

The Electronic Oral Health Record

David W. Heid, DDS; Joseph Chasteen, DDS, MA;
Arden W. Forrey, PhD



Abstract

This paper presents the history of the use of the computer for maintaining patient medical care information. An electronic record generated with a computer, which is non-specific for any healthcare specialty, is referred to as the electronic health record. The electronic health record was previously called the computer-based patient record. "Electronic" replaced the earlier term "computer-based" because "electronic" better describes the medium in which the patient record is managed. The electronic health record and its application to dentistry are discussed.

The electronic health record is a "database" of patient information that has been entered by any healthcare provider; the electronic oral health record is an "electronic record" of oral health information that has been entered by an oral healthcare provider. The significant differences between the electronic health record and the electronic oral health record are outlined and highlighted. Included is a template describing a procedure to be used by dental personnel during the decision making process of purchasing an electronic oral health record. A brief description of a practice template is also provided. These completed templates can be shared with dental software vendors to clarify their understanding of and to clearly describe the needs of today's dental practice. The challenge of introducing information technology into educational institutions' curricula is identified. Finally, the potential benefit of using electronic technology for managing oral healthcare information is outlined.

Keywords: Electronic oral health record, electronic health record, dental practice, computer

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Introduction

This article presents key issues for oral healthcare providers to consider regarding the electronic oral health record.

Several electronic "administrative information systems" are used to maintain patient accounts, conduct billing operations, schedule appointments, and record oral charting notations. These information systems do not yet provide for an oral health record that is standardized and consistent with data that is recorded in other electronic systems related to healthcare. "Standardized" means that data is recorded using conventions commonly agreed upon by national and international standards committees. Information consistency is critical if individual patient care provided by two or more healthcare providers is to be coordinated and efficient. Mistakenly, some healthcare providers do not yet recognize the role that coordinated electronic "oral" health records and electronic health records can play in providing quality patient care.

It is critical that dentistry be included in the global community of healthcare as standards are being established for the entire array of functions included in software systems. Dentistry cannot afford to be an afterthought, or left out entirely if it is to be truly integrated into present and future healthcare strategies.

On a more parochial level, standardized electronic oral health records will allow the following functions not now universally possible due to the lack of standards:

- Transmission of the patient's complete oral health record, or selected parts, to a dental or medical specialist for patient care consultation.
- Electronic transfer of a patient's complete oral health record to a new dentist when the patient moves or changes oral healthcare providers.
- Transmit and receive patient radiographic and photographic images in order to facilitate consultations, third party pre-authorization, and adjudication functions.
- Receive medical test reports from medical laboratories.
- Improve the safety and accuracy of patient care by sharing critical medical and dental information between medical and dental practitioners treating the same patient.
- Inclusion in national taxonomies as well as in diagnostic and treatment coding systems.
- Inclusion in standardized care documentation systems to facilitate interdisciplinary communication, long-term care outcomes assessment, and clinical research.

This paper describes the broad subject of the electronic oral health record as it relates to a contemporary dental practice. Dental care providers are provided with a reasonable perspective of how to proceed toward standardizing the electronic oral health record.

Brief History

Computer-based patient records were initiated in the 1960's as a way to use computers to store patient data that had been historically placed on paper. As a tangible entity, the computer-based patient record (now called the electronic health record) has evolved slowly since its inception. The 1960's also saw the development of many healthcare insurance companies and agencies (federal and private) that generated more and more paper forms to be completed.

As these agencies and companies began to use computer business programs to manage data, it was obvious that data entry from paper forms was labor intensive so electronic forms were created. Initially a general business model was used to manage electronic data, and the priority for

these agencies and companies was to use information technology to enhance and share data that only related to administrative functions. Meanwhile, utilizing information technology to enhance direct patient care became a secondary priority. However, the report from the National Committee on Vital and Health Statistics (July 2000) entitled, "Uniform Data Standards for Patient Medical Record Information" (<http://www.ncvhs.hhs.gov>) reversed these priorities. This committee reports to the Secretary of Health and Human Services.

A number of, but not all, medical specialties that are involved in multidisciplinary patient care recognize the role of the dentist in the healthcare process. These healthcare professionals also recognize the need for readily accessible information regarding the oral manifestations of systemic disease as well as the significance of the oral health treatment plan in the total care of a patient.

