EZCodes: A diagnostic terminology as the foundational step of quality for the dental profession
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CHAPTER 1

Introduction

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Introduction

Fundamental requirements for a proper indication of oral care

As in medicine, dental treatment should be based on the complex integration of a multitude of factors including the patient’s chief complaint, medical and dental history (anamnesis), findings discovered during intra- and extra-oral examination, the patient’s preferences, and social context, among others.1 In modern society, the patient should be able to expect dental treatment proposals that are based on the best available evidence. When taking this view, even preventive measures, such as tooth brushing instructions, must be seen as “treatment” and ought to be evidence based. In reality, however, patients are often advised to undergo preventive treatments where the evidence for actual oral health improvement is uncertain at best.

Evidence-based research is frequently performed in controlled environments, such as academic clinics, because field research lacks the ability for proper registration of all variables required for treatment evaluation.2 As a result, controlled environments are often not representative of the “field” or are not easily generalizable to the practicing dentist in the private or community clinic setting. Attempts should be undertaken to standardize documentation of dental treatment by the non-academic dentist in such a way that structured epidemiologic and clinical evaluations are possible. Currently, dental treatment documentation is reasonably well established in many countries throughout the world. This is because rather often, dental providers cannot generate income without adequate documentation in place. However, to enhance evidence-based research in oral care, documentation of treatment alone is insufficient. At a minimum, it has to be combined with the dental diagnosis that formed the basis for the indication of treatment. For example, when one wants to study the longevity of a Class IV restoration of the upper frontal incisor, it is of interest to differentiate between the diagnoses “fracture due to trauma from being hit by a hockey stick” and “severe caries”. It is not unreasonable to expect that a diagnosis of trauma may influence the longevity of the restoration differently than a diagnosis of disease.

The diagnostic terminology must be clear and indisputable, allowing for a straightforward, consistent collection of dental diagnostic information. When dental providers enter terms validly and efficiently, information gained will enhance teaching and digital evaluation, research and outcomes analyses, and ensure quality improvement.
Existing diagnostic systems for medicine and dentistry

The development of a standardized diagnostic terminology does not have as long of a history as that of the medical lexicon in general. Where modern medicine can trace its roots back to Hippocrates and Galen, whose writings include anatomic, pathologic, and therapeutic terms that remain still in use today, the development of diagnostic terminologies started a mere 250 years ago. After attempts by Sauvage, Cullen, and Farr, Bertillon created the first generally adopted set of standardized medical diagnoses in 1893. His “Bertillon Classification of Causes of Death” formed the basis for the current ICD diagnostic terminology used world-wide. The history of the development of ICD is documented in Figure 1.1.

Figure 1.1: History of ICD

While the International Classification of Diseases (ICD) is undoubtedly the international standard diagnostic classification used in the medical clinic, epidemiological studies, health management and economics, it does not have adequate coverage of oral and dental diagnoses. The U.S. developed ICD-CM (Clinical Modification), which has more information and detail than ICD. The current ICD-10-CM version contains 68,000 terms; ICD 10 has far less terms. Both terminologies’ oral health chapters lack sufficient detail for prudent documentation of dental diagnoses. The Systematized Nomenclature Of Medicine (SNOMED) was developed in 1965 by the College of American Pathologists as SNOP (Systematized Nomenclature of Pathology), and later extended into other medical fields. The current version SNOMED Clinical Terms (SNOMED CT) is a controlled medical terminology for use in the EHR. As a reference terminology, it has comprehensive coverage of diseases, clinical findings, etiologies, procedures, and outcomes and contains more than 311,000 unique terms organized into hierarchies. SNODENT, a Systematized Nomenclature for Dentistry, was devised by the American Dental Association (ADA) in the early 1990’s. SNODENT is composed of diagnoses, signs, symptoms, and complaints and...
currently includes over 7700 terms. In 1998, the ADA entered into an agreement to incorporate SNODENT Version I into SNOMED. In 2012, SNODENT Version II was incorporated into the SNOMED CT. Until its recent inclusion into SNOMED CT, SNODENT was only available by license and was maintained by the ADA. As a result, SNODENT has never been implemented in the dental profession. The sheer size of oral health terms makes effective integration into a dental electronic health record (EHR) difficult and actual utilization improbable.

Clinical terminologies as well as classifications capture detailed data in the EHR. Where clinical terminologies are the input format, classification systems are the output format. Though they are designed for different purposes, they should be considered complementary. ICD is considered a classification or “output” system. As a result, the primary documentation of clinical care is not its intended use. Indeed, it is mainly used in the U.S. for external reporting (billing, quality control) requirements. In contrast, SNOMED-CT is a clinical terminology, and as an “input” system, it is designed for the primary documentation of clinical care.

