Health Informatics

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Integration of Medical and Dental Care and Patient Data

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This volume is dedicated to the patients who, during the time that this book is being published, now require improved integration of healthcare and of patient records to facilitate interdisciplinary communication among their providers in order to assure their well-being and, in some cases, even safeguard their lives. Some of these patients would not now suffer chronic conditions or risks to their lives as severe as they are experiencing if they had had access to an integrated (medical-dental) interdisciplinary healthcare provider workforce earlier in their lives. Two patients who come to mind who needn't have died if they had had access to an integrated care system, are 12-year-old Deamonte Driver who died of a brain abscess in 2007 in Maryland after difficulties locating a dental provider who would accept

Medicaid and then difficulty processing Medicaid eligibility due in part to his family moving residence temporarily to a shelter and also an unnamed Michigan woman who died with severe periodontal disease in 2009, after her state government eliminated adult dental Medicaid benefits while she was recovering from pneumonia and waiting for surgery. May we not lose sight of the "true cost of inaction."

We would also like to dedicate this book to our dear colleague Dr. Heather K. Hill DDS, MS, who passed away earlier this year after a long battle with breast cancer. Dr. Hill was just 37 years old and is survived by her husband and two daughters. She earned a Bachelor of Science in 1996 and a Doctor of Dental Surgery in 2000 from the University of Minnesota and a master's degree in Biomedical Informatics in 2010 from Oregon Health & Sciences University. Dr. Hill's passion for dental informatics was unlimited and she had a great vision for the field. She has left a legacy within the short time that she spent and we are really obliged to her. The field of dental informatics has lost a great leader and a visionary.

Preface

Dentistry Is Medicine – Oral Medicine

Dentistry is medicine–oral medicine. The integration of the discipline of dentistry with the larger community of medicine, in education and in practice, is an imperative. The multi-faceted elements of health care reform, and specifically the mandate to create and implement a comprehensive health information system, has the potential to accomplish the integration that dentistry as been unable, and generally unwilling, to accomplish. The authors of this volume provide important conceptual and logistical foundations for addressing this integration imperative.

Dentistry emerged and developed as an autonomous profession based on the overwhelming prevalence of oral disease, and at a time there were few individuals trained to provide needed treatment. The assumption existed that treating teeth was simply a mechanical endeavor, as no relationship was thought to exist between the health of the teeth and that of the rest of the body. These assumptions must now be challenged. The dental profession has expanded the numbers of dentists, has significantly reduced the prevalence of dental disease, and demonstrated through research that oral health is intimately related to systemic health and well being. The time has come to acknowledge that dentists are physicians of the stomatognathic system, and that their education must be integrated with the education of physicians being trained to care for other functional organ systems; and that oral health care must be included and integrated into the nation's health care delivery system.

Dentistry emerged as a scientific, university-based discipline subsequent to the Carnegie Foundation's report in 1926 edited by William Gies, Dentistry in the United States and Canada. In that report, Gies and his colleagues favored the view that dentistry should become integrated with medicine as a specialty. They argued for an enlarged view of dentistry in which "dental surgeons and dental engineers become oral physicians." The ambivalence of the Gies' committee in believing this was possible is reflected in the statement that "the practice of dentistry should be made an accredited specialty of the practice of conventional medicine, or fully equal to such a specialty in the grade of health service." The Report then concluded that

"dentistry cannot now be made a specialty of medicine." This negative assessment of complete integration was probably due to the political culture and climate at the time, no doubt no different than that experienced today. Thus dentistry emerged and developed in the Twentieth Century as an autonomous profession, attempting to be, as the report stated, "fully equal" to a specialty of medicine as a health service.

Dentistry made notable advances in the last century in research and education that resulted in a significant improvement in the oral health of the American people; however, by the last decade of the century it had become increasingly apparent that dentistry could no longer be equal while remaining separate. In 1994, a World Health Organization report Oral Health in for the twenty-first century stated:

The changing disease patterns, the advanced diagnostic and treatment methodologies and the broadening of responsibilities illustrate the need for a new type of oral health professional, someone with special education and skills in the care of the oral and maxillofacial complex. These professionals will have principal responsibility for oral health care, and they may be assisted by specially-trained support personnel. In addition to these generalist oral physicians it is anticipated that the need will remain for specialists.

