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“In dental schools, the EHR serves as a critical tool to manage patient care and to assess and document students’ clinical experiences.”

The EHR of the Future: Supportive, Collaborative, and Barely Noticeable

Paper health records, until recently, have shown a remarkable resilience against the technological tidal wave that has swept through other industries. However, electronic health records (EHRs) are now being rapidly adopted. Most dental schools have one, or will implement one soon. The government is throwing money at healthcare providers to buy and use them. Some dental schools have reaped significant funds to offset the costs of EHR implementation through the “meaningful use” incentive program.(1) According to the Office of National Coordinator, the purpose of “meaningful use” is to use an EHR to:

- “Improve quality, safety, efficiency, and reduce health disparities
- “Engage patients and family
- “Improve care coordination and population and public health
- “Maintain privacy and security of patient health information”(2)

In dental schools, the EHR serves as a critical tool to manage patient care and to assess and document students’ clinical experiences. The EHR is often the fourth member of a dental encounter along with the patient, student dentist, and supervising faculty. In some cases, the dental provider and EHR spend more time interacting with each other than with the patient.

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In addition, the patient can now interact directly with the EHR, bypassing the person at check-in by using a kiosk, or by logging into the web portal to confirm an appointment or complete a medical history.

While good progress has been made in the development, adoption, and use of EHRs in dental schools, there is still much work to be done before we can fully realize the benefits of improved patient care while at the same time fostering an excellent learning environment for our students.

EHRs Can Help Make Care Safer, of Higher Quality, and More Cost Effective

One of the biggest potential advantages of adopting and using EHRs is the promise of improving the safety and quality of care. Information in EHRs is more legible and readable than in paper charts. The potential for misinterpreting poor handwriting is minimized. Unlike

paper charts, the information is available on demand to those who need it. Increased access to information is thought to lead to reduced costs, as healthcare providers have access to all prior exams and imaging studies, thereby lessening the need to redo these costly procedures.

However, there is limited compelling evidence to date that demonstrates that quality or safety of care has dramatically improved following the implementation of EHRs. In some hospital settings, the mortality and morbidity rate of patients actually worsened.(3) Much of this is blamed on misconfigured and poorly designed EHRs and workflows. As we have learned in dental schools, a collaborative effort is required by clinicians, IT teams, and software vendors to deploy systems that are both useful and usable.(4)

Accordingly, the EHR in dental schools is being used to explore the safety and quality of care provided. We are asking such questions

Maxillary Teeth		
Facial Contour		
Golden Proportion	Normal	02/11/2015
Incisal Embrasures	Normal	02/11/2015
Axial Inclination	Abnormal	02/11/2015
Tooth Spacing	Crowded	
Gingival Zenith	Normal	02/11/2015
Gingival Papilla	Normal	02/11/2015
Gingival Biotype	Thick	02/11/2015
Mark any irregularities on the diagram for mandibular dentition		
Mandibular Teeth		
Facial Contour		
Proportion		
Incisal Embrasures		

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as: “Do we know how many times the wrong tooth is extracted?” The EHR contains valuable data which we can use to answer such questions. A team of researchers from the dental schools at UTHealth at Houston, Harvard, UCSF, and OHSU are working on mining such EHR data to quantify and identify the types of adverse events experienced by patients while undergoing dental care.

Another approach to improving the safety and quality of care through the EHR is the use of clinical decision support (CDS) which “provides clinicians, staff, patients, or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care.”(5) Alerts and reminders that pop up on the screen notifying the provider that the patient is allergic to a medication or that a consent form needs to be signed are examples of CDS. As our colleagues in medicine have learned, these approaches are helpful but can also backfire. Due to the sheer numbers of false alerts in medical EHRs, the vast majority of computerized drug interaction alerts are ignored.(6) So even relevant alerts will be mistakenly dismissed, leading to potentially fatal consequences. Our challenge in dentistry is to

be parsimonious when implementing CDS into our systems.

EHRs as Student-Learning Platforms

EHRs are designed primarily to document clinical care, billing, and scheduling. In dental schools our systems also need to have built-in safeguards to prevent students from treating patients without faculty approval. Moreover,

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we need functionality to grade and evaluate student clinical work and to keep track of competencies attempted and mastered. Data collected in our EHRs are also used for accreditation and other reporting requirements, as well as for ongoing quality improvement processes.