It is reasonable to assume that the “one size fits all” principle will not work when trying to utilize one terminology or classification to fulfill all required administrative needs of a healthcare organization. For example, with nearly 7700 dental terms and 311,000 medical terms, SNOMED-CT is designed to identify data at the point of care. Whereas ICD, with around 100 oral health terms and 68,000 medical terms, (ICD CM has around 320 oral health terms) has the ability to aggregate data and is more suitable for claims processing. Additionally, which terminology or classification system shall be used is determined, in part, by regulatory requirements.\textsuperscript{10}

**Rationale for the development of a dental diagnostic terminology**

Until now, a commonly accepted standardized diagnostic terminology did not exist for oral diagnoses. However, the dental provider has never documented diagnoses, whether in electronic or paper format, in a structured way. In contrast, medicine has used standardized terminologies for over a century, and specifically, ICD is a requirement of the American billing process. More recently, the U.S. Office of the National Coordinator (ONC) is requiring the use of SNOMED CT\textsuperscript{11} terms for populating the problem list in the EHR for those providers who want to participate in its “Meaningful Use incentive program”.\textsuperscript{12,13}

There are a multitude of benefits for documenting diagnoses in a standardized and consistent way as our colleagues in medicine have been doing “since the bubonic plaque”\textsuperscript{14} (or rather one of its later local outbreaks: the Great Plaque of London in
1665), or to be precise, since 1763.9 They include documentation of the types and frequency of diseases encountered by the care provider and thus, the ability to track disorders treated for internal quality control. This enhances communication with patients and between care providers, especially when care is shared between health care providers, enables outcomes tracking, and facilitates data sharing across sites.15 It allows epidemiologists to evaluate disease patterns, treatment patterns, and disease outcomes. From a research point of view, it will allow health services researches to study risk-adjusted, cross sectional, and temporal variations in access to health care, health care quality, costs of care, and treatment effectiveness.16 In the academic setting, a standardized dental diagnostic terminology will allow both students and faculty to hone their formal diagnostic skills, emphasizing the link between diagnosis and treatment and thus enhancing patient care.17 Lastly, the standardization of documenting diagnoses will allow for the true measuring of outcomes, defined as the condition of a patient at the end of therapy or a disease process,18 and as such, forms the foundation of the development of clinical guidelines or recommendations to inform evidence-based dentistry (EBD).19

Figure 1.2 is a graphical representation of the relations between diagnostic codes and applications.

![Figure 1.2: Relationship between diagnostic codes and applications](image)

**Financial**

The United States is expected to spend approximately 19% of its Gross Domestic Product (GDP) on health care in 2014.20 In 2011, *per capita* healthcare spending rose by 4.6%.21 According to the Kellogg Foundation’s 2011 report titled, *Oral Health Quality Improvement in the Era of Accountability*, “the United States
healthcare system spends significantly more money \textit{per capita}…than other developed nations” while trailing other developed nations in several health indicators,\textsuperscript{22} ranking \textit{39\textsuperscript{th}} in infant mortality, \textit{43\textsuperscript{rd}} in adult female mortality, \textit{42\textsuperscript{nd}} in adult male mortality, and \textit{36\textsuperscript{th}} in overall life expectancy. Meanwhile, the mortality rate for American males 15-60 years of age is worse than in Sweden or Australia,\textsuperscript{23} countries that are similarly to the U.S with respect to population wealth (GDP/capita). Additionally, in the U.S., where health insurance is predominantly employer-sponsored, increased unemployment levels, and the subsequent loss of employer-provided insurance, have served to decrease access to healthcare. Meanwhile, as a result of reductions in dental insurance benefits, Americans are increasingly paying for oral healthcare out-of-pocket or foregoing needed dental procedures, to the point where “dental care is among the largest out-of-pocket health expenditures in the U.S., second only to prescription drugs”\textsuperscript{22}.

These sobering facts demand not only adjustments in healthcare spending, becoming more efficient, or making incremental changes, but also true innovation.\textsuperscript{24} In response to spiraling healthcare costs in the United States and resultant negative public health impacts, the “Triple Aim” was developed by the Institute for Healthcare Improvement (IHI) in an effort to create an improved model of healthcare delivery. Its three conceptual dimensions are:

(1) improving the patient experience of care;
(2) improving the health of populations, and
(3) reducing the \textit{per capita} cost of healthcare.