During the past twenty years work has proceeded on defining and documenting the structure and content of the electronic health record. The American Health Information Management Association, which represents the health record management profession, has played a major role in this effort. Historic and developmental aspects of the electronic health record as well as information on its structure and properties can be found at the website <http://www.ehrweb.org>. The web site demonstrates the multi-disciplinary involvement in the electronic health record evolution. Dental professionals involved in developing the electronic oral health record can benefit by visiting this web site. The site is an archive of papers written about this issue as well as documentation of proceedings of various national meetings related to the electronic health record.

In the early 1990's the American Dental Association (ADA) began collaboration with others to describe a specific electronic oral health record that complements the electronic health record used for general healthcare. The monograph,

"The Computer-based Oral Health Record," was an early statement of this description.¹ The ADA then established a Standards Committee for Dental Informatics (SCDI).

The mission statement for the ADA's SCDI is as follows:

"To promote patient care and oral health through the application of information technology to dentistry's clinical and administrative operations; to develop standards, specifications, technical reports, and guidelines for components of a computerized dental clinical workstation; electronic technologies used in dental practice; interoperability standards for different software and hardware products which provide a seamless information exchange throughout all facets of healthcare."

SCDI is also a member of the Health Informatics Standards Board (HISB) that is a sub-committee of the American National Standards Institute (ANSI). <http://www.ada.org/prof/prac/stands/index.html>

SCDI's membership in HISB and ANSI is important. While the HISB coordinates the development of health informatics standards in the United States, the ANSI represents the United States as international standards are developed. The ANSI ensures that common conventions developed in the United States that apply to products and services can be offered to the worldwide marketplace.

Informatic standards developed in the United States have an excellent chance to be applicable worldwide, and informatic standards developed internationally may be applicable in the United States or other nations. Therefore, the ADA's SCDI helps to provide a strong international voice on the matter of standards for the electronic oral health record from dentistry in the United States.



It is important to understand that work on the electronic oral health record is a particular aspect of what is called "Dental Informatics."^{5,6} Schleyer and Spallek discuss this term and its relationship to related terms as information science and technology have evolved over the past thirty-five years.² They outline how "informatics" has been applied to the following:

- Bibliographic referencing
- Data analysis
- Online instruction
- Image processing
- Directed reasoning for clinical decision support
- Direct machining of dental materials
- Knowledge representation of common reference material

Each of these areas contributes directly to the development of the electronic oral health record.

Careful definition of electronic oral health record concepts and using information system engineering practices^{7, 8}, helps to define "Dental Informatics" as envisioned by Schleyer and Spallek. The ANSI/ADA 1000 series of standards provides a statement of many of these eventual capabilities.³ The Schleyer and Spallek article offers a perspective of how the potential of "Dental Informatics" can be practically delivered to the practicing dentist.

The Structure of the Electronic Oral Health Record

Just as the inter-related biological concepts comprising healthcare are intrinsically complex so is the relationship of various data items in the electronic oral health record. A beginning basic framework that has some familiarity with the current paper-oriented record is shown in Figure 1. These simple groupings, identified also in the

Figure 1. Basic Data Segments in the EOHR

<ul style="list-style-type: none"> • Demographics • Practitioner Characterization • Health Conditions/Problems • Immunizations • Health History • Examinations 	<ul style="list-style-type: none"> • Treatment Plans/Clinical Orders • Diagnostic Observations (including Radiographs) • Pharmacotherapy • Scheduled Events • Patient Encounters
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Table 1. Uses of EOHR Data Segments

Data Segment	Used for:	Example Data
Demographics	Patient characteristics, insurance enrollment, claims processing	Patient Name, Address, Date of Birth
Practitioner Characterization	Capturing attributes of other practitioners dealing with other aspects of the patient's health conditions	Practitioner Name, Specialty, Practice Address and Phone
Health Conditions/ Problems	Characterizing the nature of health condition and potential problems	Health Condition/ Problem Name, Status
Immunizations	Characterizing the patient immune status	Immunization Name, Date
Health History	Used for acquiring or extending data about a patient's current status and history of health problems and prior care	List of Health Events
Examinations	Capturing both oral and physical examination event and observation data	Oral Exam
Diagnostic Observations	Capturing measurements and observation about the patient	Laboratory Data, Radiological Images
Treatment Plans	Constructing alternative treatment plans for problems and selecting one	Name of Treatment Plan, Status
Scheduled Events	Recording the appointments that are called for in treatment plans	Date of Appointment, Location, Practitioner
Patient Encounters	Characterizing each visit and patient health status and that visit's role in care plans	Date of Encounter, Location, Practitioner, Health Condition, Treatment Plan
Pharmacotherapy:	Ordering pharmaceutical interventions.	Medications Prescribed, Associated Health Condition