Although less recognized, the EHR also influences the way our students learn. I have seen how students now pause and think more carefully about their patients’ diagnoses before selecting a treatment because the EHR now requires an explicit diagnostic term to be

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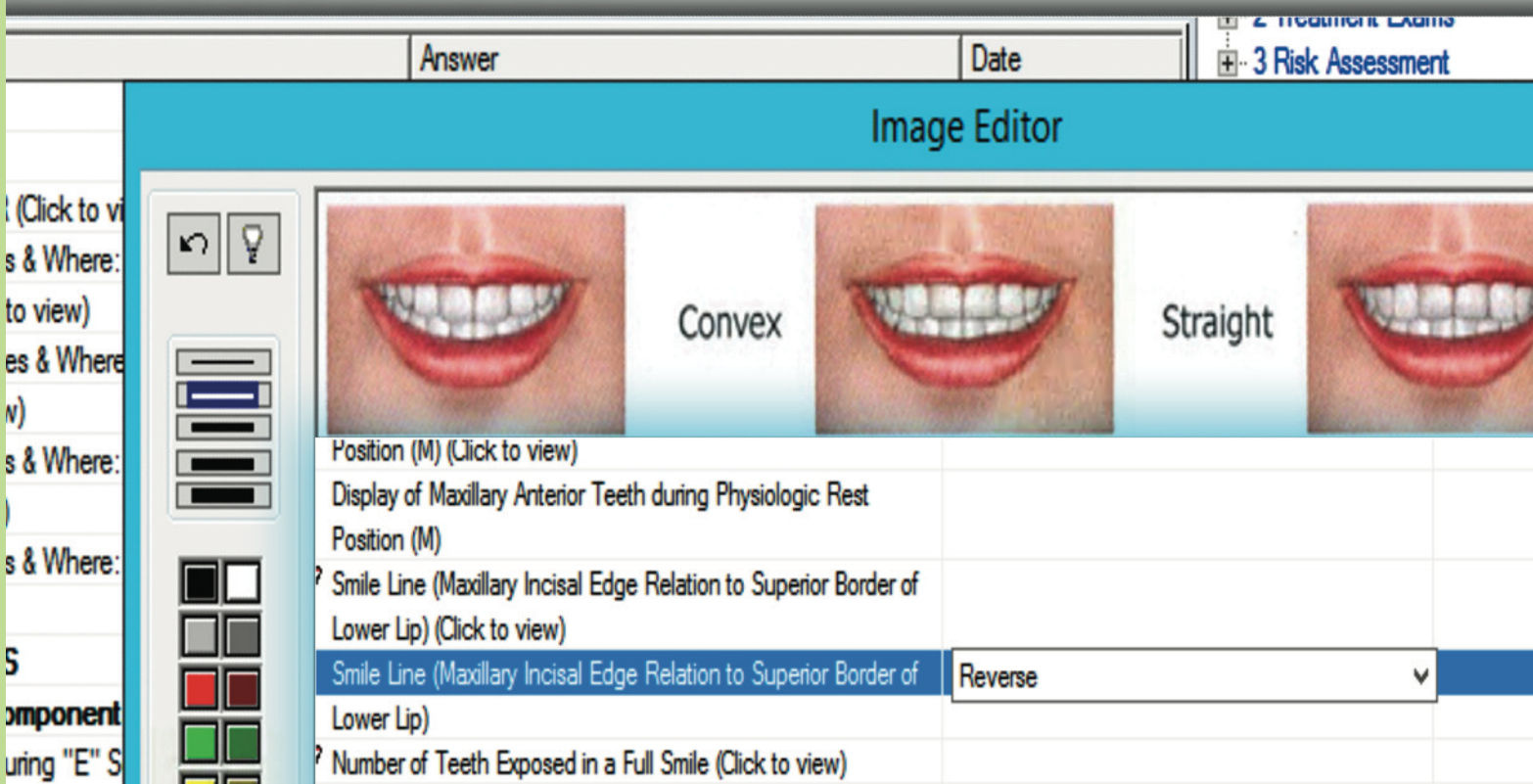
entered.(7) Recent evidence suggests that the introduction of diagnostic terminology may have a positive impact on students' critical-thinking skills.(8) Similarly, structured templates in the EHR serve as a reminder to help guide the comprehensiveness of the notes that are produced. In addition, e-prescribing applications, if well designed, help to identify potential drug interactions and provide an opportunity for discussing alternatives with the supervising faculty as well as with the patient.

It is likely that the EHR of the future, embedded with advanced clinical decision support and artificial intelligence, will be able to do some of the tasks of the dental provider. For example, our EHRs can already calculate

a patient's caries risk status based on a simple algorithm after a user inputs some data. In the future, our EHRs may be able to identify an appropriate dental diagnosis automatically by "reading" a radiograph or detect a rare lesion by interpreting a high-resolution, intraoral image.