In \textit{Pursuing the Triple Aim: Seven Innovators Show the Way to Better Care, Better Health and Lower Costs}, Bisognano and colleagues described how healthcare innovators have found a way to achieve “measurable progress on the challenges of quality and costs”\textsuperscript{25} The seven innovators present implemented solutions that produced documented results in improving patient care while controlling costs. The Triple Aim model is in part an effective model to apply to dentistry in an effort to start addressing quality and cost issues. However, it might have been better if the architects of the Triple Aim had included oral health directly into some of their approaches instead of perpetuating the siloed structure of dentistry and medicine.

One of the most effective ways to improve effectiveness of care is to increase the degree to which dental and medical providers collaborate with respect to overall care for their shared patients. This is a significant paradigm shift for both parties since currently the relationship is most often limited to one of referring for expert treatment (“cure”). However, only when the dental provider begins to function as a “health care ambassador” (i.e. monitoring blood pressure), or the medical provider as a “dental
advocate”, supplying advice and preventive care (i.e. supplying fluoride treatment for children), will the patient truly benefit through ongoing managed care, instead of episodic expert “cure”. Dentistry brings well-documented value to the Triple Aim - a partnership with the medical physician for providing screening, preventive maintenance care and actively participating as a member of the Proactive Practice Team. The dentist thereby becomes a partner in the detection of systemic diseases, as a number of systemic diseases can be first diagnosed orally. Examples include immunosuppressive diseases (i.e. pemphigus vulgaris), chronic illnesses (i.e. diabetes), and infectious diseases (i.e. HIV/AIDS, the first AIDS patient was diagnosed in San Francisco General Hospital as Karposi Sarcoma of the palate.\textsuperscript{26}) The models developed by Bellin Health\textsuperscript{25} and others can be adapted to include oral health providers. Use of a dental diagnostic terminology will hold the key to moving from “cure” to care”, as well as improving the capacity for oral public health research connecting medical and dental care. This in turn will promote collaborative efforts, and enable oral health data collection that fosters capacity for medical-dental partnerships.

Since a number of chronic diseases have oral manifestations, dentist-physician collaboration can increase early diagnosis for patients with chronic illnesses and thus prevent expensive treatment of complications later on. For example, uncontrolled diabetes will negatively influence the periodontal status of the patient, and, conversely, improving periodontal health will positively influence the diabetic status of the patient.\textsuperscript{27} One such example of dentist-physician collaboration is seen in twenty schools that are part of the Consortium for Oral Health Research and Informatics (COHRI).\textsuperscript{28} These schools are participating in efforts to engage their patients in simple primary care screening efforts as participants of the Meaningful Use Incentive Program,\textsuperscript{29} a part of the HITECH Act of 2009 that provides payment incentives for utilizing EHRs. These efforts include blood pressure measurement, tobacco use and cessation screening, asthma acerbations screening, and assuring pneumonia and influenza vaccinations. In addition to augmenting medical management of chronically ill patients, these quality measures also represent a budding partnership with the patient at the center and the medical and oral health physicians as partners and collaborators, connected to each other and the patient. The core of this effort is the ability for the provider to document a medical, as well as an oral health, diagnosis in a structured and consistent way.
Quality

Documenting diagnoses in a standardized way has to be at the foundation of any quality effort to reach the Triple Aim of better care, better health, at lower cost. Expanding the Institute of Health Improvement’s simple triad illustrates the foundational role of a dental diagnostic terminology to affecting quality in oral health (see Figure 1.3). The problem for dentistry, however, is that while ICD is undoubtedly the international standard diagnostic classification used in the medical arena, it does not have adequate coverage of oral and dental diagnoses. Conversely, SNOMED, and the majority of the oral health terms imbedded in it as SNODENT, offers such an overwhelming number of terms that it effectively becomes unmanageable chair-site. However, as mentioned earlier, the ability to capture information about oral health diagnoses in a standardized way is essential for quality of care, epidemiological health tracking, and research and cost-effectiveness reasons. Entering a diagnosis in a structured field in an EHR not only reinforces the link between diagnosis and treatment, but also allows for efficient outcomes assessment and continuous quality monitoring through data mining. Hence, the need for the development of a dental diagnostic terminology, intended to reap the benefits of being positioned as an interface terminology, becomes quite evident.