early electronic oral health record monograph¹, have complex relationships between data items and vocabularies that enable the intuitive processes of managing dental care. Note that the "Diagnostic Observation" grouping includes clinical laboratory, radiographic, and other image data that are common with other disciplines. Table 1 lists some of the basic uses of data in these segments. These groupings also facilitate the managing of academic educational processes in a way consistent with dental care practice.

Learning to use "information technology" throughout a dentist's professional career begins in the pre-clinical environment of the dental school and basic skills continue to develop throughout the academic setting.

Significance for the Practicing Dental Professional

An electronic oral health record allows the practitioner to electronically document patient care and allows claims transactions to be more quickly and reliably processed. An electronic oral health record also allows the dentist to organize and analyze clinical information associated with the practice (e.g., patient problems, pharmacotherapeutic interventions, diagnostic procedures, dental material selection, and inventory control).

Besides being able to interface (communicate) with records of other healthcare disciplines, a

standard electronic oral health record has the ability to have new functions added without major programming revisions.

Standardized electronic oral health record software allows electronic transactions that comply with the Health Insurance Portability and Accountability Act (HIPAA), PL 104-191 of 1996. Some of the Electronic Data Interchange (EDI) transactions addressed in the HIPAA regulations that are most relevant for the dentist are shown in Table 2

Obtaining an Electronic Oral Health Record

A dentist must develop a well thought out and documented idea of the intended use of an electronic oral health record before entertaining its acquisition. Example cases and general templates are now being developed for use by the dentist to help create a computer system acquisition document. The acquisition document, described only in outline form here, should contain those general functions now being recommended for all information systems but that have been adapted particularly for dental practice. The template document is in three sections. The first of which states the concept of operations of the practice, the second details the computer system requirements, and the third describes how the computer system acquisition process will actually take place. A condensed prototype template outline is shown in Table 3.

Table 2. Common Electronic Data Interchange (EDI) Transactions

Transaction Name	EDI Standard	Transaction ID
Enrollment Benefit and Maintenance	ASC X12.84	TS 834
Healthcare Claim Payment/Advice	ASC X12.85	TS 835
Healthcare Claim	ASC X12.86	TS 837
Material Safety Data Sheet	ASC X12.36	TS 848
Healthcare Eligibility/Benefit Inquiry	ASC X12.281	TS 270
Healthcare Eligibility/Benefit Information	ASC X12.282	TS 271
Healthcare Provider Information	ASC X12.398	TS 274
Patient Information	ASC X12.315	TS 275
Healthcare Claim Status Request	ASC X12.316	TS 276
Healthcare Claim Status Notification	ASC X12.317	TS 277
Healthcare Claim Review Information	ASC X12.336	TS 278

Table 3. Template Document Outline

Part A: Concept of Operations		
A1.	Scope	
A1.1		Identification
A1.2		Document Overview
A1.3		System Overview
A2.	Referenced Documents	
A3.	Current Situation	
A3.1		Background, Objectives, Scope
A3.2		Operational policies, constraints
A3.3		Description of Current System
A3.4		Modes of Operation of Current System
A3.5		User Class Descriptions
A3.5.1		Organizational Relationships and Health Plans Involving the Practice
A3.5.2		Profiles of User Classes
A3.5.3		Interactions of Users
A3.5.4		Other Users
A3.6		Present Support Environment
A4.	Justification for Change	
A4.1		Justification for Changes
A4.2		Nature of Changes
A4.3		Priority of Changes
A4.4		Considered Non-included Changes
A4.5		Assumptions and Constraints
A5.	Proposed System Concepts	
A5.1		Background
A5.2		Operational policies/constraints
A5.3		Description of proposed system
A5.4		Modes of Operation of Proposed System
A6.	Operational Scenarios	
A6.1		Specialization of the Practice
A6.2		Size and Population of the Practice
A6.3		Geographic Location and Layout of the Practice
A6.4		Personnel in the Practice
A6.5		Services Supporting the Practice
A7.	Summary of Impacts	
A7.1		Operational Impacts
A7.2		Organizational Impacts
A8.	Analysis of Proposed System	
A8.1		Summary of Improvements
A8.2		Disadvantages and Limitations
A8.3		Alternatives and Tradeoffs