In early 1995, the Institute of Medicine released the results of its 4 year study of dental education, Dental Education at the Crossroads: Challenges and Change. This landmark study by America's most prestigious science policy body proved to be provocative. While acknowledging the progress dentistry and dental education had made, the report indicated the profession had arrived at a crossroads and transformative changes were required – "the status quo [is], in effect, a path toward stagnation and decline." Significant changes in the environment had and were continuing to occur that made the profession vulnerable. "Dental education and dentistry are made vulnerable by their relative isolation from the broader university, from other health professions, and from the restructuring of health care and financing systems that characterizes most of the health care delivery system." Dentistry had become (and continues to be) isolated organizationally, intellectually, and educationally from medicine, to the detriment of society and the profession.

The recurring theme of the IOM report was one of "closer integration" of dentistry with medicine. The theme was actually emphasized visually in the cover of the report, which was lilac, the academic color of dentistry and forest green, the academic color of medicine. "Dentistry will and should become more closely integrated with medicine and the health care system at all levels: research, education and patient care. The March of science and technology in fields such as molecular biology, immunology, and genetics will, in particular, continue to forge links between medicine and dentistry as will the needs of an aging population with more complex health problems…Government and primary purchasers of health services can be expected to maintain and indeed increase the pressure on health practitioners and institutions to develop more highly integrated and constrained systems of care that stress cost containment, primary versus specialty care, and services provided by teams of professional and other personnel." The profession of dentistry reacted vigorously to the IOM report, generally viewing it negatively and with suspicion. The profession was satisfied with the status quo; dentistry was thriving economically,

a perceived prime benchmark of professional success. Organized dentistry rebutted the report with the oft heard expression "dentistry is not medicine." Dental educators, likely influenced by alumni/ae, failed, in general, to respond to the multitude of recommendations of the report, many of which would have resulted in dental education becoming less isolated and more "closely integrated" with medicine.

The environmental issues of the 1990s, affecting health care generally and dentistry specifically, have only resulted in increased pressures for change, both in dental education and dental practice. Arguably, the status quo has been maintained and dentistry is not well-prepared to address the transformations occurring in the nation's health care system. It is possible that the demands for an integrated health information system will prove to be the environmental force that will finally drive the required integration of dentistry with medicine, an integration that has been understood to be an imperative by many since William Gies and his committee advanced the concept in 1926. If so, dentistry will be able to assume its appropriate position as a recognized specialty of medicine, with education and training for the practice of dentistry being alongside individuals studying to participate in other medical specialties; and with dentists finally being understood to be physicians of the stomatognathic system–oral physicians.

Integration of Medical and Dental Care and Patient Data is an important work toward envisioning and realizing the day when dentistry is finally integrated with medicine.

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Preface

Integrating Medical and Dental Data: More Than a Technical Challenge

This book is about integrating processes and data in medical and dental care. Doing so is a significant challenge in multiple respects: technically, logistically, professionally and culturally. Yet, succeeding at this endeavor is inescapable: As clinicians, we simply owe it to our patients (Baron 2011). We can only improve health if we improve oral and general health at the same time.

The separation of dentistry from medicine is a historical accident. As Dr. Nash explains cogently in his preface, early on "treating teeth was simply a mechanical endeavor, as no relationship was thought to exist between the health of the teeth and that of the rest of the body." Today, we know better. Plenty of studies have shown associations, if not causal relationships, between dental and medical conditions.

Informatics is key to helping healthcare professionals realize the vision articulated in this book. Separating dentistry and medicine has kept things apart that are central to informatics: data, information and processes. Dentists and physicians keep their own records for the same patients, encode patient information using different approaches and rarely communicate about patients. Doing so does not only result in inefficiencies and unnecessary overhead, but also impedes good clinical decision making and patient outcomes. Both may easily understand similar or identical portions of their respective records, such as the medical or medication history. However, clinicians from either field are typically not able to understand information on forms they are not familiar with. For instance, most physicians can not make sense of a tooth chart. Neither can most dentists given a set of medical laboratory tests. So, a crucial question in integrating medicine and dentistry more closely is: How should we communicate?