Figure 1.3: Diagnosis as the foundation of Quality of Care
**Research**

Martin *et al.*, nicely outline the central issues regarding the use of dental diagnosis in dentistry and dental research when they mention that “(…) currently dentistry has a disconnect between procedure codes (…) and diagnostic codes….”. As a result, there are serious challenges to combining data across disparate sites and comparing results across studies. As Pitts noted, “Many apparently similar terms are used interchangeably in the literature, but are taken by different groups of researchers and clinicians to mean very different things”. Clearly, the dental profession’s ability to conduct research is limited by the lack of clear definitions and standardized nomenclature to describe diagnoses.

One of the stated goals of the Centers for Disease Control’s (CDC) *Healthy People 2020* is to “prevent and control oral and craniofacial diseases, conditions, and injuries, and improve access to preventive services and dental care”. Toward these goals, in September 2011, the National Priorities Partnership (NPP), formed by the nonprofit National Quality Forum (NQF), recommended including three oral health measures delineated by *Healthy People 2020* as measurable objectives. These oral health measures are:

1. the proportion of young children aged 3-5 years with dental caries experience in their primary teeth;
2. the proportion of adults with untreated dental decay, and
3. the proportion of children, adolescents, and adults who used the oral healthcare system in the past year.

In order to effectively measure these objectives, a standardized dental diagnostic terminology that is practical and easy to use chair-site will be necessary.

**Evidence-Based Dentistry (EBD)**

The periodontal community is leading the dental profession by starting the debate about the absence of a “gold standard…which contains all the information needed to form a diagnosis”. With the ongoing implementation of EHRs in the dental setting, it is important that, once the diagnosis is made, it is captured electronically, along with the procedure performed, using a dental diagnostic terminology. Nevertheless, as Meyers’ argument underscores, “dentists do not have a set of diagnostic terms or clinical pathways to attain dental health for their patients based on the best available evidence and accurate risk assessment”.
Evidence-based dentistry (EBD) is the coming together of three equally important concepts:

1. the best available, clinically relevant, scientific evidence relating to the patient’s oral and medical condition and history;
2. a dentist’s clinical expertise, and
3. the patient’s treatment needs and preferences.

Systematic reviews of published papers are considered the preferred method for assembling the best available scientific evidence. As such, the results from systematic reviews may be used for decision making about research and the provision of health care. A systematic review includes:

A stated clinical question, preferably in “PICO” format that identifies:
- Population (the individuals or groups for whom an answer is sought)
- Intervention (the treatment or clinical condition of interest, i.e. patient type, disease)
- Comparison (an alternative treatment or control group for comparison to intervention)
- Outcome (the measure(s) used to assess the effects of the intervention)

Example: In persons with adult periodontitis, how does scaling and root planing combined with local antimicrobial therapy affect bleeding and pocket depths compared to scaling and root planing alone?\textsuperscript{36}

Clearly, without a well-defined diagnosis that is documented in a standardized way throughout the literature, it will be difficult to “identify and evaluate all of the evidence with which to answer a specific, narrowly focused clinical question”.\textsuperscript{37} As such, one might argue that a number of the current EBD recommendations have a low level of certainty of net benefit. As described in the ADA Clinical Recommendation Handbook, “The ‘level of certainty’ is the probability that the Expert Panel’s assessment of the net benefit of an intervention is correct. For example, a low level of certainty may result from a lack of evidence; from studies of inappropriate design; from studies of appropriate design, which are of poor quality or have meager or no applicability; from too small and/or too few studies; and from inconsistent results between studies”.\textsuperscript{37}

When reviewing the American Dental Association Council on Scientific Affairs’ EBD recommendations, it is clear that standardized documentation of diagnosis is paramount in the development of such guidelines:
(1) Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures. The guideline reviews how “a multitude of indirect evidence was included in this guideline that investigates particular components of this complex mechanism”. It states, “Multiple high strength studies link oral procedures to bacteremia, a surrogate measure of risk for orthopaedic implant infection”. One might argue that without knowing the diagnosis and thus why a procedure was performed, it is difficult to understand the surrogate link between procedure and bacteremia. Extraction of an abscessed tooth occurs in a quite different oral environment than removal of four pre-molars for orthodontic reasons.

(2) Nonfluoride caries-preventive agents. Several studies recorded dental caries according to the World Health Organization (WHO) definitions, which include four caries stages, however, not all four stages were always included in the statistical analysis. This may have impacted understanding the preventive impact of xylitol on the formation of white lesions.