Table 3. Template Document Outline

Part B: Statement of Requirements		
B1	Introduction	
B1.1	Purpose	
B1.2	Scope	
B1.3	Definitions, Acronyms, Abbreviations	
B1.4	References	
B1.5	SRS Overview	
B2	General Description	
B2.1	Product Perspective	
B2.2	Product Functions	
B2.3	User Characteristics	
B2.4	Constraints	
B2.5	Assumptions and Dependencies	
B2.6	Apportionment of Requirements	
B3	Specific Requirements	
B3.1	External Interface Requirements	
B3.1.1	Hardware Interfaces	
B3.1.2	Software Interfaces	
B3.1.3	Communications Interfaces	
B3.2	Functional Requirements	
B3.2.1	EOHR/EHR	
B3.2.2	Clinical Decision Support	
B3.2.3	Scheduling/Work Organization	
B3.2.4	Resource Management	
B3.2.5	Logical Database	
B3.3	Performance Requirements	
B3.4	Design Constraints	
B3.4.1	Hardware Limitations	
B3.4.2	Software Environment	
B3.5	Attributes	
B3.5.1	Security	
B3.5.2	Transportability and Application Software Upgrades	
B3.6	Other Requirements	
B3.6.1	Operations	
B3.6.2	Site Adaptation Requirements	

Table 3. Template Document Outline

Part C: Project Planning and Management		
C1	Project Overview	
C1.1	Project Summary	
C1.1.1	Project Purpose, Scope and Objectives	
C1.1.2	Assumptions, Dependencies and Constraints	
C1.1.3	Project Deliverables	
C1.1.4	Schedule and Budget Summary	
C1.2	Evolution of the Management Plan	
C2	Reference Materials	
C3	Definitions and Acronyms	
C4	Project Organization	
C4.1	External Organizational Interfaces	
C4.2	Internal Organizational Structure	
C4.3	Project Roles and Responsibilities	
C5	Project Management Process Plans	
C5.1	Start-up Plan	
C5.1.1	Management Objectives and Priorities	
C5.1.2	Staffing Plan	
C5.1.3	Resource Acquisition Plan	
C5.1.4	Project Staff Training Plan	
C5.2	Work Plan	
C5.2.1	Work Activities	
C5.2.2	Schedule Allocation	
C5.2.3	Resource Allocation	
C5.2.4	Budget Allocation	
C5.3	Control Plan	
C5.3.1	Requirements Control Plan	
C5.3.2	Schedule Control Plan	
C5.3.3	Budget Control Plan	
C5.3.4	Quality Control Plan	
C5.3.5	Reporting Plan	
C5.3.6	Metric Collection Plan	
C5.4	Risk Management	
C5.5	Closeout Plan	
C6	Technical Process Plans	
C6.1	Process Model	
C6.2	Methods, Tools, Techniques	
C6.3	Infrastructure Plan	
C6.4	Product Acceptance Plan (The Delivered Product)	
C7	Supporting Process Plans	
C7.1	Configuration Management Plan	
C7.2	Operational Environment Requirements	
C7.2.1	Hardware	
C7.2.2	Software	
C7.2.3	Dependencies, Timing	
C7.3	System/Software Documentation Plan	
C7.4	System/Software Quality Assurance Plan	
C7.5	Reviews and Audits	
C7.6	Problem Resolution Plan	
C7.7	Subcontractor Management Plan	
C7.8	Process Improvement Plan	
C8	Additional Plans	

Template Document Outline Part A:

This section is critical because it orients potential software vendors to dental practice characteristics and concepts of operation for which a proposed computer system must serve. Upon completion of this section, the dentist and the vendor should understand how the electronic oral health record system could be applied in the practice. More importantly, the process in this section will help the dentist avoid thoughtlessly applying information technology to bad business practices. The insights from this step can then be applied to Part B.

Template Document Outline Part B:

This section is a detailed description of the system requirements. These details are included in the ADA's SCDI common conventions (standards) for the technology-independent "Requirements" for an EOHR system.^{7,8} These standard features will allow a compliant system to be interoperable with other healthcare areas, such as medical specialties and HIPAA administrative transactions that share claims processing. Thus, this part of the acquisition document will make clear to the potential software vendor the specific functional capabilities and record structures that have broad consensus support of the professional dental specialties. It will also note those capabilities that are present in currently marketed systems. The result of completing Part B is to help those dental specialties understand the information support of the oral healthcare of patients. This is a critical capability that is equal in importance to the capability of resource management functions that embrace claims processing and practice management.