The answer to this question is primarily a professional and cultural, rather than a technical, one. Exchanging electronic data among dentists and physicians, while not trivial, is a comparatively small problem. To the computer, medical and dental information looks the same – it is just a stream of bits. For clinicians, exchanging

information is more complicated. The main challenge is to communicate the information that the other party needs and to ensure that its meaning, as well as its implications, can be understood and acted on. Pediatricians must understand that a diagnosis of early childhood caries requires, among other interventions, nutritional counseling. Dentists, on the other hand, must be familiar with the implications of a range of medical conditions on oral and dental health. Topics of mutual interest and relevance may be most easily understood and considered in dental or medical schools focused on a multidisciplinary, systems approach to patient care. However, such schools are the exception rather than the rule. For the "installed base" of 150,000 dentists and 300,000 physicians other approaches will have to be found.

The best care will be delivered by dentists and physicians together, not separately, as is the case right now. Opportunities to do so abound. Imagine the day when physicians, dentists and other healthcare providers deliver smoking cessation interventions through a seamless and transparent collaboration (McDaniel et al. 2009). Or, when dentists help identify patients with previously undiagnosed, significant medical conditions, such as hypertension, cardiovascular disease, diabetes mellitus, hepatitis and HIV infection (Greenberg et al. 2010). Or, when dentists screen for a whole host of medical conditions using saliva diagnostics (Spielmann and Wong 2011).

Foreshadowing the discussion in this book, we presented a conceptual approach for sharing health information among different clinical disciplines in a paper in 1994 (Schleyer and Eisner 1994). We first considered what information a clinician would need under various circumstances. For instance, in dental emergencies, recently updated medical information relevant to the diagnosis or treatment of the emergency would be useful. Conversely, a recent diagnosis of oral hairy leukoplakia would be of interest to a physician who is working up a patient for a potential infection with HIV. Our concept included the idea of "shareable data" contained in discipline-specific electronic patient records. What data are shared is not static, and depends on the patient, context, goal(s) and which types of clinicians are collaborating on the patient's care. Currently, most clinicians obtain needed information from others through a written or verbal ad hoc consult. This is a cumbersome, error-prone and often slow process. In the electronic world, such information could flow much more easily, efficiently and automatically through the National Health Information Infrastructure or Health Information Exchanges, given appropriate safeguards for security and confidentiality. Standards such as the Continuing Care Record of the American Society of Testing and Materials, adapted to dentistry by the American Dental Association's Standards Committee for Dental Informatics, have begun to address what information should be subject to exchange.

Current settings which implement the exchange of medical and dental information among care providers are few and far between. Three examples are the U.S. Department of Veterans Affairs (VA), HealthPartners in Minnesota and the Marshfield Clinic in Wisconsin, described in this book. The electronic health records of these organizations include both medical and dental data, and provide partially integrated views of these data. Figure 6.3 in Chap. 6 shows a screenshot of Marshfield Clinic's Cattails Dental System that displays information from a patient's medical record in the lower left corner.

The organizations which are working towards realizing the vision articulated in this book are important practical laboratories for what works and what does not. While the VA is limited with regard to its patient population, and HealthPartners and Marshfield serve patients only in specific regions, it would be useful to learn what information clinicians exchange, how they use it, and, most importantly, how doing so influences decision making and patient care outcomes.

As many regional health information networks and health information exchanges have shown, the technical and logistical problems of exchanging health information are solvable. But, how can we help clinicians understand, use and act on received information? Many dental students learn quite a bit about medicine during their studies, but the inverse appears not to be true (Ferullo et al. 2011). We therefore should consider not just how to communicate information, but also how to assist recipients in understanding and using it. Clinical decision support can help by providing additional information and guidance when and where it is needed. However, the majority of research studies in decision support have focused on providing assistance only to individual clinicians. To support closer integration of medical and dental care, this research should be extended to provide collaborative decision support for multiple providers caring for the same patient.

This book is setting out a tall challenge for the health care community. Achieving the vision of integrating medical and dental care requires nothing less than rethinking how we care for our patients as a team of healthcare providers, not as individual practitioners. Can we achieve this vision? Maybe it is good to look at a group that already has done so. In biomedical informatics, physicians, dentists, nurses, pharmacists and members of other disciplines collaborate to advance how we use data and information in healthcare. It is telling that the idea for this book arose from the informatics community – let's hope it can serve as an example for all of healthcare!

