELATIONSHIPS

Relationships represents the association between concepts and organize them in order to facilitate access in clinical applications.

<table>
<thead>
<tr>
<th>CONCEPT (SOURCE)</th>
<th>RELATIONSHIP TYPE</th>
<th>CONCEPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNOMed CT ID 80967001</td>
<td>IS A</td>
<td>SNOMed CT ID 312128007</td>
</tr>
<tr>
<td>SNOdent ID 118065D</td>
<td></td>
<td>SNOdent ID 101050D</td>
</tr>
<tr>
<td>DENTAL CARIES (DISORDER)</td>
<td></td>
<td>BACTERIAL ORAL INFECTION</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNOMed CT ID 80967001</td>
<td>IS A</td>
<td>DISORDER OF HARD TISSUES OF TOOTH</td>
</tr>
<tr>
<td>SNOdent ID 118065D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DENTAL CARIES (DISORDER)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>STRUCTURE</td>
<td>SNOMed CT ID 128456003</td>
</tr>
<tr>
<td></td>
<td>OF HARD TISSUE</td>
<td>SNOdent ID 167836D</td>
</tr>
<tr>
<td></td>
<td>OF TOOTH FINDING</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SITE</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5. Example of Descriptions for a Single Concept

Figure 6. Sample of Relationship
SUBTYPE RELATIONSHIPS
Subtype relationships define relationships and are known as “is a” relationships.

BACTERIAL ORAL INFECTION (DISORDER)
SNOMED CT ID 312128007
SNODENT ID 101050D

DISORDER OF HARD TISSUES OF TOOTH (DISORDER)
SNOMED CT ID 46557008
SNODENT ID 111975D

ORAL MUCOSAL BACTERIAL DISEASE (DISORDER)
SNOMED CT ID 235061000
SNODENT ID 140880D

DENTAL CARIES (DISORDER)
SNOMED CT ID 80967001
SNODENT ID 118065D

SENSITIVE DENTIN (DISORDER)
SNOMED CT ID 13468005
SNODENT ID 135048D

Figure 7. Example of “is a” Relationships

The “is a” relationships form the hierarchies of SNODENT. The level of clinical detail of the specific concepts increases with the depth of the hierarchies. The “is a” relationships also provide the polyhierarchical structure of SNODENT, because a concept can have more than one “is a” relationship to other concepts (so a child concept may have multiple parent concepts).

If two concepts are directly linked by a single “is a” relationship, the first concept is said to be a “child” of the destination concept, which is referred to as a “parent”.

The top of the SNODENT hierarchy is occupied by the root concept (“SNODENT concept”). All concepts are descended from this root concept through one sequence of “is a” relationships.

The direct subtypes of the root concept are referred to as top level concepts that name the main branches of the subtype hierarchy. Each of these top level concepts, together with their many subtype descendants, forms a major branch of the hierarchy containing similar types of concept. As the hierarchies descend, the concepts within them become highly granular.
Figure 8 depicts the **high level hierarchies** with a brief description of the content.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
</tr>
</thead>
</table>
| **body structure**          | Represents normal and abnormal anatomical structures<br>Example: “bone structure of jaw (body structure),” “eruption (morphologic abnormality)” |}
| **clinical finding**        | Represents the result of a clinical observation, assessment or judgment and includes normal and abnormal clinical states<br>Example: “bleeding (finding),” “Hematoma of oral cavity (disorder),” “Hematoma of gingiva (disorder)” |}
| **event**                   | Represents occurrences excluding procedures and interventions<br>Example: “abuse (event),” “Drug not available for administration (event)” |}
| **observable entity**       | Represents a question or assessment which can produce an answer or result<br>Example: “ability to taste (observable entity),” “ability to chew (observable entity)” |}
| **organism**                | Represents organisms of significance in human and animal medicine<br>Example: “fungus (organism),” “superkingdom bacteria (organism)” |}
| **pharmaceutical/biologic product** | Represents drug products<br>Example: “anesthetic (product),” “topical anesthetic (product)” |}
| **physical force**          | Represents physical forces that can play a role as mechanisms of injury<br>Example: “friction (physical force),” “ultraviolet radiation (physical force)” |}
| **physical object**         | Represents natural and man-made objects<br>Example: “dental appliances (physical object),” “occlusal appliance (physical object)” |}
| **qualifier value**         | Represents the values for some SNODENT attributes, where those values are not subtypes of other top level concepts<br>Example: “left,” “abnormal” |}
| **situation with explicit context** | Represents conditions and procedures that have not yet occurred, that refer to a person other than the patient or that have occurred at some prior time<br>Example: “family history: diabetes mellitus (situation),” “no pain (situation)” |}
| **social context**          | Represents social conditions and circumstances significant to health care<br>Example: “voluntary body piercing (life style),” “voluntary body tattooing (life style)” |}
| **special concept**         | Represents concepts that do not play a part in formal logic of the concept model of the terminology but which may be useful for specific uses<br>Example: “Disorder of hematopoietic system (navigational concept),” “Thrombotic disorder (navigational concept)” |}
| **substance**               | Represents general substances, the chemical constituents of pharmaceutical/biological products, body substances, dietary substances and diagnostic substances<br>Example: “Amalgam (silver) dental filling material (substance),” “Dental cement (substance)” |}

*Figure 8. Top Level Hierarchies*
SNODENT ATTRIBUTES

Concepts can have properties and roles, also called relationship types or attributes, which are typically specific to a given terminology's domain. For example: SNOMED CT which deals with clinical medicine, has attributes such as Pathological Process and Finding Site.

Some SNODENT attributes have a hierarchical relationship to one another known as attribute hierarchies. In an attribute hierarchy, one general attribute is the parent of one or more specific subtypes of that attribute. Subtypes of a concept defined using the more general attribute can be defined using a more specific subtype of that attribute.