Template Document Outline Part C:

This section states how the system acquisitions project will take place. A rigorous and complete purchase process that leads to the installation and operation of an electronic oral health record in a dental practice is listed. This section will convey to the software vendor the practitioner's mastery of the management principles applying to such an electronic oral health record, and it will convey the importance of reliable ongoing and long-term continuing support. Continuing support also involves product upgrades. Also, the vendor will receive clear design requirements for system functional capabilities and data requirements. Using this strategy, a systems acquisition

document is developed from a professional consensus between the ADA's SCDI and the individual practitioner-customer. Such feedback to the software vendor will help to characterize each dentist's practice environment. These template documents are not straightjackets but rather reminders about items that are frequently overlooked that cause problems.

These completed three template documents provide an organized statement of information that can be sent to the ADA's SCDI for their review and consideration. The consideration of such feedback by the SCDI provides specific indications of new aspects and new common conventions that may be needed in electronic oral health record systems universally used by all oral health practitioners. These responses from dentists to SCDI also help confirm that the SCDI can coordinate these new conventions into its standards documents. This feedback approach also reinforces an authoritative statement regarding the importance of oral health requirements in the broader healthcare context. Communication from practitioners also helps the ADA convey consistent information technology concepts in their Dental Informatics Continuing Education programs. Using this approach can help the dentist avoid being overwhelmed in technical details by focusing on gaining mastery of basic practice framework concepts of an oral health practice. Note that standards including a statement of required capabilities do not mean all systems must be alike, but rather they must be able to operate and communicate in a consistent fashion.

Using an Electronic Oral Health Record in Dental Practice

An installed electronic oral health record system needs to have a maintenance plan. Care practices change over time and electronic oral health record basic best-recommended practices must accommodate that change. As a result, an electronic oral health record change or replacement plan is needed for worn out, damaged, or outdated electronic oral health record software and hardware. This is known as the "life cycle" for an electronic oral health record, and it is characteristic of all tools. In addition to software and hardware maintenance, one of the most frequently overlooked maintenance items is a defined staff-training schedule. Regularly scheduled training for new and existing software

and hardware systems promotes efficiency and interest among staff and teaches them to effectively use new features or repaired system functions.

It must be recognized during the drafting of the first part of the acquisition document that application of information science and the related implementing technologies will make possible functional capabilities that could not be feasibly done using paper record mechanisms. Some of these capabilities will be quite general (e.g., clinical decision support for diagnosis based upon evidence-based practice guidelines) and benefit most oral health specialties, while other capabilities may be particularly beneficial to certain

specialties. These new capabilities will need to be stated generally in the first sections of the working document and then detailed further in the second section. This step will help the acquiring practitioner to consider new and better ways of conducting his/her practice. Some of these improvements will only require innovative uses of capabilities that are already supplied with the acquired system, but others might have to wait for delivery of an improved product that results from calling the software vendor's attention to a needed capability. Figure 2 lists some of these capabilities, Figure 3 diagrammatically shows a scenario for general practice settings, and Figure 4 indicates some basic data flow links in the network of communications by a practice.

Figure 2. EOHR Functions

<ul style="list-style-type: none"> ● Patient Registration ● Practice Personnel Scheduling ● Patient Appointment Scheduling ● Practice Measurement/Observation Recording 	<ul style="list-style-type: none"> ● Patient Assessment ● Patient Treatment Planning ● Pharmacotherapy ● Encounter Recording ● Intervention Recording
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Figure 3. Basic Oral Health Scenario