(3) Dietary Fluoride Supplements. The panel concluded, “Owing to known increases in exposure to fluoride from multiple sources and the increased prevalence of enamel fluorosis, the panel recommended fluoride supplement use for children at high risk of developing caries”. The guidelines also note that “the panel did not identify studies that supported its use specifically in populations at high or low risk of developing caries” and that “the clinician should conduct a caries risk assessment to determine the appropriateness of prescribing dietary fluoride supplements. There is no exact definition of high risk of developing caries; rather, it can be a continuum”. However, a standardized diagnostic terminology that not only includes terms for the various forms of caries, but also includes terms for “High, Moderate and Low Caries Risk” should significantly help with the risk benefit analysis of preventing caries versus promoting the incidence of fluorosis.

(4) Evidence-Based Clinical Recommendations for the Use of Pit-and-Fissure Sealants. The report states that “in clinical care settings, diagnosis of caries implies not only determining whether caries is present (that is, detection) but also determining if the disease is arrested or active and, if active, progressing rapidly or slowly”. Additionally, the report states, “Pit-and-fissure sealants are underused, particularly among those at high risk of experiencing caries”. Only when the patient’s level of caries risk assessment, as well as level of disease, is documented in a consistent, standardized way, can we make conclusions regarding the true effectiveness of the intervention.
(5) Professionally applied topical fluoride. The guidelines state, “The panel encourages dentists to employ caries risk assessment strategies in their practices”. In order to assess effectiveness of this intervention for a single patient or an entire population, standardized documentation of caries risk level will be necessary.

(6) Evidence-Based Clinical Recommendations Regarding Fluoride Intake From Reconstituted Infant Formula and Enamel Fluorosis. This report states evidence-based clinical recommendations regarding the intake of fluoride from reconstituted infant formula and its potential association with enamel fluorosis. For ongoing assessment and monitoring of fluorosis among infants, documenting the various stages of fluorosis in a standardized way will be paramount.

(7) Evidence-Based Clinical Recommendations Regarding Screening for Oral Squamous Cell Carcinomas. The guidelines state, “When a clinician observes a persistent or progressive lesion, he or she may consider prompt referral to a dental or medical provider with advanced training and experience in diagnosis of oral mucosal disease before performing tissue biopsy”. This will require consistent documentation of a diagnosis in an easily retrievable manner. The preference would be an electronic format, since these are easiest to retrieve. Thus, the use of a diagnostic terminology will be essential.

**Research project of this thesis**

The study described in this thesis aims to develop a validated dental diagnostic terminology (called ‘EZCodes’) to enhance a proper registration of diagnostic findings for, amongst others, research in EBD. Basic principles for terminology development will be applied. Moreover, the notion to position the terminology as an interface terminology, interfacing with existing diagnostic and payment systems will be explored.

Chapter 2 discusses the public health impact of the use of a standardized dental diagnostic terminology. It provides an overview of how standards are developed and accepted worldwide. As an interface terminology, the EZCodes terminology is positioned to play a prominent role in this important, but yet underexplored arena.

In Chapter 3, the iterative process to develop a dental diagnostic terminology adhering to principles of terminology development is described. Additionally, a first attempt was made to build an interface terminology consisting of categories and subcategories. This resulted in 1158 terms that are mappable to:
(1) ICD for Medicaid billing purposes;
(2) SNOMED, its reference terminology, for Meaningful Use purposes, and
(3) the treatment terminology CDT, for general dental billing purposes.

In essence, the EZCodes are the center of serving or informing four crucial entities of the dental profession (see Figure 1.4).

Figure 1.4: Relationship between diagnostic codes and applications

Chapter 4 describes the validation process of the diagnostic terminology through a retrospective analysis of the use of Z codes (a subset of the EZCodes) as they relate to procedure codes. The study showed successful development, implementation, and utilization of diagnostic codes and terms in an EHR with low elective utilization but high validity.

Chapter 5 describes the assessment of the EZCodes terminology in two dental schools. After one year of non-compulsory use, utilization was low; however, validity was high.

Chapter 6 explores the role of the EZCodes in treatment planning in the EHR. The study underscores the impact of technology on the fundamental skills of diagnosis and treatment planning within the modern educational setting.

Chapter 7 describes a short use case that demonstrates the value of documenting a diagnosis in a standardized way. Four U.S. dental schools have pooled de-identified, clinical EHR data in a first-ever dental data repository. With one million unique patients, many who have diagnostic as well as treatment codes documented in their EHR, it was possible to answer research questions focused solely on the value of entering a diagnostic term.
In Chapter 8 the general discussion integrates the results of the studies, explores steps towards future research, demonstrates the value of the EZCodes terminology and provides a call to action for further integrating of the EZCodes diagnostic terminology into the curriculum of today’s dental students.
References