<table>
<thead>
<tr>
<th>IDENTIFIERS</th>
<th>CONCEPT</th>
<th>ATTRIBUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNOMED CT ID 80967001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNODENT ID 118065D</td>
<td>DENTAL CARIES (DISORDER)</td>
<td>ASSOCIATED MORPHOLOGY: CARIES</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FINDING SITE: STRUCTURE OF HARD TISSUE OF TOOTH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAUSATIVE AGENT: SUPERKINGDOM BACTERIA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PATHOLOGICAL PROCESS: INFECTIOUS PROCESS</td>
</tr>
</tbody>
</table>

Figure 9. Example of Attributes

Attributes Used to Define SNODENT concepts

The SNODENT defining attributes are used to represent the meaning of concepts in these six hierarchies:

- Clinical Finding Concepts
- Evaluation Procedure Concepts
- Body Structure Concepts
- Pharmaceutical/Biologic Product Concepts
- Situation with Explicit Context Concepts
- Physical Object Concepts
IV. THE IMPORTANCE OF MAPPING

Clinical information recorded during a dental office visit includes data that may be used either for reporting, research, claims, etc. This information may be recorded using a coding system such as ICD-9 CM, ICD-10 CM and CDT.

Maps are associations between particular codes in one code system and codes in another code system that have the same meaning.

MAPPING APPROACHES

The approaches used when undertaking mapping include human mapping, automatic mapping, or a combination of both.

Automatic mapping is when computer algorithms are used to create maps between code systems for example between the ICD-9 CM and SNODENT.

It is imperative that significant care be taken with automatic mapping since errors can result if no strict parameters and constraints are in place prior to initiating the process.

Human mapping is the use of human knowledge to create maps between code systems. The process requires thorough review of every concept in the coding systems. The main steps to be completed when mapping two or more code systems include:

• Evaluate mapping as a solution
• Produce mapping requirements
• Develop the maps
• Review activity

The SNODENT mapping used a combination of both human and automated approaches. The map from SNODENT to ICD-9 CM and ICD-10 CM are released as separate files in Excel and flat file formats. These maps are directional and specify a mapping from a SNODENT concept to one or more ICD-9 CM and ICD-10 CM codes.

• SNODENT concept ID — The SNODENT concept which is the source of the map
• SNOMED CT concept ID — The SNOMED CT concept
• ICD-9 CM code — The ICD-9 CM code which is the target of the map
• ICD-10 CM code — The ICD-10 CM code which is the target of the map

ICD-9 CM Map advice — Either “Exact”, “Narrow to Broad”, “Broad to Narrow,” or “Partial.”

“Exact” indicates that the SNODENT concept and the ICD-9 CM or ICD-10 CM term are synonymous. “Narrow to Broad” indicates that the SNODENT concept is more specific than the ICD-9 CM term or ICD-10 CM. “Broad to Narrow” indicates that the SNODENT concept is more general than the ICD-9 CM or ICD-10 CM term. “Partial” indicates that there is some overlap in meaning between the SNODENT concept and the ICD-9 CM or ICD-10 CM term, but neither completely contains the other. There may be multiple maps for a concept.

Upon completion, the maps were reviewed by subject matter experts and lessons were learned and documented for future mapping activities.
RELEASES
Release types:

SNODENT is distributed by the American Dental Association as a set of downloadable files. Interested parties wishing to implement SNODENT in a software application should understand the semi-annual release schedule, structure, and content of the release files. SNODENT is currently released following the SNOMED CT release.

DISTRIBUTION FILES AND FORMATS
The SNODENT is released as a set of files:

- Tab-delimited text files
- Excel

There are individual files with specified columns for each of the components of SNODENT:

- Concepts
- Descriptions
- Relationships

All components in the release files have permanent unique SNODENT Identifiers and SNOMED CT ID Identifiers.

There are also individual files for each SNOMED CT Subset. These files contain:

- Concepts
- Descriptions
- Relationships
- Maps to ICD-9 CM, ICD-10 CM and CDT to support implementation of a smaller subset in Dental practices or Dental Schools
V. USING SNODENT

SNODENT must be implemented as part of a clinical application. The design of the application in combination with the objectives of its users are key variables in a successful implementation.

![Diagram of SNODENT usages](image)

**Figure 10. Usages of SNODENT**

**IMPLEMENTATION IN SOFTWARE APPLICATIONS**

SNODENT can be implemented in EDRs. The functions required to implement it in an EDR are:

- **Terminology services** — Functions that can be performed without reference to data stored in a particular application record structure.
- **Record services** — Functions that involve storing, retrieving or processing application data.

Most users only require a small subset of the content of SNODENT. Some applications and users will not require all of the concepts and descriptions used in SNODENT.
The use of SNODENT makes oral health information available in a structured form which can be queried and used to trigger decision support prompts.

**Enabling Interoperability**

Oral health information can be recorded using SNODENT, independent of the EDR in use.

**Using SNODENT for Reporting**

As an official subset of SNOMED CT, SNODENT concepts are semantically consistent. Therefore, there is one unique SNODENT identifier representing a single concept. SNODENT supports recording at appropriate levels of granularity by using relevant terms.

**LEARNING MORE ABOUT SNODENT**

This guide is intended as a practical and useful starting point from which anyone with a general interest in health care information can begin learning about SNODENT. It provides a broad overview of SNODENT from which to start a more detailed exploration.

American Dental Association provides many other materials on its website that you are welcome to explore. The website also provides access to information and a tutorial video: ADA.org/SNODENT.

**CONTACT INFORMATION**

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ADA.org/SNODENT