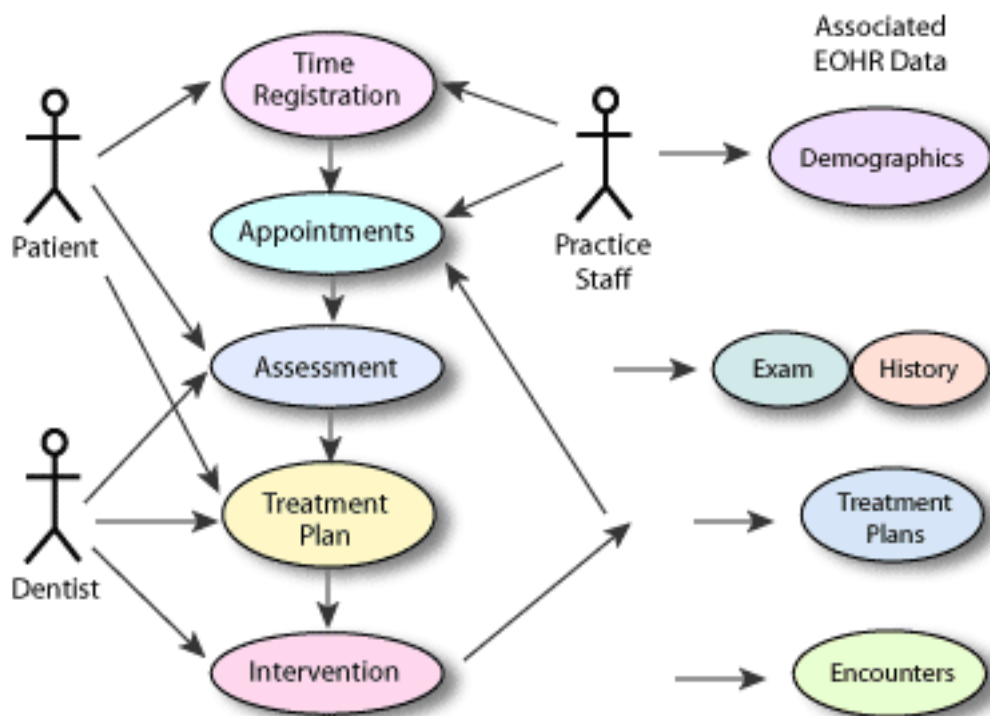
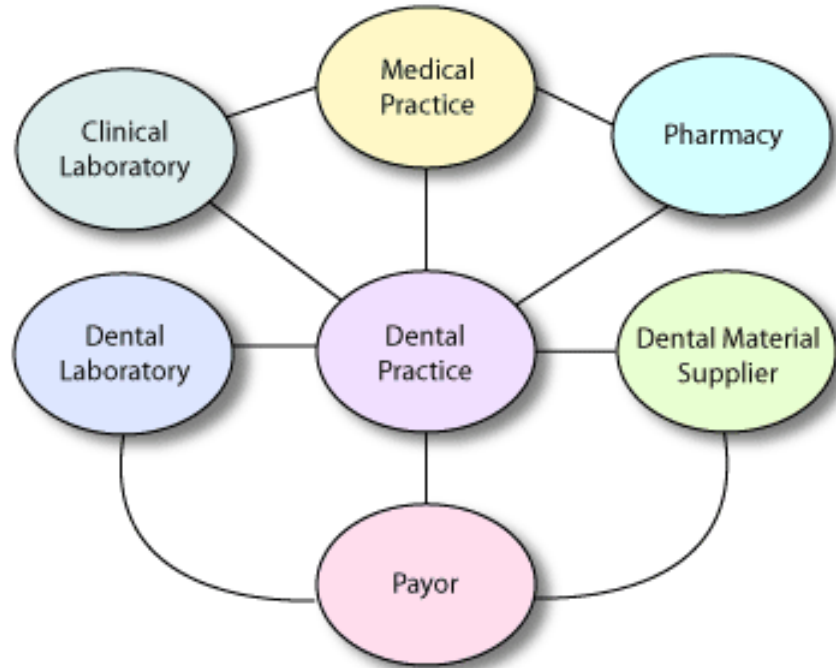


Figure 4. Dental Practice Communication Network



Setting Electronic Oral Health Record Standards that Promote New Capabilities

Other capabilities, such as Practice Guidelines and Clinical Decision Support, may need extended time to develop common conventions that can be implemented more generally and powerfully by software vendors after the capability is subjected to the consensus processes of the SCDI. Part of using the electronic oral health record will be to record, in this living template document, any identified new capabilities or needed data and then passing it on to the SCDI as noted above. Consideration of these ideas in the SCDI forum will then give credibility to the requested capabilities so that, when they are more fully defined, software vendors will have incentives to provide new capabilities in their products and services offered to the market. This is a healthy market function that depends upon the dentist's information management needs. These ideas can then also become material for educational forums at local and national professional meetings.