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Preface

Editors' Preface

This is the story of a simple idea (the mouth is part of the body) and what it means in the context of the complexities in healthcare organization, care delivery, provider education, and care reimbursement, along with recommendations. This volume seeks to optimize the delivery of healthcare by stating why isolated components of healthcare delivery need to work together, by asserting how health information technology (HIT) can help these components collaborate to improve care quality and patient safety, by documenting how existing barriers stand in way of interdisciplinary collaborative practice supported by HIT, and by recommending how to remove such barriers.

Our first reaction could have been, this is too difficult to do. The barriers to bringing dental care and medical care together into a collaborative framework include traditions of practice and education, political considerations, separate insurance or payer structures. The results of this are:

- separate statistical compilations of data for medical and dental conditions and treatment impeding a unified assessment of current conditions,
- separate cultures of practice workflow,
- (in most cases) separated electronic patient records systems for medical and dental practice and often independent goals for software standards (thus also standards that anticipate the potential need to articulate medical and dental patient records),
- negative and unproductive attitudes of some providers in the two domains toward each other,

- health care planning bodies, forums, and commissions that do not include representation from both types of providers,
- laws, regulations, and policies that do not acknowledge a need for collaboration among physicians and dentists in the treatment of a given individual patient within a single time frame,
- separate reimbursement structures, rationales, and plans, and thus also, from a technical standpoint, separate claim streams, impeding development of interdisciplinary state disease registries using performance measures to support care quality improvement and adoption of collaborative care in practices,
- care quality initiatives that, by their various respective structures, are not explicitly tasked with addressing the role of oral health care integrally in patient care, affecting the design and establishment of performance measures for care quality improvement,
- the disquieting perception that, in certain respects, the two domains were drifting further apart in the absence of a common unifying principle for education and cooperation, and,
- ultimately, the circumstance that these conditions are replicated to some extent in societies around the globe, thus affecting the care of patient populations worldwide.

When we thought of the suffering and early mortality faced by large numbers of patients with chronic illnesses and a variety of other conditions, we decided we could not avoid this task. We realized we cannot be afraid to ask questions and identify problems merely because the situation is complex.

All the editors for this volume are health informaticists, meaning that we focus on the application of information technology to health care requirements. We know that in any industry, one must match the program developed, with precision, to the activities in that industry. To develop banking software, we need to understand exactly what kinds of transaction go on in the banking industry that must be represented and processed in the system we envision. If we want to characterize software appropriate for the healthcare industry, we assume we have the skills to formulate an accurate model for that industry. When we examine the healthcare industry, we notice siloization in a number of respects. By siloization, we mean that parts of the practice of healthcare are conducted in isolation from other parts. This isolation of providers from one another carries the attendant risk that the patient may be harmed (or may not receive efficacious care) by dividing up the work into silos, where two care providers ***concurrently*** address the health needs of a ***single individual patient***, without adequate supporting communication to assure that what is done is one "stream" of care activities (administration and prescription of medications, performance of surgeries) will be safe and efficacious while, within the same time frame, care activities proceed in a second "stream." We wonder how healthcare can be optimized under conditions of less-than-adequate articulation of care delivery for a single patient. Therefore we are professionally obligated to call to the attention of the industry we serve, that certain ways of "doing business" stand in the way of getting an optimal result and should be addressed.

The most troublesome healthcare siloization for us, although by no means the only siloization present, is that isolating the education of, practices of, and payments to medical and dental providers. To underscore the point that the issues we are addressing are more general than those involved in the separation of medicine and dentistry, we are fortunate to have input from ophthalmology on how eye care imaging could be more effectively used in healthcare.

During this period of time the science and technologies of healthcare are shifting, guided by knowledge of DNA, molecular imaging, and the promise of "personalized healthcare." As we learn what genetics and proteomics can teach us, we become increasingly aware that "pathogen behavior does not consider how human healthcare delivery is structured" and that a team approach is required for optimal care delivery and truly "patient-centered" healthcare.

When we imagined the billions being allocated to health information technology (HIT), we reviewed the maxim of software development, "know what your software is supposed to do before you design and deploy it." We recognized that HIT could not be designed correctly until we had a correct healthcare delivery model. The beginning of the design process is requirements analysis. Establishing software requirements cannot start until a correct model for healthcare delivery is agreed upon, with all significant categories of providers represented at the table. If the current model is faulty, software based on that model is being designed and deployed at great expense and the resulting software, flawed by its omissions, will (in the form of technological inertia) pose a barrier to achieving integrated care in the future. HIT software corrections will subsequently require non-trivial added expenditures to revise not only the software, but also the workflows and organizational structures that match it. Ethically, with regard to the design and specification of healthcare systems, we cannot countenance this and have therefore prepared this volume.

