A diverse array of manufacturers and vendors of dental digital imaging hardware and software exists in a market that has hardly even begun to shake out the less competitive players. While analog film can be read wherever there is a view-box with sufficient luminance, digital diagnostic images have specific hardware and software requirements if display is to be achieved. Interoperability of image data files is desirable to guarantee the preservation and availability of acquired patient diagnostic information across different generations of imaging software and display hardware. Between systems from different vendors within a given facility, and to and from outside referral centers, the practitioner’s most important work-related asset is unique patient data, which even if appropriately backed up, needs to be protected from proprietary software obsolescence. Hardware can always be replaced. Interoperability for image files should be factored into the purchase decision when contemplating an investment in digital imaging equipment. Essential to protecting an investment is the ability to export and read image files that conform to the accepted International Organization for Standardization (ISO) requirements. The ISO-referenced Standard for this is the Digital Imaging and Communications in Medicine Standard (DICOM). DICOM images contain much more than the basic image; they also have tagged headers that hold important identifying information regarding the patient, procedure, procedure date, laterality, and whether the image is unaltered or “enhanced.” Such details are important for assurance of image integrity and appropriate attribution to the given patient, ordering practitioner, and time of procedure.

The American Dental Association (ADA) has resolved that interoperability should be via the DICOM standard. Dentists need to make sure that any digital radiography system they purchase conforms to the DICOM standard and permits the export and import of DICOM files. File interoperability protects patients’ data and the dentist’s investment so that he or she cannot be “held hostage” by the proprietary file formats of an individual vendor.

Examples of situations in which digital image file interoperability might be needed are shown in Figure 1. It can be necessary to read images made by a referring practitioner, or from different equipment in the same or a satellite office. Because dentistry is a part of the healthcare enterprise, images might also need to be referred to hospital physicians. The standard that makes interoperability most likely is the DICOM file format. The importance of using the DICOM format for image files has become especially the case with the introduction of cone-beam computed tomography (CBCT) systems. CBCT image volumes are frequently transmitted to oral and maxillofacial reading services for the image volume to be carefully reviewed for unsuspected pathoses. The image volumes are also exported to third-party software for special reconstructions and measurements. They may also be exported to manufacturers of physical models, surgical stents, and even for fabrication of prosthetic devices, such as artificial temporomandibular joints. A universal standard that contains precise details for ensuring appropriate reproduction of metrics and unique identification is needed for such purposes.

However, written documents alone do not ensure interoperability. The proof of interoperability is in demonstration. Several consecutive ADA Annual Sessions have included such demonstrations. These started in a rather formal demonstration in front of an audience at an ADA Technology Day seminar in 2002, and have spread to practical demonstrations within the commercial exhibit area from 2003 to 2006. In 2007 and 2008, the activity was concentrated on live demonstration of CBCT as part of “Education in the Round” and the “Live Operatory,” respectively. As a result of mergers and acquisitions within the industry, the numbers and names of companies involved has varied slightly, but these are consistently in the double figures and include the leading manufacturers and vendors of digital imaging systems, of dental practice management software, and of third-party image segmentation and analysis software.

The independent validation of DICOM conformance has done much to improve the products of all involved. The goal is to make transferring diagnostic images as easy as sending a fax. It is unlikely that manufacturers of fax machines would have much success selling their products if their machines only accepted transmissions from faxes manufactured by their own company. Hopefully, in the future communication of dental digital diagnostic images will be equally foolproof and all digital dental systems will be DICOM conformant. For the moment, caveat emptor applies: “Let the buyer beware.” Insist on vendor guarantees of DICOM conformance. Even then, also require demonstration of interoperability within your practice circumstance.
with information access, clinical workflow, administration and the underlying infrastructure.

2. Specify Integration Profiles. Experienced healthcare IT professionals identify relevant standards and define how to apply them to address the problems, documenting them in the form of IHE integration profiles.

3. Test Systems at the “Connectathon.” Vendors implement IHE integration profiles in their products and test their systems for interoperability at the annual IHE Connectathon. This allows them to assess the maturity of their implementation and resolve issues of interoperability in a supervised testing environment.

4. Publish Integration Statements. Vendors publish IHE integration statements to document the IHE integration profiles their products support. Users can reference the IHE integration profiles in requests for proposals, greatly simplifying the systems acquisition process.

The IHE technical framework consists of two parts: Profiles and Transactions. IHE Profiles model the business process problem and the solution to the problem; Transactions to support these profiles are defined in detail, using current, established standards to solve the business problem defined by each IHE Profile. IHE Profiles provide a common language for purchasers and vendors to discuss the integration needs of healthcare sites and the integration capabilities of healthcare IT products. They offer developers a clear implementation path for communication standards supported by industry partners and carefully documented, reviewed, and tested. They give purchasers a tool that reduces the complexity, cost, and anxiety of implementing interoperable systems.

IHE Profiles organize and leverage the integration capabilities that can be achieved by coordinated implementation of communication standards, such as DICOM and security standards. They provide precise definitions of how standards can be implemented to meet specific clinical needs. Such Profiles are needed for dentistry.

IHE Integration Statements are documents prepared and published by vendors to describe the intended conformance of their products with the IHE technical framework. They identify the specific IHE capabilities a given product is designed to support in terms of the key concepts of IHE: Actors and Integration Profiles.

IHE has defined a common framework to deliver the basic interoperability needed for local and regional health information networks. It has developed a foundational set of standards-based integration profiles for information exchange with three interrelated efforts: (1) Cross-Enterprise Document Sharing (XDS) support for document content interoperability. This supports a standards-based EHR across clinical encounters and care settings; (2) A security framework for protecting the confidentiality, authenticity, and integrity of patient care data; (3) Cross-domain patient identification management to ensure consistent patient information and effective searches for EHRs.

IHE is organized across a growing number of clinical and operational domains (e.g., ophthalmology, cardiology, radiology, pathology, laboratory procedures, radiologic oncology) but as yet dentistry per se remains unrepresented. Each domain produces its own set of technical framework documents, in close coordination with other IHE domains. Committees in each domain review and republish these documents annually, often expanding with supplements that define new profiles. Initially each profile is published for public comment. After the received comments are addressed, the revised profile is republished for trial implementation; that is, for use in the IHE implementation testing process. If criteria for successful testing are achieved, the profile is published as final text. An IHE in dentistry is urgently needed to effectively test the claims of manufacturers regarding interoperability of digital systems. Details concerning IHE are available at http://IHE.net.

[Editor’s Note: Dr. Farman is ADA Representative to the DICOM Standard Committee, and founding co-chair for DICOM WG 22 (Dentistry).]

REFERENCES