Other Electronic Health Records Users

Even though we have now considered the application of the electronic health record to dentistry, it is important to briefly look at the role of the electronic oral health record in the context of the whole of healthcare. In the Institute of Medicine report in 1991⁹, healthcare specialties, including dentistry, are the target for the use of computer-based patient record technology. This technology is used first to provide patient care with respect to that individual's health conditions and second to concurrently manage the resources needed to provide that care.

Data recorded in electronic health records must be consistent regardless of which "healthcare specialty" is generating the data. When two or more specialty disciplines are involved in a patient's care, data entry of information that is common among specialties must be recorded in a consistent manner. If these disciplines are to reliably communicate and coordinate their roles in the care of patients, consistency and accuracy is paramount. Dentists need to understand that patient information recorded in the electronic oral

health record is consistent with the same information captured in other healthcare settings and by other healthcare professionals. Data recorded by a Diabetologist/ Endocrinologist that is consistent with data recorded in the electronic oral health record may help the dentist be a valuable participant in the treatment of a patient's diabetes. Although not widespread, the ability to exchange patient data already exists. The Government Computer-based Patient Record (G-CPR) program of the federal healthcare agencies (DoD, VA, IHS/DHHS) is now able to do this on a beginning basis. Their ability to do this is the result of the standards activities up to the present and these abilities will only increase.

Educational Challenges

It is important to recognize at the present time common areas of information in the electronic health record across specialty disciplines is incomplete and fragmented, although the electronic health record can greatly improve that situation. Most health disciplines view the appearance of the electronic health record and its use in terms of the appearance of the paper forms currently used in the present manual record system. Changing this current attitude will require a major educational effort. Professional societies can play a major role in this effort. Also, online multimedia educational techniques can facilitate practitioner orientation in a relatively convenient fashion. The SCDI is developing electronic oral health record common conventions to be used in educational programs. The American Dental Education Association (ADEA) as well as state and local dental societies could be instrumental in promoting the use of the electronic health record.

The Benefactors

Patients, practitioners, resource managers, healthcare administrators, regulatory agencies, and vendors of information products will all benefit from the electronic oral health record because of more accurate, timely, and complete information as each participant has an important role in facilitating healthcare.

Taking the essential steps to be sure the resource management data (e.g., billing/claims data) is common with that for patient care functions and is

consistently represented and structured is critical. This consistency will ensure that patient care data can be quickly and transparently abstracted from the record of care and used for supporting resource management purposes. It can then be combined with those data that are unique to resource management so that neither the patient nor the practitioner is doubly burdened while at the same time ensuring that these functions are reliably carried out. This will clearly be the case for those data required for HIPAA transactions. Moreover, consistent accurate studies of "outcomes" of care that result from various identified interventions can be objectively and accurately conducted using the observations made during patient care over time. In addition to studies that may also be conducted in academic settings, outcomes studies could also be conducted by individual practitioners. Certainly, this analytical capability will benefit patients with respect to both the use of new biomedical concepts as well as better understanding of the health service implications of better management of the practice.

Conclusion

Current electronic technology can be used in an oral health practice to capture oral healthcare information. However, the technology must first be designed to optimize patient care and secondly designed to facilitate optimal resource management. The ADA has created a standards development organization and taken a leadership role, in concert with practicing dentists and other professional disciplines, to coordinate the application of electronic technology in a multidisciplinary environment.



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About the Authors

David W. Heid, DDS, FICD



Dr. Heid is the former Chief of Dental Services at the Seattle Veterans Medical Center in Seattle, WA and now serves as a Clinical Professor in the Department of Restorative Dentistry at the University of Washington School of Dentistry. He has also held the position of an Associate Professor in the Department Restorative Dentistry at the Medical College of Georgia.

e-mail: dheid@cablespeed.com

Joseph E. Chasteen, DDS, MA



Dr. Chasteen is an Associate Professor in the Department of Oral Medicine at the University of Washington School of Dentistry and serves as the Director of Information Technology and Research.

Arden W. Forrey, PhD



Dr. Forrey serves as a Research Associate in the Department of Restorative Dentistry, University of Washington School of Dentistry. He has served as the Veteran's Administration Decentralized Hospital Computer Project Site Manager at the Seattle VA Medical Center; a Research Fellow in Fleet Medical Informatics, US Navy Medical Research and Development Command, and in the Department of Pediatrics at Georgetown University.