To establish continuity with initiatives which have preceded this book, the first preface by Dr. David A. Nash addresses the need for integration of care, while the second preface, by Dr. Titus K. Schleyer, links this volume with the research and teaching in biomedical and dental informatics which have preceded it.

In order to help assure the appropriate interdisciplinary mix of input, we solicited contributions of varying lengths, knowing that being flexible on length would help attract contributors whose practice demands, administrative roles, and research schedules would otherwise not permit them to participate in this volume.

A brief outline of the coverage of the chapters:

Chapter 1 addresses the rationale for integrating medical and dental care and patient records and presents a timeline to demonstrate the gradually growing awareness of the need for integration.

Chapter 2 focuses on technical and theoretical requirements for establishing the integrated electronic record, including such topics as interoperability, knowledge representation, respective requirements of medical and dental providers, patient identification, and decision support.

Chapter 3 deals with metrics and measurements, including quality measures and the meaningful use concept.

Chapter 4 examines current conditions, covering economic considerations, needs of particular populations, provider viewpoints, biosurveillance, education, and translational research. By looking at how eye care imaging can be more effectively used in health care, this chapter looks beyond the medical-dental relationship toward the more general requirements of care delivery for integration of care and patient records supported by health information technology.

Chapter 5 helps the reader see to what extent integration of medical and dental care and records is or is not "on the radar" in various countries, in order to provide an international perspective. This chapter offers thorough treatment of Mexico and Portugal, with brief coverage of the United Kingdom and Canada.

Chapter 6 portrays a working example of care and data integration in the Marshfield Clinic system across a major part of rural Wisconsin.

Chapter 7 is the conclusion, collecting and highlighting recommendations made in this volume.

The first two appendices present forms and materials from two sources which have explicitly addressed integration of care: the University of Detroit Mercy School of Dentistry (Appendix A) and the Wisconsin Diabetes Mellitus Advisory Group (Appendix B).

In one of the appendices (Appendix C) you will find a cataloging of what we call *contact points* between medical and dental care and research, along with references to relevant clinical literature to each topic. The set of contact points involves a wide range of medical subspecialties as well as great range of specialties in dental care.

Appendix D furnishes a list of online resources with their URLs and the list of abbreviations precedes the prefaces.

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Dr. Amit Acharya

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understanding. I wish to acknowledge the influence of Dr. Robert Ledley, whom I never met. Dr. Ledley was a pioneer in Informatics and proved that a dentist could contribute to the field at the highest level. Lastly I thank my co-author Valerie Powell whose unrelenting belief in the rightness of the cause and forcefulness in advocacy led to numerous advancements, including this book.

Dr. Franklin M. Din

I wish to express my gratitude to my mentors in learning health informatics who helped me grasp the value of integrated health systems, Dr. Charles J. Austin, former president of Texas A&M University in Commerce and author of textbooks on information systems for health services administration, and Dr.med. Wolfgang Giere, retired director of the Medical Informatics Center, Goethe University of Frankfurt am Main and pioneer of European medical informatics, to the many electronic health record professionals in the Veterans Health Administration (VHA) and in WorldVistA who have contributed to my understanding of health information technologies, to my lifelong friend John W. Konnak, MD, who felt that, "if it affects patient care, you have to address it," to my husband, Dr. James C. Powell, who graciously read through manuscripts and provided both corrections and encouragement, to two Registered Dental Hygienists (RDHs) who helped me understand the needs and viewpoints of this important professional group in oral healthcare, Patti DiGangi and Shirley Gutowski, and to our two preface contributors, Dr. David A. Nash, who made real the connection of this project with his "oral physician" concept, and Dr. Titus Schleyer, whose leadership in biomedical and dental informatics and interest in this project have been an encouragement to all of us.