There is, of course, debate whether such "intelligent" EHRs will make our students "less smart." After all, making effective clinical decisions is one of the skills dental students

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need to master through practice and experience. One challenge we currently have is that the teams responsible for the EHR are often separate from the learning and education specialists at our schools. It is perhaps time to see the EHR as a learning and support platform, and to involve our faculty experts and instructional technologists in helping to determine how we can best structure the EHR of the future to support student learning as well as to ensure high-quality patient care.

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EHR Has Fostered a Sharing and Learning Community

Dental schools love to share. We have organizations such as the American Dental Education Association (ADEA) that bring the academic dental community together to help discuss curricular issues. The purpose of a sharing community is to learn from each other while at the same time advancing the field. Not

surprisingly then, the rapid adoption of EHRs among dental schools has spurred the growth of a sharing and learning community around this development. The Consortium of Oral Health Research and Informatics (COHRI) was formed in 2007 by a group of dental faculty and staff from dental schools that use the axiUm EHR.(9) This group has rapidly grown to include 38 member institutions committed to collaboration. The mission of COHRI includes working together to develop research projects to promote evidence-based dentistry and to define and facilitate the implementation of best practices and standards of care. The schools are motivated by the potential for pooling standardized data and have already developed standardized forms to collect medical and dental histories. Six of these schools now also contribute EHR data to the BigMouth Dental Data Repository, which contains data on over two million patients.(10) It contains demographics, diagnoses, procedures, periodontal measurements, odontogram/tooth measurements, medical and dental histories, and information about the provider type (hygienist, dentist, dental student, resident). BigMouth was recently used to determine significant gaps in how institutions followed

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periodontal treatment guidelines.(11)

Perhaps the most exciting component of COHRI is the potential for dental schools to learn from each other. In medicine, there has been increased interest in a “learning health system,” or LHS. The goal of a learning health system is to “improve the health of individuals and populations. The LHS will accomplish this by generating information and knowledge from data captured and updated over time—as an ongoing and natural by-product of contributions by individuals, care delivery systems, public health programs, and clinical research—and sharing and disseminating what is learned in timely and actionable forms that directly enable individuals, clinicians, and public health entities to separately and collaboratively make informed health decisions.”(12)

The EHR is a critical component of a learning health system as we need data to learn. However, one of the biggest challenges is interoperability of data stored in our disparate systems. Currently, many of our institutions are part of large academic medical centers. Dentists, nurses, physicians, and other providers all strive to provide safe and effective health care to patients at our clinics. As we move toward team-based and interprofessional

care, there is an even greater need for a common understanding among health professionals regarding a patient’s health status and care needs that include medical, nursing, and oral health care. We share patients between our dental and medical clinics, but few of us use the same EHR. In addition, the terminology and vocabulary used within these records are often not consistent. Any vocabulary must be relevant, understandable, and useful to multiple health professionals for efficient, effective, and safe delivery of health care. While many have opined for decades about the lack of diagnostic coding in dentistry, not until recently

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has there been a movement to adopt diagnostic terminology.(13,14) While it is unlikely that we will all use the same EHR, we do need to ensure that patient data can be passed seamlessly among our systems. This can only be achieved if we adopt existing data and terminology standards, or agree upon new

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ones where they do not exist. COHRI is an example of a collaborative platform for such work to occur in dentistry.

The EHR of the Future

Moving from paper to digital health records has been a paradigm shift. Paper is flexible, malleable, and portable. Moving to computers has required a generation of health-care providers to change the way in which they work and document care. Currently, the majority of data in EHRs are painstakingly entered manually through the keyboard and mouse. We may take the blood pressure of a patient using the latest digital technology, but we still have to walk over to and enter findings into the EHR. The EHR of the future will automatically capture such data. Further, data we store in the EHR will likely include that which is generated outside the walls of our clinics. Patients are already self-monitoring the number of steps they climb and the food they eat. As sensors become more ubiquitous, it is

not inconceivable that rather than asking a patient if they brush and floss, we will be able to see a graph of their oral hygiene behavior as reported by their toothbrushes. Our students

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and faculty will likely need some additional training in informatics to manage this onslaught of data. But it will be the role of the EHR, like any good technology, to provide the support necessary to extend the effectiveness and capabilities of humans so that the EHR of the future will be as integrated into dentistry as the dental handpiece is today.

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