Development and initial validation of a content taxonomy for patient records in general dentistry

Amit Acharya [a],[*], *Pedro Hernandez* [b], *Thankam Thyvalikakath* [b], *Harold Ye* [a], *Mei Song* [b], *Titus Schleyer* [b]

[a] *Biomedical Informatics Research Center, Marshfield Clinic Research Foundation, Marshfield, WI, USA*
[b] *Center for Dental Informatics, University of Pittsburgh, Pittsburgh, PA, USA*

ARTICLE INFO

ABSTRACT

Objective: Develop and validate an initial content taxonomy for patient records in general dentistry.

Methods: Phase 1 – obtain 95 de-identified patient records from 11 general dentists in the United States. Phase 2 – extract individual data fields (information items), both explicit (labeled) and implicit (unlabeled), from records, and organize into categories mirroring original field context. Phase 3 – refine raw list of information items by eliminating duplicates/redundancies and focusing on general dentistry. Phase 4 – validate all items regarding inclusion and importance using a two-round Delphi study with a panel of 22 general dentists active in clinical practice, education, and research.

Results: Analysis of 76 patient records from 9 dentists, combined with previous work, yielded a raw list of 1509 information items. Refinement reduced this list to 1107 items, subsequently rated by the Delphi panel. The final model contained 870 items, with 761 (88%) rated as mandatory. In Round 1, 95% (825) of the final items were accepted, in Round 2 the remaining 5% (45). Only 45 items on the initial list were rejected and 192 (or 17%) remained equivocal.

Conclusion: Grounded in the reality of clinical practice, our proposed content taxonomy represents a significant advance over existing guidelines and standards by providing a granular and comprehensive information representation for general dental patient records. It offers a significant foundational asset for implementing an interoperable health information technology infrastructure for general dentistry.

1. Introduction

The American Dental Association (ADA) defines the dental patient record as "the official office document that records all diagnostic information, clinical notes, treatment performed, and patient-related communications that occur in the dental office, including instructions for home care and consent to treatment [1]." As in medicine, dental professionals are required to maintain accurate and complete patient information in these records [2]. As expressed by the adage "dentists and patients forget but good records remember," complete and comprehensive patient records are essential to support decision-making processes and perform outcomes research [3]. However, current evidence suggests that dental records vary significantly in the degree to which they meet this

standard and in some cases may be inadequate [4,5]. Structured record cards or computerized recordkeeping systems that guide the dentist through the examination in a logical manner may help improve recordkeeping [6]. As more and more dentists adopt electronic dental records to deliver patient care [7], it is essential that we address the question of what patient information should be documented and how it should be structured [8].

During the last three decades, state, national, and international dental organizations have produced guidelines and/or standards for essential components of the dental record. Among them are 'Guidelines for Criteria and Standards of Acceptable Quality General Dental Practice' developed by Shoen et al. In 1989 [9], minimum recordkeeping standards for patient records developed by the Minnesota State Board of Dentistry in 1997 [10], 'The Dental Patient Record: Structure and Function Guidelines' developed by the American Dental Association (ADA) in 1987 [11], guidelines on content of clinical records developed by the Faculty of General Dental Practitioners (UK) [12], and criteria for characteristics, format, and content of a quality dental record developed by the Wisconsin Dental Association (WDA) Council on Dental Care [13]. Common information categories recommended in these guidelines include personal/demographic information, reason for visit, dental history, medical history, clinical examination information, diagnosis, treatment plan and informed consent information. Beyond these association-based efforts, the ADA's Standards Committee on Dental Informatics (SCDI) has completed significant work on three major standards for electronic health records (EHR) content: the ANSI/ADA Specification No. 1000: Standard Clinical Data Architecture for the Structure and Content of an Electronic Health Record [14]; ANSI/ADA Specification No. 1039: Standard Clinical Conceptual Data Model [15]; and ANSI/ADA Specification No. 1040: Dental Extension to the Continuity of Care Record [16]. However, none of these guidelines describe information categories and data fields in the general dental record in a comprehensive and granular manner. Along with the above guidelines and standards to represent the content of data fields that should be in the patient records, there are several standardized terminology sets available to represent the content of values these data fields can hold. Some of such terminology sets that are applicable to dentistry are Systematized Nomenclature of Dentistry (SNODENT) [17–19].

Several studies have suggested that dental records vary significantly in the degree to which they meet existing guidelines. Hand and Reynolds [20] audited 316 dental records from 13 facilities in New York State for the presence and adequacy of 13 data elements. Not only were more than 50% of facilities unable to present all requested records for the initial audit, but also the examined records showed significant deficiencies. Over 22% of patient records had at least four deficient elements, while only 19.3% contained all elements. Beyond deficiencies common in dental records, dentists' perceptions of record adequacy appear to be at odds with published recommendations. As Table 1 shows, respondents from a study by Osborn et al. [21] who rated their patient records as adequate did not record important clinical information in 21.3–39.3% of their records. Respondents who rated their patient records as inadequate had even higher deficiencies, ranging from 39.4%

to 58.3%. Similar observations were made in an earlier study of Florida dentists conducted by Minden [22]. A study performed by the WDA found that dentists created their own recordkeeping systems, resulting in a lack of uniformity in patient records maintained by dentists [13]. Inadequate documentation in dental records has not only been found in the United States, but also in the United Kingdom [23], Australia [24], and Scandinavia [25–28]. Several studies have stressed the need for implementation and further development of guidelines for information in an electronic dental record (EDR) [21,22].

The rapidly increasing adoption of EDRs by practicing dentists [7] means that we are about to translate our paper-based "Tower of Babel" of patient records to an electronic one, leaving many potential benefits of EDRs unattained. Electronic records could help make the type of patient record quality assurance studies described above both easier and more commonplace than they are now. They could facilitate patient-centered collaborative care [29], address oral-systemic connections [30], make the healthcare system more efficient [31–35], and support reuse of patient data for research [36,37]. A study conducted by the Center for Dental Informatics at University of Pittsburgh in 2005–2006 showed that 25% of U.S. general practitioners used a computer at chairside and 1.8% were completely paperless [38]; these figures had grown to 55.5% and 9.2%, respectively, in a 2006–2007 survey of dentists conducted by the ADA [39]. A 2010 survey of California dentists [40] showed that 23% had implemented a fully electronic dental record in their practice, as had 15.9% of solo practitioners in a recent survey by the Dental Practice-based Research Network [7].

Preceding the current study, we conducted the, to date, most detailed analysis of dental patient record formats in 2007 [41]. In that study, we analyzed the data fields of ten paper- and four computer-based patient record formats, resulting in a categorized list of 363 distinct data fields, which we called the Baseline Dental Record (BDR). The study revealed a large variation in the structure and content of both paper and computer-based dental records.

In 2010, we conducted a pilot to evaluate the feasibility of defining new patient record data fields from the content of 10 de-identified patient dental records [42] based on the framework of the BDR. We added 134 data fields, resulting in a categorized list of 497 distinct data fields [42]. Building on our previous results, we took the analysis and definition of dental patient record content one step further in this study. Our purpose was to define and validate a content taxonomy of data fields for patient records in general dentistry by analyzing de-identified patient records within the framework of our previous studies. To validate this taxonomy in light of actual practice, we performed a Delphi study with a panel of general dentists active in clinical care, research, and education.

2. Methods

Our study had four phases (see Fig. 1). In Phase 1, we obtained 95 de-identified patient dental records from a purposive sample of 11 general dentists in the United States. In Phase 2, we extracted individual data fields (henceforth called *information items*) from these records and organized them into logical