Dr. Valerie J.H. Powell

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List of Abbreviations

AADE	American Association of Diabetes Educators
AAMC	American Association of Medical Colleges
AAP	American Academy of Pediatricians
ACE	Angiotensin-Converting Enzyme
ACO	Accountable Care Organization
ADA	American Dental Association
ADA	American Diabetes Association
AM	Amalgam
AMA	American Medical Association
ARB	Angiotensin Receptor Blocker
ARRA	American Recovery and Reinvest Act
BDS	Bachelor of Dental Surgery
BioMedGT	Biomedical Grid Terminology
CAD	Coronary Artery Disease
CCD	Continuity of Care Document
CCM	Chronic Care Model
CDA	California Dental Association
CDA	Canadian Dental Association
CDS	Clinical Decision Support
CDT	Current Dental Terminology
CFR	Code of Federal Regulation
CMS	Centers for Medicare and Medicaid Services
COTS	Commercial Off–the-Shelf
CPOE	Computerized physician order entry
CPT	Current Procedural Terminology
CPU	Central Processing Unit
CQM	Clinical Quality Measure
CRF	Chronic renal failure
DDS	Doctor of Dental Surgery
DGES	Dentogingival epithelial surface area
DMD	Doctor of Dental Medicine

DMI	Dental / Medical Integration
DNP	Doctor of Nursing Practice
DO	Doctor of Osteopathy
DoD	Department of Defense
EBICP	Evidence-Based Integrated Care Plan
EDO	Extended Data-Out
EDR	Electronic Dental Record
EHR	Electronic health record
EHT	Electronic health technologies
EMR	Electronic Medical Records
EP	Eligible Professionals
ER/PR	Estrogen Receptor/Progesterone Receptor
ERG	Episode Risk Group
eRx	Electronic prescribing
ESRD	End stage renal disease
FHC	Family Health Center
GMP	General medical practitioners
GH	Group Health Cooperative
HD	Hemodialysis
HF	Heart Failure
HHS	Health and Human Services
HIT	Health Information Technology
HITECH	Health Information Technology for Economic and Clinical Health
HIV	Human Immunodeficiency Virus
HL7	Health Level 7
ICD	International Classification of Diseases
ICD-10	International Classification of Diseases, Tenth revision
ICD-10 CM	International Classification of Diseases, Tenth revision, Clinical modifications
ICD-9	International Classification of Diseases, Ninth revision
ICD-9 CM	International Classification of Diseases, Ninth revision, Clinical modifications
ICU	Intensive Care unit
IDF	International Diabetes Federation
iEHR	integrated Electronic Healthcare Record
IHS	Indian Health Service
IHTSDO	International Health Terminology Standards Development Organization
IOM	Institute of Medicine
IT	Information Technology
LDL	Low Density Lipoprotein
LIS	Laboratory information system
LOINC	Logical Observation Identifiers Names and Codes
LVSD	Left Ventricular Systolic Dysfunction
MCRF	Marshfield Clinic Research Foundation

MD	Medical Doctor
MHD	Medical History for Dentists
MI	Myocardial Infarction
MO	Mesioclussal
MS	Microsoft
MU	Meaningful Use
NCI	National Cancer Institute
NDEP	National Diabetes Education Program
NHIN	National Health Information Network
NIDDK	National Institute of Diabetes and Digestive and Kidney
NIH	National Institute of Health
NQF	National Quality Foundation
OCF	Oral Cancer Foundation
ONC	Office of the National Coordinator
ORN	Osteoradionecrosis
OS	Operating System
OSHRP	Oral and Systemic Health Research Project
PC	Personal Computer
PCMH	Patient centered medical home
PD	Perintoneal Dialysis
PCP	Primary Care Physician
PDSA	Plan-Do-Study-Act
PHC	Personalized Health Care
PHR	Patient / personal health records
POAG	Primary Open Angle Glaucoma
PPO	Preferred Provider Organization
PQRI	Physician Quality Reporting Initiative
RAM	Random Access Memory
ROM	Read Only Memory
SCT	SNOMED CT
SDO	Standards Development Organizations
SGR	Surgeon General's Report
SNODENT	Systematized Nomenclature of Dentistry
SNOMED CT	Systematized Nomenclature of Medicine – Clinical Terms
TFT	Thin film transistor
UI	User Interface
VA	Veterans Affairs
WDS	Washington Dental Service
WDSF	Washington Dental Service Foundation
WHO	World Health Organization

List of Figures